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

Yun taek Oh

Morris M. Kleiner

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Does Universal Licensing Recognition Improve Patient Access? Evidence from Healthcare Utilization

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ABSTRACT

Optimizing physician labor supply has been an important policy issue in healthcare in the United States. One of the proposed solutions has been the universal licensing recognition (ULR), allowing physicians to provide healthcare services outside their states of licensure without relicensing and increasing the local labor supply of physicians relative to the demand for their services. There has been no empirical evidence examining the economic theory on the role of such regulatory relaxation on the local labor supply and subsequent improvements of consumer welfare. In this study, we mainly use the Behavioral Risk Factor Surveillance System (BRFSS) to investigate the effect of universal reciprocity of physician licenses on healthcare utilization and use the American Community Survey and Current Population Survey to examine the changes in the local labor supply of physicians through interstate migration. Our results show that adopting the ULR significantly raises the proportion of respondents accessing healthcare, particularly among older respondents, and reduces the proportion of respondents not getting healthcare services because of high costs. We provide empirical evidence that these effects are from the 'universal reciprocity' of physician licenses, instead of unknown factors related to the ULR. We also show that the positive effect of the ULR on healthcare utilization is closely related to the increase in out-of-state practitioners – traveling physicians and telehealth providers – by showing no changes in interstate migration of physicians. The adoption of ULR may allow for a more efficient regional distribution of physicians and result in more efficient access to healthcare.

Yun taek Oh
University of Nevada, Reno
Department of Economics
1664 N Virginia St
318A Ansari Business Building
Reno, NV 89557
yuntaeko@unr.edu

Morris M. Kleiner
University of Minnesota
Humphrey School of Public Affairs
260 Humphrey Center
301 19th Street South
Minneapolis, MN 55455
and NBER
kleiner@umn.edu

1 Introduction

Optimizing physician labor supply is an important issue in healthcare (Kirch and Petelle, 2017). Due to changes in the demographic composition of the U.S. population there is expected to be a significant increase in the number of regions that will have a lower than anticipated number of physicians (Zhang et al., 2020). Although not raising the overall physician labor supply, one of the ways to optimize the geographic distribution of physicians is to allow 'interstate reciprocity' of physician licenses; this potential regulatory relaxation allows out-of-state practitioners to practice with their current licenses issued in another state. However, in a heavily regulated industry, 'interstate reciprocity' of the license was not considered until the early 2010s, restricting the labor supply that potentially limited the growth of consumer welfare in many U.S. states (Holen, 1965; Kleiner, 2000; Johnson and Kleiner, 2020).

Universal licensing recognition (ULR) is a comprehensive policy reform that waives the re-licensure processes of out-of-state licensed workers (i.e. universal reciprocity of out-of-state licenses for selected occupations). Recent studies show its positive impact on local labor supply (Bae and Timmons, 2023; Deyo and Plemmons, 2022). However, its impact on consumer welfare, such as healthcare utilization, has not been analyzed. Furthermore, similar preexisting policy reforms, such as the Interstate Medical Licensing Compact (IMLC), make measuring the impact of the ULR more complex. In this study, we evaluate the impact of the ULR on healthcare utilization separately from the IMLC by measuring the effect on healthcare utilization among the states that passed the IMLC before adopting the ULR. We mainly use the Behavioral Risk Factor Surveillance System (BRFSS) to examine the changes in state-level healthcare utilization and medical cost measures. We also use the IPUMS-ACS and IPUMS-CPS to examine the changes in physician labor supply.

Our study provides two contributions to economic literature. First, this is the first study that provides theoretical and empirical evidence on how the ULR potentially improves consumer welfare. Previous studies suggest the outcomes, including improvements in consumer welfare, based largely on economic theory. Especially, the ULR is known to be a more comprehensive regulatory relaxation than preexisting policy reforms (i.e. Interstate Licensure Compact). Our study shows that this more comprehensive relaxation of regulatory requirements increased consumer welfare for a specific service that is essential **and costly.**

Second, this study adds to the literature by providing theoretical and empirical evidence that regulatory relaxation can contribute to improving consumer welfare by increasing the state or local labor supply. Although labor market regulations are needed to protect consumers from incompetent or unscrupulous service providers and to maintain the quality of services, some of the regulations may be overly restrictive, leading to a reduction in the labor supply, access to healthcare, and potentially, consumer welfare. Thus, this regulatory relaxation may raise consumer welfare by increasing access without deteriorating the service quality or increasing malpractice costs. Both theoretical and empirical evidence shows that the policy implications through regulatory relaxations of licensing can improve consumer welfare by raising the local labor supply if the work-related requirements, such as the scope of practice and qualification exams, are substantially equivalent across the states.

To preview our findings, we first provide two theoretical models explaining physicians' labor market and the market for healthcare services. The first partial equilibrium model explains non-compete agreements for physicians limit their migration but out-of-state practices after adopting the out-of-state license reciprocity, increases the local labor supply of physicians. The general equilibrium model provides theoretical implications that the increase in local labor supply

increases consumer welfare by raising the availability and reducing the cost of healthcare services. Then, in empirical analyses, we show that adopting universal reciprocity of physician licenses raises the proportion of respondents who have personal doctors or healthcare providers, especially for older individuals, and reduces the proportion of respondents who did not see doctors due to costs. We also provide empirical evidence that the residency requirement of the ULR limits the effect of regulatory relaxation, suggesting that the positive effect of universal reciprocity for healthcare utilization is closely correlated with the increase in out-of-state practices, but not with interstate migration. Using falsification tests, we validate that the positive impact of the ULR on healthcare utilization is from the 'universal reciprocity' of physician licenses. Overall, our study shows that the ULR is a comprehensive regulatory relaxation that improves consumer welfare, which is consistent with the theoretical predictions and previous literature on the relaxation of occupational licensure regulations.

The remainder of this paper is organized as follows. In Section 2, we present a background of occupational licensure research over the last decade as well as the literature review on the impact of regulatory relief for occupational licensure. In Section 3, we provide two theoretical models explaining physicians' decision-making process between staying, migrating, and starting out-of-state practices and how the adoption of out-of-state license reciprocity increases consumer welfare. In Section 4, we provide a detailed explanation of the data, sample selection, variables, and estimation procedures. In Section 5, we outline the results from the analyses and then provide the implications of the findings. In the final section, we summarize the findings as well as their implications

2 Background on Relaxing Occupational Licensure Regulations

Licensing has its influence in the labor market through shifting out the labor market demand curve or restricting labor supply (Kleiner, 2016). The academic literature has examined both the demand and supply implications of the labor market effects of licensing. For instance, Kleiner and Krueger (2013) find that licensing generates around a 15% wage premium while not significantly reducing wage dispersion for licensed workers; they further demonstrate even bigger wage results of 23% when licensing is interacted with union membership. Gittleman et al. (2018) find a lower wage premium of around 5% using Survey of Income and Program Participation (SIPP) data, which use somewhat different questions than the ones asked in other surveys, and they also conclude that licensing is associated with higher probabilities of being employed and receiving health insurance from employers. By estimating market share ratios, Blair and Chung (2022) show that licensing reduces equilibrium labor supply by an average of 17% to 27%. Similarly, Kleiner and Soltas (2023) find that licensing raises wages and hours but reduces employment by a similar percentage.

The supply restriction effects of occupational licensing requirements on employment and earnings are well documented, both at the national level and within specific occupations (Kleiner 2016). From theory, occupational licensing restrictions limit labor supply, produce a wage premium for licensed workers, and increase prices for consumers. Previous studies show that stricter re-licensure processes increase the economic rent of pre-existing healthcare practitioners and reduce the service quality, leading to deteriorating consumer welfare (Kugler and Sauer, 2005; Peterson et al., 2014). Contrarily, the influence of relaxing occupational licensing policies in the healthcare sector has resulted in a reduction in prices with no effect on the quality of services (Kleiner et al., 2016).

Over the last decade, multiple examples of the relaxations of occupational licensing requirements have been introduced that focus on the reciprocity of out-of-state occupational licenses. The Interstate Licensure Compact (ILC) is one of the earlier policy reform that allows out-of-state licensed workers from the ILC member states to practice without a time-consuming re-licensure process (i.e. reciprocity of out-of-state licenses). Since state-specific occupational licensure discourages the interstate mobility of licensed workers (Johnson and Kleiner, 2020), the 'interstate reciprocity' of out-of-state licenses, in theory, increases the interstate mobility of licensed workers, leading to an increase in local labor supply. Previous studies provide multiple empirical evidence that the ILC increased the local labor supply, reduced labor costs, improved the quality of services, and ultimately, increased consumer welfare (Apgar, 2022; Kim et al., 2023).

Specifically for physicians, the Interstate Medical Licensure Compact (IMLC) was introduced and adopted to raise the local labor supply of physicians by waiving state-specific re-licensure processes for those who attained their physician licenses from the IMLC member states (Steinbrook, 2014). Healthcare practitioners, economists, and policymakers expected that this compact would increase the labor supply of healthcare practitioners and access to healthcare by increasing the interstate mobility of physicians, including interstate relocations and out-of-state practices (Chaudhry et al., 2015). Multiple studies provide empirical evidence that this compact raised the interstate mobility of these workers, increased the local labor supply of nurses, out-of-state practices of physicians, and improved the quality of healthcare services (e.g. Deyo and Hughes, 2019; Deyo et al., 2024; Livanos, 2020; Shakya et al., 2022). However, the reciprocity is limited to the physicians who attained their licenses from the IMLC member states. In other words, physician licenses from non-member states are not eligible for interstate reciprocity, although the

Interstate Medical Licensing Compact board recognizes that approximately 80% of U.S. physicians meet the IMLC's reciprocity requirements (Adashi et al., 2021).

Starting in the late 2010s, an increasing number of states adopted the Universal Licensing Recognition (ULR), a recent policy reform that allows out-of-state licensed workers to practice without state-specific re-licensure processes for selected occupations. The ULR is a similar policy reform as the ILC in a way that it relaxes the licensure regulation by adopting reciprocity of out-of-state licenses. However, the ULR is a more comprehensive regulatory reduction than the ILC since the ULR does not distinguish in which state the licensees attained their licenses; instead, this reform adopts 'universal[1] reciprocity' for the selected licensed occupations regardless of the states of licensure, as long as licensees' qualifications meet the reciprocity requirements such as the similar scope of practice, substantially equivalent education and experience, and sometimes, in-state residency (Timmons and Norris, 2023; Norris, 2024; Shakya et al., 2024).

Previous studies provide theoretical and empirical evidence that the ULR increased the local labor supply of licensed occupations and reduced service costs, suggesting that the ULR has a clear effect on increasing the local labor supply (Deyo and Plemmons, 2022; Bae and Timmons, 2023). Economic theory suggests that an increase in the labor supply reduces labor costs and improves the quality of services, leading to improved consumer welfare. This implies that the increase in the local labor supply of physicians due to universal reciprocity of out-of-state licenses

[1] The term 'universal' refers to its comprehensiveness. Universal reciprocity refers to the recognition of out-of-state licenses regardless of the state of issuance. This recognition sometimes includes the licenses issued in Canada. For instance, Montana and South Dakota include physician licenses obtained by passing the qualification exams and completing a residency program from the U.S. or Canada for reciprocity. Thus, this is a more comprehensive reciprocity than the ILC because the ILC only recognizes the licenses issued from the ILC member states.

will lead to the reduction of healthcare costs, improvement in the quality of services, and ultimately the increase in healthcare utilization among the states that adopted the universal reciprocity of physician licenses.

However, it is not clear whether the ULR is an effective relaxation of licensure regulation to improve healthcare utilization because the IMLC was already adopted and played similar roles: reciprocity of out-of-state licenses. Furthermore, adopting the ULR does not always mean that all the occupational licenses become subject to universal reciprocity, because this reciprocity is for the "selected" occupations only. This implies that some of the states that adopted the ULR did not adopt the universal reciprocity of physician licenses. For instance, Iowa, Utah, and Wyoming are the states that adopted the ULR but did not adopt universal reciprocity for physician licenses. This study accounts for these issues to estimate the true effect of the ULR on healthcare utilization. More information about the similarities and differences between the ULR and ILC is provided in Table 1.

In addition, it is not clear whether the 'increase in local labor supply' is due to the increased interstate migration or out-of-state practices: providing healthcare services by traveling and/or telehealth. While the studies that examine the general licensed workers show an increase in interstate migration after the regulatory relaxation (e.g. Deyo and Plemmons, 2022; Bae and Timmons, 2023), recent studies that focused on physicians do not show an increase in interstate migration but out-of-practices only (e.g. Deyo et al., 2024; Fannin, 2020), implying that physicians do not migrate but start out-of-state practices after the regulatory relaxation. This may be due to the prevalence of non-compete agreements that restrict physicians from practicing more than their contracted work hours within the region; non-compete agreements prohibit physicians from working in other hospitals located within certain miles (e.g. 50 miles and 100 miles) from their

employer hospitals (Robeznieks, 2023). Because these agreements limit physicians from working more than the contracted hours in their regions, out-of-state practice is the only way they can increase their work hours as well as their utility and earnings. This study also validates whether the positive impact of the ULR on healthcare utilization is due to the increase in interstate migration or the increase in out-of-practices by developing theoretical models and conducting econometric analyses.

3 Theoretical Models

In this section, we present two models. The first model is a partial equilibrium model of physicians, explaining how the ULR raises local labor supply by increasing out-of-state practices. The second model is a general equilibrium model of healthcare service producer and consumer, explaining how the increase in the out-of-state practices improves consumer welfare. Using these two models, we show how the adoption of the ULR improves consumer welfare among the states that previously adopted the IMLC.

3.1 A Simple Partial Equilibrium Model of Physicians: Stay, Migration, or Out-of-State Practices

This is a simple partial equilibrium model that is an adaptation of the model explaining the role of occupational licensing on interstate migration (Johnson and Kleiner, 2020). Physicians choose whether to (1) stay in the current labor market, (2) migrate to a new labor market, and (3) start out-of-state practices: providing healthcare services by traveling to different states or using telehealth system.

In this model, we assume that physicians are perfectly certain about the earnings from the current market (w_s) and from the potential migration destination (w_m) as well as the earnings

from out-of-state practices (w_t). Note that $w_t \geq w_m$, as employers generally pay more to traveling physicians than local physicians to attract more physicians to work in their hospitals (Cross et al., 2024). For example, traveling physicians, often called 'locum tenens physicians,' in the U.S. travel to various hospitals and across state lines based on hospital and patient demands. For the physicians providing telehealth services, assume that $w_t = w_m$, as Telehealth Coverage and Payment Parity Act imposes the same payment rate for telehealth services as in-person healthcare services (H.R.4480., 2021; Deyo et al., 2024).

Costs are involved in choosing between migration and starting out-of-state practices. For simplicity, we assume that there is no cost related to the loss of human capital from the current labor market and the accumulation of human capital from new labor markets, as the scope of practice of physicians is potentially the same between the current and potential labor markets. c_m is the cost of migration that is composed of the cost of re-licensure ($c_{relicense}$), relocation cost that is covered by potential employers (c_{move}), and other relocation time and monetary costs that are paid by themselves (c_{self}):

$$c_m = c_{relicense} + c_{move} + c_{self}$$

$c_{relicense}$ includes monetary cost, time, and effort to complete the re-licensure processes as well as the opportunity costs related to re-licensure processes, such as potential monetary and human capital gain from healthcare practices. c_{self} can also be seen as a disutility of migration, as it discounts the utility. Similarly, c_t is the travel cost to work as a traveling doctors, which is composed of the cost of re-licensure ($c_{relicense}$) and the travel expenses that are covered by potential employers (c_{travel}):

$$c_t = c_{relicense} + c_{travel}$$

Since c_{move} and c_{travel} are assumed to be covered by employers (i.e. hospitals in potential destinations), these costs are zero for the physicians. Note that $c_{move} > c_{travel}$, implying that the employers choose whether to pay higher fixed cost (c_{move}) with lower variable costs (w_m) to employ migrated physicians or to pay lower fixed cost (c_{travel}) with higher variable costs (w_t) to employ traveling physicians. Plus, c_{travel} is zero if a physician provides telehealth services, as they provide healthcare services without physically traveling to different locations. Also note that $c_{relicense}$ is zero if a potential destination adopted the IMLC or ULR (i.e. re-licensure is not required to practice).

The prevalence of non-compete agreements[2] for physicians imply that working more than normal hours can be done only by starting out-of-state practices. If physicians decide to start out-of-state practices, they can reduce a fraction of their work hours from the current labor market by $T_s \geq 0$ and spend a fraction of their work hours in the hospital(s) at potential destinations by $T_t > 0$. Note that $(1 - T_s) + T_t \geq 1$, indicating that these physicians can work more than their initial contract which the non-compete agreements restrict them from working more than their contracted hours in their local or migrated labor markets. This is the unique component of this model that explains physicians' decisions; while most of the licensed occupations do not impose non-compete agreements that geographically restrict licensed workers' intensive margin of labor, a significant proportion of physicians sign these agreements that restrict them to working more only by increasing out-of-state practices.

[2] A recent report from the American Medical Association (AMA) in 2023 shows that non-compete clauses affect between 37% and 45% of physicians in the US, restricting them from practicing in nearby hospitals. For more information, see: https://www.ama-assn.org/medical-residents/transition-resident-attending/ama-backs-effort-ban-many-physician-noncompete

In addition, physicians are subject to idiosyncratic preference shocks ε_s, ε_m, and ε_t that tilt preferences toward staying, migrating, and traveling respectively, and these preference shocks are dispersed at the scale of γ, which follows standard Gumbel distributions, independent of each other, and identically distributed across groups. δ_{time} is an increasing function of work hours that represents the disutility from working longer than normal hours where $\delta_{time} > 0$ if $(1 - T_s) + T_t > 1$. Note that δ_{time} for telehealth physicians are significantly smaller than that for traveling doctors working for the same hours, as providing telehealth services do not require a travel to different states.

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

$$\begin{aligned} U_s &= w_s + \gamma\varepsilon_s \\ U_m &= w_m - c_{relicense} - c_{self} + \gamma\varepsilon_m \\ U_t &= (1 - T_s)w_s + T_t w_t - c_{relicense} - \delta_{time} + \gamma\varepsilon_t \end{aligned} \tag{1}$$

3.1.1 Before Adopting Reciprocity of Out-of-State Licenses

Before adopting the reciprocity of out-of-state licenses, $c_{relicense} > 0$ and is large enough to discourage physicians from migrating or starting out-of-state practices. In other words, $U_s > U_m$ and $U_s > U_t$. Assume that the preference shocks ε_s, ε_m, and ε_t are zero at means, then these can be expressed as:

$$\begin{aligned} U_s &> U_m \\ \Rightarrow w_s &> w_m - c_{relicense} - c_{self} \\ \Rightarrow c_{relicense} + c_{self} &> w_m - w_s \end{aligned}$$

implying that physicians stay rather than migrate because the costs of migration paid by themselves are greater than the marginal earnings from migration ($w_m - w_s$), and:

$$U_s > U_t$$

$$\Rightarrow w_s > (1 - T_s)w_s + T_t w_t - c_{relicense} - \delta_{time}$$

$$\Rightarrow c_{relicense} + \delta_{time} > T_t w_t - T_s w_s$$

implying that physicians stay rather than start out-of-state practices because the sum of re-licensure cost and disutility from working longer is greater than the marginal earnings from starting out-of-state practices ($T_t w_t - T_s w_s$).

3.1.2 After Adopting Reciprocity of Out-of-State Licenses

Adopting the reciprocity of out-of-state licenses – including the IMLC and ULR – removes the cost of re-licensure (i.e. $c_{relicense} = 0$), making migration and out-of-state practices more attractive. Yet, physicians prefer starting out-of-state practices more than migrating to potential labor markets if $U_t > U_m$. In other words, removal of re-licensure cost raises the utility of starting out-of-state practices more than that of migrating or staying. In other words, $U_t > U_s$ and $U_t > U_m$. Again, assume that the preference shocks ε_s, ε_m, and ε_t are zero at means, then these can be expressed as:

$$U_t > U_s$$

$$\Rightarrow (1 - T_s)w_s + T_t w_t - \delta_{time} > w_s$$

$$\Rightarrow T_t w_t - T_s w_s > \delta_{time}$$

implying that physicians start out-of-state practices rather than stay because the marginal earnings from starting out-of-state practices ($T_t w_t - T_s w_s$) is greater than the disutility of working longer than normal hours (i.e. disutility of starting out-of-state practices), and:

$$U_t > U_m$$

$$\Rightarrow (1 - T_s)w_s + T_t w_t - \delta_{time} > w_m - c_{self}$$

$$\Rightarrow (1 - T_s)w_s + T_t w_t - w_m > \delta_{time} - c_{self}$$

implying that physicians travel rather than migrate because the difference in earnings between starting out-of-state practices ($(1-T_s)w_s + T_t w_t$) and migrating (w_m) is greater than the difference between the disutility from working longer than normal hours and the self-paid cost of migration. Since c_{self} can be seen as a disutility of migration and is likely to be greater than the disutility of working more than normal hours (δ_{time}), the right-hand side of the above inequality is likely to be negative. This implies that physicians are likely to prefer starting out-of-state practices more than migrating if the earnings from traveling are greater than the earnings from migrating.

3.1.3 Change in the Rate of Starting Out-of-State Practice

Physicians make decisions by choosing one of the options that return the highest utility. As explained in the previous subsection, physicians choose to stay before adopting the reciprocity of out-of-state licenses and choose to start out-of-state practices after adopting this reciprocity. Based on the assumptions and the properties of Gumbel distribution, we can first calculate the (log) rate of starting out-of-state practices (OSP) before adopting the reciprocity of out-of-state licenses by:

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

$$= \frac{1}{\gamma}\left[T_t w_t - T_s w_s - c_{relicense} - \delta_{time}\right]$$

If a physician's license is eligible for reciprocity[3], then the log rate is:

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

[3] This is the case if (1) a physician was licensed from the IMLC member state and decided to travel to another IMLC states to practice, or (2) a physician decided to start out-of-state practices in the states that adopted the universal reciprocity of physician licenses.

Suppose α is the proportion of physicians starting out-of-state practices who were licensed from the IMLC states. 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:

$$\Delta \log(OSP) = \frac{1}{\gamma}[T_t w_t - T_s w_s - \delta_{time}] - \alpha\frac{1}{\gamma}[T_t w_t - T_s w_s - \delta_{time}]$$

$$-(1-\alpha)\tfrac{1}{\gamma}[T_t w_t - T_s w_s - c_{relicense} - \delta_{time}] = \tfrac{1}{\gamma}(1-\alpha)c_{relicense} > 0 \quad (2)$$

The above inequality implies that the change in log rate of starting out-of-state practices is higher if the cost of re-licensure is higher and/or the proportion of physicians licensed from the IMLC states is smaller.

3.1.4 Theoretical Implications

This model provides several implications. First, physicians are not willing to migrate before and after adopting the reciprocity of physician licenses; instead, they prefer staying before and starting out-of-state practices after adopting the reciprocity. While the disutility from migrating (c_{self}) is likely to be greater than that from traveling (δ_{time}), it is likely to return higher utility by starting out-of-state practices than migrate, as $w_t \geq w_m$ and total work hours after starting out-of-state practices $(1 - T_s) + T_t \geq 1$.

Second, there is still an increase in the local labor supply of physicians after adopting the universal reciprocity of physician licenses among the states that adopted the IMLC. As Equation (2) shows, the positive change in the log rate of starting out-of-state practices implies that there is still room to increase the local labor supply by adopting the ULR. We aim to provide empirical evidence on this implication in the next sections.

Lastly, extending the implications of this model, prohibition of non-compete agreements will significantly raise the intensive margin of local labor supply of physicians and reduce

physicians traveling to different states to practice. Unlike other licensed occupations that experienced the increase in interstate migration, physicians' migration rate did not significantly change after adopting out-of-state licenses reciprocity. Our model itself cannot explain the reason why physicians do not migrate but travel, because our model assumes that the non-compete agreements restrict physicians from working longer than normal hours in their current or potential labor markets unless they start out-of-state practices. In other words, non-compete agreements restrict the intensive margin of labor supply when they work in one labor market only.

Repealing these agreements allows U_t to explain the utility of out-of-main-job practices (i.e. all the practices outside physicians' main jobs that their normal work hours are spent), with zero cost of re-licensure regardless of the state's adoption of the IMLC and ULR. In addition, the reduced travel costs of in-state traveling physicians, covered by potential in-state employers, will increase local employers' preference of local physicians over out-of-state physicians and migrated physicians, leading to reducing physicians' out-of-state travel rate. However, it is unknown whether there will be changes in out-of-state telehealth services since the cost of travel is zero for providing telehealth services; this will depend on consumers' preference between in-person and telehealth services.

3.2 Production of Healthcare Services and Consumer Welfare

This is a simple general equilibrium model explaining how consumer welfare increases as the out-of-state practices increase after adopting the reciprocity of physician licenses. Our model is of a market for goods and services where there are representative producer and representative consumer. The representative producer tries to maximize its profit by choosing the number of out-of-state physicians to employ, given the condition that its local labor supply of physicians is fixed. The representative consumer tries to maximize her utility by choosing the quantity of healthcare

services to consume given her budget for utilizing these 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 tries to maximize its profit Π by choosing and employing the number of out-of-state physicians starting out-of-state practices for this producer, 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. In other words, local physicians are fully hired and therefore cannot increase the employment of these physicians. For simplicity, assume that there are no migrated physicians; this assumption is consistent with the previous studies, showing that regulatory relaxation on licensing requirements does not increase the interstate migration of physicians (Deyo et al., 2024; Fannin, 2020). Assume that 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:

$$AL = A\left[(1-\lambda){n_s}^{\frac{\sigma-1}{\sigma}} + \lambda T_t {n_t}^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}} \tag{3}$$

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: the same parameter from the partial equilibrium model in Section 5.1. To employ local and out-of-state physicians for normal work hours, 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; as telehealth services are more prevalent, the cost of providing out-of-state practices significantly goes down.

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

$$\max_{n_t} \Pi = \max_{n_t} PAL - (w_s n_s + T_t w_t n_t)$$

$$\text{s.t. } L = \left[(1-\lambda) n_s^{\frac{\sigma-1}{\sigma}} + \lambda T_t n_t^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}} \tag{4}$$

where P is the price of healthcare services.

3.2.2 Consumer's Problem

The representative consumer of healthcare services tries to maximize her individual utility by choosing the quantity of healthcare services to consume, denoted by q, given the probability that she needs healthcare services (ρ), the price of these services (P), and the budget for utilizing these services (B) which is dispersed at the scale of η.

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

$$\max_{q} U_c(q) \text{ s.t. } \rho P q \leq \eta B \tag{5}$$

where $\frac{\partial U_c(q)}{\partial q} > 0$, implying that increasing the consumption of healthcare services increases consumer utility.

We can express the quantity of healthcare services as a demand for healthcare services that is a function of the price and budget for utilizing these services, denoted by $q(P, B)$. Note that $\frac{\partial q(P,B)}{\partial P} < 0$, implying that the quantity demanded for healthcare services decreases as the price of these services increases. The first-order conditions above imply that:

$$\frac{\partial U_c(q)}{\partial P} < 0 \tag{6}$$

as $\frac{\partial U_c(q)}{\partial P} = \frac{\partial U_c(q)}{\partial q} \frac{\partial q(P,B)}{\partial P}$.

3.2.3 Equilibrium and Implications of the Model

Definition. Given the number of local physicians employed n_s, 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 (4).

2. Consumer's optimization behavior: A representative consumer choosing q solves Equation (5).

3. Market clears: The price of healthcare services P is such that the healthcare market clears:

$$AL = \rho q$$

We now present two equilibrium relationships which, together, compose the system of equations that we solve to obtain comparative statics. The derivations of these equations are provided in Appendix A. First, Equation (3) implies that the marginal product of out-of-state physicians is positive:

$$\frac{\partial L}{\partial n_t} = \lambda T_t \left(\frac{L}{n_t}\right)^{1/\sigma} > 0 \tag{7}$$

This means that the quantity of healthcare services produced increases as more out-of-state physicians are employed. Second, Equation (4) implies that the price of healthcare services at equilibrium is a function of w_t, n_t, and L:

$$P^* = \frac{w_t}{A\lambda}\left(\frac{n_t}{L}\right)^{1/\sigma} \tag{8}$$

Given the consumer's and producer's problems as well as the equilibrium relationships, we summarize three corollaries explaining how the price of healthcare services and wages for out-of-state physicians changes. Proofs and derivations of equations are provided in Appendix A.

Corollary 1. The change in the price of healthcare services with respect to the change in the production of healthcare services is negative:

$$\frac{\partial P}{\partial L} = -\frac{1}{A\sigma\lambda L}\left(\frac{n_t}{L}\right)^{1/\sigma} < 0 \tag{9}$$

This corollary shows that the price of healthcare services decreases as more healthcare services are produced.

Corollary 2. Given Equations (7) and (9), the price of healthcare services decreases as more out-of-state physicians are employed by the representative producer:

$$\frac{\partial P}{\partial n_t} = \frac{\partial P}{\partial L}\frac{\partial L}{\partial n_t} = -\frac{T_t}{A\sigma L} < 0 \tag{10}$$

This corollary shows that the price of healthcare decreases as more out-of-state physicians are employed by the representative producer.

Corollary 3. Given Equations (8) and (10), the wage of out-of-state physicians decreases as more out-of-state physicians are employed. In other words,

$$\frac{\partial w_t}{\partial n_t} = \frac{\partial w_t}{\partial P}\frac{\partial P}{\partial n_t} = -\frac{\lambda T_t L^{1-\sigma}}{{n_t}^{\sigma}} < 0 \tag{11}$$

This corollary shows that the increase in physician labor supply after adopting the reciprocity of out-of-state licenses reduces the economic rent of occupational licensing, created by the labor supply restriction effect of occupational licensing.

We now analyze the change in consumer welfare after adopting out-of-state licenses reciprocity. We define the 'increase in consumer welfare' as the increase in the utility of representative consumer of healthcare services. As shown in Equations (5) and (6) and their first-order conditions, consumer welfare increases as the consumption of healthcare services increases or the price of the services decreases.

Given the corollaries and the first-order conditions, we explain how the increase in the employment of out-of-state physicians increases consumer welfare. Proofs and derivations of equations are provided in Appendix A.

Theorem 1. Suppose a representative producer tries to maximize its profit by choosing and employing the number of out-of-state physicians to employ. At the same time, a representative consumer of healthcare services tries to maximize her utility by choosing the quantity of healthcare services to consume. Adoption of reciprocity of out-of-state physician licenses significantly reduces the cost of employing these physicians as well as reducing the disutility of starting out-of-state practices, allowing the producer to employ these physicians at a significantly lower cost. Then, adopting the reciprocity of out-of-state physician licenses increases consumer welfare in the healthcare services market:

$$\frac{\partial U_c}{\partial n_t} = \frac{\partial U_c}{\partial P}\frac{\partial P}{\partial n_t} > 0 \tag{12}$$

This theorem shows that consumer welfare increases when more out-of-state physicians are employed and start practicing in representative consumer's local market, because the increase in physician labor supply due to the increase in out-of-state practices reduces the price of healthcare services, leading to increasing the utility of this consumer.

In Section 3.1, we show that the log rate of starting out-of-state practice among the state that previously adopted the IMLC and then adopt the ULR is $\frac{1}{\gamma}(1-\alpha)c_{relicense}$, showing that there is still a room to increase the local labor supply of physicians among these states. The approximation of the change in consumer welfare in these states is:

$$\frac{\partial U_c}{\partial n_t}\left[n_t^1 e^{\frac{1}{\gamma}(1-\alpha)c_{relicense}}\right] > 0 \tag{13}$$

which implies that adoption of the ULR among the states that previously adopted the IMLC also increases consumer welfare. In summary, this model predicts that consumer welfare increases by the increase in local labor supply of physicians via increasing out-of-state practices. In the next

sections, we present the empirical model and econometric analyses to show that the predictions from this model are true.

4 Data and Methods

4.1 Healthcare Utilization Measures

We mainly use the Behavioral Risk Factor Surveillance System (BRFSS) 2018-2023. The BRFSS, publicly available in the Center for Disease Control and Prevention (CDC), is an annual cross-sectional telephone survey that provides abundant health-related information, such as healthcare utilization, health outcomes, and health-related behaviors, on the nationally representative sample of Americans aged 18 and older. The benefit of using the BRFSS is that the survey provides both the state of residency and month of survey of each respondent; this is particularly important to distinguish the time before and after the implementation of the ULR in each state.

We first select the sample of respondents aged between 25 and 64. We specifically select this age group because Medicare eligibility and receipt at age 65 or older significantly increases healthcare utilization, possibly distorting the effect of the ULR (Card et al., 2008); as a robustness check, we conduct a separate analysis using the sample of respondents with ages 65 through 79. Then, the respondent-level healthcare utilization measures are shrunk into state-half-year cells; each cell provides the proportion of respondents in each state who utilized corresponding healthcare services during the given 6-month period. For the analysis by age group, we follow the same procedure, but using a subset of respondents based on their ages: ages between 25 and 44 (younger population) and ages between 45 and 64 (older population). By examining the changes

in this proportion before and after the implementation of the ULR, we can validate the effect of the ULR on healthcare utilization.

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

Therefore, we carefully selected three 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" is a measure that captures whether a respondent has a personal doctor or healthcare provider. Although the 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.[4] In Appendix B, we provided the difference in the proportions of respondents who have one or more personal doctors or healthcare providers from the BRFSS 2020 and 2021, separately by the ULR adoption status; this table shows that the difference in the change in this proportion between the states that adopted and did not adopt the ULR is only 0.3 percentage point. Therefore, this change

[4] For more information about the survey question and changes in the responses, check the SHADAC's blog: https://www.shadac.org/topic/behavioral-risk-factor-surveillance-system-brfss-data?page=1

can be controlled by using time fixed effects of the event study design. Second, "could not see a doctor because of cost" is a measure that captures whether a respondent experienced not seeing a doctor because of high healthcare costs. Lastly, "received routine health checkups within a year" is a measure that captures whether a respondent received a routine health checkup within a year. The complete survey questions from the questionnaire are provided in Appendix C.

These variables are particularly useful given the period because these measures are not critically influenced by COVID-19: a potential confounder of the impact of this relaxation of regulations by raising the needs of medical doctors for COVID-19 diagnosis and patient care. These measures are shrunk into state-half-year cells, and the final data is composed of state-level panel data that has a set of healthcare utilization variables. We choose the half-year time interval because the sizes of denominator for subgroup analyses are not sufficient to accurately obtain the proportions for monthly and quarterly time interval.

4.2 Treatment and Control Groups

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 group the states that adopted the IMLC in the same year, so that it is plausible to assume that the healthcare utilization trends of treatment and control group states are parallel before the ULR was adopted. Appendix E shows the trends of healthcare utilization measures during the survey periods, showing parallel trends before the ULR.

First, 11 states adopted the IMLC in 2015 (see Table 2). Out of these 11 states, 6 states adopted the ULR: Idaho, Iowa, Montana, South Dakota, Utah, and Wyoming. However, three states – Iowa, Utah, and Wyoming – did not include physician occupations in the list of occupations for universal reciprocity. In other words, the other three states – Idaho, Montana, and South Dakota

– are the states that adopted the universal reciprocity of physician licenses; these 3 states are chosen as a treatment group, and the other 8 states are chosen as a control group for the baseline analysis, named '2015 Cohort.' 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.

We also conduct a set of falsification tests to examine whether the estimated effects are from the 'universal reciprocity of physician licenses' or other unknown factors related to the ULR. First, we conduct the same analyses by adding the three states that adopted the ULR but did not include physician occupations for the universal reciprocity (Iowa, Utah, and Wyoming) in the treatment group. In other words, we create a counterfactual treatment group by adding these states. This allows us to test whether the impact of the URL on healthcare utilization is from the 'universal reciprocity' of physician licenses or other unknown factors related to the ULR. Second, we conduct the same analyses using the baseline treatment group (Idaho, Montana, and South Dakota) and the three counterfactual treatment group states (Iowa, Utah, and Wyoming) as the control group. This does not only allow measuring the effect of the universal reciprocity of physician licenses but also allow comparing the states that are geographically nearby and having similar state characteristics; in the baseline control group, there are three other states (Illinois, Minnesota, and Wisconsin) that are significantly more urbanized than the treatment group states, and another two states (Alabama and West Virginia) are geographically distant from the treatment group states.

Second, 6 states adopted the IMLC in 2016. Out of these 6 states, 5 states adopted the ULR. However, one state – Colorado – excluded physician occupations from the list of occupations for universal reciprocity, and three states – Arizona, Kansas, and Mississippi – added residency requirements for universal reciprocity of physician licenses. For a robustness check, despite the

residency requirement, four states include physician occupations to the list of occupations for universal reciprocity – Arizona, Kansas, Mississippi, and New Hampshire – are chosen as a treatment group, and the two other states – Connecticut and Colorado – are chosen as a control group, named '2016 Cohort.' This robustness check provides results on the outcomes of the ULR when the residency requirement – restricting out-of-state practices – is imposed. Table 2 shows the list of states that are being used as treatment and control groups in this study. Table 3 provides descriptive statistics of the sociodemographic characteristics of respondents by their states' ULR adoption status and the year of adoption of the IMLC from January to June of 2018 (the initial wave of the final data).

4.3 Physician Local Labor Supply Measures

Using the IPUMS-USA and IPUMS-CPS, we obtain two measures that examine the changes in the interstate migration of physicians (Flood et al., 2023; Ruggles et al., 2023). First, from both IPUMS-USA and IPUMS-CPS, we obtain the proportion of physicians using the state of residency, calculated by dividing the total number of physicians living in the corresponding state by the state's population. Second, from the IPUMS-USA, we obtain the proportion of physicians using the primary place of work, calculated by dividing the total number of physicians working in the corresponding state by the state's population. Note that the variable that indicates the primary place of work is provided in IPUMS-USA only. These measures are useful in examining the changes in the level of interstate migration after the ULR was adopted, which are used in previous studies examining interstate migration issues (e.g. Johnson and Kleiner, 2020; Bae and Timmons, 2023). Third, from the IPUMS-CPS, we obtain the proportions of self-employed physicians and work-for-pay (i.e. employed by hospitals) physicians, as migration patterns may differ by their employment types.

The IPUMS-CPS is a monthly survey data that provides in which month the survey was conducted, and therefore we obtain the proportion of physician measures by shrinking the respondent-level data into state-year cells; each cell provides the proportion of physicians in each state during the given 1-year period. However, since IPUMS-USA is an annual survey data without months of survey, the proportion of physician measures are shrunk into state-year. More information about the variables for obtaining these measures is provided in Appendix D.

4.4 Estimation Procedure

For the estimation, we mainly use a Callaway-Sant'Anna (2021) staggered difference-in-difference model. There are two reasons we chose this method. First, because we expect that the impact of this policy reform is 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 estimations (Goodman-Bacon, 2021). Callaway-Sant'Anna staggered difference-in-difference (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:

$$Y_{st} = \alpha + \mathbf{ULR}_{st}\boldsymbol{\beta} + s + t + \varepsilon_{st} \tag{14}$$

where s and t are the state and time fixed effects respectively, Y_{st} is the proportion of respondents living in state s in time t who received corresponding healthcare service or had medical cost issues, or the proportion of physicians from the population in state s in time t, and $\mathbf{ULR}_{st}$ is the vector of event study regressors capturing the time since the ULR was adopted, including both pre- and post-treatment. We present the results of four pre-treatment waves and nine post-treatment waves.

5 Results

5.1 Healthcare Utilization Among the States Adopted IMLC in 2015

Figure 1 shows the results from the CSDID of Equation (14), using data from the states that adopted the IMLC in 2015. There are three sub-figures. The first sub-figure, on the upper left corner of the figure, shows the result using 'having personal doctors or healthcare providers (Personal Doctor)' as an outcome. This sub-figure shows that the proportion of respondents having one or more personal doctors or healthcare providers significantly increased among the states that adopted universal reciprocity of physician licenses starting at Time 0. Furthermore, since Time 0, the magnitude of the estimated effects increases for the first two and half years since the treatment, implying that the effect of the ULR gradually increases.

The second sub-figure, on the upper right corner of the figure, shows the result using 'could not see a doctor because of cost (Cost Issue)' as an outcome. This sub-figure shows that the proportion of respondents not seeing a doctor due to the cost significantly decreased among the states that adopted universal reciprocity of physician licenses starting Time 0. The last sub-figure, on the lower left corner of the figure, shows the result using 'received routine health checkups within a year (Routine Check within 1 Year)' as an outcome. Although the estimated effects since Time 0 are positive, these effects are not statistically significant.

Overall, the results from the first two sub-figures provide clear evidence that access to healthcare increased and the concern about medical costs decreased since the universal reciprocity of physician licenses was adopted, implying a positive impact of regulatory relief on consumer welfare. Note that the estimated effects present the increase in healthcare utilization and reduction in cost issue among the treatment group, instead of the reduction in healthcare utilization and/or increase in cost issue among the control group. The figures in Appendix E show parallel trends

before the earliest treatment was given (Montana, adopting the ULR in March 2019), and then the magnitudes of the effects grow as more states in the treatment group adopted the ULR.

5.2 Analyses by Age Group, 2015 Cohort

Figures 2 and 3 show the results from the CSDID of Equation (14), using the healthcare utilization measures that were generated from selected respondents based on their ages: ages between 25 and 44 (Figure 2) and ages between 45 and 64 (Figure 3). The sub-figures in Figure 2 show unclear effects of the universal reciprocity of physician licenses. For instance, the first sub-figure shows that the treatment effects are positive and statistically significant since Time 0 and Time -2. On the other hand, the second sub-figure shows that the effects are not statistically significant across all time periods. The last sub-figure shows that the estimated effects are statistically significant since Time 7 and Time -3. These results do not provide clear evidence of the effect of universal reciprocity of physician licenses on healthcare utilization among younger populations.

On the other hand, the first sub-figure in Figure 3 provides clear evidence of the effect of universal reciprocity of physician licenses on healthcare utilization; the difference in the proportion of respondents having personal doctors or healthcare providers is not statistically significant before adopting universal reciprocity of physician licenses, and then it became statistically significant after adopting this reciprocity. However, the other sub-figures do not provide clear evidence. The second sub-figure shows that the treatment effects are negative and statistically significant since Time 0 and Time -2. The last sub-figure shows that the treatment effects are not statistically significant across all time.

Overall, these results suggest that the effect of universal reciprocity of physician licenses on having personal doctors or healthcare providers is statistically significant across all post-

treatment time points for older respondents (aged between 45 and 64) who are concerned and need more healthcare services than younger respondents (aged between 25 and 44). Note that the results from robustness check using the measures generated from respondents aged 65 and older are provided in Section 5.5, which are consistent with this result. Since healthcare services become more and more essential as people age, these results are consistent with the growth of healthcare service demand by age.

5.3 Robustness Check: Residency Requirement Limits the Effect of ULR?

Figure 4 shows the results from the CSDID of Equation (14) using data from the states that adopted the IMLC in 2016. The results in all three sub-figures do not provide the clear effect of the universal reciprocity of physician licenses. In addition, Figures 5 and 6 show the results from the CSDID of Equation (14) using proportion of physicians from the population measures of the 2015 cohort from IPUMS-USA and IPUMS-CPS. Using the data of the states that do not impose residency requirements, we estimate the changes in the level of interstate migration of physicians by using the measures of the proportion of physicians from states' populations. The results in all the sub-figures do not provide the clear effect of the universal reciprocity of physician licenses on interstate migration of physicians.

Overall, the results in Figures 4, 5, and 6 provide clear evidence that the positive effects of the ULR on healthcare utilization we obtained in previous estimations are due to the increase in out-of-state practices instead of the interstate migration of physicians. Imposing residency requirements works as a barrier for the out-of-state licensed physicians to practice without moving in and living for a prescribed duration. In addition, the results in Figures 5 and 6 confirm that there is no change in interstate migration even if residency requirements are not imposed. These results are consistent with the previous studies that examined the role of the IMLC on interstate migration

and out-of-state practices of physicians, showing that the IMLC increased the out-of-state practices but did not increase the interstate migration of physicians (Deyo et al., 2024; Fannin, 2020).

These results provide two implications. First, the positive effect of the ULR on healthcare utilization is due to the increase in out-of-state practices: providing in-person services by traveling to different states and/or telehealth services. Second, residency requirement is clearly a regulatory barrier that prohibits out-of-state licensed workers from practicing without relocation, limiting the effect of such regulatory relaxations.

5.4 Falsification Test: Universal Reciprocity or Unknown Factors Related to ULR?

Figure 7 shows the results from the CSDID of Equation (14) using counterfactual treatment group. The data is composed of measures from the states that adopted the IMLC in 2015, yet the states that adopted the ULR without including physician occupations for universal reciprocity are also included in the treatment group. In other words, we include these states in the treatment group to create a counterfactual treatment group. Obtaining the treatment effect using the states that passed the ULR, regardless of including physician occupations in the list of occupations for universal reciprocity, reveals whether the effect of the ULR on healthcare utilization was from the 'universal reciprocity' of physician licenses or the unknown effects from the ULR.

There are four sub-figures: two sub-figures on the left show the effects of ULR using the true treatment group (i.e. the three states that adopted the universal reciprocity of physician licenses), and the other sub-figures on the right show the effects using the counterfactual treatment group. We exclude the sub-figures for 'Routine Check within 1 Year' because the estimations using both true and counterfactual treatment groups produce results that are not statistically significant. The sub-figures in the first row used 'having personal doctors or healthcare providers (Personal Doctor)' as an outcome, and the sub-figures in the next row used 'could not see a doctor because

of cost (Cost Issue)' as an outcome. The results in these sub-figures illustrate that the estimated effects of the ULR are statistically significant only if we use the true treatment group; the results using the counterfactual treatment groups are not statistically significant. Note that the statistically significant estimate in Time 8 in the sub-figure in the upper right corner was obtained from one state (Montana) that adopted the ULR in 2019: the state that did not exclude physician licenses from the list of occupations for universal reciprocity.

Figure 8 shows the results from another CSDID of Equation (14) using the states that adopted the universal reciprocity of physician licenses as the treatment group and the states that adopted the ULR but did not adopt the universal reciprocity of physician license as the control group. In other words, all the states in this analysis adopted the IMLC in 2015 and adopted the ULR, yet only the treatment group states adopted the universal reciprocity of physician licenses. Note that the states in treatment and control groups here are geographically nearby, implying that this analysis also controls geographical variations by using the data of states that are geographically nearby. The results clearly indicate the increased proportion of respondents with personal doctors and the reduced proportion of respondents not seeing a doctor due to the cost after adopting the universal reciprocity of physician licenses. In summary, the results in Figures 6 and 7 reveal that the positive impacts of the ULR on consumer welfare are due to the universal reciprocity of physician licenses instead of other unknown factors related to the ULR.

5.5 Robustness Check: Healthcare Utilization Among Older Populations (Age 65+)

The sample we use for the baseline analysis and most of the robustness checks exclude the respondents aged 65 and older because of the potential distortion of healthcare utilization due to Medicare eligibility and receipt; Card et al. (2008) shows a drastic increase in the healthcare utilization at age 65, implying that Medicare eligibility and receipt significantly change the level

of healthcare utilization of U.S. older adults. However, this is an important population to study because of its high demand for healthcare services and relatively lower concern about the costs that are substantially covered by Medicare. Although these characteristics make this population different from our baseline populations (i.e. age 25-64), analyzing the outcomes from this population still provides important implications.

In theory, universal reciprocity of physician licenses that leads to increasing the local labor supply of physicians will significantly benefit this population by greater availability of physicians, leading to increasing healthcare utilization. However, this population would partially or not significantly benefit from this universal reciprocity in terms of reducing the cost burden, since the costs have already been substantially covered by Medicare. In other words, for individuals aged 65 and older, the effect of the ULR on healthcare utilization will be positive and large while that on the cost issue will be relatively small.

To test whether this is true, as a robustness check, we conduct the same analysis using the data of this population separately. Because the BRFSS topcodes the value of the age variable at 80, we cannot determine the true age of the respondents whose ages are shown to be 80 in the data. Thus, we use the respondents whose ages are between 65 and 79. We use the 2015 cohort for this analysis.

Figure 9 shows the results from the CSDID of Equation (14) using the data of respondents aged between 65 and 79. The first sub-figure shows the result using 'having personal doctors or healthcare providers (Personal Doctor)' as an outcome. This sub-figure clearly indicates the increase in the proportion of respondents who have one or more personal doctors after the ULR was adopted. However, the other two sub-figures do not show a statistically significant effect of

the ULR. This implies that there is no significant change in the proportion of respondents with cost issues, which is consistent with our predictions.

These results provide clear evidence that the adoption of the ULR increased the access to healthcare for these older respondents while their concern about medical costs did not significantly change. Although only one measure (Personal Doctor) is statistically significant, these results provide evidence that the adoption of the ULR increased the consumer welfare of this population, which is also consistent with our theoretical model.

5.6 Robustness Check: Effect of ULR during Medicaid Expansions

Established under the Affordable Care Act of 2010, so called "Medicaid expansion," many of the U.S. states extended their Medicaid eligibility to individuals with incomes up to 138% (or higher among some states) of the federal poverty level (FPL). This expansion allowed more individuals, especially among those with lower income, to obtain health insurance, leading to increased access to healthcare services (Sommers et al., 2012; Courtemanche et al., 2016; Mazurenko et al., 2018; Borgschulte and Vogler, 2020). However, the timing of Medicaid expansion vary by state; while some states expanded before or during the first wave of expansion in 2014, other states either did not expand or expanded in 2019 or later. For instance, Utah, one of the states in the control group of 2015 Cohort, expanded in January 2020, which is in the middle of our study period. This means that there can be a variation in healthcare utilization due to Medicaid expansion. Furthermore, some states' expansion encompasses larger groups of individuals by raising the FPL threshold for the households with children or pregnant women. For instance, Illinois expanded Medicaid eligibility for adult under 65 up to 138% of the FPL, yet that for the households with children is up to 147% and that for the households with pregnant women is up to 213%, with coverage extended for 12 months after birth. This means that healthcare

utilization can vary also by the characteristics of households: including household annual income, number of family members, and presence of child and pregnant women.

Thus, considering the impact of Medicaid expansion is needed to measure the true effect of universal reciprocity of physician licenses on healthcare utilization. However, the BRFSS 2018-2023 is limited in directly accounting for Medicaid expansions because of the change in the survey question on 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-engineer of the survey and its questions, leading to a change in the response rates for some of the questions. Note that the wording of the survey question on primary sources of healthcare coverage did not change but the order (i.e. being asked later in the survey). Since the survey response rates are drastically different between the two time periods, using this coverage measure to take Medicaid expansion into account would not provide accurate answers.

Thus, we select the sample of respondents who are not affected by Medicaid expansion. Since the majority of the states in 2015 Cohort have Medicaid eligibility thresholds of 138% of the FPL regardless of having children or pregnant women in the household, we first choose the states in this cohort that have the maximum of 138% thresholds for Medicaid eligibility. This step drops Alabama[5], Iowa, Illinois, Minnesota, and Wisconsin. Then, we select the respondents whose household annual income is above the 150% FPL based on the number of family members in the household; we chose the households with one to five family members, covering approximately 90%

[5] While Alabama's Medicaid eligibility is up to 138% of the FPL for adults, that for the households with children or pregnant women is up to 146%, with 12 months extension for 12 months after birth. Although 146% FPL is below 150% FPL, we exclude Alabama from the sample to create more homogeneous sample.

of the households in 2015 Cohort states. The BRFSS provides household income measures in categories, and we use these categorical measures to determine and drop the respondents whose FPLs based on the number of family members are below 150%. More information on sample selection is provided in Appendix F. Then, we lastly select the respondents who are covered by health insurance; this is a binary measure that has a response rate over 95% across all survey periods, meaning that it was not significantly affected by the survey re-engineering in 2021.

The final sample of respondents are those living in the states in 2015 Cohort, with the Medicaid eligibility below 138% FPL, whose households' FPL is above 150% FPL and covered by some form of health insurance. In other words, these respondents are not affected by the Medicaid expansions before and after. Using the data of these respondents, we obtain the state-half-year healthcare utilization measures.

Figure 10 shows the shows the results from the CSDID of Equation (14) using the data of respondents aged between 25 and 64 and are not affected by Medicaid expansions. The results are consistent with our findings in the baseline analysis: an increase in the proportion of respondents having one or more personal doctors or healthcare providers, and reduction in the proportion of respondents not seeing a doctor due to the cost. Although these results, due to data limitation, do not explain how the ULR improved the welfare of economically vulnerable populations in the healthcare market, these results provide consistent and clear evidence that adopting the universal reciprocity of physician licenses increases the consumer welfare in the healthcare market.

5.7 Robustness Check: Estimations Using Other Staggered Difference-in-Difference Approaches

To ensure our empirical results, we conduct another robustness check by using recent econometric methods that deal with event study designs. Wang et al. (2024) classify some of the

recent staggered difference-in-difference methods into three groups based on how 'non-parallel outcome dynamics' are dealt: group-time estimator approach, imputation approach, and regression approach. CSDID is classified as a group-time estimator approach. The methods that are classified as an imputation approach include Borusyak et al. (2024) and Liu et al. (2024), using not-yet-treated observations to impute counterfactual outcomes for each treated unit in the absence of treatment. The methods that are classified as a regression approach include Sun and Abraham (2021), Cengiz et al. (2019), and Wooldridge (2021, 2023), running a regression with event study regressors interacted with group indicators and/or time periods.

We first conduct Bacon decomposition (Goodman-Bacon, 2021) to distinguish the overall treatment effect and the effects from different treatment timing. Table 4 provides the results, showing that both effects are in the same direction across all healthcare utilization measures. Then, we choose one method for each approach – Borusyak et al. (2024) for an imputation approach and Wooldridge (2021) for a regression approach – to obtain the results on how healthcare utilization changes after adopting the ULR. Figure 11 shows the results from using other staggered difference-in-difference estimations of Equation (14). The sub-figures on the left are the results using the imputation approach. All three sub-figures are consistent with our findings from the baseline analysis and robustness checks, and, notably, the estimated effects are at higher levels of significance.

On the other hand, the results using the regression approach, the sub-figures on the right, are slightly different from our previous findings; the estimated effects using the cost issue as a dependent variable (the second figure) are not statistically significant. However, surprisingly, the result in the third sub-figure, measuring the estimated effect of the ULR on utilizing routine health checkup, is positive statistically significant after the treatment. In summary, all these results are

consistent with our predictions that adopting the universal reciprocity of physician licenses increases healthcare utilization.

6 Conclusions

We examine how the recent policy reform on relaxing the licensure regulations may improve consumer welfare by evaluating the impact of universal reciprocity of physician licenses on healthcare utilization. We first provide a partial equilibrium model explaining how non-compete agreements make physicians prefer starting out-of-state practices over migrating after adopting the reciprocity of out-of-state licenses and then provide a general equilibrium model explaining how the ULR improves consumer welfare in the healthcare market. Then, we use public healthcare utilization data to estimate the change in access to healthcare before and after adopting the universal reciprocity of physician licenses.

The results from these estimates are consistent with our theoretical model; the universal reciprocity of physician licenses significantly raises the proportion of respondents accessing healthcare, particularly among older respondents, and reduces the proportion of respondents not getting healthcare services due to cost considerations. We also examine how residency requirements of the ULR change the outcomes using another subset of states that adopted the IMLC in 2016. We show that the positive effect of the ULR on healthcare utilization is not observed among the states that adopt universal reciprocity but impose residency requirements. Plus, the analysis of the change in the proportion of physicians in each state confirms that there is no statistically significant change in the interstate migration of physicians. These results imply that the universal reciprocity of physician licenses has a significant role in the decision-making process for doctors who are considering out-of-state practices, but not in interstate migration. Lastly, we

use a counterfactual treatment group to validate whether the positive effect of the ULR on healthcare utilization is due to the universal reciprocity of physician licenses or unknown factors associated with the ULR. Our results clearly reveal that the positive effect is due to universal reciprocity.

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). By making would-be practitioners undergo specific training, pass exams, and complete other requirements, according to this rationale, the public is better protected from fraudulent, disreputable, and unqualified service providers. Nevertheless, by making it more difficult to enter an occupation across state lines, licensing can affect employment in licensed occupations, wages of licensed workers, the prices for their services, and reduce worker economic opportunities more broadly. Further, if these policies result in an inability to achieve regional or local equilibrium, policies that reduce these barriers could enhance both consumer and worker welfare in healthcare.

Although our study reveals the influence of the ULR on healthcare utilization by developing theoretical models and utilizing a relevant data set and method, there are limitations. First, the outcome variable 'received routine health checkups within a year' is somewhat limited in reflecting the changes in healthcare utilization in the short term. The routine medical checkup comprises various types of medical examinations with different suggested cycles. For instance, for men aged between 40 and 64, a blood pressure check is recommended at least once every year while a colonoscopy is recommended every 5 years (Davidson et al., 2021; Whelton et al., 2022). Furthermore, these recommendations also vary by age and sex.[6] The outcome variable for routine

[6] For more information about government's recommendations on routine medical checkups by age and sex, check the NIH's webpage: https://medlineplus.gov/ency/article/002125.htm

medical checkups used in this study may account for a shorter interval of time (1 year) than it should have been depending on the types of checkups and the age of respondents. However, the majority of states adopted the ULR in 2020 and 2021, suggesting that the current availability of data cannot take the long-term effect of universal reciprocity of physician licenses into account. Also, while we show the reduction in the proportion of individuals having experience in not seeing a doctor because of cost issue, this study does not show the actual cost reduction due to the ULR; the BRFSS does not provide the data on actual healthcare expenses. In addition, for the same reason, this study does not show the influence of the ULR on the change in service quality.

Therefore, future research should extend our findings to obtain the long-term effects of universal reciprocity by utilizing upcoming data sets. Also, future research can utilize other healthcare data sets to examine the influence of the ULR on actual healthcare cost and service quality, especially the outcomes among the economically vulnerable populations who could not be included in this study due to data limitation. Plus, the recent ongoing debates on prohibiting non-compete agreements for physicians should be studied to see whether repealing these agreements would increase the in-state traveling physicians and reduce the out-of-state practices or not. Lastly, it would be fruitful to examine the change in consumer welfare from different occupational sectors, as the ULR includes various occupations for universal reciprocity. Nevertheless, our analysis adds to the role that changes in statutes affecting physicians' ability to practice can enhance patient well-being and consumer welfare.

References

Adashi, Eli Y., I. Glenn Cohen, and Winston L. McCormick. 2021. "The Interstate Medical Licensure Compact: Attending to the Underserved." *JAMA* 325 (16): 1607-1608.

Apgar, Dawn. 2022. "Social Work Licensure Portability: A Necessity in a Post-COVID-19 World." *Social Work* 67 (4): 381-390.

Bae, Kihwan, and Edward Timmons. 2023. "Now You Can Take It with You: Effects of Occupational Credential Recognition on Labor Market Outcomes."

Blair, Peter Q., and Bobby W. Chung. 2022. "Job Market Signaling through Occupational Licensing." *Review of Economics and Statistics*: 1–45.

Borgschulte, Mark, and Jacob Vogler. 2020. "Did the ACA Medicaid Expansion Save Lives?" *Journal of Health Economics* 72: 102333.

Borusyak, Kirill, Xavier Jaravel, and Jann Spiess. 2024. "Revisiting Event-Study Designs: Robust and Efficient Estimation." *Review of Economic Studies* 91 (6): 3253-3285.

Callaway, Brantly, and Pedro HC Sant'Anna. 2021. "Difference-in-Differences with Multiple Time Periods." *Journal of Econometrics* 225 (2): 200-230.

Card, David, Carlos Dobkin, and Nicole Maestas. 2008. "The Impact of Nearly Universal Insurance Coverage on Health Care Utilization: Evidence from Medicare." *American Economic Review* 98 (5): 2242–2258.

Cengiz, Doruk. Arindrajit Dube, Attila Lindner, and Ben Zipperer. 2019. "The Effect of Minimum Wages on Low-Wage Jobs." *The Quarterly Journal of Economics* 134 (3): 1405-1454.

Centers for Disease Control and Prevention (CDC). Behavioral Risk Factor Surveillance System Survey Data. Atlanta, Georgia: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, 2018-2023.

Chaudhry, Humayun J, Lisa A Robin, Eric M Fish, Donald H Polk, and J Daniel Gifford. 2015. "Improving Access and Mobility—The Interstate Medical Licensure Compact." *New England Journal of Medicine* 372 (17): 1581-1583.

Courtemanche, Charles, James Marton, Benjamin Ukert, Aaron Yelowitz, and Daniela Zapata. 2017. "Early Impacts of the Affordable Care Act on Health Insurance Coverage in Medicaid Expansion and Non-Expansion States." *Journal of Policy Analysis and Management* 36 (1): 178-210.

Cross, James, Yeshwanth Lolla, Chris Fichman, Michael Weingarten, and Michael Howley. 2024. "The Cost of a Locum: A Simulation to Determine When You Are Paying Too Much for Your Anesthesia Locum Tenens Coverage." *Cureus*, *16* (4).

Davidson, Karina W., Michael J. Barry, Carol M. Mangione, Michael Cabana, Aaron B. Caughey, Esa M. Davis, Katrina E. Donahue et al. 2021**.** "Screening for Colorectal Cancer: US Preventive Services Task Force Recommendation Statement." *JAMA* 325 (19): 1965-1977.

Deyo, Darwyyn, and Danny Hughes. 2019. "Crossing State Borders: The Interstate Medical Licensure Compact and Hospital Quality." *8th Annual Conference of the American Society of Health Economist*.

Deyo, Darwyyn, Sriparna Ghosh, and Alicia Plemmons. 2024. "Access to Care and Physician-Practice Growth after the Interstate Medical Licensure Compact." *Available at SSRN 4755497*.

Deyo, Darwyyn, and Alicia Plemmons. 2022. "Have License, Will Travel: Measuring the Effects of Universal Licensing Recognition on Mobility." *Economics Letters* 219: 110800.

Fannin, William Clay. 2020. "Evaluating the Labor Supply and Migration Effects of the Interstate Medical Licensure Compact." MPA/MPP/MPFM Capstone Projects. 404.

Flood, Sarah, Miriam King, Renae Rodgers, Steven Ruggles, J. Robert Warren, and Michael Westberry. Integrated Public Use Microdata Series, Current Population Survey: Version 12.0 [dataset]. Minneapolis, MN: IPUMS. 2018-2023.

Gittleman, Maury, Mark A. Klee, and Morris M. Kleiner. 2018. "Analyzing the Labor Market Outcomes of Occupational Licensing." *Industrial Relations* 57 (1): 57–100.

Goodman-Bacon, Andrew. 2021. **"**Difference-in-Differences with Variation in Treatment Timing." *Journal of Econometrics*, *225* (2): 254-277.

Hest, Robert. 2022. "BRFSS Estimates Show Potential Break in Series for Usual Source of Care: New Data on State Health Compare." *State Health Access Data Assistance Center*, 20 October. Available at: https://www.shadac.org/news/brfss-potential-break-series-usual-source-care (Accessed 25 February 2025).

Holen, Arlene S. 1965. "Effects of Professional Licensing Arrangements on Interstate Labor Mobility and Resource Allocation." *Journal of Political Economy* 73 (5): 492-498.

H.R.4480 – 117th Congress. 2021. Telehealth Coverage and Payment Parity Act. H.R.4480, 117th Cong. (2021-2022). https://www.congress.gov/bill/117th-congress/house-bill/4480/text

Johnson, Janna E., and Morris M. Kleiner. 2020. "Is Occupational Licensing a Barrier to Interstate Migration?" *American Economic Journal: Economic Policy* 12 (3): 347–73.

Kim, Joy J., Michael M. Joo, and Laura Curran. 2023. "Social Work Licensure Compact: Rationales, Expected Effects, and a Future Research Agenda." *Clinical Social Work Journal* 51 (3): 316-327.

Kirch, Darrell G, and Kate Petelle. 2017. "Addressing the Physician Shortage: The Peril of Ignoring Demography." *JAMA* 317 (19): 1947-1948.

Kleiner, Morris M. 2000. “Occupational Licensing.” *Journal of Economic Perspectives* 14 (4): 189–202.

Kleiner, Morris M. 2015. "Reforming Occupational Licensing Policies." Brookings Institution, Hamilton Project.

Kleiner, Morris, M. 2016. “Milton Friedman and Occupational Licensing.” In *Milton Friedman: Contributions to Economics and Public Policy*, edited by Robert A. Cord and J. Daniel Hammond, pp. 480–498. Oxford University Press.

Kleiner, Morris M., and Alan B. Krueger. 2013. "Analyzing the Extent and Influence of Occupational Licensing on the Labor Market." *Journal of Labor Economics* 31 (2): S173–S202.

Kleiner, Morris M., Allison Marier, Kyoung Won Park, and Coady Wing. 2016. "Relaxing Occupational Licensing Requirements: Analyzing Wages and Prices for a Medical Service." *The Journal of Law and Economics* 59 (2): 261-291.

Kleiner, Morris M. and Evan J Soltas. 2023. “A Welfare Analysis of Occupational Licensing in U.S. States.” *Review of Economic Studies* 90 (5): 2481–2516.

Kugler, Adriana D., and Robert M. Sauer. 2005. "Doctors without Borders? Relicensing Requirements and Negative Selection in the Market for Physicians." *Journal of Labor Economics* 23 (3): 437-465.

Liu, Licheng, Ye Wang, and Yiqing Xu. 2024. “A Practical Guide to Counterfactual Estimators for Causal Inference with Time-Series Cross-Sectional Data.” *American Journal of Political Science* 68 (1): 160-176.

Livanos, Nicole. 2020. "Mobility for Healthcare Professional Workforce Continues to Soar." *Journal of Nursing Regulation* 10 (4): 54-56.

Mazurenko, Olena, Casey P. Balio, Rajender Agarwal, Aaron E. Carroll, and Nir Menachemi. 2018. "The Effects of Medicaid Expansion Under the ACA: A Systematic Review." *Health Affairs* 37 (6): 944-950.

National Institute of Health. 2023. *Physical Examination Frequency.* Available at: https://medlineplus.gov/ency/article/002125.htm (Accessed 21 November 2024).

Norris, Conor. 2024. "Is Reform Contagious?: The Diffusion of Universal Recognition Reforms." *Journal of Economics and Finance*: 1-19.

Peterson, Brenton D., Sonal S. Pandya, and David Leblang. 2014. "Doctors with Borders: Occupational Licensing as an Implicit Barrier to High Skill Migration." *Public Choice* 160: 45-63.

Robeznieks, Andis. 2023. "AMA Backs Effort to Ban Many Physician Noncompete Provisions." American Medical Association. https://www.ama-assn.org/medical-residents/transition-resident-attending/ama-backs-effort-ban-many-physician-noncompete

Ruggles, Steven, Sarah Flood, Matthew Sobek, Daniel Backman, Annie Chen, Grace Cooper, Stephanie Richards, Renae Rodgers, and Megan Schouweiler. IPUMS USA: Version 15.0 [dataset]. Minneapolis, MN: IPUMS. 2018-2023.

Shakya, Shishir, Sriparna Ghosh, and Conor Norris. 2022. "Nurse Licensure Compact and Mobility." *Journal of Labor Research* 43 (2): 260-274.

Shakya, Shishir, Alicia Plemmons, and Conor Norris. 2024. "Military Spouse Licensing: A Case Study of Registered Nurses Near Military Bases." *Journal of Regulatory Economics* 66: 1-22.

Sommers, Benjamin D., Katherine Baicker, and Arnold M. Epstein. 2012. "Mortality and Access to Care among Adults after State Medicaid Expansions." *New England Journal of Medicine* 367 (11): 1025-1034.

Steinbrook, Robert. 2014. "Interstate Medical Licensure: Major Reform of Licensing to Encourage Medical Practice in Multiple States." *JAMA* 312 (7): 695-696.

Sun, Liyang, and Sarah Abraham. 2021. "Estimating Dynamic Treatment Effects in Event Studies with Heterogeneous Treatment Effects." *Journal of Econometrics* 225 (2): 175-199.

Timmons, Edward, and Conor Norris. 2023. "Help Military Families by Passing Universal Licensing Recognition."

Wang, Guangyi, Rita Hamad, and Justin S White. 2024. "Advances in Difference-in-Differences Methods for Policy Evaluation Research." *Epidemiology* 35 (5): 628-637.

Whelton, Paul K., Robert M. Carey, Giuseppe Mancia, Reinhold Kreutz, Joshua D. Bundy, and Bryan Williams. 2022. "Harmonization of the American College of Cardiology/American Heart Association and European Society of Cardiology/European Society of Hypertension Blood Pressure/Hypertension Guidelines: Comparisons, Reflections, and Recommendations." *European Heart Journal* 43 (35): 3302-3311.

Wooldridge, Jeffrey M. 2021. "Two-Way Fixed Effects, the Two-Way Mundlak Regression, and Difference-in-Differences Estimators." *Available at SSRN 3906345.*

Wooldridge, Jeffrey M. 2023. "Simple Approaches to Nonlinear Difference-in-Differences with Panel Data." *The Econometrics Journal* 26 (3): C31-C66.

Zhang, Xiaoming, Daniel Lin, Hugh Pforsich, and Vernon W Lin. 2020. "Physician Workforce in the United States of America: Forecasting Nationwide Shortages." *Human Resources for Health* 18: 1-9.

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

	Interstate Licensure Compact (ILC)	Universal Licensing Recognition (ULR)
Similarity	• Reciprocity of occupational licenses for certain occupations. o "Reciprocity" means to give out-of-state licensed workers "right to practice" without going through the state-specific re-licensure processes. • There are separate compacts for each occupation(s), administering 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 to give 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 the 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)	• Licenses that are issued by any US states are reciprocity (more comprehensive than ILC) o Some states (e.g. Montana and South Dakota) also adopt reciprocity for the licenses issued from Canada

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

State		IMLC				ULR				
Name		FIPS	Year	Month	ULR Adopted	Bill Number	Year	Month	Residency Required	Physician License Excluded
Idaho	ID	16	2015	3	Yes	SB 1351	2020	7		
Montana	MT	30	2015	4	Yes	HB 105	2019	3		
South Dakota	SD	46	2015	3	Yes	HB 1077	2021	2		
Iowa	IA	19	2015	7	Yes	HF 2627	2020	6		Yes
Utah	UT	49	2015	3	Yes	SB 23	2020	5		Yes
Wyoming	WY	56	2015	2	Yes	SF 18	2021	7		Yes
Alabama	AL	1	2015	5	No					
Illinois	IL	17	2015	7	No					
Minnesota	MN	27	2015	5	No					
Wisconsin	WI	55	2015	12	No					
West Virginia	WV	54	2015	3	No					
Arizona	AZ	4	2016	5	Yes	HB 2569	2019	4	Yes	
Kansas	KS	20	2016	5	Yes	HB 2066	2021	7	Yes	
Mississippi	MS	28	2016	5	Yes	HB 1263	2021	7	Yes	
New Hampshire	NH	33	2016	5	Yes	SB 382	2022	8		
Connecticut	CT	9	2016	5	No					
Colorado	CO	8	2016	6	Yes	HB 1326	2021	1		Yes

Note: Some states adopted the IMLC before 2015 or after 2016, yet there are not enough number of states that passed the ULR in the same year either, which is a necessary condition for the parallel trend assumption. Plus, among the states that did not pass the IMLC before 2023, we only have two states that passed the ULR (New Jersey is an exception because it passed the ULR in 2018 which is too early in our study's time frame). Thus, it does not seem plausible to use data from states that are not on this list.

Table 3. Descriptive Statistics of States' Healthcare Utilization and Demographic Characteristics

	IMLC in 2015				IMLC in 2016			
Passed ULR	No		Yes		No		Yes	
	Prop/Mean	SD	Prop/Mean	SD	Prop/Mean	SD	Prop/Mean	SD
Healthcare Utilization Measures								
Personal Doctor	.792	.406	.752	.432	.884	.320	.784	.411
Cost Issue	.126	.331	.121	.326	.096	.294	.143	.351
Routine Check within 1 Year	.749	.433	.705	.456	.793	.405	.732	.443
Sociodemographic Characteristics								
Women	.522	.500	.510	.500	.537	.499	.539	.499
Age	47.5	11.5	47.0	11.6	49.4	10.6	47.8	11.5
Race and Ethnicity								
NH White	.806	.396	.841	.366	.744	.437	.743	.437
NH Black	.091	.288	.011	.104	.093	.290	.096	.294
NH Others	.055	.229	.082	.274	.074	.262	.064	.244
Hispanic	.048	.214	.066	.249	.090	.286	.098	.298
Level of Education								
Less than HS and HS Graduate	.300	.458	.315	.465	.266	.442	.312	.463
Some College or Higher	.698	.459	.682	.466	.729	.444	.685	.464
MSA	.658	.474	.395	.489	.944	.231	.618	.486
Has Health Insurance	.911	.285	.889	.314	.942	.233	.879	.326

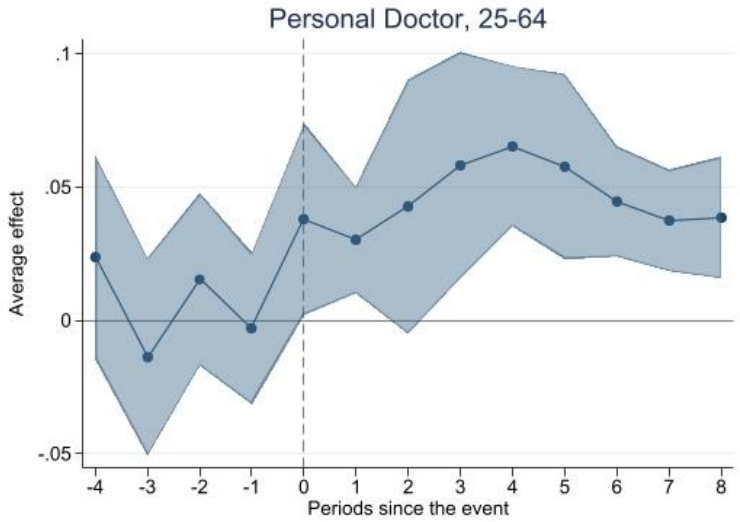
Note: Prop - proportion; SD - standard deviation; NH - non-Hispanic; HS - high school; MSA - metropolitan statistical area. The above descriptive statistics are from the BRFSS 2018 January-June.

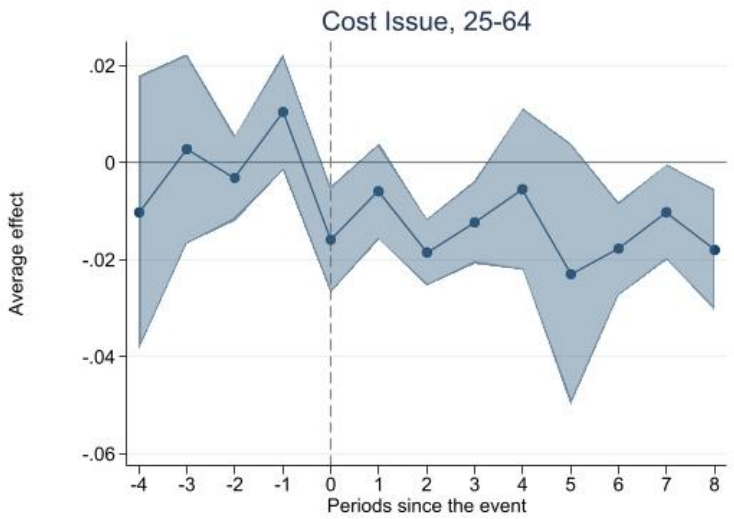
Table 4. Bacon Decomposition, 2015 Cohort, Age 25-64 (*N* = 132)

				Bacon Decomposition			
	Two-Way Fixed Effects			Timing Groups		Never Treated vs Treated	
	EST	SE	p	Beta	Total Weight	Beta	Total Weight
Personal Doctor	.055	.007	.000	.031	.088	.057	.912
Cost Issue	-.006	.005	.198	-.012	.088	-.006	.912
Routine Check	.019	.007	.005	.006	.088	.020	.912

Note: The results above are generated using 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 1. Impact of Universal Licensing Recognition on Healthcare Utilization, 2015 Cohort, Age 25-64 (*N* = 132)





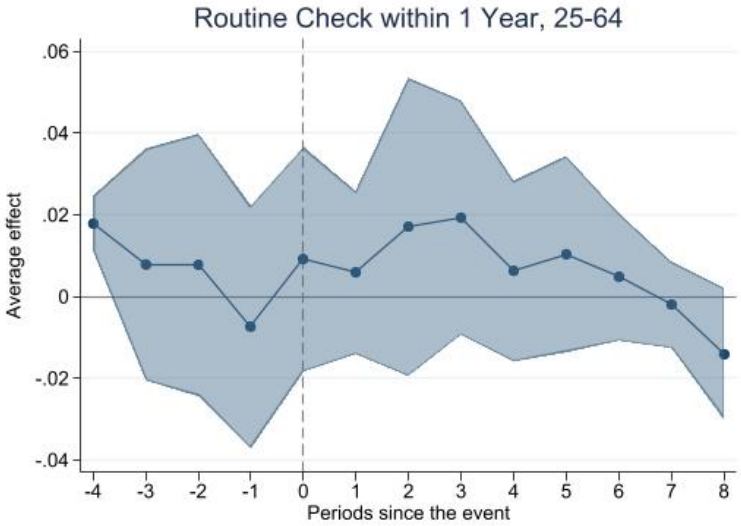
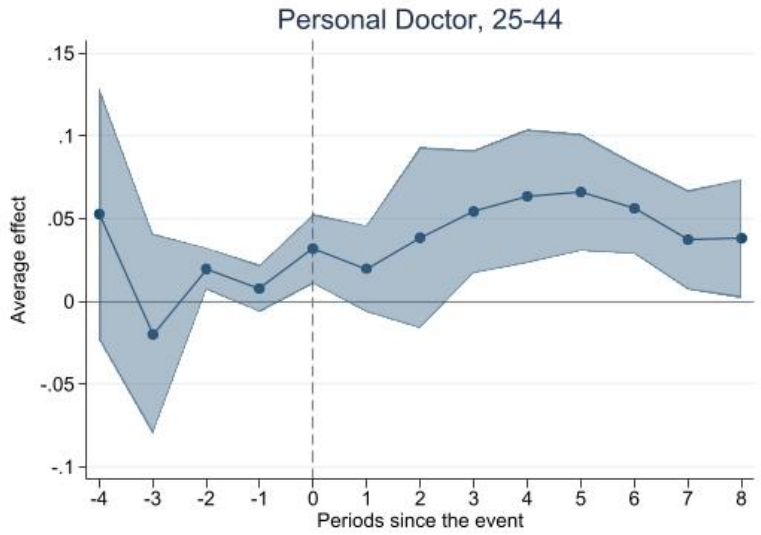
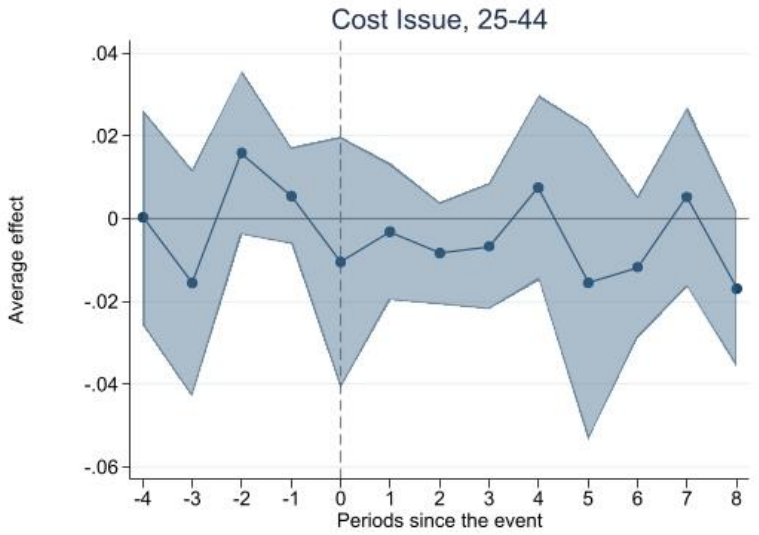


Figure 2. Impact of Universal Licensing Recognition on Healthcare Utilization, 2015 Cohort, Age 25-44 (*N* = 132)





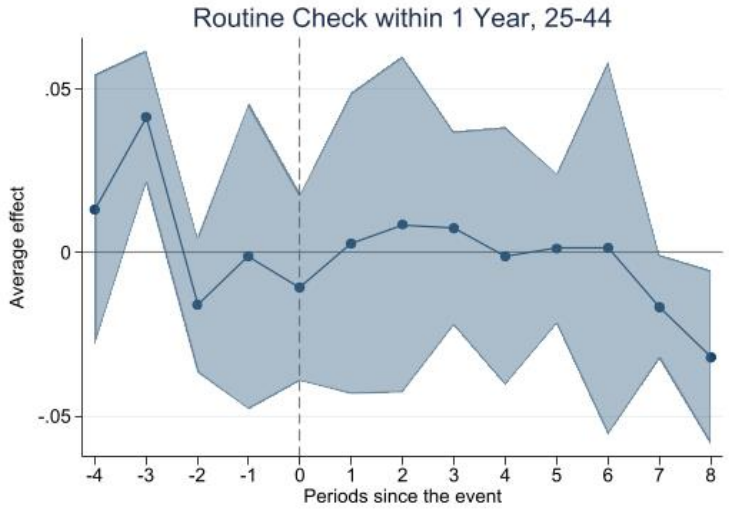
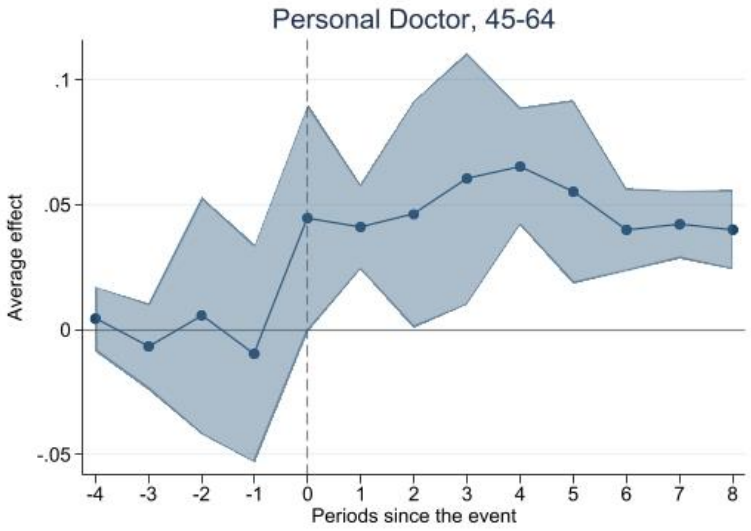
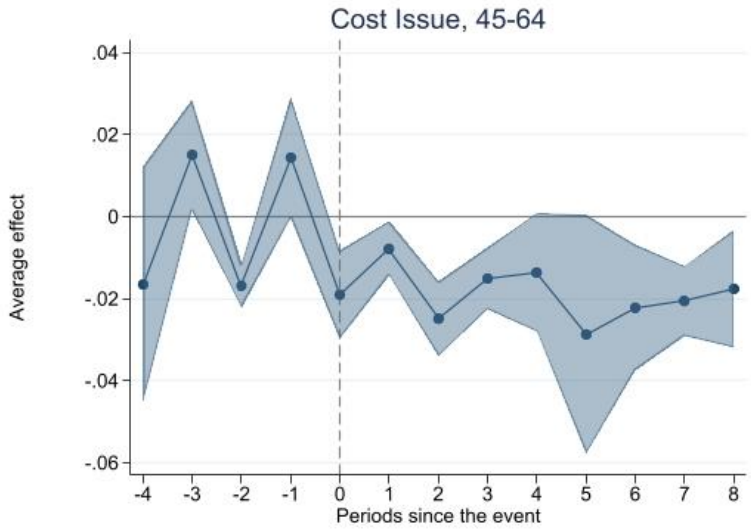


Figure 3. Impact of Universal Licensing Recognition on Healthcare Utilization, 2015 Cohort, Age 45-64 (*N* = 132)





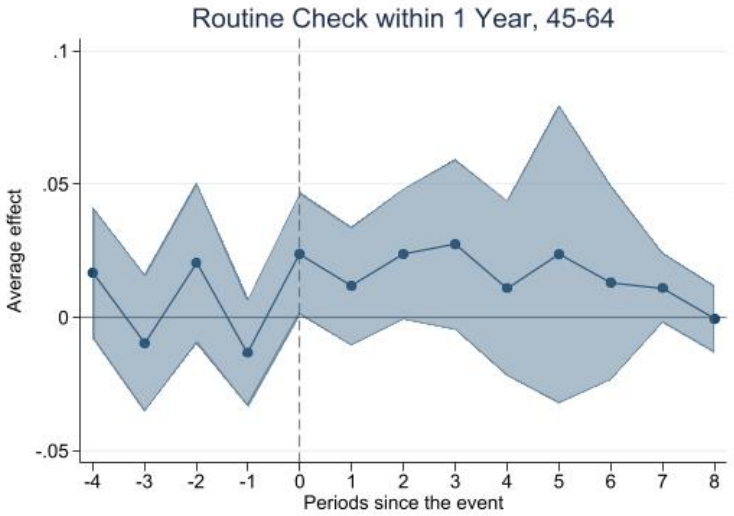
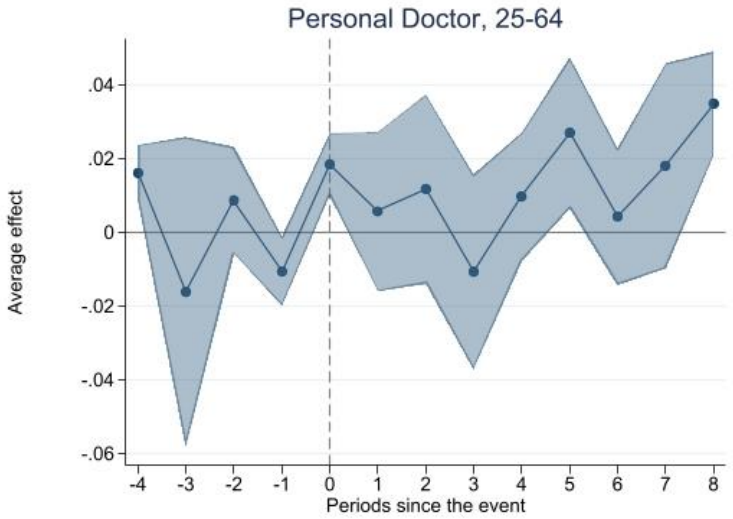
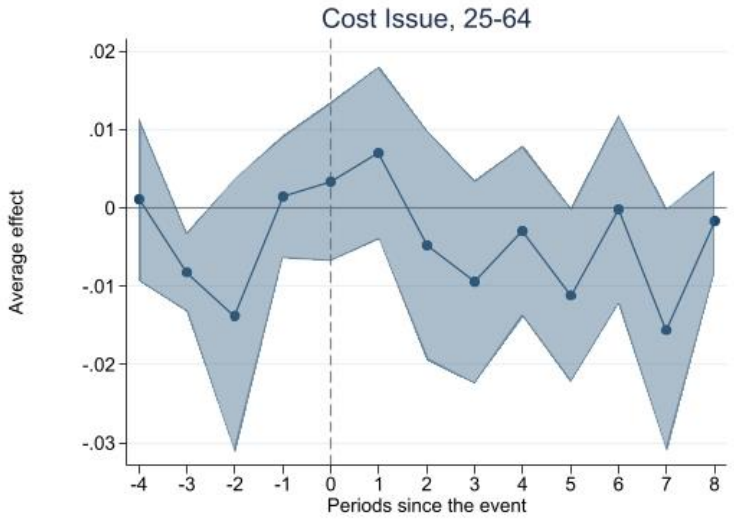


Figure 4. Impact of Universal Licensing Recognition on Healthcare Utilization, 2016 Cohort, Age 25-64 (*N* = 72)





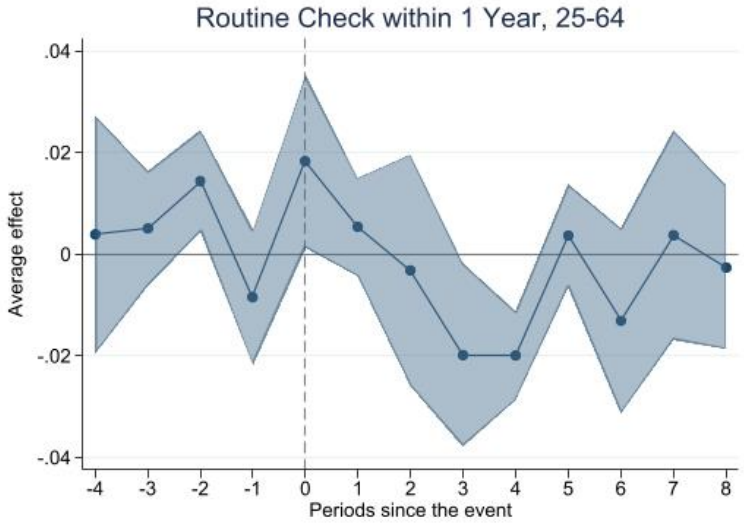
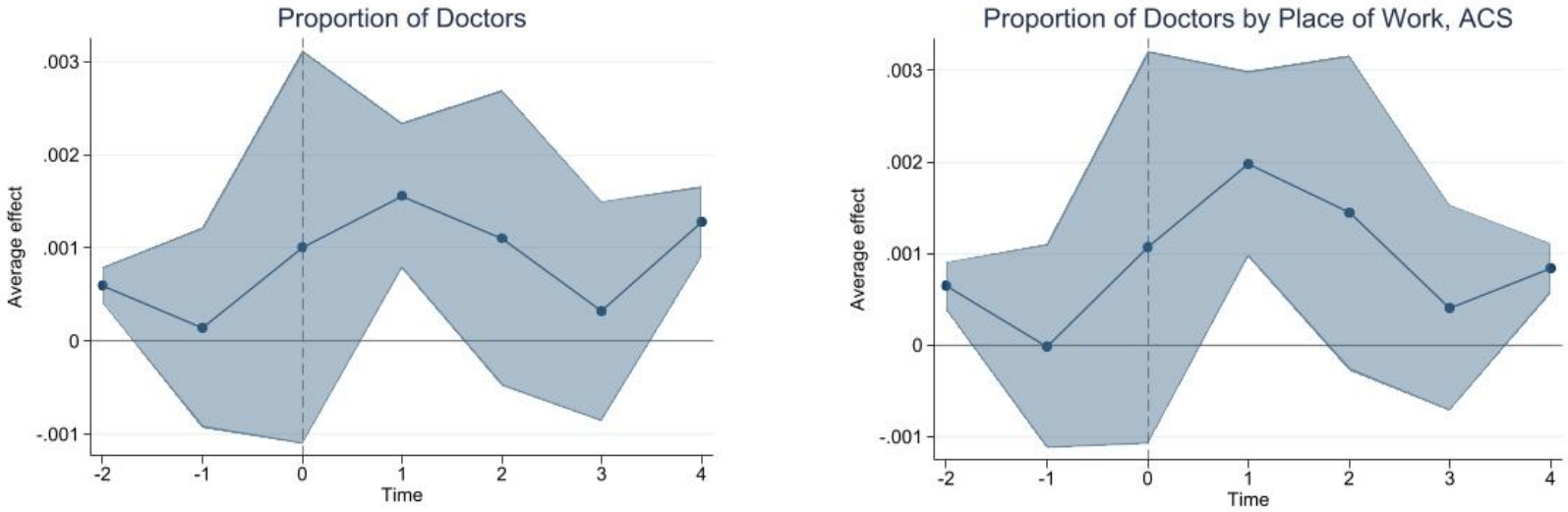
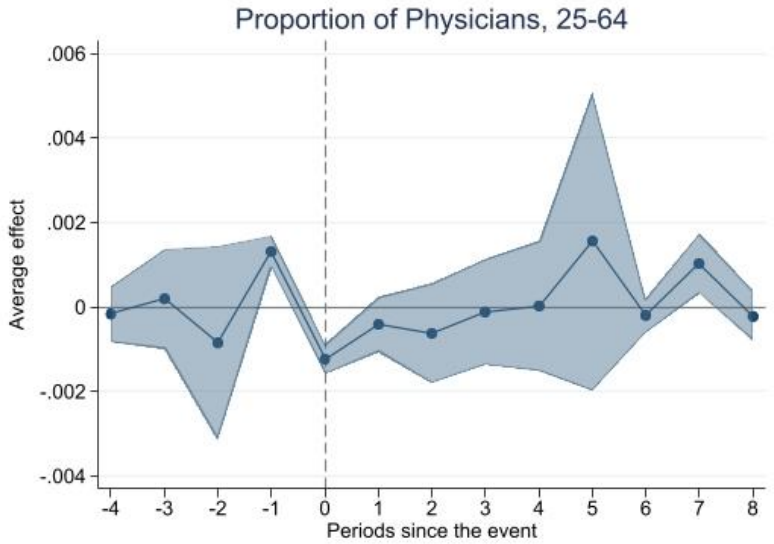


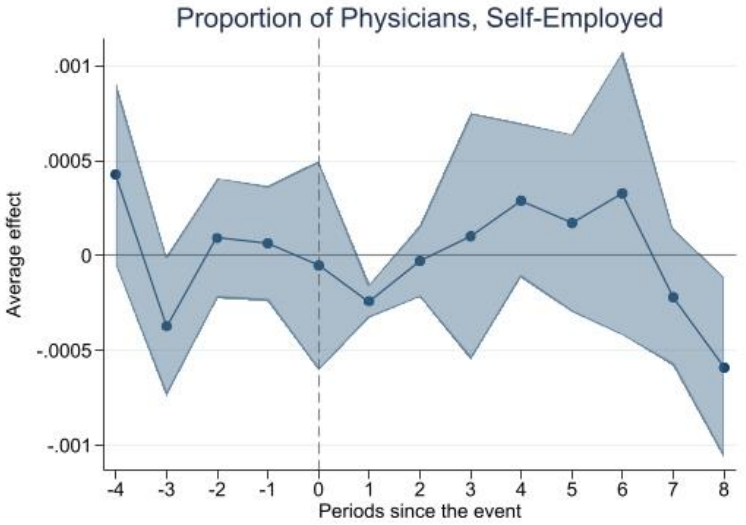
Figure 5. Interstate Migration of Physicians, IPUMS-USA, 2015 Cohort



Note: The sub-figure on the left used the proportion of physicians derived by the total number of physicians living in a corresponding state in corresponding year divided by the state's population in corresponding year. The sub-figure on the right used the proportion of physicians derived by the total number of physicians working in a corresponding state in corresponding year divided by the state's population in corresponding year.

Figure 6. Interstate Migration of Physicians, IPUMS-CPA, 2015 Cohort





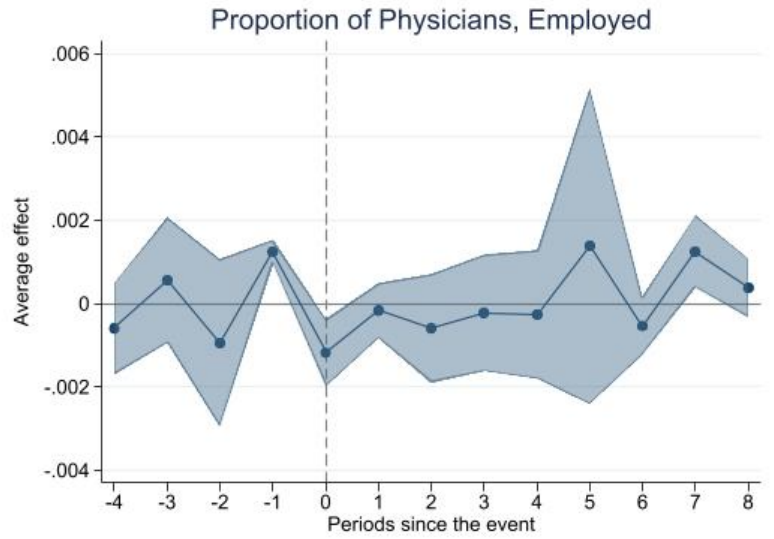


Figure 7. Measuring Effect of Universal Reciprocity of Physician Licenses Using Counterfactual Treatment Group (*N* = 132)

True Model | **Counterfactual Model**

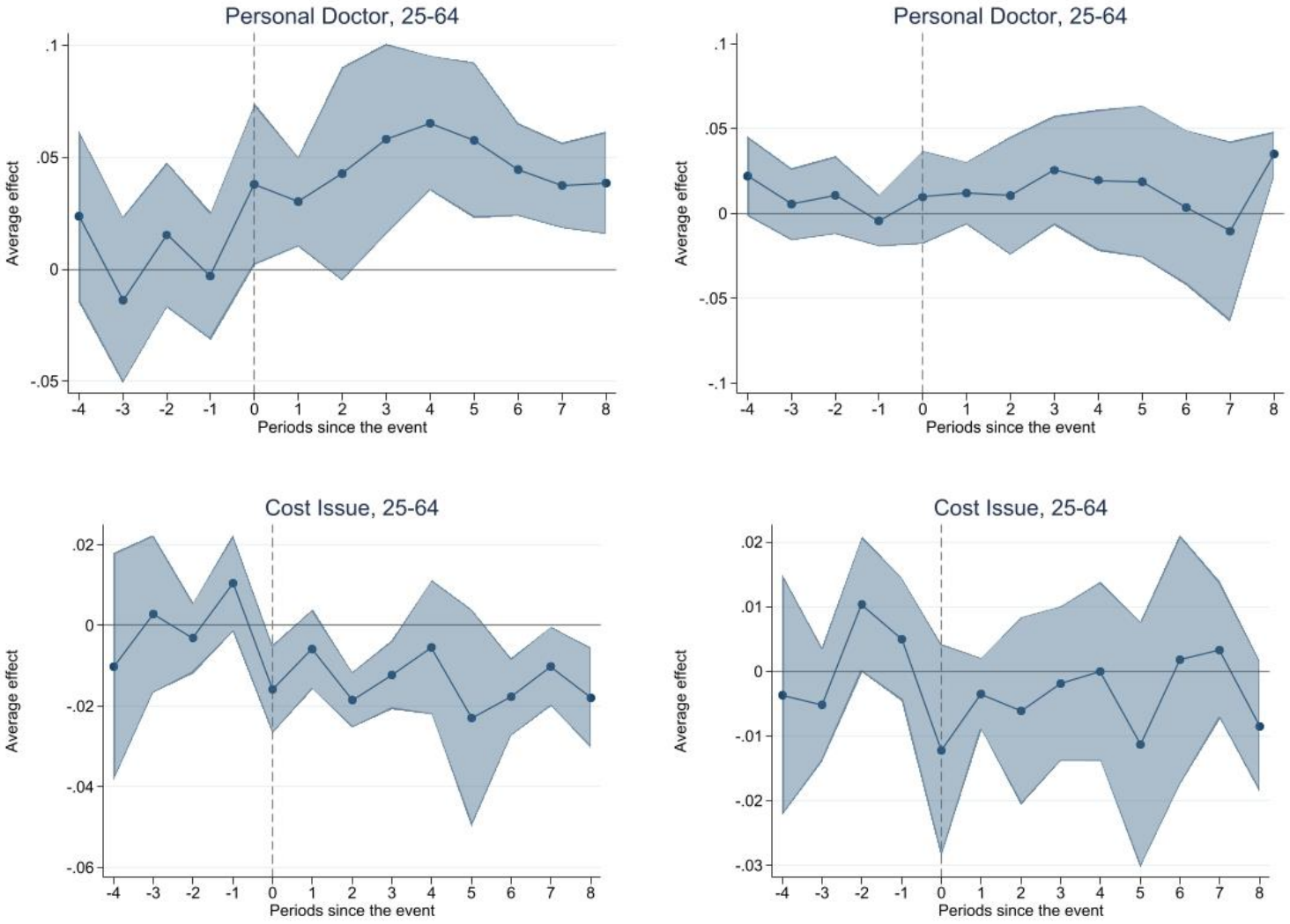
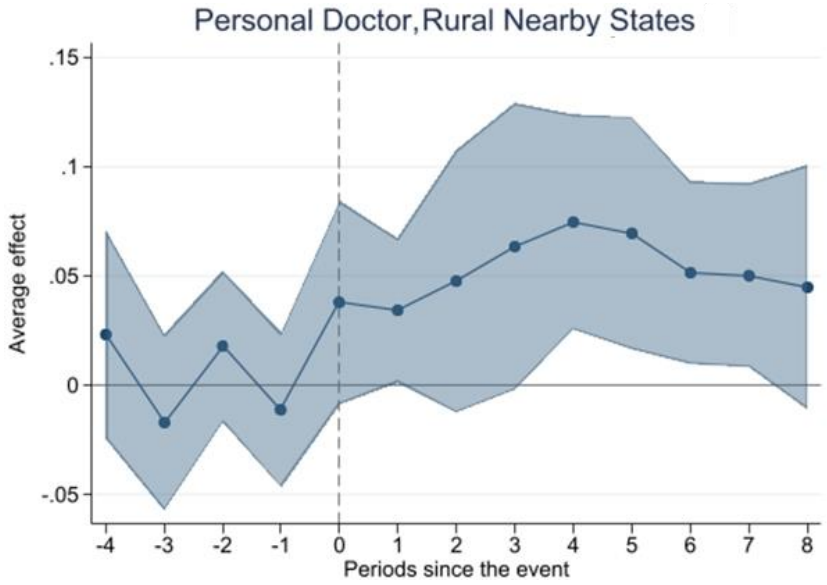
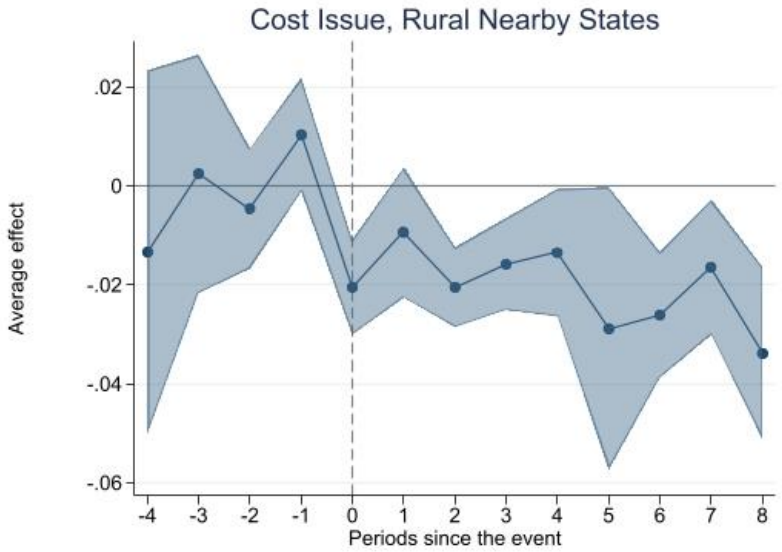


Figure 8. Measuring Effect of Interstate Reciprocity of Physician Licenses Using ULR States Only (*N* = 132)





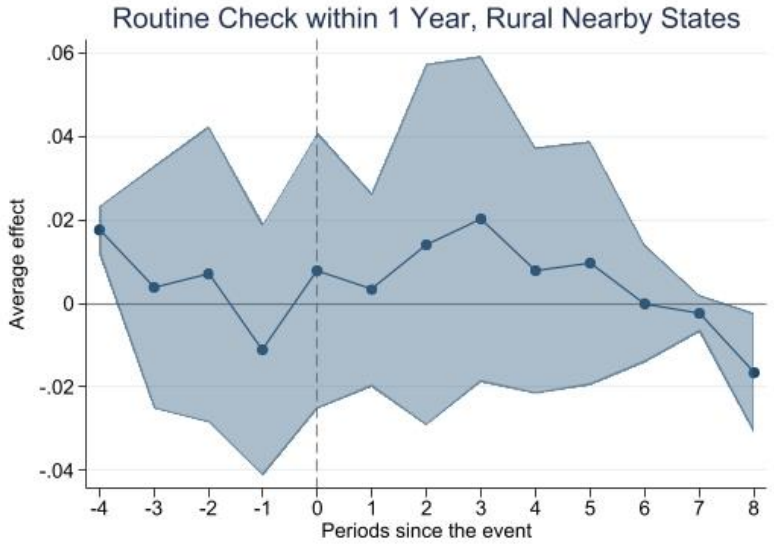


Figure 9. Impact of Universal Licensing Recognition on Healthcare Utilization, 2015 Cohort, Age 65-79 (*N* = 132)

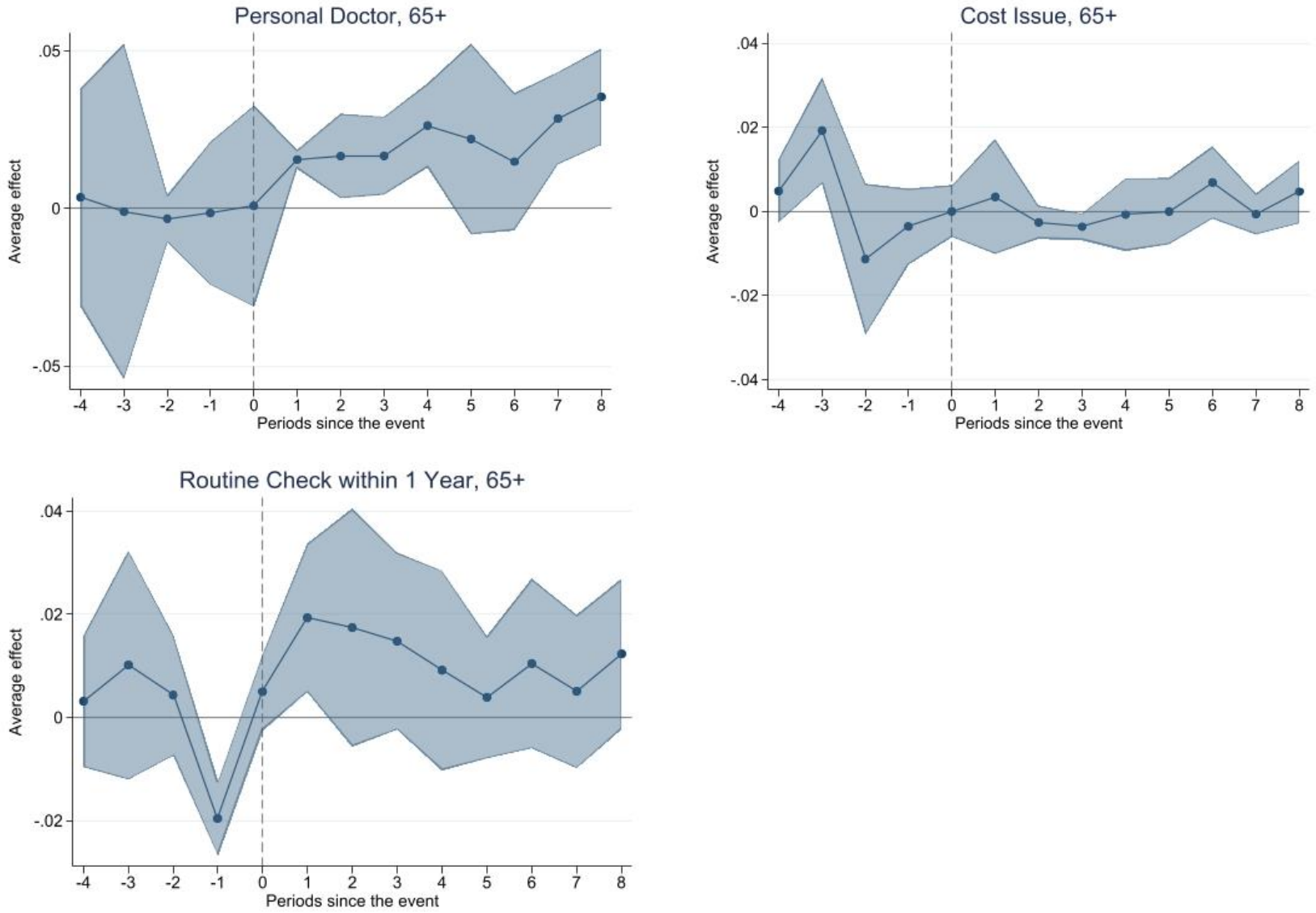
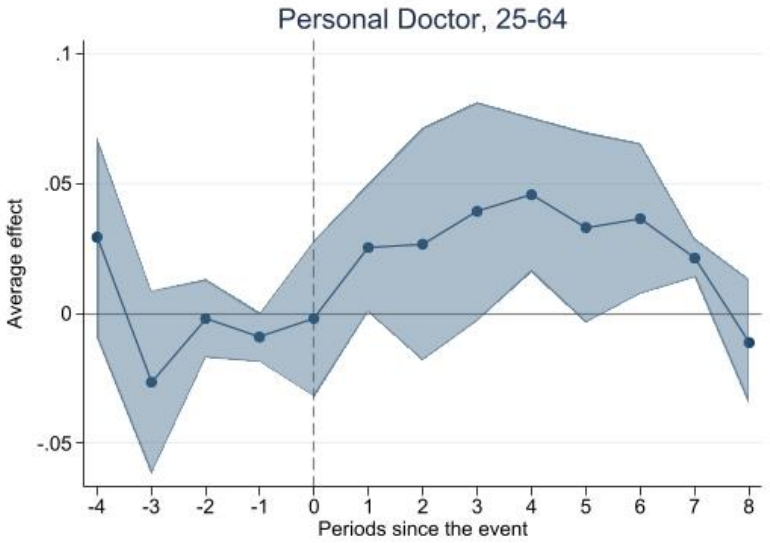
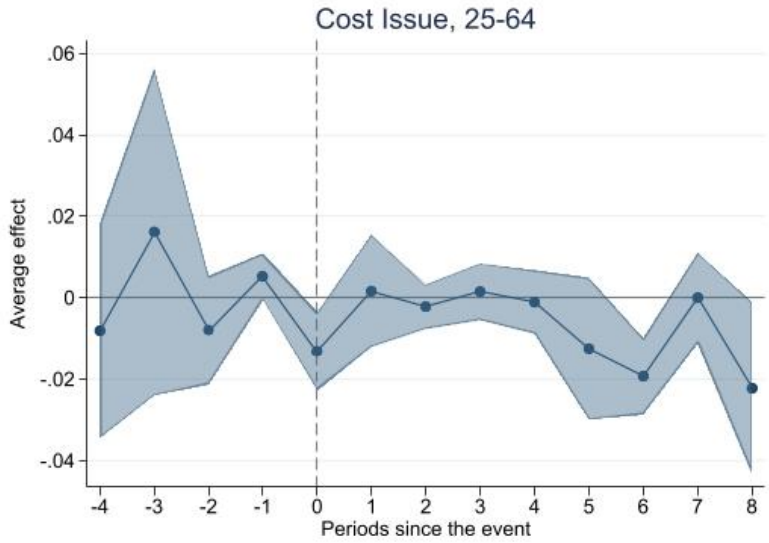


Figure 10. Measuring Effects from Respondents Not Affected by Medicaid Expansion, 2015 Cohort, Age 25-64 (*N* = 72)





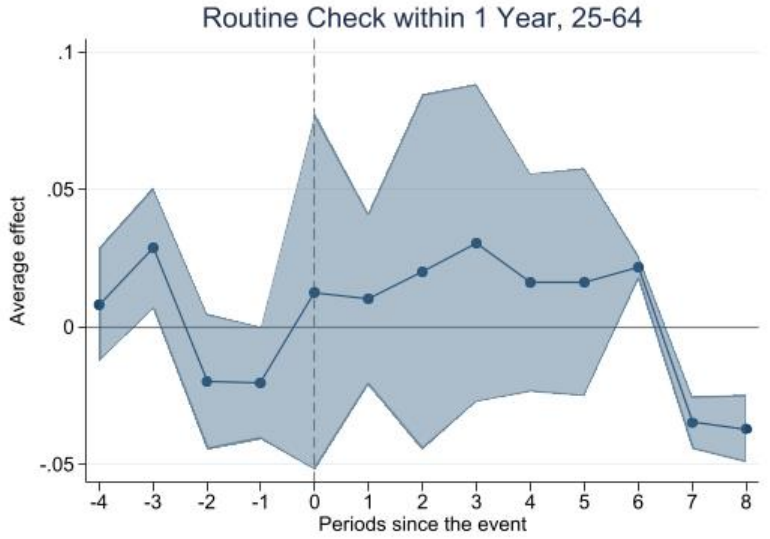


Figure 11. Use of Different Staggered Difference-in-Difference Approaches, 2015 Cohort, Age 25-64 (*N* = 132)

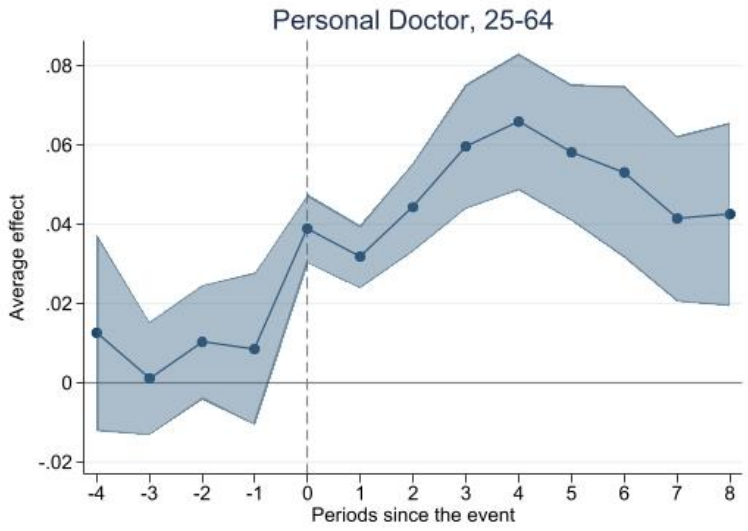
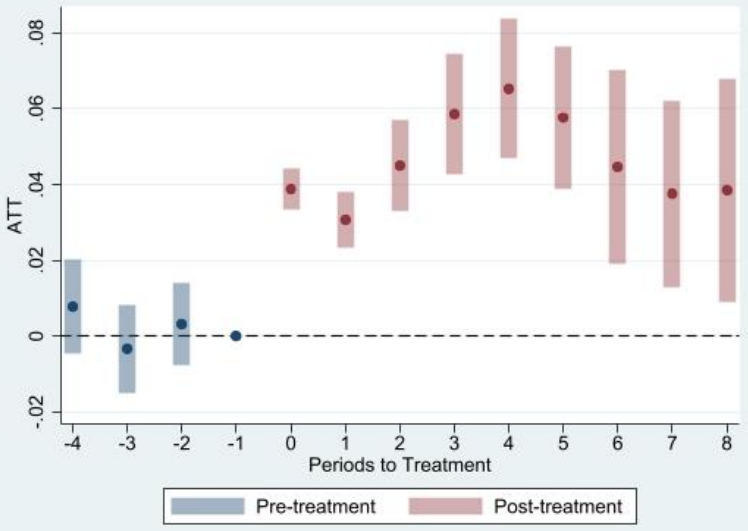
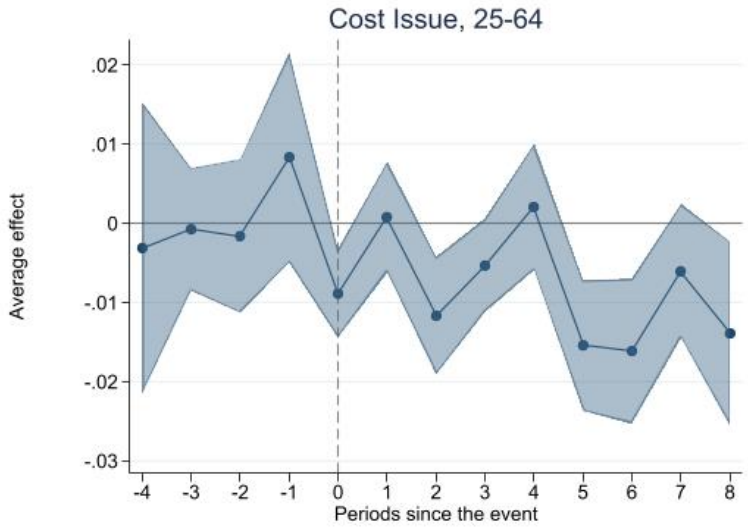
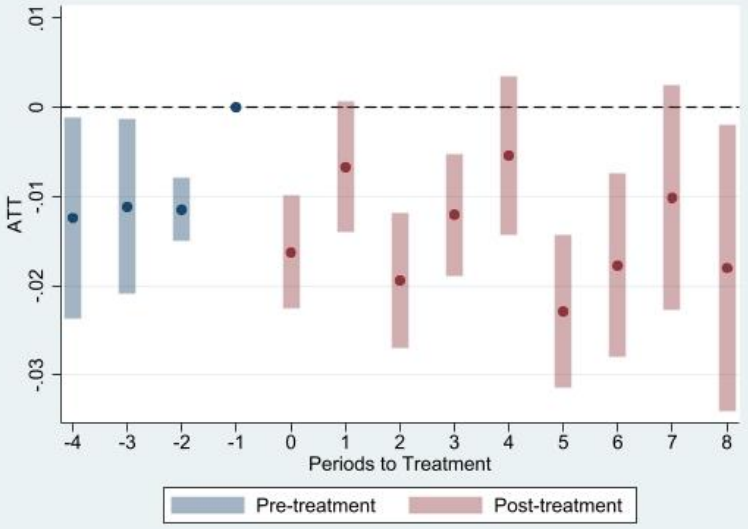
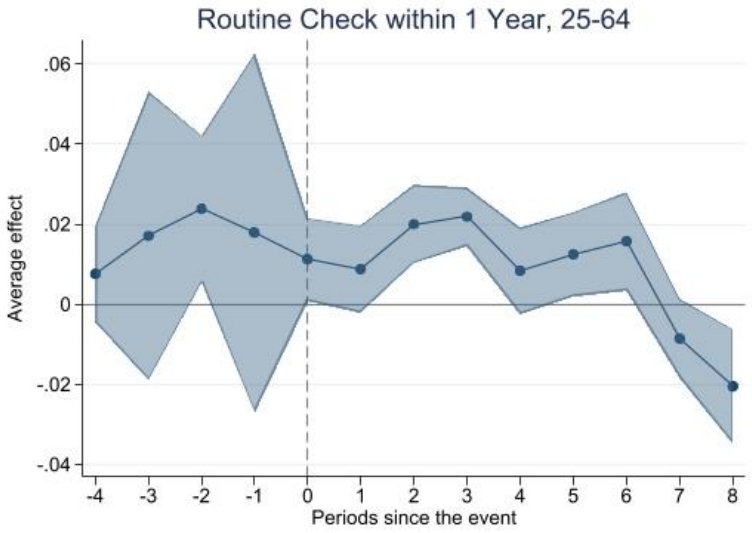
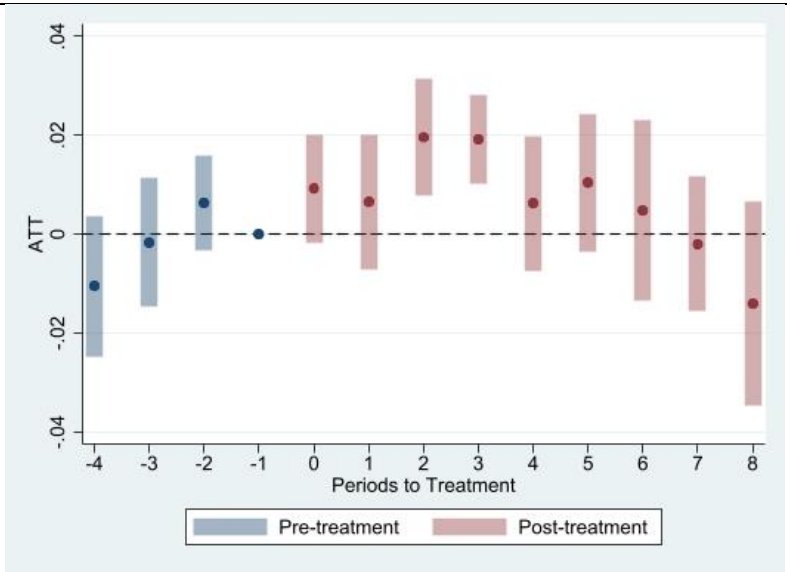
Borusyak et al. (2024)	Wooldridge (2021)
	
	

Figure 11 Continued





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

A.1 Derivation of Equation (7)

Given the production function, Equation (3), 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 Equation (8)

Given the profit maximization problem, Equation (4), the marginal revenue and marginal cost are:

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

$$MC = T_t w_t$$

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, $MR = MC$:

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

Solve for P, then:

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

A.3 Derivation of Equation (9)

Given the function of price of healthcare services, Equation (8), we can derive the derivative of the price with respect to the production of healthcare services:

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

A.4 Derivation of Equation (10)

Equation (7) shows that the quantity of healthcare services produced increases as more out-of-state physicians are employed. On the other hand, Equation (9) shows that the price of healthcare services decreases as more healthcare services are produced. Then, 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.5 Derivation of Equation (11)

Equation (8) shows that the price is a function of a wage of out-of-state physicians, number of out-of-state physicians, and the labor productivity. This can be re-written by solving for w_t:

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

Given the above equation, we can calculate the change in the wage of out-of-state physicians with respect to the price of healthcare services

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

Equation (10) shows that the price of healthcare services decreases as more out-of-state physicians are employed by the representative producer. Therefore,

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

A.6 Proof of Inequality (12)

Equation (6) shows that the utility of a representative consumer decreases when the price of healthcare services increases. Similarly, Equation (10) shows that the price of healthcare services decreases as more out-of-state physicians are employed by the representative producer. 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.7 Derivation and Proof of Inequality (13)

Equation (12) shows that the utility of a representative consumer increases when the number of out-of-state physicians 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 $n_t^2 > n_t^1 > 0$[7]. Equation (2) 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:

[7] 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.

$$n_t^2 - n_t^1 = n_t^1 e^{\frac{1}{\gamma}(1-\alpha)c_{relicense}}$$

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:

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

Appendix B. Comparison of Measures Between 2020 and 2021: Personal Doctor

	No ULR		ULR	
Year	Mean	SD	Mean	SD
2020	.802	.047	.782	.057
2021	.862	.039	.845	.043
Diff (2021-2020)	.060		.063	

Note: The above descriptive statistics show the proportion of respondents who have one or more personal doctors or healthcare providers in 2020 and 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."

Appendix C. Operationalization of Survey Questions, Behavioral Risk Factor Surveillance System (BRFSS)

Outcome Variable	Question from the Survey	Response Choices	Operationalization
Personal Doctor	[BRFSS 2018-2020] "Do you have one person you think of as your personal doctor or 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}
	[BRFSS 2021-2023] "Do you have one person (or group of doctors) that you think of as your personal health care provider?"		
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 within 1 Year	[BRFSS 2018-2023] "About how long has it been since you last visited a doctor for a routine checkup?"	1 – Within past year (anytime < 12 months ago) 2 – Within past 2 years (1 year but < 2 years ago) 3 – Within past 5 years (2 year but < 5 years ago) 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}

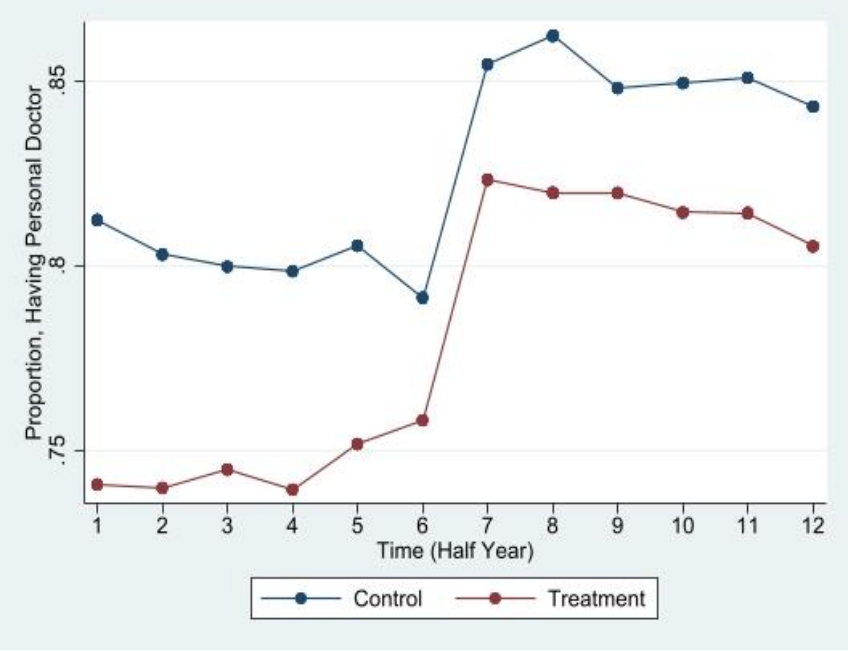
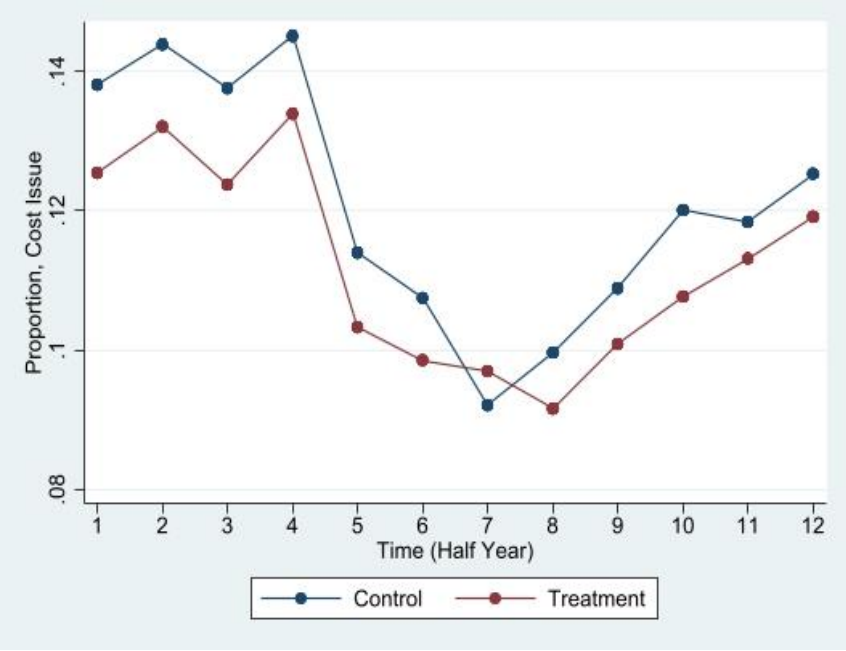
Note: BRFSS – Behavioral Risk Factor Surveillance System. There was a change in the wording of the survey question for "Personal Doctor" in 2021; therefore, we provide both question texts in this table.

Appendix D. Operationalization of Survey Questions, IPUMS-USA and IPUMS-CPS

Outcome Variable	Description	Response Choices	Operationalization
State of Residency	[Both IPUMS-USA and IPUMS-CPS] The state in which the household was located, using the Federal Information Professing Standards (FIPS) coding scheme.	FIPS Code (e.g. 01 – Alabama, 02 – Alaska, etc)	= FIPS Code if $1 \leq FIPS \leq 56$ where FIPS 1 = Alabama and FIPS 56 = Wyoming
Primary Place of Work	[IPUMS-USA only] The state in which the respondent's primary workplace was located. If the person worked abroad, this is also indicated.	FIPS Code (e.g. 01 – Alabama, 02 – Alaska, etc)	= FIPS Code if $1 \leq FIPS \leq 56$ where FIPS 1 = Alabama and FIPS 56 = Wyoming

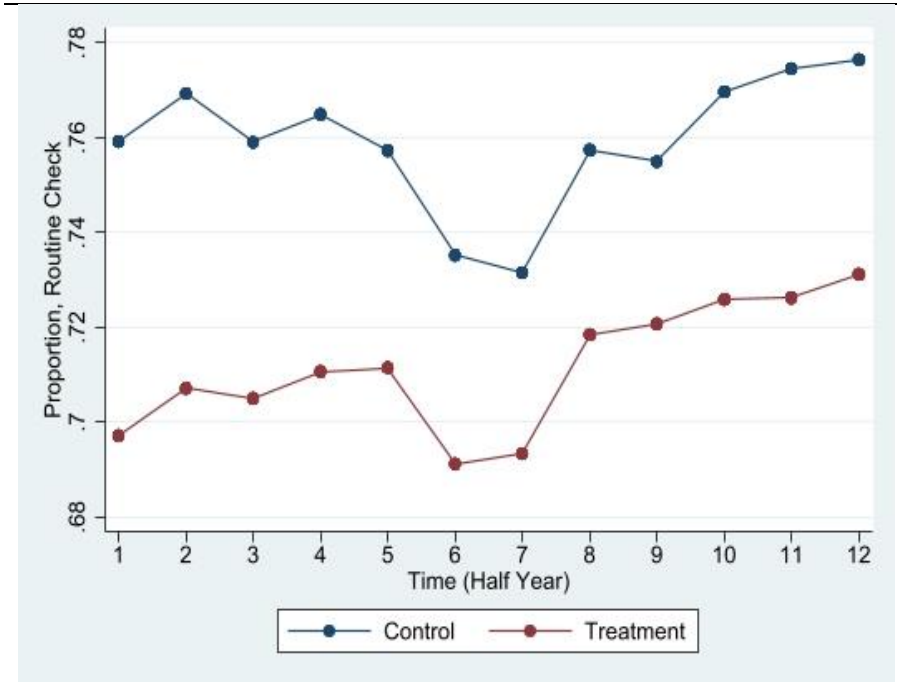
Note: IPUMS – Integrated Public Use Microdata Series; IPUMS-USA – American Community Survey integrated in IPUMS system; CPS – Current Population Survey.

Appendix E. Changes in Healthcare Utilization Measures Over Time

Having Personal Doctors or Healthcare Providers, 2018-2023	Could Not See a Doctor Because of Cost, 2018-2023
	

Appendix E Continued

Received Routine Health Checkups within a Year, 2018-2023



Note: The first treatment (i.e. adopting the ULR) was in Time 3 (first half of 2019). The wording for the question "having one or more personal doctors or healthcare providers" was changed in the BRFSS 2021, leading to the increase in the proportion of respondents with personal doctors or healthcare providers across all the states in the US. 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 the SHADAC's blog: https://www.shadac.org/topic/behavioral-risk-factor-surveillance-system-brfss-data?page=1

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

F.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.

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

Because the BRFSS does not provide the continuous measures of annual household income but the 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 A. 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)