Appalachian State University

Department of Economics Working Paper

Number 24-02| February 2024

Anti-Maintenance of Certification and Elderly Physician Supply

Shishir Shakya
Appalachian State University

Tulasiram Nepal
University of Memphis

Edward Timmons
West Virginia University

Department of Economics
Appalachian State University
Boone, NC 28608
Phone: (828) 262-2148
Fax: (828) 262-6105
www.business.appstate.edu/economics

Anti-Maintenance of Certification and Elderly Physician Supply

Shishir Shakya*
Tulasiram Nepal†
Edward Timmons‡

Abstract

The Maintenance of Certification (MOC) program of the American Board of Medical Specialties (ABMS) requires physicians to pass the MOC exam every ten years to maintain board certification. Proponents argue that MOC enhances patient care and physician competencies. Critics perceive it as an expensive, burdensome, and time-consuming recertification process that may lead to the departure of elderly physicians from the workforce. Notably, some states are adopting Anti-MOC laws. Our analysis, employing a generalized difference-in-difference method and event-study frameworks, demonstrates a statistically significant 3.5-6% increase in actively practicing physicians aged 60 and above in states implementing Anti-MOC laws, with no impact on physicians aged below 60. Our findings have implications for healthcare, offering the potential to improve access to quality care and tackle physician shortages in the United States.

Keywords: Scope of Practice, anti-Maintenance of certification, physicians
JEL Classification: J01, J08, J21, J44, J7, K30

*Shishir Shakya, Assistant Professor of Economics, Department of Economics, Walker College of Business, Appalachian State University, 416 Howard Street, Peacock Hall, Boone, NC 28608 Email: shakyas@appstate.edu

†Tulasiram Nepal, Ph.D. student at the Department of Economics, Fogelman College of Business and Economics, The University of Memphis, 3675 Central Ave, Memphis, TN Email: trnepal@memphis.edu

‡Edward Timmons, Service Associate Professor and Director of the Knee Regulatory Research Center, the John Chambers College of Business and Economics at West Virginia University. Senior Affiliated scholar with the Mercatus Center at George Mason University and a Senior Research fellow with the Archbridge institute.

1 Introduction

The Maintenance of Certification (MOC) program mandates physicians who achieved board certification after 1990 to either pass in-person exams every ten years or accrue MOC points through participation in the longitudinal knowledge assessment, confirming their ongoing safe and competent practice in their respective specialty. The MOC is mandatory for most medical specialty boards in the US and is a prerequisite for many physicians' licensure, hospital credentialing, and insurance reimbursement.

Proponents of MOC argue that MOC improves patient care, physician competencies, and patient satisfaction. However, physicians find MOC an endless recertification process that is expensive and time-consuming. Physicians and certain states have opposed the MOC and enactment of Anti-MOC laws due to perceived costliness, time consumption, and lack of evidence-based support. These Anti-MOC state laws typically impose limitations or restrictions on MOC requirements for physicians concerning state licensure, hospital affiliations, insurance reimbursement, and participation in preferred provider networks.

Within such an influx of debates among MOC and Anti-MOC proponent physicians, we argue that MOC introduces an unintended consequence. MOC, a time-consuming and endless recertification process, forces elderly physicians into early retirement, potentially restricting patients' access to physicians. Thus, we hypothesize that states implementing Anti-MOC laws exhibit a higher proportion of actively practicing elderly physicians than states with MOC requirements.

In this paper, we investigate how implementing Anti-MOC laws in states contributes to improving elderly physicians' workforce participation. We consider the quasi-experimental setting of six states, Texas, Georgia, North Carolina, Oklahoma, Tennessee, and Arkansas, implementing complete state prohibition of MOC or passing Anti-MOC laws between 2016-2018. We use the State Physician Workforce Data Report, a biennial publication by the Association of American Medical Colleges (AAMC), to retrieve state-specific data about active physicians and physicians in training to identify the proportion of physicians above and below 60. Based on this data and staggered adoption of Anti-MOC laws, we implement generalized difference-in-differences, Goodman-bacon Decomposition, and event study frameworks. We provide the first quantitative evidence that Anti-MOC laws implemented in states improve the percentage of elderly physicians who are 60+ in the workforce compared to states with MOC laws. Our evidence also indicates that states implementing Anti-MOC laws do not statistically differ in the proportion of physicians below 60 compared to states without such laws.

States implementing Anti-MOC laws enhance the percentage of physicians aged 60 and above in the workforce without affecting those below 60. Our finding is relevant to policy discussions, considering the ongoing physician shortage crisis in the United States, projecting a deficit of up to 124,000 physicians across all specialties by 2034. The strain on the healthcare system, exacerbated by factors such as the rising prevalence of chronic diseases and an aging population, can be mitigated by implementing Anti-MOC laws.

Section 2 provides details on the institutional background. Section 3 and 4 outline the data and methodology to examine our hypothesis that the Anti-MOC state has higher shares of actively practicing elderly physicians. Section 5 shows descriptive analytics, primary results, robustness checks, and falsification tests. Finally, Section 6 concludes our study.

2 Institutional background

Before 1990, medical specialty boards in the US would grant lifetime certification to physicians upon passing the initial board exam (Fisher and Schloss, 2016). While some specialties had introduced the recertification of physicians' specialties before 1990, it was voluntary. Several medical specialty boards initiated the mandatory term-limited certification for physicians in 1990. Physicians certified before 1990 were no longer required to participate in the continuous recertification process, and they are often referred to as

"Grandfathered" physicians.[1]

Although several medical specialties boards were implemented before 2000, the American Board of Medical Specialties (ABMS), a prominent certifying body for US medical doctors representing 24 medical specialty boards, decided to transition from providing lifetime certification to introducing term-limited certification across all boards in 2000 under the MOC program.[2] Unlike state licensure requirements, which establish legal prerequisites for practicing medicine, MOC is a voluntary process in which physicians have the freedom to participate, at least on paper, in the specialty board's requirement for recertification.[3]

ABMS claims that the MOC is committed to professionalism, lifelong learning, self-assessment, and measures of knowledge, judgment, and skills, emphasizing ongoing improvement in medical practice.[4] The program focuses on continuously assessing physicians' medical expertise and cognitive skills through four components: Licensure and Professional Standing, Lifelong Learning and Self-Assessment, Cognitive Expertise, and Practice Performance Assessment (Source), including six core competencies adopted by the Accreditation Council of Graduate Medical Education (ACGME). By adhering to these principles, specialty boards can conduct MOC examinations tailored to their specific requirements.

Although the MOC requirements set by the specialties board differ, most boards offer 10-year certification or continuous assessment to their physicians. Physicians are required to obtain recertification before their 10-year certificates expire. Under the MOC program, this recertification process mandates physicians to take 10 hours of in-person exams in the presence of a proctor in a designated test center and earn the necessary MOC points, which vary across the 24 specialties boards. For instance, to be certified by the American Board of Internal Medicine (ABIM), a physician must earn 100 MOC points every five

[1] https://shorturl.at/fhosE
[2] https://medicine.iu.edu/continuing-education/maintenance-of-certification/faq
[3] https://dlpgnf31z4a6s.cloudfront.net/media/40437/abms-moc-myths-facts.pdf
[4] https://shorturl.at/gpuH0

years and 200 MOC points every ten years.[5], Some boards conduct continuous assessment programs that allow physicians to accrue MOC points over time.

ABMS updated MOC requirements 2014 to include more frequent testing and practice improvement models. As proposed in the new requirement, most specialty boards have recently started offering the Longitudinal Knowledge Assessment (LKA) as an alternative to the 10-year MOC exam to make MOC more physician-friendly. LKA operates on a shorter 5-year cycle, during which physicians can accrue MOC points to retain their certification. The LKA test provides an alternative route to obtaining MOC certification without replacing the existing MOC exam.

For additional note, there are three major specialty certification organizations in the US: American Board of Medical Specialties (ABMS), the American Board of Physician Specialists (ABPS), and the American Osteopathic Association (AOA)-that offer specialty certifications to physicians. The ABMS and AOA also offer periodic certification to their physicians, but how they administer exams and certify physicians periodically varies with ABMS. However, all these boards serve the same purpose: certifying and recertifying physicians' specialties and their physicians to maintain their certification. Among these certifying bodies, approximately 71% of the total physicians (978,425) working in the United States participated in the continuation of the certification program of ABMS in 2022, which was about 60% of 868,952 in 2016.[6]

The MOC program is a controversial topic among physicians. MOC proponents argue that MOC improves patient care, physician competencies, and patient satisfaction. Holmboe et al. (2008) found that physicians who perform well on cognitive skills, measured through MOC examination, tend to provide better care to Medicare patients by following recommended procedures and guidelines. In their study, Chesluk et al. (2019) claimed that preparing for the MOC exam is beneficial for physicians as it helps them acquire knowledge in their respective fields, improving the quality of patient care. As

[5] https://www.abim.org/maintenance-of-certification/earning-points/

[6] https://www.abms.org/wp-content/uploads/2023/11/abms-board-certification-report-2022-2023.pdf

reported by Gray et al. (2014), the physicians required to participate in MOC saved an average of $167 per Medicare patient per year compared to physicians(Grandfathered) not needed to participate in MOC. Furthermore, the proponents argue that continuing medical education (CME) needs to be uniformly rigorous enough for physicians to routinely demonstrate their medical knowledge and cognitive competencies and see MOC as the only option moving forward.

However, the opponents of MOC argue that it is not associated with quality care and patient satisfaction. In their study, Cook et al. (2016) identified a tenuous connection between MOC and patient care. Some physicians think that the MOC requirement may lead to a possible decline in the supply of qualified doctors, forcing them into early retirement Christman (2013). They perceive MOC as an endless recertification process (Teirstein and Topol, 2015) that is expensive (Strasburger, 2011) and time-consuming (Kempen, 2013) and a source of burnout (Sawalha and Coit, 2019). They also question its relevance, stating that MOC focuses on testing rather than meaningful learning (Cook et al., 2016). Others are concerned that MOC enables the monopoly that the American Board of Medical Specialties (ABMS) has on the ability of physicians to practice medicine (Candeub, 2020).

In the wake of a growing debate, several states have enacted Anti-MOC laws to address long-held concerns among physicians regarding MOC. These Anti-MOC laws limit or restrict MOC requirements for physicians as a condition for state licensure, hospital employment and privileges, insurance reimbursement, and participation in preferred provider networks. Another rationale behind these Anti-MOC laws is that MOC requirements overlap with existing state-imposed continuing medical education (CME) requirements, making MOC redundant.

Since August 2023, fifteen states have enacted Anti-MOC laws (see Table 1). In six states(Arkansas, Georgia, Oklahoma, South Carolina, Tennessee, and Texas), these laws ban state licensing boards, insurance providers, and hospitals from making MOC mandatory to maintain specialty certification. The nine other states (Arizona, Kentucky, Maine, Maryland, Michigan, Missouri, North Dakota, South Carolina, and Washington) have introduced partial prohibitions, where state medical licensure boards no longer enforce any form of licensure maintenance as a requirement for physician licensure.

3 Data

The State Physician Workforce Data Report is a biennial publication by the Association of American Medical Colleges (AAMC) that provides state-specific data about active physicians and physicians in training.

The AAMC gathers information on active physicians through the American Medical Association (AMA) Physician Masterfile and the US Census Bureau. From 2007 to 2021, the AAMC has released eight biannual reports. Specific to a given year, these reports present data on active physicians in each state for the previous year. In this context, active physicians are defined by the AAMC as individuals licensed by states, actively engaged in work for a minimum of 20 hours per week, and holding either a Doctor of Medicine (MD) or a Doctor of Osteopathic Medicine (DO) degree.

4 Methods

4.1 Generalized difference-in-differences

To estimate the effect of Anti-MOC state laws on physician workforce participation, we use a generalized difference-in-differences framework with the following equation:

$$y_{st} = \delta D_{st} + \nu_s + \mu_t + \epsilon_{st} \tag{1}$$

Where s and t are state and time indexes. y_{st} is the dependent variable, which measures the proportion of active elderly physicians aged 60 and above. $D_{st} = treat \times post$ is the treatment indicator and equals 1 after state s has been exposed to the treatment (Anti-MOC) and equals 0 otherwise. δ is the average treatment effect. ν_s and μ_t are

Table 1: Staggered adoption of Anti-MOC

State	Year (state passed the bill)	Nature of the bill
Arkansas	2019	Full state prohibition
Texas	2018	Full state prohibition
Georgia	2017	Full state prohibition
North Carolina	2016	Full state prohibition
Oklahoma	2016	Full state prohibition
Tennessee	2016	Full state prohibition
North Dakota	2019	Partial state prohibition
Michigan	2018	Partial state prohibition
South Carolina	2018	Partial state prohibition
Washington	2018	Partial state prohibition
Maine	2017	Partial state prohibition
Maryland	2017	Partial state prohibition
Kentucky	2016	Partial state prohibition
Missouri	2016	Partial state prohibition
Arizona	2015	Partial state prohibition

Note: Table 1 shows the nature of Anti-MOC laws enacted. The 'Full state prohibition' refers to laws banning the state's licensing boards, insurance providers, and hospitals from making MOC mandatory. The 'Partial state prohibition refers to the state's laws, which only ban licensure maintenance as a requirement for physician licensure. The state's status on MOC and the nature of the law they enacted are collected from 'the Connecticut General Assembly Office of Legislative Research.'

additive individual state and year fixed-effects respectively. A significant negative value of δ suggests that the Anti-MOC reduces the proportion of the active physician workforce. However, a positive and significant δ shows that states with Anti-MOC have a higher proportion of active physician workforce than states that do not have Anti-MOC. We hypothesize for the proportion of active physician workforce aged 60 plus or elderly physicians as an outcome variable, the treatment effect δ is positive.

4.2 Goodman-bacon decomposition

Goodman-Bacon decomposition is a method used to understand the differences-in-differences estimator in two-way fixed effects models when treatment timing varies or staggered adoption of treatment. Table 1 shows staggered adoption of Anti-MOC state laws.

Goodman-Bacon decomposition decomposes the differences-in-differences estimator into a weighted average of all possible two-by-two difference-in-differences estimators: comparisons between (relatively) early adopters and later adopters over the periods when the later adopters are not yet treated; comparisons between early adopters and later adopters over the periods when the early adopters are treated – so that they can be used as a comparison group for the later adopters; comparisons between different timing groups (e.g., early adopters or later adopters) and the never-treated group, if there is one. Thus, these decompositions can help to identify the change in treatment effects over time. The differences-in-differences estimator is biased when treatment effects change over time within units.

4.3 Event study

We implemented an event study framework as follows.

$$y_{gt} = \sum_{l=-K}^{-2} \lambda_l D_{gt}^l + \sum_{l=0}^{L} \tau_l D_{gt}^l + \mu_s + \nu_t + \varepsilon_{gt} \tag{2}$$

The variable D_{gt}^l is a binary indicator set to 1 when the observation's periods relative to group g's initial treated period is the same as the value l; otherwise, it is set to 0 (and 0 for all never-treated groups). The parameters of interest are denoted as λ_l and τ_l.

It is important to note that the values of l associated with λ_l are negative, representing "lags" and indicating periods before implementing the Anti-MOC policy. Consequently, the estimates of λ capture the effect of the Anti-MOC policy before its implementation. According to the parallel trends assumption necessary for causal inference, where the average outcomes of treated and control units follow parallel paths in pre-treatment periods, the estimates of λ should be statistically zero.

On the other hand, the values of l linked to τ_l are zero or positive, signifying "leads" and indicating periods following the implementation of Anti-MOCs. Consequently, the estimates of τ_l capture the assessed impact of the Anti-MOCs at l periods post-implementation. The variable $-K$ represents the lowest number of lags, concluding at period $l = -2$, which aligns with pre-treatment periods in the observed sample. Variable L signifies the highest number of lags, commencing from $l = 0$, corresponding to post-treatment periods in the observed sample. One of the periods must be dropped to avoid perfect multicollinearity (as in most fixed-effects setups), and $l = -1$ is used as the dropped reference.[7]

5 Results

5.1 Descriptive analysis

We provide Figure A1 in the Appendix, which shows two panels. Panel (a) shows the number of active physicians within the US states in 2006, and Panel (b) exhibits the number of active physicians over 60 in 2006. Figure A1 correlates with population density in the US. Highly populous states have more active physicians.

We can consider Figure A1 with Figure A2 in the Appendix, where we index the numbers of active physicians in 2006 as 100 and generate the active physician growth index. Panel (a) shows the index for the growth of active physicians within the US states. For example, Utah's state index is 145, which means Utah's active physicians in 2006 grew from 4,962 to an additional 45% by 2020, which is the highest growth of physicians, followed by Texas, Colorado, and Nevada. However, despite the fact New York has one of the second highest numbers of physicians (see Figure A1, Panel (a)) in 2006, it grew only 14%, and New Jersey is the tenth highest number of active physician, it increased the least compared to all the US states.

Figure A2 panel (b) shows the index for the growth of active physicians over 60 years old within the US states, and it paints different dynamics. States like South Dakota, North Carolina, Minnesota, Georgia, Nebraska, Nevada, and South Carolina have doubled the number of active physicians over 60 by 2020 compared to 2006.

[7] https://lost-stats.github.io/Model_Estimation/Research_Design/event_study.html

5.2 Main results

Table 2 presents the estimates from naive ordinary least square methods in Columns (1)-(3). Table 2 also gives the estimates of a two-way fixed effect model or generalized difference-in-differences analysis in Columns (4)-(6) illustrating the average treatment effect of Anti-MOC laws on the proportion of actively practicing physicians aged 60 and above. The analysis utilizes biennial data from the State Physician Workforce Data Report, capturing information on actively practicing physicians in the US from 2006 to 2020.

Table 2: Impact of Anti-MOC on Physician Supplies

	Proportion of 60+ physicians					
	Naive OLS model			Two-way fixed effect model		
	Any Anti-MOC vs. MOC	Full Anti-MOC vs. MOC excludes partial MOC	Partial Anti-MOC vs. MOC	Any Anti-MOC vs. MOC	Full Anti-MOC vs. MOC excludes partial MOC	Partial Anti-MOC vs. MOC
	(1)	(2)	(3)	(4)	(5)	(6)
treat × post	0.053***	0.046**	0.054**	0.007*	0.010*	0.004
	(0.015)	(0.015)	(0.016)	(0.003)	(0.005)	(0.003)
Intercept	0.277***	0.279***	0.280***			
	(0.014)	(0.014)	(0.014)			
Fixed-effects						
state				Yes	Yes	Yes
year				Yes	Yes	Yes
Fit statistics						
Observations	408	336	360	408	336	360
R^2	0.060	0.024	0.043	0.950	0.948	0.948
Within R^2				0.013	0.015	0.004
Goodman-bacon decomposition						
Earlier vs Later Treated				0.01 [0.05]	0.02 [0.02]	0.24 [0.03]]
Later vs Earlier Treated				-0.00 [0.01]	-0.00 [0.00]	-0.12 [0.00]
Treated vs Untreated				0.01 [0.94]	0.01 [0.98]	0.43 [0.96]

*Notes: Clustered (state & year) standard-errors in parentheses. Signif. Codes: ***: 0.01, **: 0.05, *: 0.1. Goodman-Bacon (2021) decomposition average treatment effects are accompanied by respective weights in parenthesis '[ ].'*

In Table 2, Columns (1)-(3) display intercept values of 0.277, 0.279, and 0.280, respectively. These values imply that within states lacking Anti-MOC, approximately 27%-28%

of actively practicing physicians are aged 60 and above. However, in states with implemented Anti-MOC, an additional 4.6% to 5.4% of actively practicing physicians aged 60 and above, depending on the sample.

In Table 2, Column (4) illustrates that Anti-MOC laws increase the proportion of actively practicing physicians aged 60 and above by 0.7%. This estimate is statistically significant at the 10% level of significance. According to the decomposition method proposed by Goodman-Bacon (2021), the analysis primarily assigns weights to the "Treated vs. Untreated" category (approximately 94%). This result strongly suggests that the results in Table 2, Column (4), obtained from the generalized difference-in-differences or two-way fixed effect model, are primarily influenced by states that have implemented Anti-MOC laws as compared to those that have not. The observed bias appears minimal, around 1%, with the "Later vs. Earlier Treated" group contributing only a fraction of the weight to the coefficient of interest.

We reassess the generalized difference-in-differences, explicitly focusing on states that fully implemented Anti-MOC, excluding those with partial Anti-MOC, as presented in Table 2, Column (5). The results reveal a similar direction, albeit with more pronounced magnitudes of 1%. In Column (5), states with full Anti-MOC exhibit 1% more actively practicing physicians aged 60 and above than states with MOC. This estimate is statistically significant at the 10% level of significance. The decomposition analysis by Goodman-Bacon (2021) suggests that treatment heterogeneity is less likely to influence the treatment effect.

In Column (6) of Table 2, we present the results comparing the proportion of actively practicing physicians aged 60 and above in states with partial Anti-MOC to those without any types of Anti-MOC laws. Our findings indicate statistically insignificant changes in actively practicing physicians in states transitioning from partial Anti-MOC to full MOC implementation. The decomposition analysis by Goodman-Bacon (2021) suggests that the treatment effect is less likely to be influenced by treatment heterogeneities in this context.

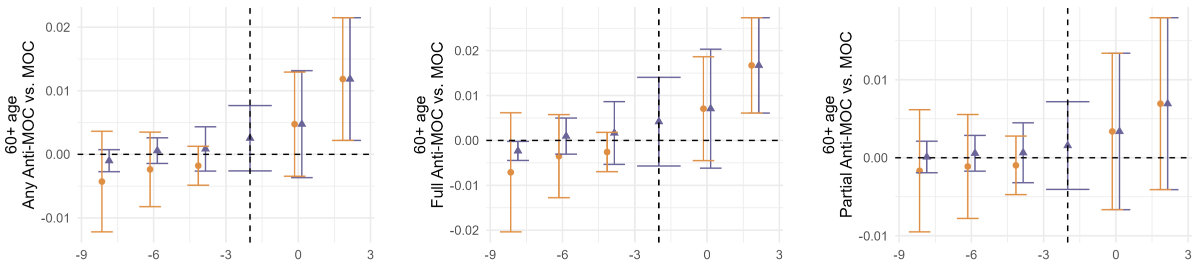
We must be cautious about interpreting the results that Anti-MOC laws increase the proportion of actively participating physicians aged 60 and above in the labor market because this proportion may be influenced by lower active participation of physicians aged 60 and below. In Appendix Table A1, we assess the plausibility of this threat by counting the numbers of actively participating physicians aged 60 and below using Poisson difference-in-differences with model specifications similar to that in Table 2 Columns (1)-(6). We find no statistically significant difference in the number of actively participating physicians aged 60 and below between states passing full or partial Anti-MOC laws and those without such laws. However, upon examining actively participating physicians aged 60 and above using Poisson difference-in-differences with model specifications, in Appendix Table A2, we find results that are similar and robust to the primary analysis presented in Table 2.

Considering the collective findings from Table 2, Appendix Table A1, and A2, we can infer that it is plausible for MOC requirements to compel elderly physicians to leave the labor market potentially. In other words, Anti-MOC laws may enhance the participation of physicians aged 60 and above in the labor market.

5.3 Event studies

We introduce event study frameworks developed by Gardner (2022) and Borusyak et al. (2021), which offer adjustments for treatment heterogeneity. These frameworks operate under the assumptions of parallel trends for all units, limited anticipation, and the correct specification of $Y(0)$, as outlined by Butts (2021). They provide a methodological approach to account for potential variations in the impact of the treatment over time and across units.

Figure 1: Event study



(a) Any Anti-MOC vs. MOC **(b)** Full Anti-MOC vs. MOC, exclude partial MOC **(c)** Partial Anti-MOC vs. MOC

Notes: ■ *Gardner (2021) and* ▲ *Borusyak, Jaravel, Spiess (2021).*

In Panel (a) of Figure 1, we present the dynamic average treatment effect using event study frameworks from Gardner (2022) (denoted by ■) and Borusyak et al. (2021) (denoted by ▲), along with their respective 95% confidence interval error-bar whiskers. This Panel illustrates a comparable pre-treatment trend (before the implementation of Anti-MOC laws) in the proportion of actively practicing physicians aged 60 and above. However, following the implementation of Anti-MOC laws in states, there has been a noticeable upward trend in the proportion of actively practicing physicians aged 60 and above.

In Panel (b) of Figure 1, a substantial effect is evident among actively practicing physicians aged 60 and above in Anti-MOC states compared to MOC states while excluding partial Anti-MOC implementing states. Conversely, in Panel (c), no statistical changes are observed when comparing practicing physicians aged 60 and above from states implementing partial Anti-MOC with states with MOC laws.

Considering the overall findings from Table 2 (Columns 1-3) and Figure 1 (Panels a-c), we can infer that MOC requirements may prompt elderly physicians to exit the labor market. In other words, Anti-MOC laws may contribute to the increased participation of physicians aged 60 and above in the labor market.

Table 3: Impact of Anti-MOC on physician supplies, GLM with binomial link

	Proportion of 60+ physicians by age group		
	Any Anti-MOC vs. MOC (1)	Full Anti-MOC vs. MOC excludes partial MOC (2)	Partial Anti-MOC vs. MOC (3)
Variables			
did	0.034^{**}	0.057^{**}	0.019
	(0.016)	(0.025)	(0.015)
Fixed-effects			
state	Yes	Yes	Yes
year	Yes	Yes	Yes
Fit statistics			
Observations	408	336	360
Squared Correlation	0.951	0.948	0.949
Pseudo R^2	0.443	0.443	0.441
BIC	624.0	512.6	551.3

*Notes: Clustered (state & year) standard-errors in parentheses. Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

5.4 Generalized linear model (GLM)

The dependent variable, representing the proportion of physicians aged 60 and above, takes values between 0 and 1. However, the linear model presented in Table 2 Columns (4)-(6) provides a general direction but lacks meaningful interpretation in the context of proportions. To address this, we employ a Generalized Linear Model (GLM) with a binomial distribution and an appropriate link function, presenting the refined results in Table 3.

In Column (1) of Table 3, we observe that Anti-MOC laws lead to a statistically significant increase in the proportion of actively practicing physicians aged 60 and above, amounting to approximately 3.5% ($exp^{0.034} - 1$), significant at the 5% level. Moreover, when focusing exclusively on fully implemented Anti-MOC states (excluding partial implementations), Column (2) reveals a more substantial increase of approximately 6%

($exp^{0.057} - 1$), also significant at the 5% level.

Interestingly, excluding fully implemented Anti-MOC and comparing partial Anti-MOC states with the remaining states in Column (3) shows no significant changes in the proportion of actively practicing physicians aged 60. These findings suggest that full Anti-MOC implementation yields more substantial impacts than partial implementations.

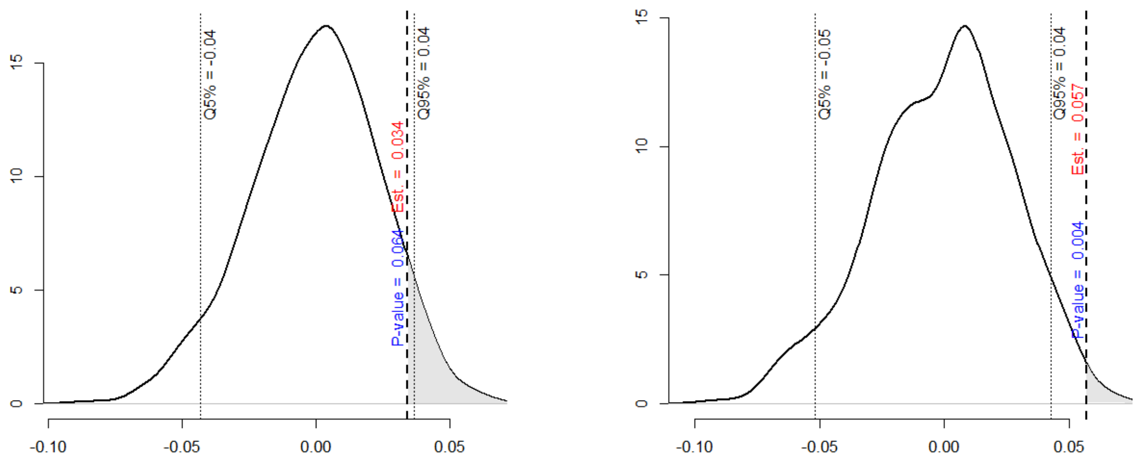
5.5 Randomized treatment effects

We simulate a randomized treatment effect by iteratively assigning states to implement Anti-MOC over 1000 iterations. The goal is to estimate the impact of randomly assigned Anti-MOC on the proportion of actively practicing physicians aged 60 and above. The results of these 1000 iterations are visualized in Figure 2, with Panel (a) representing the overall impact and Panel (b) focusing exclusively on fully implemented Anti-MOC states (excluding partial implementations). The 95% confidence intervals are depicted with loosely dotted lines in both panels.

In Figure 2 Panel (a), we incorporate the treatment effect from Table 3, Column (1), represented by a dotted line. This line falls within the 95% confidence interval of the randomized treatment effect, suggesting that it is statistically plausible that Anti-MOC may not lead to significant changes in the proportion of actively practicing physicians aged 60 and above. This observation raises the possibility of additional mediating relationships at play.

In Figure 2 Panel (b), we incorporate the treatment effect from Table 3, Column (2), represented by a dotted line. Interestingly, this line also falls within the 95% confidence interval of the randomized treatment effect, indicating that full Anti-MOC implementation yields more substantial impacts than partial implementations and is statistically significant. This finding reinforces the importance of considering the full implementation of Anti-MOC laws when assessing their impact on the proportion of actively practicing physicians aged 60 and above.

Figure 2: Randomized treatment effect



(a) Any Anti-MOC vs. MOC

(b) Full Anti-MOC vs. MOC, excludes partial MOC

Notes: Randomized treatment effects were obtained by randomly assigning a state implementing Anti-MOC over 1000 iterations. The 95% confidence interval in both panels is depicted with a loosely dotted line. A solid line represents the reported effect in Table 3 Column (1) and (2), respectively.

6 Discussion and Conclusion

Before 1990, board certification conferred a lifelong designation. However, after 1990, boards initiated the issuance of time-limited certificates. A physician grandfathered under the preceding system, having acquired certification in 1989, enjoyed a perpetual certification. In contrast, a slightly younger counterpart who completed the same training in 1990 faced expiration after ten years. The lack of supporting evidence raises questions about the rationale behind this dual-tier system, particularly considering that numerous board executives declined participation in their own MOC programs, at least until compelled to do so to retain their lucrative positions (Jane M. Orient, 2015).

Utilizing data from the State Physician Workforce Data Report, biennially published by the Association of American Medical Colleges (AAMC), our analysis reveals that Anti-MOC laws lead to a statistically significant improvement in the proportion of actively practicing physicians aged 60 and above by 3.5%. The physician supply, excluding states with partial Anti-MOC laws, has experienced a rise of about 6% after the introduction of Anti-MOC laws.

Given that many physicians perceive MOC as a time-consuming, costly, and irrelevant requirement in their medical practice (Stephenson et al., 2018), the realization that MOC poses a significant obstacle becomes particularly pertinent for those with 30 years or more in their profession, approaching the latter stages of their careers. This realization makes it highly probable that the Anti-MOC laws catalyze elderly physicians to remain in active medical practice.

The study has been conducted using biennial data with the age distribution of active physicians, and the dataset does not include the sex, race, and other background characteristics of these physicians. Consequently, the study may need help to identify disparities in the effects of these laws on different groups of physicians, and the analysis might need a comprehensive understanding of how these laws impact healthcare professionals with varying backgrounds and identities. One caveat of this study is that if the MOC exam is not that difficult, regarding the questions being asked, time, and resources required for physicians, the impact of Anti-MOC laws on the supply of elderly physicians is less likely. To our knowledge, there is no systematic study out there to measure the degree of difficulty of the MOC exam.

Several surveys on physicians provide hints that can indirectly measure how demanding the MOC exams are. A study conducted with 515 US physicians by MDlink shows that about 89% of physicians have to allocate at least a month to more than six months to prepare for the 10-year MOC exam. About 65% reported that the exam has no clinical value, meaning it does not associate with what physicians practice day-to-day.[8] In a survey conducted with 515 rheumatologists in the US Sawalha and Coit (2019) found that approximately 77.7% of survey participants perceive the requirement of MOC may lead to physician burnout and around 67.4% anticipate early physician retirement as a consequence of MOC; additionally, 63.9% foresee a potential reduction in the overall number

[8] https://www.mdlinx.com/article/physician-survey-the-clinical-value-and-future-of-moc/lfc-2818

of practicing rheumatologists, indicating apprehensions about the impact of MOC on the workforce in the field of rheumatology.

The favorable effect of Anti-MOC laws in retaining experienced physicians holds significant implications for the broader healthcare system. These laws could enhance access to quality care for patients across all age groups and medical requirements, ensuring the presence of a skilled and seasoned workforce. The results indicate that eliminating MOC requirements may address physician shortages in the United States. Exploring how Anti-MOC laws influence health outcomes, care quality, and costs by increasing the supply of elderly doctors presents intriguing avenues for future research.

Declaration

During the preparation of this work, the author(s) used ChatGPT, Bing, and Grammarly in order to improve language and readability. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

References

Borusyak, K., Jaravel, X., and Spiess, J. (2021). Revisiting event study designs: Robust and efficient estimation. *arXiv preprint arXiv:2108.12419*.

Butts, K. (2021). *did2s: Two-Stage Difference-in-Differences Following Gardne(2021)*.

Candeub, A. (2020). The american board of medical specialties: Certification and the need for antitrust enforcement. *Available at SSRN 3584793*.

Chesluk, B., Gray, B., Eden, A., Hansen, E., Lynn, L., and Peterson, L. (2019). "that was pretty powerful": a qualitative study of what physicians learn when preparing for their maintenance-of-certification exams. *Journal of General Internal Medicine*, 34:1790–1796.

Christman, K. D. (2013). Maintenance of certification (moc): The elite's agenda for medicine. *JPANDS*, 18:84–7.

Cook, D. A., Blachman, M. J., West, C. P., and Wittich, C. M. (2016). Physician attitudes about maintenance of certification: A cross-specialty national survey. *Mayo Clinic Proceedings*, 91(10):1336–1345.

Fisher, W. G. and Schloss, E. J. (2016). Medical specialty certification in the united states—a false idol? *Journal of Interventional Cardiac Electrophysiology*, 47:37–43.

Gardner, J. (2022). Two-stage differences in differences. *arXiv preprint arXiv:2207.05943*.

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

Gray, B. M., Vandergrift, J. L., Johnston, M. M., Reschovsky, J. D., Lynn, L. A., Holmboe, E. S., McCullough, J. S., and Lipner, R. S. (2014). Association between imposition of a maintenance of certification requirement and ambulatory care–sensitive hospitalizations and health care costs. *Jama*, 312(22):2348–2357.

Holmboe, E. S., Wang, Y., Meehan, T. P., Tate, J. P., Ho, S.-Y., Starkey, K. S., and Lipner, R. S. (2008). Association Between Maintenance of Certification Examination Scores and Quality of Care for Medicare Beneficiaries. *Archives of Internal Medicine*, 168(13):1396–1403.

Jane M. Orient, M. (2015). Testimony of aaps for sb 1257 and scr 1003 (anti-moc, anti-compact). Addressed to Arizona Senate Committee on Health and Human Services. https://www.azaaps.org/testimony-of-aaps-for-sb-1257-and-scr-1003-anti-moc-anti-compact/.

Kempen, P. M. (2013). Maintenance of certification–important and to whom?

Sawalha, A. H. and Coit, P. (2019). Evaluating the perception among rheumatologists of maintenance of board certification in the us. *Arthritis care & research*, 71(3):337–342.

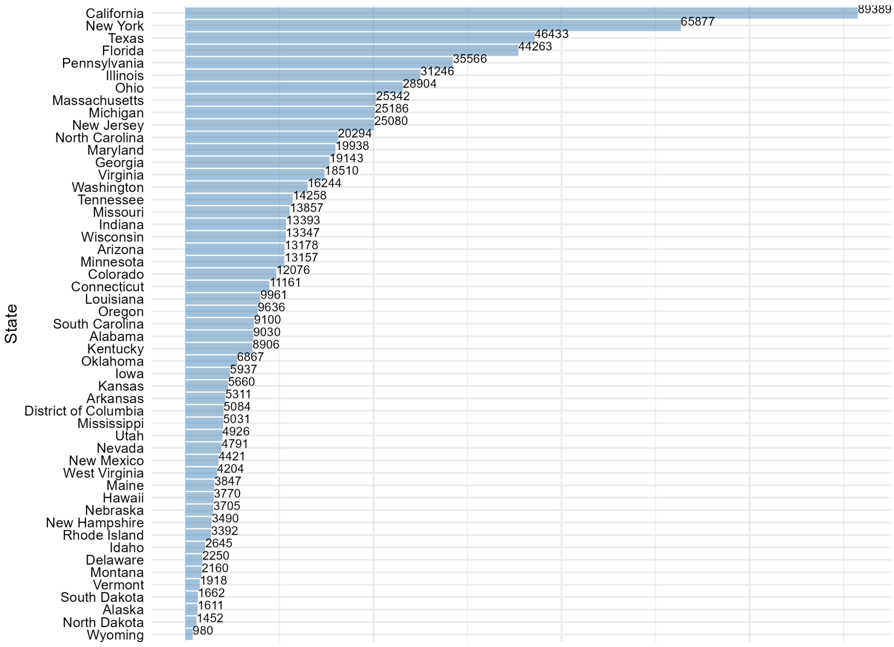
Stephenson, C. R., Wittich, C. M., Pacyna, J. E., Wynia, M. K., Hasan, O., and Tilburt, J. C. (2018). Primary care physicians' perceptions of practice improvement as a professional responsibility: a cross-sectional study. *Medical education online*, 23(1):1474700.

Strasburger, V. C. (2011). Ain't misbehavin': is it possible to criticize maintenance of certification (moc)? *Clinical Pediatrics*, 50(7):587–590.

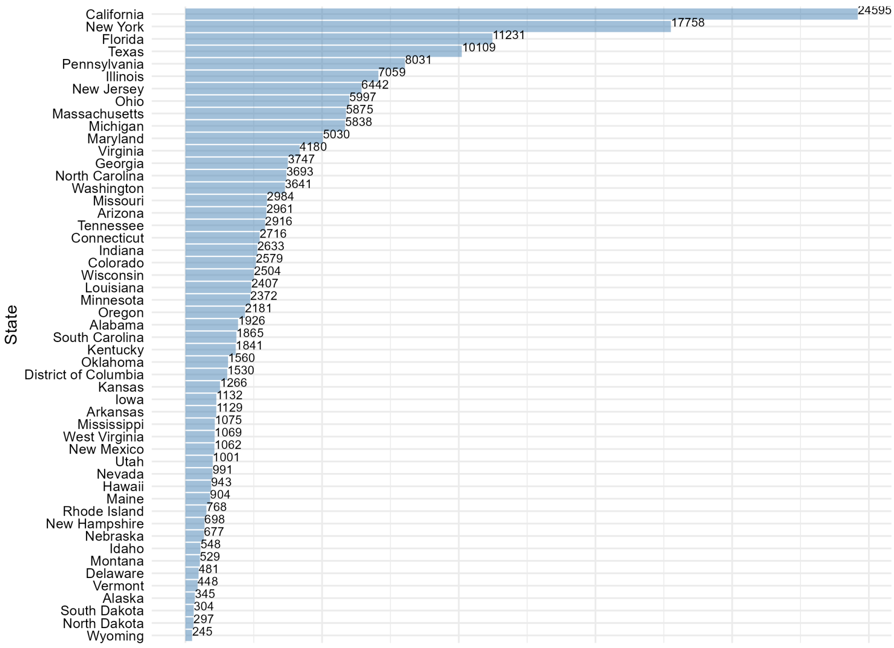
Teirstein, P. S. and Topol, E. J. (2015). The role of maintenance of certification programs in governance and professionalism. *Jama*, 313(18):1809–1810.

A Appendix A

Figure A1: Total numbers of active physicians, 2006

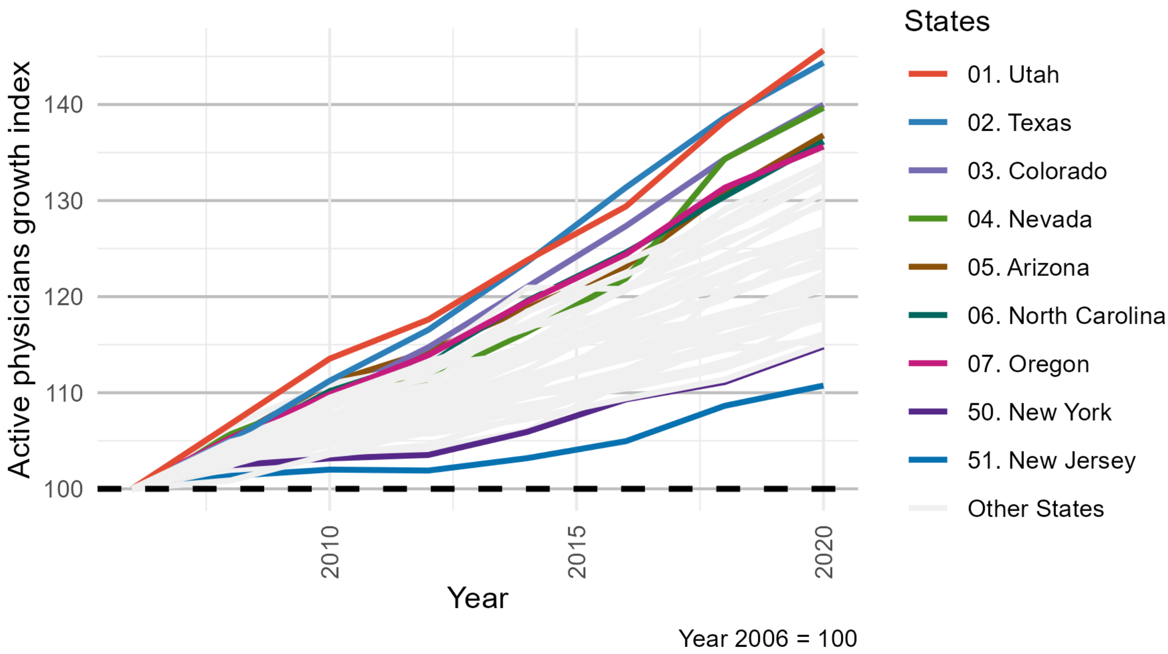


(a) Total numbers of active physicians, 2006

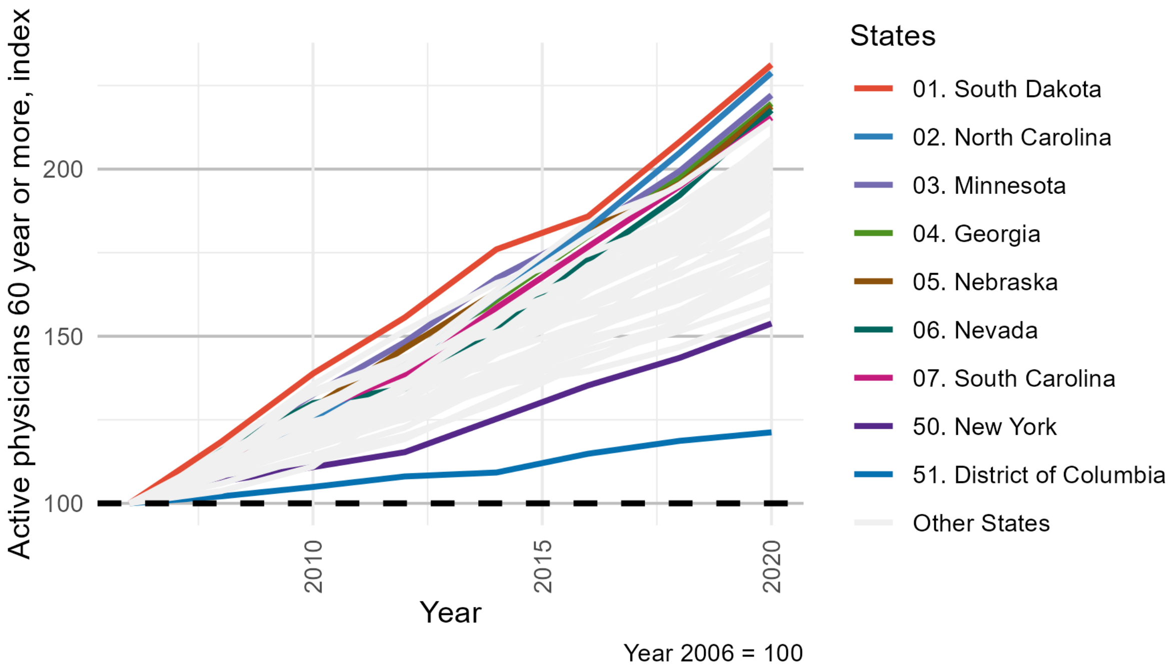


(b) Total numbers of active physicians, age 60+, 2006

Figure A2: Growth index of actively practicing physicians, 2006



(a) Growth index, active physicians, 2006-2020



(b) Growth index, active physicians, age 60+, 2006-2020

Table A1: Impact of Anti-Maintenance of Certification on Physician Supplies, age less than 60

	Number of physicians, age less than 60					
	Naive OLS model			Two-way fixed effect model		
	Any Anti-MOC vs. MOC	Full Anti-MOC vs. MOC excludes partial MOC	Partial Anti-MOC vs. MOC	Any Anti-MOC vs. MOC	Full Anti-MOC vs. MOC excludes partial MOC	Partial Anti-MOC vs. MOC
	(1)	(2)	(3)	(4)	(5)	(6)
treat × *post*	0.154	0.349	-0.010	0.019	0.035	0.005
	(0.148)	(0.235)	(0.170)	(0.016)	(0.026)	(0.012)
Intercept	9.36^{***}	9.39^{***}	9.32^{***}			
	(0.162)	(0.184)	(0.179)			
Fixed-effects						
state				Yes	Yes	Yes
year				Yes	Yes	Yes
Fit statistics						
Observations	408	336	360	408	336	360
Squared Correlation	0.001	0.003	0.001	0.998	0.998	0.999
Pseudo R^2	0.001	0.003	0.001	0.998	0.998	0.998

*Notes: Clustered (state & year) standard-errors in parentheses. Signif. Codes: ***: 0.01, **: 0.05, *: 0.1. Goodman-Bacon (2021) decomposition average treatment effects are accompanied by respective weights in parenthesis '[ ].'*

Table A2: Impact of Anti-Maintenance of Certification on Physician Supplies, age 60 and more

	Number of physicians, age 60 and more					
	Naive OLS model			Two-way fixed effect model		
	Any Anti-MOC vs. MOC	Full Anti-MOC vs. MOC excludes partial MOC	Partial Anti-MOC vs. MOC	Any Anti-MOC vs. MOC	Full Anti-MOC vs. MOC excludes partial MOC	Partial Anti-MOC vs. MOC
	(1)	(2)	(3)	(4)	(5)	(6)
treat × post	0.324	0.470^{*}	0.178	0.053^{**}	0.083^{***}	0.024
	(0.198)	(0.265)	(0.209)	(0.022)	(0.028)	(0.020)
Intercept	8.44^{***}	8.48^{***}	8.43^{***}			
	(0.193)	(0.214)	(0.210)			
Fixed-effects						
state				Yes	Yes	Yes
year				Yes	Yes	Yes
Fit statistics						
Observations	408	336	360	408	336	360
Squared Correlation	0.004	0.005	0.001	0.998	0.998	0.998
Pseudo R^2	0.005	0.006	0.001	0.997	0.997	0.997

*Notes: Clustered (state & year) standard-errors in parentheses. Signif. Codes: ***: 0.01, **: 0.05, *: 0.1. Goodman-Bacon (2021) decomposition average treatment effects are accompanied by respective weights in parenthesis '[ ].'*