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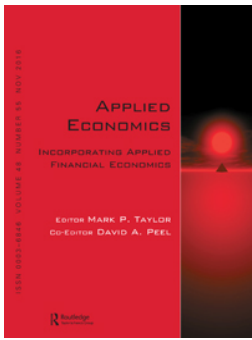
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The relationship between the markets for health insurance and medical malpractice insurance

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ABSTRACT

This article evaluates the interdependence of medical malpractice insurance markets and health insurance markets. Prior research has addressed the performance of these markets, individually, without specifically quantifying the extent to which they are linked. Increasing levels of health insurance losses could increase the scale of potential malpractice claims, boosting medical malpractice losses, or could embody an improvement in medical care quality, which will reduce malpractice losses. Our results for a state panel data set from 2002 to 2009 demonstrate that health insurance losses are negatively related to medical malpractice insurance losses. An additional dollar of health insurance losses is associated with a \$0.01–\$0.05 reduction in medical malpractice losses. These findings have potentially important implications for assessments of the net cost of health insurance policies.

KEYWORDS

Health insurance; medical malpractice; health reform; Affordable Care Act; health care

JEL CLASSIFICATIONS

I13; G22; K13

I. Introduction

In the United States, the markets for medical malpractice insurance and health insurance are structurally distinct, i.e. different insurers supply the insurance coverage for health risks and medical malpractice liability risks, and the buyers of these coverages are distinct groups: medical providers, on the one hand, and employers and individual consumers on the other. Both markets have been the focus of regulatory and legal attention as the country seeks to control the increasing amount spent on health care. Although regulatory scrutiny varies substantially across states, insurers in these markets are highly regulated with respect to rates 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.¹

While prior studies have examined the relationship that exists between different product markets (e.g. Coulson and Stuart 1995) and different insurance markets for the same type of risk (Pauly and Percy 2000), few studies have addressed the relationship between health insurance and medical malpractice insurance markets.² These two insurance markets are inextricably linked via the health care system: losses (i.e. claims) in each insurance market arise specifically from encounters between patients and health care providers. That is, providers' interactions with patients affect both the size and frequency of health insurance claims and the exposure to potential liability. Prior research has explored how changes in the medical malpractice environment – specifically the enactment of tort reform measures³ – affect health insurance premiums (e.g. Morrissey, Kligore, and Nelson 2008; Avraham and Schanzenbach 2010;

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¹Kessler (2011) provides an overview of the malpractice system that includes statistics on payouts and a discussion of the intent of tort reform laws.

²Medical malpractice refers to the legal liability incurred by physicians and other medical professionals when patients sustain injuries while receiving medical care. More specifically, if a physician deviates from normal standards of care, as determined by the prevailing tort laws of a state, and injures a patient, the medical professional is said to have committed medical malpractice.

³A tort reform measure places restrictions on the amount of damages a victim can collect for injuries arising out of a tort, such a medical malpractice. There are several types tort reform measures enacted in various states and the four most common measures considered in the insurance economics literature are caps on noneconomic damages, caps on punitive damages, reforms to joint and several liability rules, and reforms to collateral source rules (e.g. Viscusi and Born 2005; Born, Viscusi, and Baker 2009).

Avraham, Dafny, and Schanzenbach 2012), but this literature falls short of linking the health insurance market experience to the actual performance of the medical malpractice insurance market. Our focus instead is on the opposite linkage – the determinants of medical malpractice losses in models that account for the interdependence of health insurance and medical malpractice insurance.

A better understanding of this relationship is especially important for assessing the effects of public policies, such as the *Patient Protection and Affordable Care Act of 2010*, designed to control the cost of health care services and increase the number of people with health insurance. The intended direct effect of such policies may be clear – e.g. expansion of Medicaid eligibility should increase the number of individuals with health insurance. But the indirect effects are often more difficult to anticipate or estimate – e.g. the expansion of Medicaid eligibility may cause some privately insureds to switch coverage to Medicaid. Such policies may have unexpected and unintended consequences in the legal system and, subsequently, in the medical malpractice insurance market. Assessing the full costs of such health care policies requires that cost ramifications for medical malpractice insurance be taken into account.

The purpose of our analysis is to evaluate and document the influence of the health insurance market on the medical malpractice insurance market. We describe the mechanisms that lead us to hypothesize how the US health insurance market is related to the US medical malpractice insurance market. We then test these hypotheses using state-level data from the National Association of Insurance Commissioners (NAIC) and other publicly available sources for the years 2002–2009.

Our results indicate that the markets for health insurance and medical malpractice insurance are related in a statistically significant manner during our sample period. In particular, we find that higher levels of losses in health insurance markets are associated with lower levels of losses in medical malpractice insurance markets. As attested to by consistency across several model specifications and estimation techniques, the relationship we document does not appear to be spurious or inconsequential. Rather, our analysis suggests the existence of a cross-sectional relationship between the two markets that

likely makes assessing the effects of regulatory intervention in either market more complex. As such, our analysis helps to inform a variety of economic agents interested in the operations of health and medical malpractice insurance markets.

Our article proceeds as follows. We provide a discussion of the relevant literature pertaining to health insurance and medical malpractice insurance in the next section and develop our hypotheses in the section that follows. A fourth section includes a description of our data and our empirical framework. This is followed by a discussion of our methods, the results, and our conclusion.

II. Background

In this study, we focus on a unique market relationship. Our two insurance markets are characterized by different buyers and sellers, so we cannot draw on the typical economic constructs (e.g. cross elasticities of substitution or franchise fees among vertically integrated firms) to evaluate how one market may influence the other. Rather, we propose that the two insurance markets are linked because outcomes in each insurance market rely on the behaviours of patients and health care providers and, further, changes to either insurance market have the potential to influence these behaviours. In the analysis that follows, we do not focus directly on any specific activities in the health care market (e.g. utilization of specific services or changes in the number of providers), but rather we attempt to describe how varying levels of activity in one insurance market (e.g. changes in health care coverage) relate to varying levels of activity in the other (e.g. a change in malpractice risk). We evaluate this relationship using variation across states and times in health and medical malpractice claims per capita.

First, we consider state health insurance markets, which have undergone significant changes over the past few decades, most notably with the transition from fee-for-service health care to the formation of managed care plans that integrate the provision of health care and insurance. This system, in which networks of health care providers agree, under negotiated terms, to provide services to insured groups, suggests a strong relationship between the health insurance market and the health care market. Further, we assume changes in the health insurance

market, such as modifications to plan design or new offers of coverage, encourage subsequent changes in provider behaviour (e.g. seeing more high risk patients or providing fewer diagnostic tests).⁴

The literature strongly supports the assumption that health insurer characteristics and, more broadly, health insurance market characteristics are associated with varying levels of health care utilization. First, we note that insurer reimbursement mechanisms have a significant effect on the time providers spend with patients. For example, Melichar (2009) finds that physicians spend more time with noncapitated patients than with capitated patients.⁵ Godsen et al. (2009) find that, relative to capitation, fee-for-service arrangements result in more primary care visit and visits to specialists.⁶ Interestingly, Casalino et al. (2009) find evidence that physicians and other health care professionals spend a considerable amount of time interacting with managed care organizations, and the authors estimate that the cost of this interaction is approximately \$23–\$31 billion per year.⁷

Research that examines changes in health insurance coverage, including new offers of coverage or changes in cost sharing mechanisms, generally finds that expansions in coverage – and, similarly, reductions in cost sharing – lead to a significant increase in the use of health care services. For example, the comprehensive literature review by Buchmueller et al. (2005) indicates that health insurance coverage increases outpatient hospital utilization, inpatient hospital utilization, and preventative care office visits 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. Barros, Machado, and Sanz-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 patient receives. Finally, Savage and Wright (2003) find that private health

insurance increased the expected duration of hospital stays.

The relationship between the health care market and the medical malpractice insurance is derived through the interactions between providers and patients and the resulting potential for malpractice liability. The growth of managed care altered the nature of interactions between patients and physicians by implementing mechanisms to control utilization and costs (e.g. the use of a gatekeeper primary care provider and preauthorization for surgery). These measures and other changes in the health insurance industry, including expansions of coverage to select populations and laws that mandate coverage for certain types of providers, treatments, or treatment settings, all have the potential to affect the liability of health care providers as they encourage, or even demand, changes in provider behaviour. The effect of these behavioural changes on medical malpractice insurance losses depends on whether such changes generally increase or reduce the potential for error in providing health care services.

Research on the cause of medical errors suggests that increasing utilization of health care services might be associated with an increase in errors if it is due to a larger patient volume for individual providers. For example, in a study of intensive care units, Steyrer et al. (2013) note a significant relationship between workload and medical errors. On the other hand, some studies have found that higher hospital volume is related to better health outcomes (Birkmeyer et al. 2002; Halm, Lee, and Chassin 2002). This correlation may be explained by the 'practice makes perfect' effect, i.e. a higher volume of patient interactions facilitates learning by doing (Luft, Hunt, and Maerki 1987). An increase in utilization of health care services could also reflect an increase in the provision of some services that were previously withheld. Then we might expect better outcomes (i.e. fewer complications leading to malpractice suits) if such services improve the quality of care, i.e. a diagnostic test that allows for earlier

⁴See Robinson (2001) for a review of the various forms of physician payment and analysis of physician incentives to provide the appropriate level of care, accept risk, and maintain productivity. See also Avraham and Schanzenbach (2013) for a discussion of physician incentives to induce demand, also known as 'offensive medicine'.

⁵Under a capitation arrangement, providers are paid a fixed amount per-member per-month.

⁶From 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).

⁷To the extent that time spent interacting with health insurance plans leads to less time spent with patients, this evidence further suggests that health insurance markets have a meaningful influence on the way that medical professionals interact with patients.

detection of a condition that would have required more risky surgical procedure.

Demographic factors such as the size of the urban population, the age of the population, the medical exposure, and legal environment all have a varying effect on medical malpractice insurance claims (Danzon 1984, 1986). The frequency and severity of malpractice claims, absent any policy or structural changes that influence health care provider or consumer behaviours would, according to Bovbjerg, Sloan, and Rankin (1997), 'reach a steady state of filing per year that is related to the underlying phenomena that generate injuries' (p. 87). Assuming such a 'rate' that captures injury generation exists in a steady state – when the characteristics of the health care environment are constant – we expect no significant changes in the frequency and severity of medical malpractice insurance losses over time unless the volume of services or the nature of services provided changes. Hyman and Silver (2006) discuss the many factors that intervene to affect the stability of the medical malpractice system. They note that, 'even if nothing inside the system changes – that is, even if patients claim at the same rate, plaintiffs' attorneys accept requests for representation at the same rate, and juries evaluate claims consistently – the system's outputs will nonetheless vary in response to external forces' (p. 1129). The health insurance market has the potential to be a strong external force: an expansion of health insurance coverage to previously uninsured patients is a disruption to the 'steady state' as is a requirement that insurers cover services provided by chiropractors.

The empirical literature suggests that providers' responses to changes in the medical malpractice environment may vary. Changes in premiums may influence physicians' practice decisions (e.g. entering and leaving the medical field or specific specialty, geographic location), which is especially a concern for patients in certain specialties or geographic areas. An increase in malpractice risk has been associated with a reduction in physicians practising in high-risk specialty areas. For example, Dranove and Gron (2005) found that the supply of neurosurgeons in

Florida fell significantly as medical malpractice premiums rose, and Mello et al. (2005) found that Pennsylvania specialists were more likely to retire early as a result of liability exposure. Baiker and Chandra (2005) also consider whether malpractice premiums influence the physician workforce or various medical treatments.⁸ While they find no evidence that malpractice premiums affect the number of practising physicians, the authors provide evidence that rising premiums are significantly related to increased use of mammography. In addition, malpractice tort reform has been found to increase the supply of physicians in high-risk specialties, (Kessler, Sage, and Becker 2005).

Further, several studies conclude that liability-reducing malpractice tort reforms result in a reduction in 'defensive medicine' practices (Kessler and McClellan 1996, 2002; Kessler, Summerton, and Graham 2006).⁹ Dubay et al. (1999) evaluate data on caesarean section rates and conclude that physicians practise defensive medicine in obstetrics. While some studies have not established a significant link between tort reform and medical decisions (e.g. Sloan and Shadle 2009), the existing literature generally indicates a relationship between changes in the malpractice environment and the performance of providers, but the consequences for the utilization of health care services is not clear.

In sum, prior studies indicate several ways in which health insurance coverage is related to the types and frequency of services available to the patient. Research also suggests ways in which health care utilization influences the medical malpractice environment. These studies all have important implications for policies that will affect the number of people who are insured or alter the likelihood of a malpractice suit. However, these studies are all limited to focusing on only one insurance market. We extend this literature to recognize that the effects of a policy change in one insurance market may have important implications for the other insurance market. Current research provides only limited information on this relationship. For example, Avraham and Schanzenbach (2010) examine the influence of tort

⁸The authors evaluated changes in the total number of physicians, and the change in those practising in obstetrics/gynaecology, surgery, and internal medicine.

⁹Changes in physician behaviour in response to malpractice risk are often referred to as 'positive defensive medicine' (actions taken to improve the quality of care) and 'negative defensive medicine' (actions taken that are unnecessary, or withdrawal of actions that are necessary). See Kachalia, Choudhry, and Studdert (2005).

reform on private health insurance coverage, using individual-level survey data from 1982 through 2007. The authors find that tort reform results in an increase in health insurance coverage rates. In contrast, Morrisey, Kligore, and Nelson (2008) examine the relation between noneconomic damage caps and employer-sponsored health insurance premiums and do not find any evidence that damage caps reduce the cost of employer-sponsored health insurance.

III. Hypothesis development

To evaluate the influence of the health insurance market on the medical malpractice insurance market, we exploit the variation in loss experience across state insurance markets. First, we note that state variation in the number and variety of health insurance contracts reflects existing regulation and population characteristics.¹⁰ We assume, then, that differences across states in the use of insured health care services reflect differences in the number and variety of insurance contracts available which, consequently, vary in the extent of coverage (i.e. the proportion of the population that is insured) or the type of coverage (e.g. a health maintenance organization). For our empirical analysis, we capture this state variation in health insurance losses using the value of health insurance claims per capita.

Similarly, differences across states in their experience with medical malpractice torts reflect the legal environment and population characteristics. With regard to the former, differences include whether the state enforces a cap on noneconomic and/or punitive damages, how collateral sources of recovery are considered, and whether joint and several liability is strictly applied. Further, we expect that differences in the variety of providers operating in the state, income levels, employment opportunities, and litigiousness are important drivers of a state's malpractice tort experience. For our empirical analysis, we capture this state variation in medical malpractice insurance losses using the value of medical malpractice insurance claims per capita.

In the empirical analysis that follows, we evaluate whether and how variations in health insurance losses are associated with medical malpractice losses. Specifically, we propose to test:

H1: There is a positive relationship between health insurance losses and medical malpractice losses.

We propose that the relationship between losses in these two markets is driven by the ways in which the volume of health services provided impacts the use of health care services and, subsequently, the change in opportunities for providers to be found liable for malpractice. Our hypothesis favours the assumption that higher levels of health insurance claims, representing a higher volume of services provided, are related to higher levels of medical malpractice claims because the additional volume and type of services provided increase the potential for error. The set of health insurance claims potentially subject to error increases as providers 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.¹¹ We refer to this as the 'Volume Effect': *as health insurance claims increase, medical malpractice claims increase.*

A Volume Effect could pose a credible threat to the US legal system which suffers from its own set of challenges. Tort caseloads have been growing steadily, causing delays for plaintiffs seeking damages. Medical malpractice tort costs, composed of the benefits paid, the defence costs, and administrative expenses, have level out more recently, but overall tort costs have grown dramatically over the past several decades.¹² An increase in medical malpractice cases could overwhelm the current system.

It is possible, on the other hand, that higher levels of health insurance claims may reflect provider-patient interactions that reduce liability exposure, such as prescribing preventative prescription drugs, or performing routine physical exams, follow-up exams, or medically necessary diagnostic tests. In this case, higher health insurance losses may be

¹⁰For 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).

¹¹All medical errors do not necessarily result in a malpractice lawsuit and all medical malpractice lawsuits do not necessarily involve medical errors (or adverse events). A recent article by Sohn (2013) provides an analysis and discussion of the characteristics of malpractice cases in the US tort system.

¹²According to TowersWatson, US tort costs grew 8.7% per year, on average, between 1951 and 2010 (Towers Watson 2012).

associated with lower provider liability due to, for example, an increase in the use of preventative procedures that reduce the need to perform high risk procedures for which malpractice risk is high. We refer to this as the ‘Quality Effect’: *as health insurance claims increase, medical malpractice losses decrease.*

Changes in the medical malpractice insurance market – such as the enactment of a tort reform measure – may further exacerbate or temper the effects described above. We expect providers may respond to changes in the malpractice environment as it may be perceived as a change in the risk of a malpractice suit. This depends, perhaps, on whether the physician’s malpractice insurance premiums are increased (or reduced) over time, or if the physician witnesses changes in malpractice lawsuits among his or her peers. As noted above, providers may react to a change in the malpractice risk by increasing or reducing the health care services they provide.

The existing literature supports both the Volume Effect and the Quality Effect when considered in certain contexts, e.g. on a case-by-case or service-by-service basis (e.g. DeKay and Asch 1998; Abbott, Ou, and Bird 2003; Perils et al. 2006). As we do not have data to evaluate each insured health care service provided on the basis of its contribution to the risk of error, nor can we evaluate the direction of each provider’s response to the potential change in the malpractice risk, we focus here on the net and ultimate effects of these responses. Our interest, ultimately, is whether the Volume Effect dominates the potential Quality Effect in the aggregate.

IV. Data and empirical framework

To test our hypothesis, 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. The NAIC provide detailed data pertaining to health and medical malpractice 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 contains insurer level loss information for each state in which the insurer operates.¹³ We first apply filters to account for reporting inaccuracies and other illogical values and also to mitigate the influence of outliers in our analysis.¹⁴ Firm–state–year observations of medical malpractice insurer losses and other financial data, are aggregated to the state level, resulting in a dataset of 392 observations. Specifically, 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 year in our sample.¹⁵ We then include several state-level variables, provided from various sources, such as median income, population age, and active physicians. Detailed descriptions of variable sources are given below and summary statistics for our sample are presented in Table 1. The longitudinal aspect of the data makes it possible to control for fixed effects by state, as well as for time-specific effects.

We develop a model to evaluate the cross-sectional relationship between health insurance claims and medical malpractice insurance claims at the state-level and control for other state-level factors that potentially influence the medical malpractice insurance market.¹⁶ We describe the relationship between the markets at the state-level as:

$$MMInsLossPC_{it} = f(\text{HealthInsLossPC}_{it}, \text{StateMktControls}_{it}) \quad (1)$$

¹³The health insurance market data utilized in our analysis are acquired from the by-state Exhibit of Premiums, Enrolment, and Utilization of the NAIC Health Annual Statement filings. Our unscaled measure of health insurance claims is an aggregation of claims across all business segments (i.e. individual, group, Medicare supplement, vision, dental, FEHBP, Medicare, Medicaid, and all other lines reported in the Exhibit). Medical malpractice insurance market data are acquired from the by-state Exhibit of Premiums and Losses of the NAIC Property and Casualty Annual Statement filings. The Exhibit contains direct losses incurred in the business segment of medical professional liability, which is our unscaled measure of medical malpractice insurance loss levels.

¹⁴We 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 1000, and also of those insurers with loss ratios less than 1% and greater than 500%, in order to ensure that our sample contains viable, operating insurance companies. In unreported analyses, we find that our main result remains qualitatively unchanged when the loss ratio filter is not imposed.

¹⁵The state-level data set contains information relating to medical malpractice insurer losses and health insurer losses for all states except California, which was excluded from our analysis due to incomplete data from health insurers operating in the state.

¹⁶Variable sources, detailed definitions, and within and between-state variations are provided in Appendix 1. All variables capturing monetary values are expressed in terms of 2009 dollars.

Table 1. Summary statistics ($N = 392$).

| Variable | Mean | Std. Dev. | Max. | Min. |
|--|------------|-----------|------------|------------|
| Medical malpractice insurance losses PC (\$) | 20.000 | 13.093 | 84.388 | 1.485 |
| Health insurance losses PC (\$) | 888.729 | 487.539 | 2,443.423 | 2.931 |
| Metropolitan percentage (%) | 72.463 | 17.555 | 100.000 | 30.015 |
| Active physicians (%) | 0.256 | 0.625 | 0.470 | 0.160 |
| Young (%) | 24.393 | 1.814 | 31.210 | 20.310 |
| Median income (\$) | 50,677.260 | 7,732.778 | 72,426.450 | 35,011.630 |
| Non-economic damage cap | 0.434 | 0.496 | 1 | 0 |

where

$MMInsLossPC_{it}$ = medical malpractice insurance losses incurred per capita for state i in year t ,

$HealthInsLossPC_{it}$ = health insurance losses incurred per capita for state i in year t ,

and $StateMktControls_{it}$ is a vector of variables for state i in year t that includes:

Metropolitan Percentage = the percentage of the population living in a metropolitan area

Active Physicians = total active physicians per capita,

Young = the number of persons under the age of 18 per capita,

Median Income = the median income per capita, and

Non-Economic Damage Cap = an indicator variable equal to 1 if the state has limits on non-economic damage award amounts, 0 otherwise.

The following subsections discuss hypothesized relationships between our independent variables and medical malpractice insurance losses.

Variables of interest

Our principal variables of interest are $MMInsLossPC_{it}$ and $HealthInsLossPC_{it}$. $MMInsLossPC_{it}$ is defined

as state-wide medical malpractice insurance losses incurred, per capita, for state i in year t . This variable is indicative of medical malpractice insurance claims levels. $HealthInsLossPC_{it}$ is defined as state-wide health insurance losses incurred in all, per capita, for state i in year t . This variable is indicative of health insurance claims levels.¹⁷ The direction and statistical significance of the estimated coefficient on $HealthInsLossPC_{it}$ in Equation 1 will confirm or refute our hypothesis. Specifically, if the estimated coefficient is positive and significant, we have support for our hypothesis that health insurance losses have a ‘Volume Effect’ on medical malpractice losses.

State market controls

In our empirical framework, $StateMktControls_{it}$ is a vector of state level variables hypothesized to influence the level of claims in medical malpractice insurance markets.¹⁸ These include *Metropolitan Percentage_{it}*, *Active Physicians_{it}*, *Young_{it}*, *Median Income_{it}*, and *Non-Economic Damage Cap_{it}*.¹⁹

Metropolitan Percentage_{it} is included in many prior studies related to medical malpractice insurance claims levels (e.g. Danzon 1984, 1986; Avraham 2007) and captures population characteristics that may influence the frequency and/or severity of medical malpractice insurance awards.²⁰ Since urbanization has been found in previous studies to be positively related to total malpractice claims filed, we expect that *Metropolitan Percentage_{it}* will be positively related to medical malpractice insurance losses incurred.

Active Physicians_{it} controls for the possibility that higher numbers of loss exposures (i.e. physicians) are potentially associated with higher levels of medical malpractice claims. Similarly, the variable accounts for the possibility that differences in the physician labour force affect medical malpractice insurance losses in ways related to contract design

¹⁷Health insurance losses incurred is the total of the insurers’ health insurance claims in all lines of health insurance business, as reported in the NAIC Health Annual Statement.

¹⁸We considered additional state market controls for inclusion in the models such as Medicaid and Medicare enrolment, uninsured persons, specialist physicians, hospital admissions, and Health Maintenance Organization enrolment. These variables are omitted from our reported analysis in an effort to mitigate potential endogeneity and/or multicollinearity problems. In unreported analyses, we find that our main result is robust in a variety of model specifications which include these additional state-level market controls. The inclusion of state and year fixed effects in our model (described in an ensuing section) helps to further control for omitted state market factors.

¹⁹It was necessary to scale several state market control variables in the regression analysis for reporting and formatting purposes. *Active Physicians_{it}* was increased by a factor of 1000, *Young* was increased by a factor of 10, and *Median Income_{it}* was scaled by 100.

²⁰For 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.

and pricing.²¹ Therefore, we hypothesize that *Active Physicians_{it}* will be positively related to medical malpractice insurance incurred losses.

We include *Young_{it}* because the medical malpractice insurance literature indicates that the size of medical malpractice awards is partially determined by the expected remaining lifetime of a person (e.g. Avraham 2007). We expect that higher levels of persons under the age of 18 per capita will be positively related to medical malpractice insurance losses incurred per capita.

Similar to *Young_{it}*, *Median Income_{it}* is included to control for the fact that higher income earners are likely to suffer higher amounts of financial losses as a result of a malpractice injury and therefore be awarded higher malpractice claims amounts. The variable also captures additional socioeconomic factors that may influence malpractice claims such as educational attainment, access to legal professionals, or access to health care services. We therefore expect a positive relation between *Median Income_{it}* and medical malpractice insurance losses per capita.

Non-Economic Damage Cap_{it} is included in our analysis as a result of the findings of prior studies (e.g. Viscusi and Born 2005; Born, Viscusi, and Baker 2009; Grace and Leverty 2013) which indicate that tort reforms, and specifically noneconomic damage caps, are negatively related to medical malpractice insurance losses at the state level and at the insurer level.²² Controlling for the significant effect of caps on noneconomic damages on medical malpractice insurance losses is therefore important because it helps to ensure our analysis correctly identifies the effect of health insurance losses on medical malpractice insurance losses. We therefore expect that this variable will have a negative coefficient when included in a regression on medical malpractice insurance losses.

V. Methods and results

Our empirical strategy involves several stages of analysis which attempts to identify and measure the influence of the health insurance market on the medical malpractice insurance market and then confirm the robustness of the results. We begin by

noting that endogeneity is a potential econometric concern in modelling the state-level effect of health insurance losses on medical malpractice insurance losses. Unobserved regulatory constraints, state demographic characteristics, or health care delivery market operations are examples of factors that could potentially influence both markets and lead to a correlation between *HealthInsLossPC_{it}* and the error term in our model. In addition, there exists the potential that causality between the two markets runs in both directions which, if the case, would provide further reason to suspect a correlation between *HealthInsLossPC_{it}* and the modelled error term.

Previous researchers facing similar econometric concerns in modelling economic relationships employ the Arellano–Bond estimator. For example, Caselli, Esquivel, and Lefort (1996) examine how country-level demographic factors influence economic growth. Similar to ours, their analysis is complicated by the possibility that (1) unobserved factors in the modelled error term are correlated with both the independent variables (e.g. various country-level demographic measures) and the dependent variable (e.g. economic growth) and (2) past levels of the dependent variable (e.g. economic growth) may influence current levels of one or more of the independent variables (e.g. population growth rate or other similar demographics). Caselli, Esquivel, and Lefort (1996) utilize Arellano and Bond's (1991) methods to obtain consistent estimates of the factors influencing economic growth. Additional studies have employed the dynamic panel estimation techniques based on Arellano and Bond (1991) to address similar econometric concerns (e.g. Sequeira and Nunes 2008; Eugenio-Martin, Morales, and Scarpa 2004).

Our first approach is to follow the Arellano–Bond dynamic panel GMM estimation procedure, which we believe one appropriate method for addressing the econometric concerns in modelling the effect of state health insurance losses on state medical malpractice insurance losses. The first step of the procedure is a first difference transformation of the general model (Cameron and Trivedi 2010), which, as it pertains to our analysis, yields:

²¹Controlling for the effect of physicians on medical malpractice insurance claims is consistent with prior literature (e.g. Danzon 1984; Barker 1992).

²²Caps on noneconomic damages place limits on amounts awarded to injured parties for pain and suffering, emotional distress, loss of consortium, and similar nonpecuniary losses (e.g. Grace and Leverty 2013; Viscusi and Born 2005).

$$\begin{aligned} \Delta MMInsLossPC_{it} = & \alpha_{it} + \beta_1 \Delta MMInsLossPC_{it-1} \\ & + \beta_2 \Delta HealthInsLossPC_{it} \\ & + \delta' \Delta StateMktControls_{it} + \Delta \varepsilon_{it} \end{aligned} \quad (2)$$

In this equation, all variables are previously defined. This first difference transformation removes the individual state-level effects in the model, thereby eliminating correlations between the unobserved state-level effects captured in the error term and $HealthInsLossPC_{it}$.²³

In the second stage of the procedure, consistent estimates are obtained by Instrumental Variables (IV) estimation of the first difference model parameters (Cameron and Trivedi 2010). Arellano and Bond (1991) show that appropriate lags of the variables in the first-differenced model are valid instruments in an IV framework, which greatly increases the number of available instruments to be used in the IV estimation. As it relates specifically to our model, we also treat $HealthInsLossPC$ as endogenous in order to account for the fact that it may be correlated with past error terms and specifically that past shocks in $MMInsLossPC$ may influence current levels of $HealthInsLossPC$. Including the lagged value of $MMInsLossPC$ as a regressor further accounts for the potentially dynamic effects of the relationship between health insurance losses and medical malpractice insurance losses.

Table 2, Model 1 displays the estimated influence of health insurance losses per capita on medical malpractice insurance losses per capita using

the Arellano–Bond estimator.²⁴ Health insurance losses per capita is treated as endogenous and the two step GMM method is used to improve efficiency (Cameron and Trivedi 2010). The results are also robust to heteroskedasticity via Windmeijer's (2005) procedure and a total of 48 instruments are utilized.²⁵ The validity of the results are confirmed by performing two specification tests developed by Arellano and Bond (1991). First, because the procedure developed by Arellano and Bond (1991) requires that the error term in the first differenced equation be serially uncorrelated, we the test for autocorrelation in the first differenced errors and find no evidence of second order autocorrelation in the error terms.²⁶ Second, we perform a Sargan test of over-identifying restrictions and the resulting p -value of 0.481 fails to reject the null hypothesis that the over-identifying restrictions are valid.

As given in Table 2, the coefficient on $HealthInsLossPC_{it}$ is negative and statistically significant at the one percent level, suggesting that higher levels of health insurance losses per capita are associated with lower levels of medical malpractice insurance losses per capita.²⁷ This result leads us to reject our null hypothesis of no relationship in favour of the alternative hypothesis. Furthermore, the result obtained from the Arellano–Bond method is robust to several other estimation techniques, the results of which are also given in Table 2.²⁸ In particular, various fixed effects, two stage least squares (2SLS) model specifications based on the general form given in Equation 1 yield results consistent to those of the

²³Studies such as Caselli, Esquivel, and Lefort (1996) do not include time dummies in the Arellano–Bond framework because variables are taken as deviations from period means.

²⁴Our Arellano–Bond estimator results are based on 294 observations of 49 states over a six year period. This is due to the fact that the procedure requires a two year lag of $HealthInsLossPC$ as part of the identification process, which reduces our total number of state–year observations.

²⁵Because $HealthInsLossPC$ is endogenous, valid instruments for the variable are $HealthInsLossPC$ in years $t - 2$ to $t - n$, yielding a total of 20 instruments for this variable in our model. Instruments for $MMInsLossPC_{it}$ are lags of the variable in years $t - 1$ to years $t - n$, resulting in 28 instruments for this variable in our model.

²⁶As noted by Cameron and Trivedi (2010), if the error terms are serially uncorrelated, then we would expect to reject the null hypothesis of autocorrelation at the first order but not at higher orders. In our model, we find strong evidence against the null hypothesis of first order autocorrelation (p -value < 0.001) but fail to reject the null at order two (p -value = 0.565).

²⁷In the Arellano–Bond model, the one year lag of $MMInsLossPC$ is also included in the model as an independent variable but was omitted in the table for consistency of reporting alongside the additional model specifications. This estimated coefficient of this variable is 0.226 and is statistically significant at the 10% level.

²⁸We also conduct two additional unreported analyses which suggest our results are not driven by highly influential state-observations. First, we estimate our main model, drop observations with an t -student value greater than 2 and less than negative 2 and re-estimate the model without the influential observations ($N = 377$ for this model). The negative and significant relation between health and medical malpractice insurance is still present in this model. Second, we calculate the z -score of health insurance losses per capita based for the full sample of 392 state–year observations and then drop state–year observations with z -scores greater than 2 and less than negative 2. When we re-estimate the model based on the reduced sample ($N = 367$ for this model), we also find a negative and statistically significant coefficient on health insurance losses per capita.

Table 2. State-level regression.

| | Dependent variable = medical malpractice insurance losses PC | | | |
|---|--|-----------------------|------------------------|-----------------------|
| | Model 1 | Model 2 | Model 3 | Model 4 |
| Health insurance losses PC | −0.0420*** [0.012] | −0.0509*** [0.009] | −0.0147*** [0.004] | −0.0070*** [0.002] |
| Metropolitan percentage | 1.0412 [0.977] | 2.2208 [1.474] | −0.8998 [0.590] | 0.1034** [0.047] |
| Active physicians | 34.4521*** [13.305] | 27.7458 [17.394] | 8.0486 [7.900] | 11.3312*** [1.937] |
| Young | 24.8465 [15.663] | 21.2393 [14.184] | 40.3862*** [10.259] | −4.0830 [3.850] |
| Median income | 0.0029 [0.021] | 0.0042 [0.025] | −0.0064 [0.021] | −0.0087 [0.011] |
| Non-economic damage cap | −5.0731 [3.139] | −3.5688 [3.216] | −13.4982*** [3.067] | −3.9364*** [1.092] |
| Constant | −173.2140** [84.339] | | −11.7423 [57.409] | 5.7821 [10.080] |
| Specification | Arellano–Bond | 2SLS, State/Year FE | State/Year FE | OLS |
| Hausman/Endogeneity Test (<i>p</i> -value) | | 0.0000 | 0.0002 | |
| Observations | 294 | 329 | 392 | 392 |
| <i>R</i> ² | | 0.0100 | 0.3613 | 0.2627 |

Robust standard errors in brackets

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Arellano–Bond estimator.^{29,30} When we further estimate the general model form given in Equation 1 as a regression model that includes state and year effects, the negative and significant relation on *HealthInsLossPC* is not negated.³¹ A simple OLS model of Equation 1 also yields a negative and statistically significant result on health insurance losses per capita. In general, our results suggest that, evaluated at the mean, a \$1 increase in health insurance losses per capita is associated with a \$0.01–\$0.05 reduction in medical malpractice insurance losses per capita. This result suggests the Quality Effect dominates the Volume Effect in the aggregate.

While the state and year effects reduce the likelihood that our results are biased by omitted variables, we acknowledge that other factors, not explicitly considered in our main models, could potentially influence medical malpractice insurance

losses. In particular, the proportion of the population over age 65, number of hospital beds, number of hospitals, gender, ethnicity, education level, and unemployment rate may also influence medical malpractice insurance losses.³² Many of these factors exhibit strong correlations with the control variables identified by prior literature and included in our main models, meaning that also including these additional factors could potentially lead to econometric concerns regarding the estimated effect of health insurance losses on medical malpractice insurance losses. Nonetheless, we re-estimate all of the models given in Table 2 with these additional state-level factors included and report the results in Appendix 2. For all models, the negative and significant coefficient on *HealthInsLossPC* remains and the statistical significance also remains in all but one model. This evidence further eases the concern

²⁹The 2SLS method is an alternative approach to addressing the potential for endogeneity in our model. To obtain the 2SLS output in Table 2, we follow an approach similar to McShane, Cox, and Butler (2010) and calculate an instrument equal to the average of health insurance losses per capita in year $t - 1$ for all states which border state i . Unreported analysis indicates the instrument is positive and statistically significant in the first stage regression model and the partial R^2 of the excluded instruments is 0.161. Further analysis also indicates the 2SLS model is not under-identified nor weakly identified. Finally, as given in the table, the null of exogeneity is rejected at the 1% level.

³⁰Our results are also robust to the inclusion of several other instruments. First, we use the proportion of a given states' population that has been told they have high blood cholesterol levels (available via the Centers for Disease Control and Prevention (CDC)) as an alternative instrument. The literature related to medicine indicates that genetic factors play a larger role in determining cholesterol levels than do environmental factors (e.g. Heller et al. 1993; Cuchel and Rader 2003), which is evidence that *Cholesterol* may not be correlated with the same socioeconomic or demographic factors associated with the tendency to file a lawsuit. The negative and significant relationship remains when *Cholesterol* is used as an instrument. Our results also remain quantitatively unchanged when we employ total health insurance premiums earned per capita as an instrument or the proportion of a given state's population smokes cigarettes on a regular basis, *Smokers*. When we consider multiple instruments for *HealthInsLossPC*, our main results are consistent for any combination of *Cholesterol*, *Smokers*, health insurance losses per capita in bordering states, and health insurance premiums earned per capita. With one exception, all models pass the relevant instrument validity tests (e.g. first stage F-test and under/weak/over identification tests). The exception is that when health insurance premiums per capita is included with additional instruments, the models are over-identified.

³¹The inclusion of state and year fixed effects reduces the likelihood of biased results arising from omitted variables and, as reported in the table, a Hausman test supports the inclusion of state and year fixed effects.

³²We thank an anonymous referee for identifying these specific factors.

Table 3. State-level regressions with lags and alternative scaling.

| | DV = medical malpractice insurance losses PC | DV = medical malpractice insurance losses per physician |
|--|--|---|
| | Model 5 | Model 6 |
| Health insurance losses PC | -0.0110*** [0.004] | |
| L. Health insurance losses PC | -0.009*** [0.002] | |
| L2. Health insurance losses PC | -0.002 [0.002] | |
| Health insurance losses per enrollee | | -1.3100** [0.599] |
| L. Health insurance losses per enrollee | | 0.7644 [0.503] |
| L2. Health insurance losses per enrollee | | -1.5830** [0.733] |
| Metropolitan percentage | -0.775 [0.622] | -1031.2804*** [275.127] |
| Active physicians | 8.455 [7.562] | -441.4670 [3,123.594] |
| Young | 34.253*** [12.598] | 11 750.3158** [4939.375] |
| Median income | -0.013 [0.023] | -1.8721 [9.062] |
| Non-economic damage cap | -3.892*** [1.248] | -3,503.3569*** [638.652] |
| Constant | -1.913 [55.441] | 60 965.1142** [24 690.790] |
| Fixed effects | Yes | Yes |
| Observations | 294 | 294 |
| R ² | 0.2965 | 0.2090 |

Robust standard errors in brackets.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

that the conclusions drawn from Table 2 are biased by omitted control variables.

Aside from our key variable of interest we also note that several other variables in our model are significantly related to state level medical malpractice losses in the hypothesized direction. The coefficient of *Active Physicians* is positive and statistically significant at the 99% level or better in Models 1 and 4 and *Metropolitan Percentage* is positive and significant in Model 4. *Young* is positively related to medical malpractice insurance losses per capita in a statistically significant manner in Model 3. The estimated coefficient on the noneconomic damages cap dummy variable is negative and statistically significant in Models 3 and 4.

While the results presented in Table 2 provide robust evidence in support of a negative and statistically significant relation between health and medical malpractice insurance markets, we further explore the correlation using alternative specifications that include: (1) consideration of lagged

effects and (2) alternative scaling for our key variables.

The first column of Table 3 presents the results of estimating Model 5, which includes lagged values of health insurance losses. Here, we find a negative and statistically significant coefficient on health insurance losses per capita in year t and year $t - 1$. This result provides additional support for our conclusion above.

To the extent that scaling state-wide health and medical malpractice insurance losses by the population might distort the relationship between the markets, we also consider alternative scaling methods for our key variables of interest. We use a fixed effects framework to estimate a model where health insurance losses are not on a per capita basis but are scaled by total health enrollees, and medical malpractice insurance losses are scaled by the total number of active physicians in a state.³³

The estimated coefficients from Model 6 are provided in the second column of Table 3, and provide

³³Total health enrollees is defined as the sum of all health enrollees in state i during year t across all health insurers and data are obtained from the NAIC health filings. The alternative scaling is insightful because it allows us to allocate losses for the respective insurance markets more closely to the population for which each type of coverage is relevant. While the results using the alternatively scaled variables provide important and robust evidence, we provide the evidence using uniform scaling of all variables by population for consistency.

further support for the negative relationship between health insurance losses and medical malpractice insurance losses³⁴ Here, the dependent variable is medical malpractice insurance losses per active physician and the independent variables of interest are health insurance losses per enrollee. The negative and statistically significant coefficient on health insurance losses per enrollee in year t provides additional support for a negative cross sectional relation between health insurance losses and medical malpractice insurance losses.

In summary, our empirical analysis finds strong evidence that higher levels of health insurance losses are associated with lower levels of medical malpractice insurance losses: an additional dollar of health insurance losses is associated with a \$0.01–\$0.05 reduction in medical malpractice losses. Our result is robust to several different model specifications such as the Arellano–Bond estimator, the inclusion of state and year fixed effects, a 2SLS procedure, the inclusion of lagged values of health insurance losses, and an alternative scaling format. The robust evidence in our article identifies health insurance losses as an important source of variation in medical malpractice insurance loss levels. As such, our evidence suggests that the Quality Effect dominates the Volume Effect and implies that the medical malpractice insurance market should be a consideration for policy-makers evaluating the potential consequences of health insurance market operations.

VI. Conclusion

In this article, we endeavour to analyse and document the influence of health insurance markets on medical malpractice insurance markets. We describe how the characteristics of a health insurance market may influence the frequency and types of services patients receive from health care providers. These services, in turn, are related to providers' professional liability exposure, and consequently have an influence on medical malpractice 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 relationship between these markets and find strong support to indicate that higher levels of health

insurance claims lead to a reduction in medical malpractice insurance claims. Further, the results of the analysis are robust to the presence of state and year fixed effects, the level of aggregation (state vs. individual insurer) and across different model specifications.

The novelty of our analysis is that it establishes the existence of a robust correlation between loss levels in two distinct insurance markets that are linked only by the *health care* market. Our findings suggest that in the aggregate, higher levels of expenditures by health insurers on patient claims likely influence health care delivery in such a way that professional liability exposure, and ultimately the level of medical malpractice insurance claims paid by property-casualty insurers, is reduced. While data limitations prevent us from examining the underlying mechanisms leading to this result (e.g. the specific services/interactions that reduce liability exposure), we are unaware of any other study that suggests loss levels in the health insurance market are associated with loss levels in the medical malpractice insurance market. As a result, we hope that our findings will inspire future researchers to examine, in more detail, the underlying mechanisms that might lead claims levels in health insurance markets to influence medical malpractice insurance losses.

Further, while we do not purport to establish causality in our analysis, the relationship between the two markets documented in our analysis suggests an interdependence between the two markets that likely makes assessing the policy impacts of various government interventions in insurance markets a much more complex process. Our results also are economically significant and generally imply that a one dollar increase in health insurance claims per capita lead to a \$0.01–\$0.05 reduction in malpractice claims per capita. To the extent that regulatory interventions in health insurance markets perturb the constant relationship with medical malpractice markets, our analysis therefore suggests that regulators and policy-makers should be particularly cognizant of the indirect economic effects of health insurance reforms.

Increasing the number of individuals with health insurance remains a top priority in US health policy,

³⁴Active physicians is omitted as an independent variable due to the fact that it is used to scale the dependent variable.

as does ensuring that individuals are receiving access to services. At the same time, the US legal system has faced its own set of challenges, with tort costs and caseloads growing steadily for decades. Our results suggest that expanding health insurance coverage is not likely to overload the legal system with additional medical malpractice cases. While our data do not allow us to directly assess whether a health insurance expansion leads to higher quality of care at the individual level, we are encouraged by the findings here that suggest this may be the case and additional efforts to extend health insurance coverage are warranted.

Disclosure statement

No potential conflict of interest was reported by the authors.

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Appendix 1. Variable descriptions

A.1 Insurance Specific Variables

MMInsLossPC 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 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. The between-state (within-state) standard deviation of the variable during our sample period is 10.56 (7.86).

HealthInsLossPC 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. The between-state (within-state) standard deviation of the variable during our sample period is 461.70 (168.37).

A.2 State Market Factors

Metropolitan Percentage is the percentage of a state's residents living in a metropolitan area for state i in year t . We obtain the number of persons living in a metropolitan area during our sample period from the US Census Bureau. The between-state (within-state) standard deviation of the variable during our sample period is 17.70 (0.62).

Active Physicians is the total number of active physicians, per capita, in a given state for a given year. We collected data on active physicians from the US Census Bureau. The between-state (within-state) standard deviation of the variable during our sample period is 0.0006 (0.00007).

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 source for the number of person under the age of 18 is the US Census Bureau. The between-state (within-state) standard deviation of the variable during our sample period is 0.02 (0.01).

Median Income is the median income, in 2009 dollars, in a given state for a given year. Data regarding *Median Income* are acquired from the US Census Bureau. The between-state (within-state) standard deviation of the variable during our sample period is 7544.04 (1937.53).

Non-Economic Damage Cap is a dummy variable equal to one if a given state has a limit on noneconomic damage award amounts in a given year. For our sample period, we collect by state data on *Non-Economic Damage Cap* from the American Tort Reform Association. The between-state (within-state) standard deviation of the variable during our sample period is 0.47 (0.16).

Appendix 2. Additional regression analysis

| | Dependent variable = medical malpractice insurance losses PC | | | |
|----------------------------|--|--------------------------|--------------------------|-------------------------|
| | Model 1 | Model 1 | Model 3 | Model 4 |
| Health insurance losses PC | -0.0431*** [0.016] | -0.1518 [0.111] | -0.0101** [0.004] | -0.0099*** [0.002] |
| Metropolitan percentage | 0.3161 [1.456] | 6.9724 [6.995] | 0.1962 [0.666] | 0.3374*** [0.068] |
| Active physicians | 33.6947*** [12.200] | 84.0510 [59.329] | 12.4186* [7.156] | 12.9949*** [2.237] |
| Young | 22.8905* [13.053] | 33.5043 [30.649] | 23.9218** [10.270] | -7.3116 [4.909] |
| Median income | 0.0155 [0.027] | 0.0226 [0.055] | -0.0115 [0.024] | -0.0126 [0.015] |
| Non-economic damage cap | -5.3426 [7.389] | 4.1518 [11.885] | -13.2299*** [3.131] | -5.6030*** [1.232] |
| Over 65 | 56.8981 [135.190] | 742.1383 [847.823] | -251.7286** [117.043] | -104.9408* [58.512] |
| Hospitals | 0.2225 [0.368] | 0.9375 [0.712] | 0.1081 [0.216] | -0.0078 [0.009] |
| Females | 96.2017 [217.659] | -466.3859 [434.235] | -200.1774 [143.799] | 155.9217 [97.623] |
| Education | -0.5824 [0.808] | 1.3143 [2.037] | -0.6190 [0.478] | -0.3175 [0.223] |
| Unemployment | 0.2987 [0.480] | -0.7783 [1.162] | -0.0296 [0.309] | -0.6134** [0.289] |
| White | 147.6549 [151.721] | -294.4167 [569.292] | 262.2353*** [75.040] | -6.6413 [5.189] |
| African American | -21.4478 [989.890] | -1,047.8852 [982.434] | -35.9663 [194.250] | -46.4087*** [10.690] |
| Hospital beds | -17.0665* [9.138] | -44.0664 [37.716] | 2.3019 [5.421] | 4.3346*** [0.984] |
| Constant | -252.0044 [196.342] | | -144.3206 [104.960] | -58.2154 [47.530] |
| Specification | Arellano-Bond | 2SLS, State/Year F.E. | State/Year F.E. | OLS |
| Observations | 294 | 329 | 392 | 392 |
| R ² | | -3.9859 | 0.4316 | 0.3425 |

Robust standard errors in brackets.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.