DOES UNIVERSAL OCCUPATIONAL LICENSING RECOGNITION IMPROVE PATIENT ACCESS? EVIDENCE FROM HEALTHCARE UTILIZATION

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Abstract

This paper examines the impact of universal reciprocity of out-of-state physician licenses on the regional labor supply of physicians and consumers' access to healthcare services. After adopting universal reciprocity, out-of-state practice physicians per capita increased by 0.012. Respondents with personal doctors or healthcare providers increased by 6.0 percentage points, and those having medical cost issues decreased by 1.5 percentage points among working-age individuals. Residency requirements for license reciprocity serve as barriers to improving access to healthcare services. Reducing regulatory barriers could achieve regional equilibrium and enhance both consumer and worker welfare in healthcare.

Keywords: occupational licensing, universal licensing recognition, healthcare access, physician labor supply, consumer welfare

JEL Classification: I31, I50, J08, J22, J40, J44, J48, J68

1 Introduction

Optimizing the regional labor supply of physicians is a significant issue in the healthcare sector (Kirch and Petelle, 2017). Scholars forecast that a number of regions experiencing scarcity of healthcare services will increase due to an increase in the aging population that demands more healthcare services (Zhang et al., 2020). Although it does not raise the overall number of physicians, adopting interstate reciprocity of physician licenses contributes to optimizing their regional labor supply by allowing out-of-state physicians to practice with their current licenses (Deyo et al., 2024).

Universal licensing recognition (ULR) is a comprehensive policy reform that allows out-of-state licensed workers to practice without a state-specific re-licensure process. Recent studies show its positive impact on the regional labor supply of licensed workers via increasing interstate mobility (Bae and Timmons, 2023; Deyo and Plemmons, 2022). Yet, its impact on labor supply and consumer welfare in the healthcare sector, where it has different regulatory and institutional barriers, has not been studied. Furthermore, the Interstate Medical Licensure Compact (IMLC), the preexisting, less-comprehensive reform, makes measuring the impact of ULR more difficult.

In this study, we evaluate the impact of ULR on the regional labor supply of physicians and healthcare access separately from the IMLC's by measuring its effects among the states that adopted the IMLC before adopting ULR. We use the IPUMS-USA and the Doctors and Clinicians National Downloadable File from the Centers for Medicare & Medicaid Services to examine the changes in regional labor supply of physicians and use the Behavioral Risk Factor Surveillance System to examine the changes in state-level healthcare access and medical cost issues.

Our study provides an important contribution to the literature in health and labor policy. This is the first study that provides theoretical and empirical evidence of how reciprocity of out-of-state licenses improves consumer welfare in the healthcare sector. Although the first licensure compact, the Nurse Licensure Compact, was implemented in 2000, previous studies' predictions on the outcomes of such regulatory relaxations are broadly defined based on economic theory, without taking sector-specific regulatory barriers into account. Although it provides essential services that require higher standards for consumer protection, some regulations in this sector are overly restrictive, leading to a reduction in the labor supply, access to healthcare, and consumer welfare. Simultaneously, there are sector-specific regulatory relaxations (e.g., the IMLC), that work as confounding factors, obfuscating the impact of one regulatory relaxation over another. Our theoretical model takes these regulatory factors into account to show how physicians'

decision-making changes after relaxing one regulatory barrier (i.e., ULR) while other preexisting factors remain fixed. Then, we use various data sets to validate our theoretical predictions; as being more comprehensive regulatory relaxation than the previous reforms, ULR increased the regional labor supply of physicians and subsequently increased consumer welfare for the services that are large, essential, and costly, even among the states that adopted the IMLC before.

To preview our findings, we first develop two theoretical models explaining how the adoption of universal reciprocity of physician licenses changes physicians' decision to start out-of-state practices, as well as the regional labor supply and consumer welfare. Then, in the empirical analyses, we show that adopting universal reciprocity of physician licenses increases the regional labor supply of physicians by increasing out-of-state practices – that is, healthcare services provided by out-of-state physicians via locums and telehealth. We show improvements in healthcare access, including an increase in the proportion of individuals who have personal doctors or healthcare providers, and a reduction in the proportion of individuals who did not see doctors because of costs. We also show that residency requirements for reciprocity work as barriers to improving consumer welfare.

The remainder of this paper is organized as follows. In Section 2, we present a background of recent regulatory relaxation on interstate reciprocity of physician licenses. In Section 3, we provide two theoretical models explaining how ULR contributes to increasing physicians' out-of-state practices and thereby the consumer welfare. In Section 4, we explain the data and estimation procedures and methods. In Section 5, we outline the results and their implications. In Section 6, we summarize the findings and policy implications and discuss the limitations and suggestions for future studies.

2 Background on Reciprocity of Physician Licenses

The supply restriction effects of occupational licensing requirements are well documented, both at the national- and occupation-level (Kleiner, 2016; Bae et al., 2025; Carollo et al., 2025; Oh, 2025). From economic theory, occupational licensing restricts labor supply, produces a wage premium for licensed workers, and increases prices for consumers (Kleiner, 2000; Kleiner and Krueger, 2013; Oh and Kleiner, 2025). By contrast, relaxing licensing policies has resulted in a reduction in prices, with no effect on the service quality in health care (Kleiner et al., 2016).

Over the last decade, there have been multiple efforts to introduce reciprocity of out-of-

state physician licenses. The Interstate Medical Licensure Compact (IMLC) was the earlier reform that allows physicians licensed from other IMLC member states to practice without completing state-specific re-licensure processes (Steinbrook, 2014). These processes include multiple administrative procedures (e.g., fingerprint-based background checks) as well as various fees and a long processing time. Therefore, policymakers expected that this compact would increase the regional labor supply of physicians and access to healthcare (Peterson et al., 2014; Chaudhry et al., 2015). However, the coverage of this reciprocity is limited to the physicians who attained their licenses from the IMLC member states. Therefore, physician licenses from non-member states are not eligible for interstate reciprocity, although the IMLC board recognizes that approximately 80% of U.S. physicians meet the IMLC's reciprocity requirements (Adashi et al., 2021).

From the late 2010s onward, an increasing number of states adopted the Universal Licensing Recognition (ULR), a policy reform that allows out-of-state licensed workers in selected occupations to practice without having to go through state-specific re-licensure processes (Norris, 2024). The ULR is a similar policy reform to the IMLC in that it waives the re-licensure processes for out-of-state practitioners. However, ULR is a more comprehensive reform than the IMLC since it adopts the reciprocity of licenses for the selected occupations regardless of the states of licensure, as long as licensees meet the qualifications, such as a similar scope of practice, substantially equivalent education and experience, and, sometimes, in-state residency (Shakya et al., 2024).

Previous studies provide empirical evidence that ULR increased the regional labor supply of licensed workers and reduced labor costs via increased interstate labor mobility (i.e., interstate migration), showing that ULR has a clear effect on increasing the regional labor supply (Deyo and Plemmons, 2022; Bae and Timmons, 2023). Based on the theory, the increased regional labor supply of physicians leads to an increase in production and quality of healthcare services and a reduction of service costs: improved consumer welfare (Kleiner, 2000; Poghosyan et al., 2019).

However, it is not clear whether the ULR is effective in this respect, because the IMLC was already adopted to achieve a similar goal: reciprocity of out-of-state licenses. Furthermore, adopting ULR does not always mean that all licensed occupations become subject to universal reciprocity, because this reciprocity is for 'selected' occupations only; some states that adopted the ULR did not adopt universal reciprocity for physician licenses. In addition, it is not clear whether the increase in regional labor supply is due to the increased interstate migration or out-of-state practices – that is, providing healthcare services by locums and/or telehealth. While recent studies

that examine licensed workers in general show an increase in interstate migration after adopting the reciprocity (e.g. Deyo and Plemmons, 2022; Bae and Timmons, 2023), other studies that focused on physicians do not find an increase in interstate migration, but in out-of-state practices (Deyo et al., 2024). This may be due to the restrictions on physicians' moonlighting (i.e., having second jobs), because these restrictions often limit physicians from moonlighting in nearby healthcare providers (Novinson and Kim, 2021). Because of this geographical restriction, out-of-state practice may be the only way physicians can increase their work hours and earnings. Through the development of theoretical models and implementation of econometric analyses, we show the impact of ULR on the regional labor supply through out-of-state practices and on access to healthcare services. Table 1 provides more detailed information about the IMLC and ULR.

3 Theoretical Models

In this section, we present two theoretical models. The first model is a partial equilibrium model explaining how physicians make their decisions to start out-of-state practices after the adoption of ULR. The second model is a general equilibrium model, explaining how the increase in out-of-state practices improves consumer welfare. Using these two models, we show how the adoption of ULR improves consumer welfare among the states that previously adopted the IMLC.

3.1 Physicians' Decision-Making: Stay, Migrate, or Start Out-of-State Practices

This is a simple partial equilibrium model that is an adaptation of Johnson and Kleiner's (2020) model, explaining the role of occupational licensing on interstate migration. In this model, physicians choose whether to (a) stay in the current labor market, (b) migrate to a new labor market, and (c) start out-of-state practices. We assume that physicians are perfectly certain about the earnings from staying (w_s), migrating (w_m), and starting out-of-state practices (w_t). Costs are involved in choosing migration or starting out-of-state practices. For simplicity, we assume that there is no cost related to the loss or accumulation of human capital and monetary cost related to traveling and moving: one-time cost covered by employers. Then, physicians' costs of migration include the re-licensure ($c_{relicense}$) and other time costs and disutility from relocation (c_{self}). Similarly, physicians' cost of starting out-of-state practices includes $c_{relicense}$.

Because of the restrictions on moonlighting for nearby healthcare providers, starting out-of-state practices is the only option to raise earnings. If physicians decide to start out-of-state practices, they spend additional work hours $T_t > 0$ for the out-of-state employers they work for.

In addition, physicians are subject to idiosyncratic preference shocks ε_s, ε_m, and ε_t, which tilt preferences toward staying, migrating, and traveling, respectively, and these preference shocks are dispersed at the scale of γ, which follows standard Gumbel distributions, independently of each other and identically distributed across groups. Lastly, δ_{time} is an increasing function of time that denotes the disutility from working longer: $\delta_{time} > 0$ if $1 + T_t > 1$. Note that $\delta_{time} < c_{self}$, indicating that the disutility from out-of-state practices is smaller than the disutility from migrating.

Then, the utilities of staying (U_s), migrating (U_m), and starting out-of-state practices (U_t) are given by the following expressions:

$$U_s = w_s + \gamma\varepsilon_s$$
$$U_m = w_m - c_{relicense} - c_{self} + \gamma\varepsilon_m$$
$$U_t = w_s + T_t w_t - c_{relicense} - \delta_{time} + \gamma\varepsilon_t.$$

Before the reciprocity of out-of-state licenses is adopted, $c_{relicense} > 0$ and is large enough to discourage physicians from migrating or starting out-of-state practices (i.e., $U_s > U_m$ and $U_s > U_t$). Assume the preference shocks ε_s, ε_m, and ε_t are zero at means, then, we can express as

$$U_s > U_m \;\Rightarrow\; c_{relicense} + c_{self} > w_m - w_s, \text{ and}$$
$$U_s > U_t \;\Rightarrow\; c_{relicense} + \delta_{time} > T_t w_t.$$

On the other hand, adopting reciprocity removes the re-licensure cost (i.e., $c_{relicense} = 0$), making migration and out-of-state practices more attractive. Because $\delta_{time} < c_{self}$, physicians start out-of-state practices instead of migrating to potential destinations (i.e., $U_t > U_s$ and $U_t > U_m$). Assume that the preference shocks ε_s, ε_m, and ε_t are zero at means, then we can express as

$$U_t > U_s \;\Rightarrow\; T_t w_t > \delta_{time}, \text{ and}$$
$$U_t > U_m \;\Rightarrow\; w_s + T_t w_t - w_m > \delta_{time} - c_{self}.$$

We can calculate the log rates of starting out-of-state practices before and after adopting the reciprocity of out-of-state licenses as:

$$\log\left(OSP_{Before}\right) = (1/\gamma)[(1 - T_s)w_s + T_t w_t - c_{relicense} - \delta_{time} - w_s]$$
$$= (1/\gamma)[T_t w_t - T_s w_s - c_{relicense} - \delta_{time}]$$
$$\log\left(OSP_{After}\right) = (1/\gamma)[(1 - T_s)w_s + T_t w_t - \delta_{time} - w_s] = (1/\gamma)[T_t w_t - T_s w_s - \delta_{time}].$$

Suppose α denotes the proportion of physicians who were licensed from the IMLC states and starting out-of-state practices. Then, we can write the changes in the rate of starting out-of-state practices for the IMLC states after adopting the universal reciprocity of physician licenses as

$$\Delta \log(OSP) = (1/\gamma)[T_t w_t - T_s w_s - \delta_{time}] - \alpha(1/\gamma)[T_t w_t - T_s w_s - \delta_{time}]$$
$$-(1-\alpha)(1/\gamma)[T_t w_t - T_s w_s - c_{relicense} - \delta_{time}] = (1/\gamma)(1-\alpha)c_{relicense} > 0, \quad (1)$$

showing that the local labor supply can still increase even if the state previously adopted IMLC and the magnitude of this increase depends on the proportion of physicians licensed from non-IMLC states $(1-\alpha)$.

3.2 Production of Healthcare Services and Consumer Welfare

This is a general equilibrium model explaining how consumer welfare increases after adopting the reciprocity of physician licenses. Our model is of a market for healthcare services where there is a representative producer, maximizing its profit by choosing the number of out-of-state physicians to employ, and representative consumer, maximizing their utility by choosing the quantity of healthcare services. We capture the change in consumer welfare by deriving how the utility of the representative consumer changes with respect to the change in the number of out-of-state physicians employed by the representative producer.

3.2.1 Producer's Problem

The representative producer maximizes its profit Π by choosing and employing the number of out-of-state physicians, denoted by n_t. As physician shortage is a prevalent issue in the U.S. healthcare market, assume that the number of local physicians, denoted by n_s, is fixed (i.e., full employment). Assume there are no migrated physicians, and thus the production of healthcare services is based on n_s and n_t, with the constant elasticity of substitution (CES), where σ denotes the elasticity of substitution. Then, the production of healthcare services can be expressed as

$$AL = A\left[(1-\lambda)n_s^{\frac{\sigma-1}{\sigma}} + \lambda T_t n_t^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}}, \quad (2)$$

where A is the production constant, λ is the share parameter, and T_t is the fraction of hours that out-of-state physicians spend working for this producer. To employ physicians full-time, the producer pays w_s and w_t, respectively. Since out-of-state physicians work a fraction of hours, denoted by T_t, the wage these physicians receive is $T_t w_t$. In addition, for simplicity, assume that the cost of travel, subsidizing out-of-state physicians' travel, is zero.

Statement. A producer maximizes its profit by choosing the number of out-of-state physicians to employ:

$$\max_{n_t} \Pi = \max_{n_t} PA\left[(1-\lambda)n_s^{\frac{\sigma-1}{\sigma}} + \lambda T_t n_t^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}} - (w_s n_s + w_t T_t n_t), \quad (3)$$

where P is the price of healthcare services.

3.2.2 Consumer's Problem

The representative consumer maximizes their utility by choosing the quantity of healthcare services to consume, denoted by q, given the probability of the need for healthcare services (ρ), the price of these services (P) and the budget (B), dispersed at the scale of η.

Statement. A consumer maximizes their utility by choosing the quantity of healthcare services to consume:

$$\max_{q} U_c(q) \text{ s.t. } \rho P q \leq \eta B, \tag{4}$$

where $\frac{\partial U_c(q)}{\partial q} > 0$, implying that increasing the consumption of healthcare services increases utility. We can express q as a demand for healthcare services that is a function of the price and budget, denoted by $q(P, B)$. Then, the quantity demanded for healthcare services decreases as the price of these services increases (i.e., $\frac{\partial q(P,B)}{\partial P} < 0$). These first-order conditions above imply that

$$\frac{\partial U_c(q)}{\partial P} = \frac{\partial U_c(q)}{\partial q}\frac{\partial q(P,B)}{\partial P} < 0. \tag{5}$$

3.2.3 Equilibrium and Implications of the Model

Definition. Given the number of local physicians employed n_s, the consumer's budget for healthcare utilization B, and parameters $\{A, \sigma, \lambda, \rho, \eta, T_t\}$, an equilibrium is defined by the endogenous quantities n_t and q such that:

1. Producer's optimization behavior: A representative producer choosing n_t solves Equation (3).

2. Consumer's optimization behavior: A representative consumer choosing q solves Equation (4).

3. Market clears: The price of healthcare services P is such that the market clears: $AL = \rho q$.

Given the consumer's and producer's problems, we summarize three corollaries explaining equilibrium relationships. Proofs and derivations of equations are provided in Appendix A.

Corollary 1. The marginal product of out-of-state physicians is positive. In other words, the quantity of healthcare services produced increases as more out-of-state physicians are employed:

$$\frac{\partial L}{\partial n_t} = \lambda T_t \left(\frac{L}{n_t}\right)^{1/\sigma} > 0. \tag{6}$$

Corollary 2. The price of healthcare services decreases as more healthcare services are produced:

$$\frac{\partial P}{\partial L} = -\frac{1}{A\sigma\lambda L}\left(\frac{n_t}{L}\right)^{1/\sigma} < 0. \tag{7}$$

Corollary 3. The price of healthcare services decreases as more out-of-state physicians are

employed by the representative producer:

$$\frac{\partial P}{\partial n_t} = \frac{\partial P}{\partial L}\frac{\partial L}{\partial n_t} = -\frac{T_t}{A\sigma L} < 0. \quad (8)$$

We now analyze the change in consumer welfare after adopting reciprocity. We define the increase in consumer welfare as the increase in the utility of the representative. As shown in Inequality (5) and first-order conditions, consumer welfare increases when consumption of healthcare services increases or the price of healthcare services decreases. Using these relationships, we explain how adopting ULR increases consumer welfare.

Theorem 1. Suppose a representative producer maximizes its profits by choosing the number of out-of-state physicians to employ. At the same time, a representative consumer maximizes their utility by choosing the quantity of healthcare services to consume. Adopting universal reciprocity reduces the cost of employing each out-of-state physician, leading to an increase in the local labor supply of physicians and thereby consumer welfare. In other words,

$$\frac{\partial U_c}{\partial n_t} = \frac{\partial U_c}{\partial P}\frac{\partial P}{\partial n_t} > 0. \quad (9)$$

This theorem shows that consumer welfare increases because the increase in local labor supply of physicians reduces the price of healthcare services, leading to an increase in the consumption of healthcare services and thereby the consumer's utility.

Inequality (1) presents the log rate of starting out-of-state practice among the states that previously adopted the IMLC and then adopted ULR, showing the increase in the local labor supply of physicians. The approximation of the change in consumer welfare in these states is

$$\frac{\partial U_c}{\partial n_t}\left[n_t^1 e^{(1/\gamma)(1-\alpha)c_{relicense}}\right] > 0, \quad (10)$$

implying that adoption of ULR among the states that previously adopted IMLC also increases consumer welfare.

3.3 Testable Hypotheses

Based on the implications of our theoretical models, we test a set of hypotheses below:

Hypothesis 1. The states that adopted the universal reciprocity of physician licenses experience an increase in the regional labor supply of physicians due to the increase in out-of-state practices.

Hypothesis 2. The states that adopted the universal reciprocity of physician licenses experience an increase in healthcare access.

Hypothesis 2-1. The states that adopted ULR but did not adopt the universal reciprocity of physician licenses do not experience an increase in healthcare access.

Hypothesis 2-2. The states that impose residency requirements for ULR do not experience an increase in healthcare access because this requirement restricts out-of-state physicians' practices.

4 Data and Methods

4.1 Physician Local Labor Supply Measures

We use two datasets to examine the changes in the regional labor supply of physicians. First, using IPUMS-USA 2018–2023, we obtain two measures that examine the changes in the interstate migration of physicians (Ruggles et al., 2023): per capita proportions of physicians using the state of residency and the state of primary workplace. These proportions are calculated by dividing the total number of physicians living/working primarily in the corresponding state by the state's population. These measures allow examining the changes in the level of interstate migration after the ULR was adopted, which are used in previous studies examining interstate migration of licensed workers (e.g., Johnson and Kleiner, 2020; Bae and Timmons, 2023). Since IPUMS-USA is an annual survey without months of survey, the proportions of physician measures are shrunk into state-year cells. More information about the variables is provided in Appendix B.

Second, we use the Doctors and Clinicians National Downloadable File 2018-2023 from the Centers for Medicare & Medicaid Services (CMS). It provides information on where each clinician and physician works. Using each physician's unique identification, the National Provider Identifier (NPI), we obtain two measures indicating physicians' out-of-state practice statuses. The first measure is the status of whether a physician works in two or more states. The second measure is the status of whether a physician works in two or more states, at least one of which did not adopt the IMLC nor ULR. This measure is particularly important because our theoretical model predicts that the increase in the regional labor supply is due to the physicians from non-IMLC states. Using these measures, we calculate the per capita proportion of out-of-state practice physicians. These measures are shrunk into state-half-year cells.

4.2 Healthcare Access Measures

We use the Behavioral Risk Factor Surveillance System (BRFSS) 2018-2023 to measure the changes in healthcare access. The BRFSS, publicly available from the Centers for Disease Control and Prevention (CDC), is an annual cross-sectional telephone survey that provides health-related information, including healthcare access and health outcomes, on a nationally representative sample of Americans aged 18 and older. The benefit of using the BRFSS is that it

provides both the state of residency and the month of survey of each respondent; this is particularly important for distinguishing the time before and after the adoption of the ULR in each state.

We use the sample of respondents aged 25 and older and covered by any health insurance. As demand and access to healthcare services vary by age (Card et al., 2008), we also conduct subgroup analyses by age groups: working-age group (age 25-64) and older adults (age 65 and older). Then, the respondent-level healthcare access measures are shrunk into state-half-year cells. Each cell provides the proportion of respondents in each state who utilized the corresponding healthcare services during the given 6-month period. We choose the half-year time interval to ensure that each proportion is obtained from a significantly large number of respondents (i.e., large denominators for the calculation of these proportions); by using large denominators for the calculation of these proportions, our dependent variables reflect the state-level healthcare access measures without a significant variation due to respondent-level variations or measurement errors.

Although the BRFSS provides numerous healthcare access measures, the majority of the measures cannot be used because the survey questions for the corresponding measures are asked only for specific groups of respondents based on their age and sex. For instance, the question on the time since last sigmoidoscopy or colonoscopy was asked of respondents who are aged 50 or older, and the question on the time since last mammogram was asked to women only. This leads to an insufficient number of respondents to accurately obtain the proportion of respondents who received corresponding healthcare services. In addition, some of the questions are asked biennially (e.g., time since last dental checkup), which limits the possibility of using an event study design to measure the pre- and post-treatment effects in each time interval.

Therefore, we carefully selected two variables whose questions in the survey remained relatively similar across all survey years and were asked to all the survey respondents. First, "having one or more personal doctors or healthcare providers (Personal Doctor)" is a measure that captures whether a respondent has a personal doctor or healthcare provider at the time of the survey. Although a minor change in the wording of this survey question in 2021 led to an increase in the proportion of respondents who have personal doctors or healthcare providers, this increase was observed at a similar rate across all states (Hest, 2022). In Appendix C, we provide a comparison of this measure separately by ULR adoption status, presenting no statistically significant difference in the changes in the proportion due to this survey question change. Second, "could not see a doctor because of cost (Cost Issue)" is a measure that captures whether a respondent experienced not

seeing a doctor because of high healthcare costs. These variables are particularly useful given our study time window because they are not critically influenced by COVID-19, the possible confounder. The complete survey questions from the questionnaire are provided in Appendix B.

4.3 Estimation Procedure

In this study, we use the event study framework to estimate the reduced form effect of the ULR. We carefully select the treatment and control groups that allow us to make a parallel trend assumption. To do so, we sample 20 states that implemented the IMLC before 2018, the initial wave of our study time window. Out of these states, 11 states adopted ULR. Among these states, four states – Arizona, Iowa, Kansas, and Mississippi – imposed residency requirements for license reciprocity. In addition, three states – Colorado, Utah, and Wyoming – did not include physician licenses for universal reciprocity. Thus, there are four states – Idaho, Montana, New Hampshire, and South Dakota – that adopted universal reciprocity of physician licenses without residency requirements; these states are categorized as a true treatment group, and the other seven states are categorized as a control group. Note that the states that adopted the universal reciprocity of physician licenses impose the same rules and requirements for physicians with the Medical Doctor (MD) degree and those with the Doctor of Osteopathic Medicine (DO) degree. Table 2 shows the list of states being used as treatment and control groups in this study. Table 3 provides descriptive statistics of the sociodemographic characteristics of respondents from the initial wave by their states' ULR adoption status. Appendix C shows the trends of healthcare access measures during the survey periods, showing parallel trends before the ULR's adoption.

For the estimation, we use a Callaway-Sant'Anna (2021) staggered difference-in-difference (CSDID). There are two reasons we use this method. First, we expect that the impact of this policy reform will be introduced gradually, and therefore an event study design is more appropriate to capture the change in the magnitude of the effect over time. Second, the ordinary event study design is limited in accounting for so-called 'non-parallel outcome dynamics' that lead to biased and inconsistent estimates (De Chaisemartin and D'Haultfœuille, 2020; Goodman-Bacon, 2021). CSDID allows us to account for these issues so that we can obtain the causal measures that present the effect of this policy reform on healthcare utilization. The estimation model is

$$Y_{st} = \alpha + \mathbf{ULR}_{st}\boldsymbol{\beta} + \theta_s + \theta_t + \varepsilon_{st}, \tag{11}$$

where Y_{st} is the measure of dependent variable from state s in time t, $\mathbf{ULR}_{st}$ is the vector of event study regressors capturing the time since the ULR was adopted, including both pre- and post-

treatment, and θ_s and θ_t are the state and time fixed effects. We present the results of four pre-treatment and seven post-treatment waves. As a robustness check, we also use Sun and Abraham (2021) staggered difference-in-difference (SADID).

4.4 Threats to Validity and Solutions

To validate our theoretical predictions and baseline findings, we conduct three robustness checks. First, we replicate the analyses by including the states that imposed residency requirements in the treatment group. Our theoretical model predicts that the increase in consumer welfare is due to the increase in out-of-state physicians, primarily from non-IMLC states, delivering healthcare services via locums and telehealth. Yet, imposing residency requirements for license reciprocity restricts out-of-state practices and thereby limits the improvements in consumer welfare. We test this to confirm our theoretical prediction and the magnitude of the potential barrier.

Second, we conduct a falsification test to validate whether the estimated effects are from the universal reciprocity of physician licenses or other, unknown factors related to the ULR. We create a counterfactual treatment group by including the states that adopted ULR regardless of including physician licenses for universal reciprocity. Then, we replicate our analyses and compare the results with those from the analyses using a true treatment group.

Last, we conduct a validation test by accounting for Medicaid expansion and state-specific public health insurance programs. The Affordable Care Act of 2010 included a Medicaid expansion, and many U.S. states extended their Medicaid eligibility to individuals with incomes up to 138% (or higher) of the federal poverty level (FPL). This expansion allowed more individuals, especially those with lower income, to obtain health insurance, leading to increased access to healthcare services (Mazurenko et al., 2018; Borgschulte and Vogler, 2020). In addition, some states, such as Illinois and Minnesota, operate their own programs with substantially higher FPL thresholds. Furthermore, each state imposes different FPLs for pregnant women's public health insurance eligibility, ranging from 138% FPL for Idaho to 306% FPL for Wisconsin. These introduce unobserved heterogeneity into our sample; due to the state-level difference in Medicaid eligibility and receipt, the socioeconomic statuses of respondents in each state vary.

However, BRFSS 2018–2023 is limited in directly accounting for these differences because of the change in the survey question on the primary source of healthcare coverage. While the response rates of the survey question on primary source of healthcare coverage in the BRFSS 2018–2020 are below 15%, those in the BRFSS 2021–2023 are above 95%. This is due to the

BRFSS's re-engineering of the survey and its questions in 2021, which led to a change in the response rates for some of the questions. Since the survey response rates are drastically different between the two time periods, utilizing health insurance coverage measures directly would not solve this issue.

To account for this issue, we select the sample of respondents who are not affected by these factors. We first select the states that have the 150% FPL or lower threshold for public health insurance eligibility. Since Illinois and Minnesota operate their own programs with eligibility thresholds above 150% FPL, we exclude them from the sample. Then, we exclude the respondents who are pregnant, as the eligibility FPL thresholds significantly vary by state. For consistency, we sample the respondents who are aged 49 and below because the question on pregnancy is asked to women aged 49 and below. We then select the respondents who are covered by any health insurance; the response rate of this measure is over 95% across all survey periods, meaning that it was not significantly affected by the survey re-engineering in 2021. Lastly, we select the respondents whose household annual income is above the 150% FPL, considering the number of family members in the household; we choose the households with one to four family members, covering approximately 86% of the households in the BRFSS. The BRFSS provides household income measures in categories, and we use these categorical measures in this step. More information on sample selection using these measures is provided in Appendix E. Lastly, we obtain the state-half-year healthcare access measures and conduct estimations using the data of these respondents.

5 Results

5.1 Changes in Local Labor Supply: Interstate Migration Versus Out-of-State Practices

Figure 1 shows the results from the CSDID of Equation (11) using physician labor supply measures. We also provide the results from Bacon decomposition to present the directions, magnitudes, and weights of the overall treatment effect and those from different treatment timing at the bottom (Goodman-Bacon, 2021). The two sub-figures on the left (Figures 1A and 1B) are from the analyses using IPUMS-USA, illustrating the changes in the proportion of physicians from the population, indicating the interstate migration of physicians. Yet, both sub-figures show that the ULR has no statistically significant effect on the interstate migration of physicians.

On the other hand, the two sub-figures on the right, from the analyses using the CMS

National Downloadable File, present results related to the changes in regional labor supply via out-of-state practices. Figure 1D shows that out-of-state practice physicians from non-IMLC states per capita increased by 0.012 after adopting ULR, indicating an increase in the inflow of physicians from non-IMLC states via out-of-state practices after adopting ULR. In summary, adopting ULR increases the regional labor supply of physicians by increasing out-of-state practices but not interstate migration, consistent with our predictions.

5.2 Changes in Healthcare Access

Figure 2 shows the results from the CSDID of Equation (11) using healthcare access data. We also provide the results from Bacon decomposition at the bottom. There are six sub-figures where two sub-figures in each row present the result using the sample of respondents from the same age groups: overall, working-age group, and older adults. Each column presents the results using different healthcare access variables: Personal Doctor on the left, and Cost Issue on the right.

The first two sub-figures at the top do not present any statistically significant results. Yet, the next four sub-figures present meaningful results. First, Figure 2C shows an increase in the proportion of respondents with personal doctors or healthcare providers among the working-age group by 6.0 percentage points after adopting ULR. In addition, Figure 2D shows a reduction in the proportion of respondents who could not see doctors because of the cost among the working-age group by 1.5 percentage points. These results clearly indicate the improvement in consumer welfare after adopting ULR: an increase in access and a reduction in the cost issue.

Second, Figure 2E shows an increase in the proportion of respondents with personal doctors or healthcare providers among older adults by 2.5 percentage points, while Figure 2F shows no statistically significant changes in the cost issues. As the majority of respondents aged 65 and older are covered by Medicare and therefore are less concerned about healthcare costs (Card et al., 2008), the increase in access to healthcare services without changes in the cost issue is reasonable. Also, due to this difference, it is possible that the estimates using the overall age group are not statistically significant. In summary, these results provide evidence of the improvement in consumer welfare after adopting ULR.

5.3 Robustness Check and Validations

Figure 3 shows the results from the CSDID of Equation (11) using healthcare access data by including the states that imposed residency requirements for license reciprocity in the treatment group. We also provide the results from Bacon decomposition at the bottom. The results illustrate

that residency requirements work as a barrier to improving consumer welfare. Other than Figure 3F, none of the sub-figures show a clear effect of ULR on healthcare access. Furthermore, the statistically significant effect in Figure 3F is small, and the results from Bacon decomposition show that the directions of effects from the timing group and the treated versus never-treated group are opposite. Since the residency requirement restricts out-of-state physicians from providing out-of-state practices, the regional labor supply of physicians and thereby healthcare access cannot increase. This is consistent with our theoretical predictions as well.

Figure 4 shows the results from the CSDID of Equation (11) using the counterfactual treatment group: the states that adopted ULR regardless of their physician license reciprocity. We also provide the results from Bacon decomposition at the bottom of the figure. The results are consistent with our predictions. First, Figures 4D and 4E are not statistically significant anymore, whereas their counterparts, Figures 2D and 2E, are statistically significant. Second, the confidence intervals in Figure 4C, compared to its counterpart, Figure 2C, are substantially wider. Although the estimated effects in Figure 4A become statistically significant, the results from Bacon decomposition show a substantial increase in the total weight from the timing group and a reduction in overall estimated effects from both the timing group and treatment versus the never-treated group.

Figure 5 shows the results from the CSDID of Equation (11) using healthcare access data of respondents who are not affected by Medicaid expansions. Despite the confidence intervals with greater magnitudes due to the smaller samples used for obtaining half-year proportions, Figure 5A shows that the proportion of respondents with personal doctors or healthcare providers increased by 4.4 percentage points after the ULR among the respondents not eligible for Medicaid. In addition, although the estimated effects in Figure 5B are not statistically significant, the sample of respondents in this estimation is in better financial circumstances (above 150% FPL), and thus, the likelihood of having cost issues could be lower than those below 150% FPL. Regardless, the results show an increase in access to healthcare services after adopting ULR.

Lastly, we use SADID to replicate the results in Figures 1 and 2: those from the CSDID. Figure 6 provides the results from the SADID, which are the same as those in Figures 1 and 2. Figure 6B shows that per capita out-of-state practice physicians from non-IMLC states increased after adopting ULR, consistent with our findings in Figure 1. Figures 6C, D, and E show the increases in the proportion of respondents with personal doctors or healthcare providers for both

working-age groups and older adults, and the proportion of those who could not see doctors because of the cost among working-age respondents decreased. Overall, all these results support our predictions that adopting ULR increases out-of-state practices and thereby consumer welfare.

6 Conclusions

We examine how the recent policy reform on relaxing the licensure regulations improves regional labor supply and consumer welfare in the healthcare sector. We first provide two complementary theoretical models explaining how the adoption of ULR increases the regional labor supply and subsequently increases consumer welfare in the market for healthcare services. We then estimate the change in the regional labor supply of physicians and healthcare access after adopting ULR. The results are consistent with our predictions. Adopting ULR increased out-of-state practices, particularly by the physicians potentially from non-IMLC states, but not interstate migration. Also, universal reciprocity of physician licenses significantly increased access to healthcare services and reduced the cost issues among working-age individuals. We also show that the residency requirements for license reciprocity work as a barrier to improving consumer welfare.

The main rationales for occupational licensing are to protect the health and safety of consumers and to ensure a sufficiently high level of product or service quality (Kleiner, 2015). According to this perspective, by making would-be practitioners undergo specific training, pass exams, and complete other requirements, licensing protects the public from fraudulent, disreputable, and unqualified service providers. Nevertheless, by making it more difficult to enter an occupation across state lines, licensing can affect employment and wages in licensed occupations, the prices for their services, and reduce workers' economic opportunities more broadly. Further, if these policies result in an inability to achieve state or local equilibrium, policies that reduce these barriers could enhance both consumer and worker welfare in healthcare.

There are several limitations in this study. First, this study does not show the reduction in actual medical costs, but the proportion of those not seeing doctors because of cost issues, because the BRFSS does not provide healthcare expense measures. Second, for the same reason, this study does not examine the change in service quality. Last, due to the data limitation, our validation test that accounts for public health insurance programs provides the estimations only by utilizing an approximate subsample of respondents who would not be financially eligible for these programs.

Therefore, future research should extend our findings to obtain the long-term effects of

universal reciprocity by utilizing upcoming datasets. Also, future research can utilize other healthcare datasets to examine the influence of ULR on actual healthcare costs and service quality, especially the outcomes among economically vulnerable populations. Lastly, it would be fruitful to examine the change in consumer welfare from different occupational sectors, as ULR includes various occupations. Nevertheless, our analysis adds to the role that changes in statutes affecting physicians' ability to practice can enhance patient well-being and consumer welfare.

Data Statement

This publication is based on data from the Behavioral Risk Factor Surveillance System (BRFSS) 2018-2023, IPUMS-USA 2018-2023, and Doctors and Clinicians National Download File 2018-2023 from the Centers for Medicare & Medicaid Services (CMS). Data and analytic STATA code may be available from the corresponding author (Yun taek Oh) upon request.

Declaration of Competing Interest

The authors, Yun taek Oh and Morris M. Kleiner, have no conflict of interest to report.

Generative AI and AI-assisted Technologies in the Manuscript Preparation Process

During the preparation of this work the authors used Microsoft Copilot in order to collect the information on the dates of implementation of Interstate Medical Licensure Compact (IMLC) and Universal Licensing Recognition (ULR) for the 20 states listed in Table 2. After using this tool/service, the authors reviewed and edited the content, as needed, and take full responsibility for the content of the published article.

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Table 1. Comparison Between Interstate Licensure Compact and Universal Licensing Recognition

	Interstate Licensure Compact	Universal Licensing Recognition

Similarity	• Reciprocity of occupational licenses for certain occupations.
	  o "Reciprocity" means giving out-of-state licensed workers "right to practice" without going through the state-specific re-licensure processes.
	• There are separate compacts for each occupation that administer the matters for corresponding occupations. For instance, the *Interstate Medical Licensure Compact* administers the matters related to physician licenses, while the Nurse Licensure Compact administers the matters related to nurse licenses.
	  o Therefore, some of the occupational licenses are eligible for reciprocity while others are not, depending on whether the corresponding state is in the compact for corresponding occupations or not.
		• Reciprocity of occupational licenses for selected occupations.
		  o "Reciprocity" means giving out-of-state licensed workers "right to practice" without going through the state-specific re-licensure processes.
		• The occupations for recognition are selected at the time of adopting the ULR; other occupations can be added later via amendments.
		  o Therefore, some of the occupational licenses are eligible for reciprocity while others are not, depending on whether the corresponding occupation is included for the ULR or not.

Difference	• Only the licenses that are issued by the member states are eligible for reciprocity (less comprehensive than ULR).
	• Reciprocity of out-of-state licenses for different occupations are managed by different institutions.
	  o For instance, physician licenses are managed by the Interstate Medical Licensure Compact, while nurse licenses are managed by the Nurse Licensure Compact.
		• Licenses that are issued by any U.S. state qualify for reciprocity (more comprehensive than ILC).
		  o Some states (e.g., Montana and South Dakota) also adopt reciprocity for the licenses issued from Canada.

Example	• Physicians (Interstate Medical Licensure Compact) • Nurses (Nurse Licensure Compact) • Dentists and Dental Hygienist (Dentist and Dental Hygienist Compact,) • Social Workers (Social Work Licensure Compact)	• Physicians, nurses, dentists, physician assistants, plumbers, electricians, cosmetologists, barbers, etc • Note that the list of occupations varies by state. Some states do not include physician licenses for reciprocity although other occupations do (e.g., Iowa, Utah, and Wyoming)

Table 2. Interstate Medical Licensure Compact and Universal Licensing Recognition Status of U.S. States

State		IMLC Month/ Year	ULR					Note
			Impl. by 2023	Bill #	Month/ Year	Residency Required	Physician License Excluded	
Arizona	AZ	08/2016	Yes	HB 2569	04/2019	Yes	No	ULR was implemented on 08/2019
Colorado	CO	06/2016	Yes	HB 1326	06/2020	No	Yes	ULR was implemented on 01/2021
Idaho	ID	03/2015	Yes	SB 1351	07/2020	No	No	
Iowa	IA	07/2015	Yes	HF 2627	06/2020	Yes	No	Residency requirement removed in 07/2022
Kansas	KS	05/2016	Yes	HB 2066	07/2021	Yes	No	
Mississippi	MS	05/2016	Yes	HB 1263	07/2021	Yes	No	
Montana	MT	04/2015	Yes	HB 105	03/2019	No	No	
New Hampshire	NH	05/2016	Yes	HB 594	08/2023	No	No	
South Dakota	SD	03/2015	Yes	HB 1077	02/2021	No	No	
Utah	UT	03/2015	Yes	SB 23	05/2020	No	Yes	
Wyoming	WY	02/2015	Yes	SF 18	07/2021	No	Yes	
Alabama	AL	05/2015	No					
Illinois	IL	07/2015	No					
Maine	ME	11/2017	No	PL 2021	07/2021	No	No	ULR was implemented on 01/2025
Minnesota	MN	05/2015	No					
Nebraska	NE	04/2017	No	LB 390	03/2024	No	No	ULR was implemented on 07/2024
Tennessee	TN	01/2017	No					
Washington	WA	07/2017	No					
West Virginia	WV	03/2015	No					
Wisconsin	WI	12/2015	No					

Note: IMLC – Interstate Medical Licensure Compact; ULR – Universal Licensing Recognition; Impl. - Implemented. We select the states that implemented the IMLC before 2018, the initial time of our analytic sample. Nevada was excluded from the analytic sample because it passed the ULR before our study time window (pre-2018).

Table 3. Healthcare Utilization and Demographic Characteristics, BRFSS 2018

	Adopted the ULR			
	No		Yes	
	Prop/Mean	SD	Prop/Mean	SD
Healthcare Utilization Measures				
Personal Doctor	.794	.404	.769	.422
Cost Issue	.130	.337	.132	.339
Sociodemographic Characteristics				
Women	.530	.499	.525	.499
Age	47.5	11.5	47.4	11.5
Race and Ethnicity				
NH White	.822	.383	.791	.407
NH Black	.065	.247	.054	.226
NH Others	.055	.229	.072	.259
Hispanic	.058	.233	.083	.275
Level of Education				
Less than HS and HS Graduate	.316	.465	.313	.464
Some Colleges or Higher	.682	.466	.684	.465
MSA	.579	.494	.503	.500
Has Health Insurance	.901	.299	.884	.320

Note: BRFSS - Behavioral Risk Factor Surveillance System; Prop - proportion; SD - standard deviation; NH - non-Hispanic; HS - high school; MSA - metropolitan statistical area. The above descriptive statistics are from the BRFSS 2018, January–June.

Figure 1. Changes in Regional Labor Supply

Interstate Migrations (IPUMS-USA)

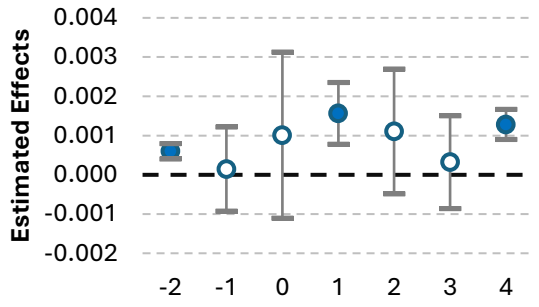


Figure 1A. Interstate Migration, Residency

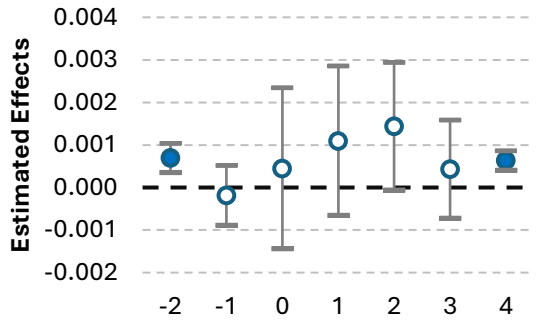


Figure 1B. Interstate Migration, Workplace

Out-of-State Practices (CMS File)

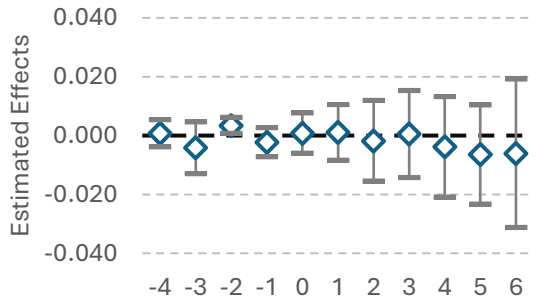


Figure 1C. Out-of-State Practices, Overall

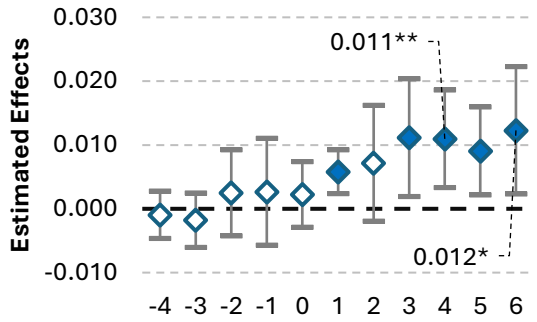


Figure 1D. Out-of-State Practices, Non-IMLC

	Two-Way Fixed Effects			Bacon Decomposition			
				Timing Groups		Never Treated vs Treated	
Bacon Decomposition	EST	SE	|p|	Beta	TW	Beta	TW
IPUMS-USA, Residency	.001	.000	.001	.000	.093	.001	.907
IPUMS-USA, Workplace	.001	.000	.005	.000	.077	.001	.923
CMS, Overall	-.001	.003	.663	-.009	.080	.000	.920
CMS, Non-IMLC	.012	.003	.000	.000	.080	.014	.920

Note: TW – total weight. The sub-figures are obtained using Callaway-Sant'Anna staggered difference-in-difference, using the states that implemented the Interstate Medical Licensure Compact (IMLC) before 2018. The two sub-figures on the left column are the results from the analyses using IPUMS-USA, $N = 120$ (20 States × 6 time points). The two sub-figures on the right column are the results from the analyses using the CMS National Downloadable File, $N = 240$ (20 States × 12 time points). The table at the bottom presents the results from Bacon decomposition (Goodman-Bacon, 2021) to distinguish the directions, magnitudes, and weights of the overall treatment effect and the effects from different treatment timing.

Figure 2. Changes in Healthcare Access by Age Group

Personal Doctor

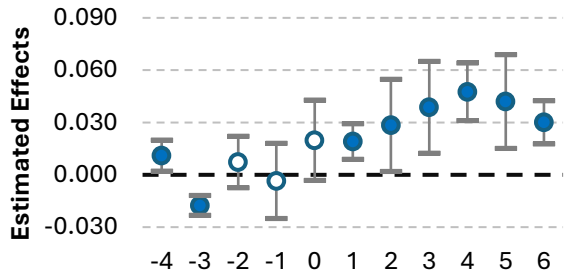


Figure 2A. All Ages

Cost Issue

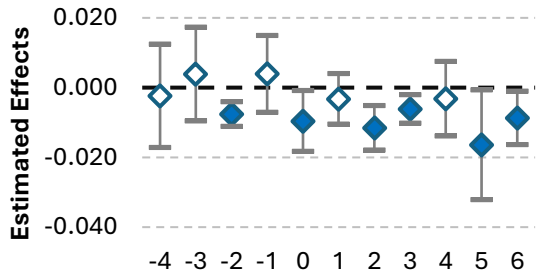


Figure 2B. All Ages

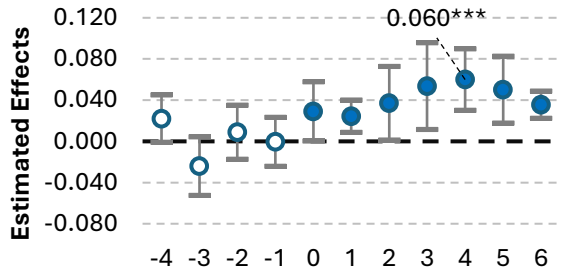


Figure 2C. Age 25-64

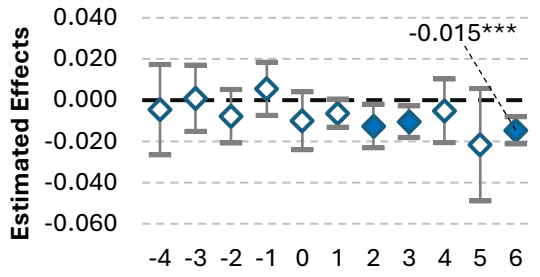


Figure 2D. Age 25-64

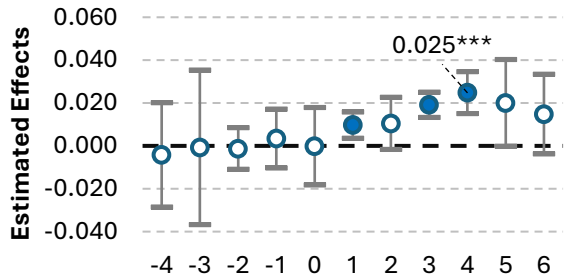


Figure 2E. Age 65+

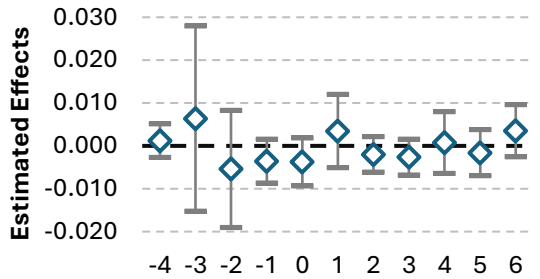


Figure 2F. Age 65+

	Two-Way Fixed Effects			Bacon Decomposition			
				Timing Groups		Never Treated vs Treated	
Bacon Decomposition	EST	SE	|p|	Beta	TW	Beta	TW
Personal Doctor, Overall	.027	.005	.000	.017	.080	.028	.920
Cost Issue, Overall	-.005	.003	.103	-.007	.080	-.005	.920
Personal Doctor, Age 25-64	.039	.006	.000	.029	.080	.040	.920
Cost Issue, Age 25-64	-.007	.004	.065	-.010	.080	-.007	.920
Personal Doctor, Age 65+	.013	.003	.000	.005	.080	.014	.920
Cost Issue, Age 65+	-.001	.002	.543	-.005	.080	-.001	.920

Note: TW – total weight. The sub-figures are obtained using Callaway-Sant'Anna staggered difference-in-difference, using the states that implemented the Interstate Medical Licensure Compact (IMLC) before 2018 from the Behavioral Risk Factor Surveillance System (BRFSS) 2018-2023; $N = 240$ (20 States × 12 time points). The table at the bottom presents the results from Bacon decomposition (Goodman-Bacon, 2021) to distinguish the directions, magnitudes, and weights of the overall treatment effect and the effects from different treatment timing.

Figure 3. Changes in Healthcare Access – Residency Requirements

Personal Doctor

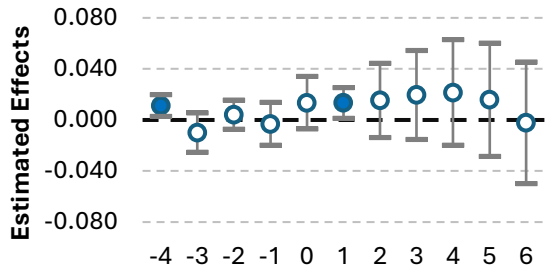


Figure 3A. All Ages

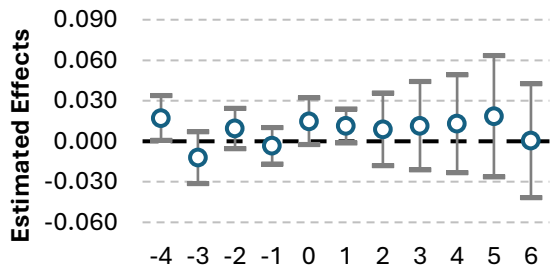


Figure 3C. Age 25-64

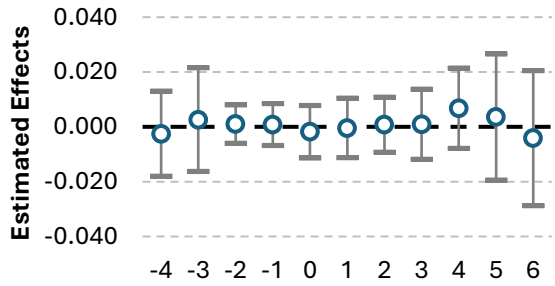


Figure 3E. Age 65+

Cost Issue

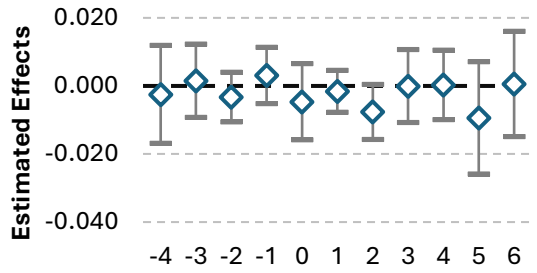


Figure 3B. All Ages

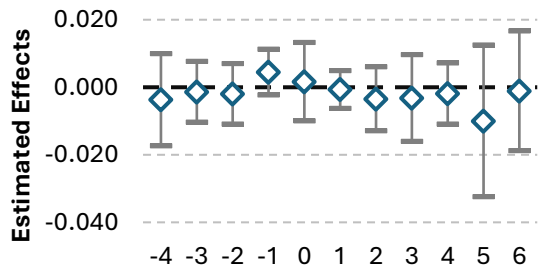


Figure 3D. Age 25-64

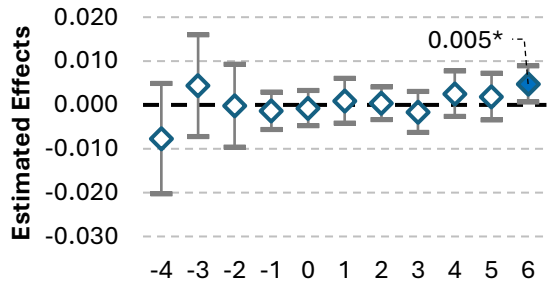


Figure 3F. Age 65+

	Two-Way Fixed Effects			Bacon Decomposition			
				Timing Groups		Never Treated vs Treated	
Bacon Decomposition	EST	SE	|p|	Beta	TW	Beta	TW
Personal Doctor, Overall	.012	.005	.008	.014	.100	.012	.900
Cost Issue, Overall	-.001	.003	.791	-.005	.100	.000	.900
Personal Doctor, Age 25-64	.013	.005	.010	.009	.186	.014	.814
Cost Issue, Age 25-64	-.001	.003	.752	.001	.186	-.001	.814
Personal Doctor, Age 65+	.002	.003	.346	.001	.186	.003	.814
Cost Issue, Age 65+	.001	.002	.443	-.003	.186	.002	.814

Note: TW – total weight. The sub-figures are obtained using Callaway-Sant'Anna staggered difference-in-difference, using the states that implemented the Interstate Medical Licensure Compact (IMLC) before 2018 from the Behavioral Risk Factor Surveillance System (BRFSS) 2018-2023; $N = 240$ (20 States × 12 time points). The table at the bottom presents the results from Bacon decomposition (Goodman-Bacon, 2021) to distinguish the directions, magnitudes, and weights of the overall treatment effect and the effects from different treatment timing.

Figure 4. Changes in Healthcare Access – Falsification Test

Personal Doctor

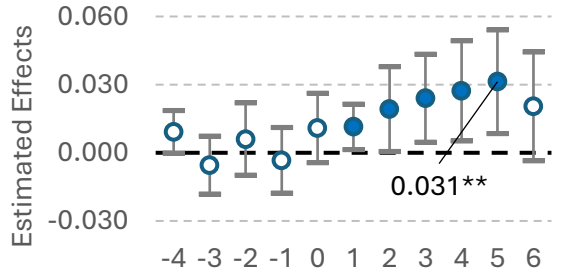


Figure 4A. All Ages

Cost Issue

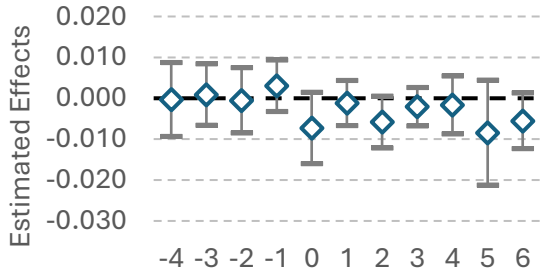


Figure 4B. All Ages

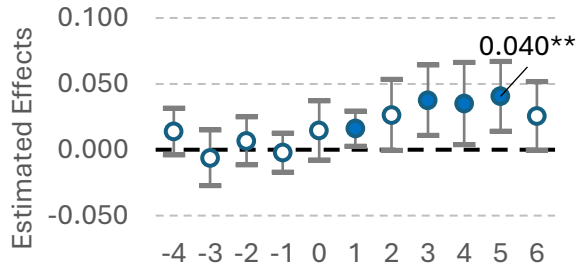


Figure 4C. Age 25-64

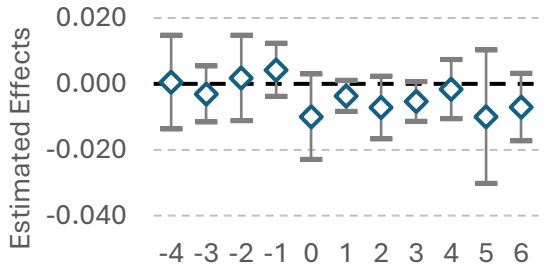


Figure 4D. Age 25-64

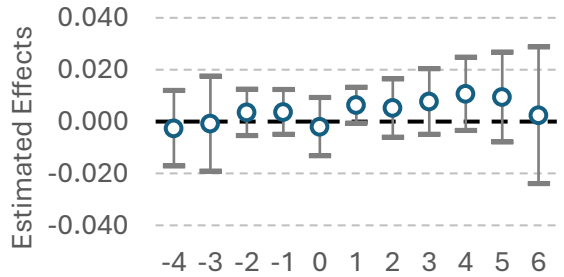


Figure 4E. Age 65+

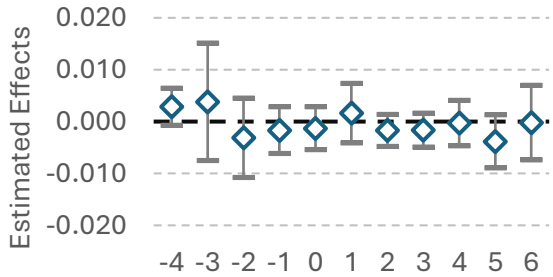


Figure 4F. Age 65+

	Two-Way Fixed Effects			Bacon Decomposition			
				Timing Groups		Never Treated vs Treated	
Bacon Decomposition	EST	SE	|p|	Beta	TW	Beta	TW
Personal Doctor, Overall	.018	.004	.000	.007	.139	.020	.861
Cost Issue, Overall	.000	.002	.900	-.004	.139	.000	.861
Personal Doctor, Age 25-64	.027	.005	.000	.014	.139	.028	.861
Cost Issue, Age 25-64	-.001	.003	.717	-.006	.139	.000	.861
Personal Doctor, Age 65+	.008	.003	.001	.002	.139	.009	.861
Cost Issue, Age 65+	.000	.002	.892	-.003	.139	.000	.861

Note: TW – total weight. The sub-figures are obtained using Callaway-Sant'Anna staggered difference-in-difference, using the states that implemented the Interstate Medical Licensure Compact (IMLC) before 2018 from the Behavioral Risk Factor Surveillance System (BRFSS) 2018-2023; $N = 240$ (20 States × 12 time points). The table at the bottom presents the results from Bacon decomposition (Goodman-Bacon, 2021) to distinguish the directions, magnitudes, and weights of the overall treatment effect and the effects from different treatment timing.

Figure 5. Changes in Healthcare Access – Not Affected by Medicaid Expansion Only

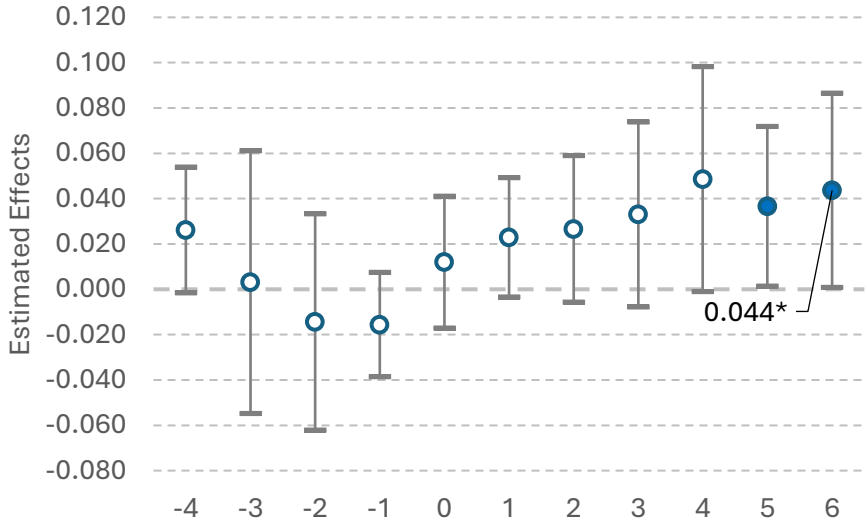


Figure 5A. Personal Doctor, Age 25-49

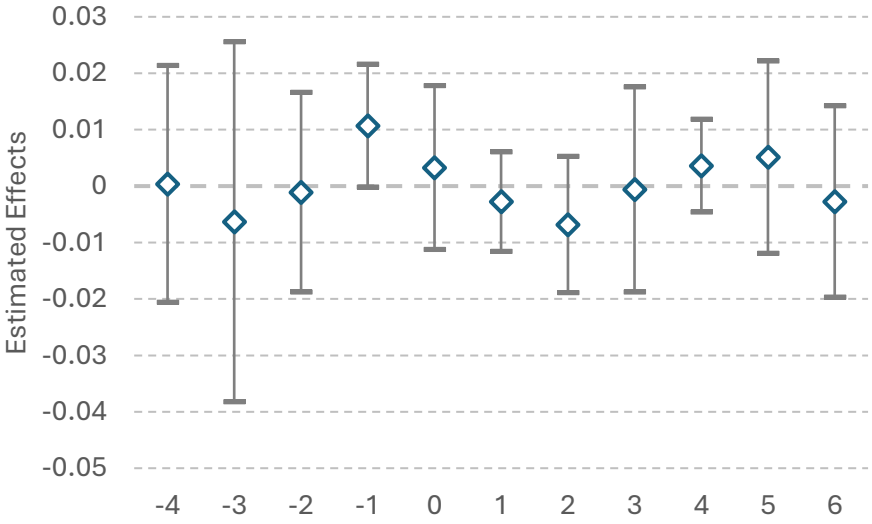


Figure 5B. Cost Issue, Age 25-49

	Two-Way Fixed Effects			Bacon Decomposition			
				Timing Groups		Never Treated vs Treated	
Bacon Decomposition	EST	SE	|p|	Beta	TW	Beta	TW
Personal Doctor, Age 25-64	.020	.008	.013	.004	.154	.023	.846
Cost Issue, Age 25-64	.004	.005	.353	.005	.154	.004	.846

Note: TW – total weight. The sub-figures are obtained using Callaway-Sant'Anna staggered difference-in-difference, using the states that implemented the Interstate Medical Licensure Compact (IMLC) before 2018 from the Behavioral Risk Factor Surveillance System (BRFSS) 2018-2023; $N = 216$ (18 States × 12 time points). The table at the bottom presents the results from Bacon decomposition (Goodman-Bacon, 2021) to distinguish the directions, magnitudes, and weights of the overall treatment effect and the effects from different treatment timing.

Figure 6. Use of Other Staggered Difference-in-Difference Method: Sun and Abraham (2021)

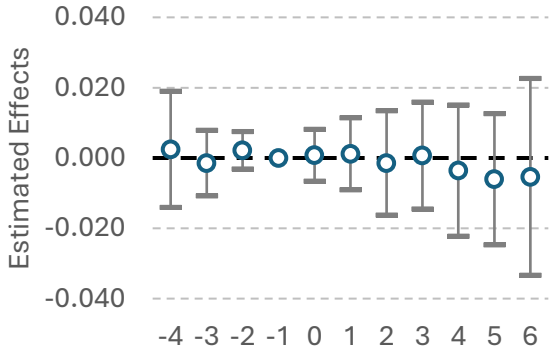


Figure 6A. Out-of-State Practices, Overall

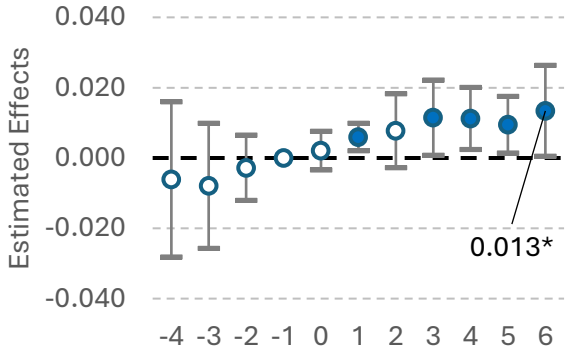


Figure 6B. Out-of-State Practices, Non-IMLC

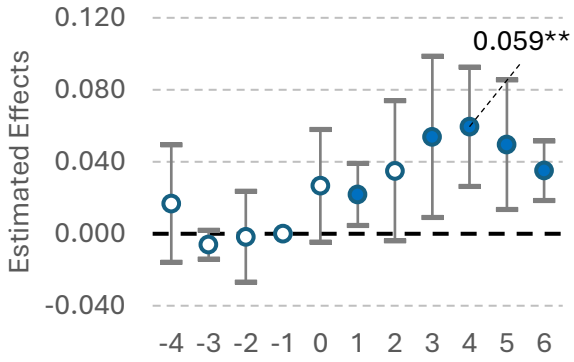


Figure 6C. Personal Doctor, Age 25-64

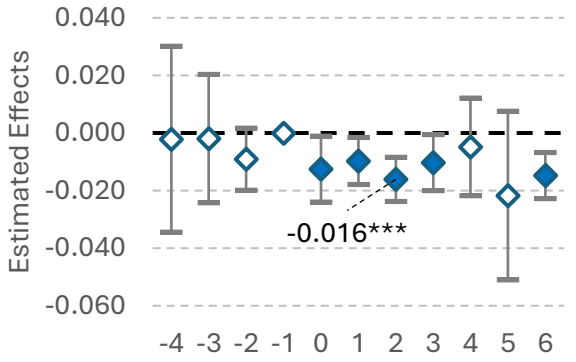


Figure 6D. Cost Issue, Age 25-64

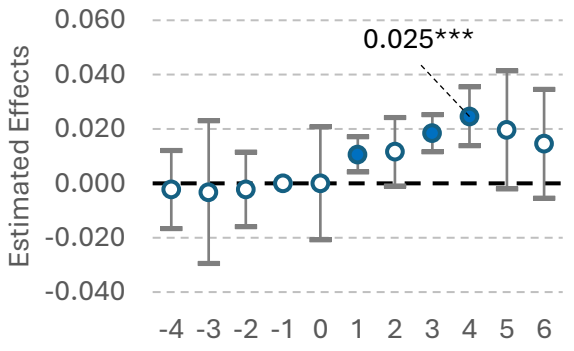


Figure 6E. Personal Doctor, Age 65+

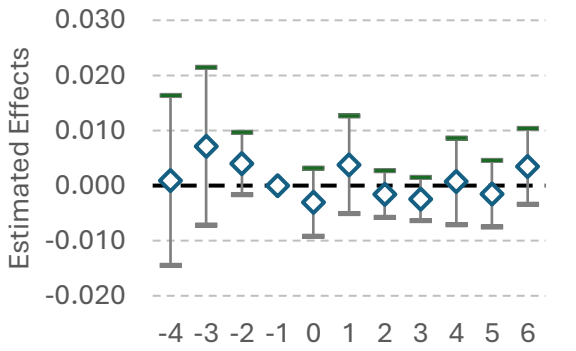


Figure 6F. Cost Issue, Age 65+

Note: The sub-figures are obtained using Sun and Abraham (2021) staggered difference-in-difference method, using the states that implemented the Interstate Medical Licensure Compact (IMLC) before 2018 from the Behavioral Risk Factor Surveillance System (BRFSS) 2018-2023; $N = 240$ (20 States × 12 time points).

Appendix A. Derivations and Proofs of Equilibria and First-Order Conditions

A.1 Derivation of Inequality (6)

Given the production function, Equation (2), the marginal product of out-of-state physicians is

$$\frac{\partial L}{\partial n_t} = \left(\frac{\sigma}{\sigma-1}\right)\left[(1-\lambda){n_s}^{\frac{\sigma-1}{\sigma}} + \lambda T_t {n_t}^{\frac{\sigma-1}{\sigma}}\right]^{\frac{1}{\sigma-1}} (\lambda T_t)\left(\frac{\sigma-1}{\sigma}\right){n_t}^{-\frac{1}{\sigma}},$$

where $\left[(1-\lambda){n_s}^{\frac{\sigma-1}{\sigma}} + \lambda T_t {n_t}^{\frac{\sigma-1}{\sigma}}\right]^{\frac{1}{\sigma-1}} = L^{1/\sigma}$. Therefore,

$$\frac{\partial L}{\partial n_t} = \left(\frac{\sigma}{\sigma-1}\right) L^{1/\sigma}(\lambda T_t)\left(\frac{\sigma-1}{\sigma}\right){n_t}^{-\frac{1}{\sigma}} = \lambda T_t \left(\frac{L}{n_t}\right)^{1/\sigma} > 0.$$

A.2 Derivation of Inequality (7)

Given the profit maximization problem, Equation (3), the marginal revenue and marginal cost are

$$MR = PA\left(\frac{\lambda T_t}{{n_t}^{1/\sigma}}\right)\left[(1-\lambda){n_s}^{\frac{\sigma-1}{\sigma}} + \lambda T_t {n_t}^{\frac{\sigma-1}{\sigma}}\right]^{\frac{1}{\sigma-1}}, \text{ and}$$

$$MC = T_t w_t,$$

where $\left[(1-\lambda){n_s}^{\frac{\sigma-1}{\sigma}} + \lambda T_t {n_t}^{\frac{\sigma-1}{\sigma}}\right]^{\frac{1}{\sigma-1}} = L^{1/\sigma}$. Therefore,

$$MR = PA\left(\frac{\lambda T_t}{{n_t}^{1/\sigma}}\right) L^{1/\sigma}.$$

At equilibrium, $MR = MC$, and therefore,

$$PA(\lambda T_t)\left(\frac{L}{n_t}\right)^{\frac{1}{\sigma}} = T_t w_t.$$

Assume interior solution, solve for P:

$$P^* = \frac{w_t}{A\lambda}\left(\frac{n_t}{L}\right)^{1/\sigma}.$$

We can use P^* to derive the first-order condition with respect to L:

$$\frac{\partial P}{\partial L} = \frac{w_t}{A\lambda}{n_t}^{1/\sigma}\left(-\frac{1}{\sigma}\right)L^{\frac{-1-\sigma}{\sigma}} = -\frac{1}{A\sigma\lambda L}\left(\frac{n_t}{L}\right)^{\frac{1}{\sigma}} < 0.$$

A.2 Derivation of Inequality (8)

Given Inequalities (6) and (7), the change in the price of healthcare services when more out-of-state physicians are employed can be expressed as

$$\frac{\partial P}{\partial n_t} = \frac{\partial P}{\partial L}\frac{\partial L}{\partial n_t} = \left[\lambda T_t \left(\frac{L}{n_t}\right)^{1/\sigma}\right]\left[-\frac{1}{A\sigma\lambda L}\left(\frac{n_t}{L}\right)^{1/\sigma}\right] = -\frac{T_t}{A\sigma L} < 0.$$

A.3 Proof of Theorem – Inequality (9)

Inequality (5) shows that the utility of a representative consumer decreases when the price of healthcare services increases. Inequality (7) shows that the price of healthcare services decreases as more healthcare services are produced. Then, the change in the utility of a representative consumer when the representative producer employs more out-of-state physicians can be expressed as

$$\frac{\partial U_c}{\partial n_t} = \frac{\partial U_c}{\partial P}\frac{\partial P}{\partial n_t} = \frac{\partial U_c}{\partial P}\left(-\frac{T_t}{A\sigma L}\right),$$

where $\frac{\partial U_c(q)}{\partial P} < 0$ and $-\frac{T_t}{A\sigma L} < 0$. Therefore, $\frac{\partial U_c}{\partial n_t} > 0$.

A.4 Derivation and Proof of Inequality (10)

Inequality (9) shows that the utility of a representative consumer increases when the number of out-of-state physicians employed increases. Suppose the number of out-of-state physicians before the adoption of the ULR is n_t^1 and that after the adoption is n_t^2, where $n_t^2 > n_t^1 > 0$[1]. Inequality (1) shows the change in the log rate of out-of-state practices ($\Delta \log(OSP)$) that is equal to $\frac{1}{\gamma}(1-\alpha)c_{relicense}$. This can be expressed as

$$\Delta \log(OSP) = \frac{1}{\gamma}(1-\alpha)c_{relicense} = \log\left(\frac{n_t^2 - n_t^1}{n_t^1}\right) > 0,$$

which means $n_t^2 - n_t^1 = n_t^1 e^{\frac{1}{\gamma}(1-\alpha)c_{relicense}}$. The change in the utility of a representative consumer (i.e., consumer welfare) after adopting the ULR is

$$\Delta U = \int_{n_t^1}^{n_t^2} \frac{\partial U_c}{\partial n_t}\partial n_t = \lim_{N\to\infty} \sum_{i=1}^{N} \frac{\partial U_c}{\partial n_t}\frac{n_t^2 - n_t^1}{N} > 0.$$

The approximation of the change in consumer welfare can be expressed as

$$\Delta U_{Approximation} = \frac{\partial U_c}{\partial n_t}(n_t^2 - n_t^1) = \frac{\partial U_c}{\partial n_t}\left[n_t^1 e^{\frac{1}{\gamma}(1-\alpha)c_{relicense}}\right] > 0.$$

[1] The employers in the states that adopted the IMLC before adopting the ULR can employ out-of-state physicians who attained their licenses from the IMLC member states. Furthermore, among the states that did not adopt any of the regulatory relaxation, there are physicians who have two or more physician licenses from multiple states.

Appendix B. Operationalization of Survey Questions

Outcome Variable	Question from the Survey	Response Choices	Operationalization
1. IPUMS-USA			
State of Residency	The state in which the household was located, using the Federal Information Professing Standards (FIPS) coding scheme.	FIPS (e.g. 01 – Alabama, 02 – Alaska, etc.)	= FIPS if 1 ≤ FIPS ≤ 56 where FIPS 1 = Alabama and FIPS 56 = Wyoming
Primary Place of Work	The state in which the respondent's primary workplace was located. If the person worked abroad, this is also indicated.	FIPS (e.g. 01 – Alabama, 02 – Alaska, etc.)	= FIPS if 1 ≤ FIPS ≤ 56 where FIPS 1 = Alabama and FIPS 56 = Wyoming
2. Behavioral Risk Factor Surveillance System (BRFSS)			
Personal Doctor	[BRFSS 2018–2020] "Do you have one person you think of as your personal doctor or health care provider?" [BRFSS 2021–2023] "Do you have one person (or group of doctors) that you think of as your personal health care provider?"	1 – Yes, only one 2 – More than one 3 – No 7 – Don't know / Not sure 9 – Refused	= "Yes" if Response = {1,2} = "No" if Response = {3}
Cost Issue	[BRFSS 2018–2023] "Was there a time in the past 12 months when you needed to see a doctor but could not because you could not afford it?"	1 – Yes 2 – No 7 – Don't know / Not sure 9 – Refused	= "Yes" if Response = {1} = "No" if Response = {2}
Routine Check	[BRFSS 2018–2023] "About how long has it been since you last visited a doctor for a routine checkup?"	1 – Within past year 2 – Within past 2 years 3 – Within past 5 4 – 5 or more years ago 7 – Don't know / Not Sure 8 – Never 9 – Refused	=" Yes" if Response = {1} = "No" if Response = {2,3,4,8}

Note: IPUMS: Integrated Public Use Microdata Series; IPUMS-USA: American Community Survey integrated in IPUMS system; BRFSS – Behavioral Risk Factor Surveillance System. There was a change in the wording of the survey question for "Personal Doctor" in 2021; therefore, we provide both question texts in this table.

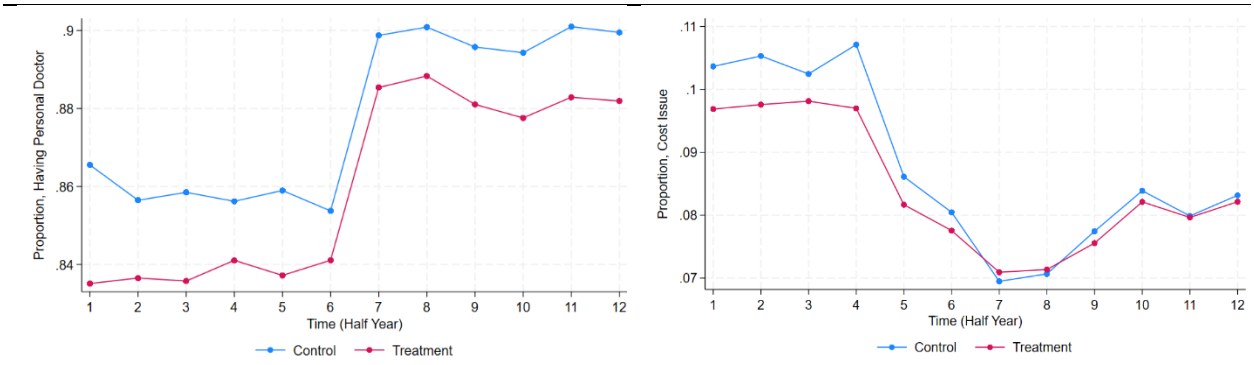
Appendix C. Comparison of Measures Between 2020 and 2021

C.1 Comparison: Second Half of 2020 and First Half of 2021

	Personal Doctor				Cost Issue			
	No ULR		ULR		No ULR		ULR	
Year	Mean	SD	Mean	SD	Mean	SD	Mean	SD
2020	.848	.037	.849	.053	.081	.019	.074	.013
2021	.891	.033	.898	.033	.072	.018	.065	.016
Diff (2021-2020)	.043		.049		.009		.009	

Note: The above descriptive statistics show the proportion of respondents who have one or more personal doctors or healthcare providers in the second half of 2020 and the first half of 2021, separately by the ULR adoption status: the states that adopted the ULR are included in the group "ULR," and those that did not adopt the ULR are included in the group "No ULR."

C.2 Changes in Healthcare Utilization Measures Over Time



Personal Doctor, 2018–2023 | Cost Issue, 2018–2023

Note: The first treatment (i.e., adopting the ULR) was in Time 3 (first half of 2019), $N = 240$ (20 States × 12 time points). The wording for the question "having one or more personal doctors or healthcare providers" was changed in the BRFSS 2021, which led to the increase in the proportion of respondents with personal doctors or healthcare providers across all the states in the U.S. Yet, this increase was observed at a similar rate across all states, and therefore this can be controlled by the use of time fixed effects in staggered difference-in-difference methods. For more information about the survey question and changes in the responses, check SHADAC's blog: https://www.shadac.org/news/brfss-potential-break-series-usual-source-care

Appendix D. List of Physician Specialty Classifications

From the CMS National Downloadable File, we identified that respondents are physicians by checking their credentials (variable name: *cred*): Medical Doctors (MD) and Doctor of Osteopathic Medicine (DO). Then, we identified physicians by checking respondents' primary specialty (variable name: *pri_spec*). The classification and the list of specialties are provided below:

1. Generalists

Family Medicine, Family Practice, General Practice, and Internal Medicine.

2. Specialists:

Addiction Medicine, Adult Congenital Heart Disease (ACHS), Advanced Heart Failure And Transplant Ca, Advanced Heart Failure And Transplant Cardiology, Allergy/Immunology, Anesthesiology, Cardiac Electrophysiology, Cardiovascular Disease (Cardiology), Critical Care (Intensivists), Dermatology, Diagnostic Radiology, Emergency Medicine, Endocrinology, Gastroenterology, Geriatric Medicine, Geriatric Psychiatry, Hematology, Hematology/Oncology, Hematopoietic Cell Transplantation And Cellular Therapy, Hospice/Palliative Care, Hospitalist, Infectious Disease, Interventional Cardiology, Interventional Pain Management, Interventional Radiology, Medical Genetics And Genomics, Medical Oncology, Medical Toxicology, Micrographic Dermatologic Surgery (MDS), Neurology, Neuropsychiatry, Nuclear Medicine, Pain Management, Pathology, Pediatric Medicine, Peripheral Vascular Disease, Physical Medicine And Rehabilitation, Preventative Medicine, Psychiatry, Pulmonary Disease, Radiation Oncology, Rheumatology, Sleep Medicine, Sports Medicine, and Undersea And Hyperbaric Medicine.

3. Surgeons:

Cardiac Surgery, Colorectal Surgery (Proctology), General Surgery, Gynecological Oncology, Hand Surgery, Maxillofacial Surgery, Neurosurgery, Obstetrics/Gynecology, Oral Surgery, Orthopedic Surgery, Otolaryngology, Plastic And Reconstructive Surgery, Surgical Oncology, Thoracic Surgery, Urology, and Vascular Surgery.

Appendix E. 150% Federal Poverty Level – Determining Respondents Not Being Affected by Medicaid Expansions

E.1 150% Federal Poverty Level, 2018–2023

Family Size	Year					
	2018	2019	2020	2021	2022	2023
1	$18,210	$18,735	$19,140	$19,320	$20,385	$21,870
2	$24,690	$25,365	$25,860	$26,130	$27,465	$29,580
3	$31,260	$32,000	$32,580	$32,940	$34,545	$37,290
4	$37,740	$38,625	$39,300	$39,750	$41,625	$45,000
5	$44,220	$45,225	$45,780	$39,750	$49,050	$52,710

Note: Family size is operationalized by adding total number of adults and total number of children in the household.

E.2 Operationalization of Respondents with the Federal Poverty Level > 150%

Because the BRFSS does not provide the continuous measures of annual household income, only categorical income measures, we identify the respondents whose household income exceeds 150% of the Federal Poverty Level (FPL) by using these categorical measures. The income levels above 150% in each year by family size are provided in Appendix H.1. Note that the BRFSS added three more income categories in 2021, three upper-level categories ($100,000 to $150,000, $150,000 to $200,000, and $200,000 or more).

The annual household income categories in the BRFSS 2018–2020 are (1) less than $10,000, (2) $10,000–$15,000, (3) $15,000–$20,000, (4) $20,000–$25,000 (5) $25,000–$35,000, (6) $35,000–$50,000, (7) $50,000–$75,000, and (8) $75,000 and more. The annual household income categories in the BRFSS 2021-2023 are (1) less than $10,000, (2) $10,000–$15,000, (3) $15,000–$20,000, (4) $20,000–$25,000, (5) $25,000–$35,000, (6) $35,000–$50,000, (7) $50,000–$75,000, and (8) $75,000–$100,000, (9) $100,000–$150,000, (10) $150,000–$200,000, and (11) $200,000 or more. For more information, check the BRFSS's codebook.

1. Year 2018

- Family Size = 1, 150% FPL = $18,210: if household income level > $20,000 (Category 4)
- Family Size = 2, 150% FPL = $24,690: if household income level > $25,000 (Category 5)
- Family Size = 3, 150% FPL = $31,260: if household income level > $35,000 (Category 6)
- Family Size = 4, 150% FPL = $37,740: if household income level > $50,000 (Category 7)
- Family Size = 5, 150% FPL = $44,220: if household income level > $50,000 (Category 7)

2. Year 2019

- Family Size = 1, 150% FPL = $18,735: if household income level > $20,000 (Category 4)

- Family Size = 2, 150% FPL = $25,365: if household income level > $35,000 (Category 6)
- Family Size = 3, 150% FPL = $32,000: if household income level > $35,000 (Category 6)
- Family Size = 4, 150% FPL = $38,625: if household income level > $50,000 (Category 7)
- Family Size = 5, 150% FPL = $45,225: if household income level > $50,000 (Category 7)

3. Year 2020

- Family Size = 1, 150% FPL = $19,140: if household income level > $20,000 (Category 4)
- Family Size = 2, 150% FPL = $25,860: if household income level > $35,000 (Category 6)
- Family Size = 3, 150% FPL = $32,580: if household income level > $35,000 (Category 6)
- Family Size = 4, 150% FPL = $39,300: if household income level > $50,000 (Category 7)
- Family Size = 5, 150% FPL = $45,780: if household income level > $50,000 (Category 7)

4. Year 2021

- Family Size = 1, 150% FPL = $19,320: if household income level > $20,000 (Category 4)
- Family Size = 2, 150% FPL = $26,130: if household income level > $35,000 (Category 6)
- Family Size = 3, 150% FPL = $32,940: if household income level > $35,000 (Category 6)
- Family Size = 4, 150% FPL = $39,750: if household income level > $50,000 (Category 7)
- Family Size = 5, 150% FPL = $39,750: if household income level > $50,000 (Category 7)

5. Year 2022

- Family Size = 1, 150% FPL = $20,385: if household income level > $25,000 (Category 5)
- Family Size = 2, 150% FPL = $27,465: if household income level > $35,000 (Category 6)
- Family Size = 3, 150% FPL = $34,545: if household income level > $35,000 (Category 6)
- Family Size = 4, 150% FPL = $41,625: if household income level > $50,000 (Category 7)
- Family Size = 5, 150% FPL = $49,050: if household income level > $50,000 (Category 7)

6. Year 2023

- Family Size = 1, 150% FPL = $21,870: if household income level > $25,000 (Category 5)
- Family Size = 2, 150% FPL = $29,580: if household income level > $35,000 (Category 6)
- Family Size = 3, 150% FPL = $37,290: if household income level > $50,000 (Category 7)
- Family Size = 4, 150% FPL = $45,000: if household income level > $50,000 (Category 7)
- Family Size = 5, 150% FPL = $52,710: if household income level > $75,000 (Category 8)