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Analyzing the Influence of Occupational Licensing Duration and Grandfathering on Labor Market Outcomes*

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Abstract

The length of time from the implementation of an occupational licensing statute (i.e., licensing duration) may matter in influencing labor market outcomes. Adding to or raising the entry barriers are likely easier once an occupation is established and has gained influence in a political jurisdiction. States often enact grandfather clauses and ratchet up requirements that protect existing workers and increase entry costs to new entrants. We analyze the labor market influence of the duration of occupational licensing statutes for 13 major state universally licensed occupations over a 75-year period. These occupations comprise the vast majority of workers in these regulated occupations in the United States. We provide among the first estimates of potential economic rents to grandfathering. We find that duration years of occupational licensure are positively associated with wages for continuing and grandfathered workers. The estimates show a modest negative relationship of duration with hours worked, and we find moderately negative results for participation in the labor market. We also find less labor-market churning into and out of these licensed occupations. The occupations, however, exhibit heterogeneity in outcomes. Consequently, unlike some other labor market public policies, such as minimum wages or direct unemployment insurance benefits, occupational licensing would likely influence labor market outcomes when measured over a longer period of time.

Introduction

Occupational licensure is the legal process by which governments (mostly the U.S. states but also local governments and the federal government) identify the qualifications that are required to practice a trade or profession, after which time only licensed practitioners are allowed by law to receive pay for doing the work in the occupation. This form of labor market regulation has rapidly become one of the most significant institutional factors affecting labor markets in the United States and other industrialized countries (Kleiner, 2015). Over the past several decades, the share of U.S. workers holding an occupational license has grown sharply. For example, during the 2012–2013 state legislative sessions, at least seven new occupations were licensed in at least one state—occupations ranging from scrap metal recyclers in Louisiana to body artists in the District of Columbia.[1] U.S. government estimates suggest that over 1,100 occupations are regulated to some extent in at least one state, but fewer than 60 are licensed in all 50 states, showing substantial differences in which occupations states choose to regulate (Department of the Treasury Office of Economic Policy, Council of Economic Advisers, and Department of Labor, 2015).

The time from the implementation of occupational licensing laws may be important in analyzing regulation's influence on the labor market. One rationale is that states often enact grandfather clauses that protect existing workers by allowing them to practice either when licensing laws are passed or after the enactment of new regulations, even though they may not meet the current requirements. In contrast, new entrants must have higher entry standards than the existing members of the occupation.[2] We, therefore, anticipate that individuals who are

[1] These data are from a LexisNexis search of statutes passed during the legislative session.

[2] A model of grandfathering presented by Shavell (2007) assumes that if the best standard in period 1 exceeds the level of risk that would be appropriate for the expected harm, grandfathering may be desirable. If in period 2 the known harm is below a threshold, grandfathering is optimal—parties who engaged in the activity in period 1 can

grandfathered would have incentives to encourage licensing and their continued participation in the occupation at pre-licensing levels of education and training. They would likely obtain economic rents by limiting supply and increasing the demand for the higher quality service.[3] In the labor market, the process of older, lesser trained workers leaving the workforce or moving to other occupations and newer workers with higher entry requirements entering the field takes many years or even decades as the process works its way through the labor market, resulting in potentially higher wages. Finally, we provide among the first estimates of the labor market returns to grandfathering. Further, we also provide among the first estimates of how occupational licensing may reduce movement into and out of occupations, or what is often called labor market churning (Davis and Haltiwanger, 2014). We examine these issues of duration over a 75-year period to determine the influence of occupational licensing on key labor market outcomes.

In examining the influence of occupational licensing duration on the labor market, we initially review the literature of duration effects on labor market outcomes and show that our study is the first comprehensive examination of the issue using more than one occupation and implements a substantially longer time period of analysis. More important, we also present evidence that goes beyond analyzing wage determination to examine hours worked entry and exit from occupations, and participation in the regulated occupation for large numbers of workers. Consistent with other findings, we show that occupational licensing raises wages in the regulated occupations and that the duration of state licenses is also associated with higher wages. We find this to be the case across a number of robustness tests, and it is also the case for grandfathered workers. In addition, the estimates show that the duration of state licensing is associated with an

maintain their period 1 level of risk in period 2, but parties who enter the activity in period 2 should take the new conventionally optimal precaution for the known harm, and they have certainty of the outcome in the second period.

[3] Another source of rents also may be schools that chose to teach classes that are required for licensing attainment, courses for continuing education requirements, or exam preparation classes (Kleiner, 2015).

insignificant change in yearly hours worked by those in the occupation, but movement into and out of the occupations we examine are smaller than for never licensed occupations and that participation in the occupation in the labor market also largely shows an insignificant influence after the licensing laws are implemented. However, the labor market outcomes for the occupations we examine exhibit heterogeneity. We implement several sensitivity tests to examine the robustness of our estimates for labor market outcomes. These results are largely consistent with a monopoly model of regulation that shows gains to those in the regulated occupation through higher wages, but which may limit entrants, yet reduce outflows from an occupation over a longer time period.

Reviewing Duration in the Labor Market for Licensed Occupations

The duration of occupational statutes has been identified in previous studies as a factor that may raise wages (Law and Marks, 2009, Timmons and Thorton, 2013). In both studies, the authors examined one occupation and focused on wage determination. Our study expands on these studies by examining 13 universally licensed occupations (i.e., licensed in all states), some of which have been regulated in all states for over 100 years and others that became universally licensed in all U.S. during the past decade. The number of workers in these occupations represents about 60 percent of all universally licensed workers in the United States in 2013 from our estimates using the American Community Survey (ACS). These occupations were chosen because the date of initial licensure was available, there were sufficient observations in the census for statistical analysis, and that the vast majority of workers must obtain a license in order to work (Gittleman and Kleiner, 2016). Also, the states that licensed these occupations regulated them at different times, allowing for a difference-in-differences estimation strategy.

The Growth and Wage Effects of Occupational Licensing

Occupational licensing has grown to be one of the largest institutions in the U.S. labor market (Kleiner and Krueger, 2013). To illustrate, funeral attendants are licensed in nine states and florists in only one state. Estimates from national surveys find that the wages of unlicensed workers are 8 to 15 percent lower than those of licensed workers with similar levels of education, training, and experience (Kleiner, 2006, Kleiner and Krueger, 2013, Kleiner and Volotnikov, 2017, Gittleman, Klee, and Kleiner, 2018). At the upper end, Kleiner and Krueger (2013) find that licensing at the state level confers a wage premium of around 17 percent, and the combination of state and either federal or local licensing has an estimated impact of around 25 percent. Local licenses by themselves are not associated with higher wages, and certification has a smaller effect on wages using estimates from data from the Survey of Income and Program Participation (Gittleman, Klee, and Kleiner, 2018).

Unlike the minimum wage or unemployment insurance which requires all employers that are covered by the law to pay the new wage or transfer payment immediately, occupational licensing allows individuals who are working in the occupation, but do not meet the current licensing requirements, to continue working. This practice is called "grandfathering." In addition, the regulated occupation generally has the ability to ratchet up the requirements—that is, raise the requirements for initial entry or movement into the occupation from other political jurisdictions with minimal constraints from policy makers (Wheelan, 1999). Again, individuals who do not meet the current requirements are allowed to keep working with permission from the government. Further, occupations that are licensed may make it more difficult to enter work in the profession, and they may have fewer incentives to leave. In our analysis, we examine how time from initial licensure, which we call duration, influences key labor market outcomes such as wages, hours worked, and churning.

The Role of Different Institutions on Wage Determination and Labor Market Outcomes

A helpful analogy of the influence of institutions in the labor market can be drawn from unions. When unions first organize a firm or establishment, the wage increases are generally small (Freeman and Kleiner, 1990, DiNardo and Lee, 2004, Lee and Mas, 2012). However, cross-sectional estimates of the impact of unions are between 15 to 20 percent (Hirsch and Macpherson, 2013). The additional cost of having a union worker is approximately $40,500 over the course of that worker's employment with the firm (Lee and Mas, 2012). Moreover, unions appear to raise the wages and benefits with a statistically significant effect the longer they are in an establishment (Freeman and Kleiner, 1990). We examine whether wage growth may also be the case for occupational licensing.

Unions may raise wages through collective bargaining and withholding their labor services through concerted activities to gain wages and benefits. On the other hand, occupational licensing could raise wages by choosing the right set of regulations to restrict supply and limit the tasks of unlicensed workers, and thus enhance demand by signaling and education that they are providing a higher quality service (Friedman, 1962, Spence, 1973). In a manner similar to unions, the institutional mechanism and design that occupational licensing uses also takes time to implement and the full effects may only reach fruition over several decades of strengthening these rules (Hurwicz, 1973).

Background on Grandfathering and Ratcheting Requirements

Initially, the influence of licensing duration on labor market outcomes was identified in a National Bureau of Economic Research volume published in 1945 by Milton Friedman and Simon Kuznets (Friedman and Kuznets, 1945). They noted that in 1911, the American Medical Association, through the implementation of the Flexner Report, ratcheted up requirements for

becoming a doctor through tougher admissions requirements, length of education in medical school, and limits on the number of new openings for medical education (Beck, 2004). While increasing the requirements for graduation from medical school and pushing for tougher licensing, the Flexner Report did not require currently working doctors to meet the same higher requirements; this was a classic case of grandfathering (Beck, 2004). Friedman and Kuznets went on to examine the influence of the regulations more than 20 years later in the late 1930s, and they found that doctors were able to raise their wages by 17 percent more than dentists, who did not substantially change their requirements. This example illustrates how an occupation can raise wages that involved rents to those who were in the occupation and how entry requirements for an occupation were raised for just new entrants.

More recent estimates of the influence of the length of licensing statutes on wage determination include results for massage therapists, nurses, lawyers, and barbers (Law and Marks, 2009, Pagliero, 2010, Timmons and Thornton, 2010, Timmons and Thornton, 2013). The main results suggest that for specific occupations such as massage therapists and barbers, the length of time that a licensing statute has been in place enhances the earnings of these practitioners, but little evidence of the influence of duration was found for nurses (Law and Marks, 2013). However, the estimates are limited to these occupations over a relatively short time period. Our estimates expand upon and provide evidence beyond simply the wage determination effects of licensing duration on labor market outcomes.

Although not explicitly addressed, the process occurs by allowing current practitioners to avoid the explicit general and specific education requirements, internships, tests, continuing education mandates, and good moral character investigations if they were in good standing prior to the new licensing laws. To the extent that these requirements raise marginal productivity, they

may also raise wages. Also, it takes many years for the individuals who did not meet these requirements to leave the occupation or retire, and as a result, the educational quality of the new entrants is higher, and they dominate the current members of the occupation only after a substantial period of time. Moreover, the longer the occupation is licensed, the greater the ability of the members of the occupation to lobby the legislature and licensing boards to ratchet up requirements for entry within the occupation for those who might enter from unregulated states or occupations. For example, accountants increased the years of university schooling from four to five years in the 1990s in order to attain a Certified Public Accountant (CPA) license (Carpenter and Stephenson, 2006). In addition, physical therapists raised their education requirements from a bachelor's degree in the 1990s to a doctor of physical therapy license by 2016 through 2018 and occupational therapists are moving to impose similar requirements (Cai and Kleiner, 2016). In both cases, the national professional association promoted these enhanced or ratcheted-up requirements through the state boards of licensing or the state legislature. Although the policies may have enhanced the educational quality of the new workers, they could have also reduced access to the occupation by practitioners and consumers and limited the supply of labor to the occupation.

The Rationale for Grandfathering and Ratcheting

In the labor market, the process of older, lesser trained workers leaving the workforce or moving to other occupations and newer workers with higher entry requirements entering the field takes many years or decades as the process works its way through the labor market, resulting in potentially higher wages.[4] In addition, occupations could also ratchet up the requirements for

[4] An illustration of the process over three periods is shown in Appendix Figure 1. The figure shows the evolution of grandfathered participants over time and how they diminish by leaving the occupation, through occupational mobility, retirement, or death. By the end of the period, only individuals who have gone through the licensing process are in the occupation. However, the process may limit the supply of labor in the long run by increasing entry

already licensed occupations. Therefore, licensing duration—the time from the implementation of occupational licensing legislation—may matter. It may take years for the full effects of occupational licensing to be realized in the labor market, and for the analyst to observe these changes on wages, hours, and employment. A similar effect of regulation would occur when the occupation ratchets up the requirements for entry, such as the increases in education that occurred in accounting and physical therapy. This would likely result in both reduced movement to the occupation and a reluctance of workers to leave the occupation if wages were now higher.

A further implication of the role of time for occupational licensing is that it captures the work of unregulated workers and tasks as exemplified in the *North Carolina State Board of Dental Examiners v. Federal Trade Commission* Supreme Court case (2015). Moreover, legal cases involving the Institute for Justice challenged cosmetologists capturing the work of hair braiding for their occupation. In addition, veterinarians have tried to legally capture the work of farmhands who do teeth filing for horses, suggesting that only trained veterinarians can do these tasks for farm animals. In all of these cases, the number of hours provided in the regulated occupations would grow as unlicensed workers declined and as the tasks were legally mandated by regulated workers, as presented in our theory overview.

The Empirical Model

We gathered statutory information for each occupation by year for each state that passed a licensure law from several different legal data sources. In order to calculate the duration of licensure for all states, we used a couple of different resources. Our major source of data used a Council of State Governments (1952) report to obtain information by year for each state listing

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and mobility requirements and may allow those licensed in the occupation to gain economic benefits by limiting employment growth.

their first licensing legislation for the major universally licensed occupations in our analysis. From this source alone, we were able to obtain 60 percent of the required statutory data for the thirteen universally licensed occupations. We also used the LexisNexis legal resource database to obtain the remaining statutory information.[5] Since teacher licensing statutes and date of initial licensure have been particularly difficult to obtain we developed an improved data set shown in Appendix Table 14, which also lists the statute that licensed teachers in that state by year.

In order to develop a model with a sufficient time line to analyze how duration may influence labor market outcomes, we use all available data from the census and the American Community Survey (ACS) for a 75-year time period from 1940 to 2015 (Meyer and Osborne, 2005). We begin with 1940 since that was the first year wage data was added to the census. We include in our sample individuals who worked in 13 major universally licensed occupations that had more than 152 million workers over time, and which represented more than 10 percent of the U.S. workforce and about 60 percent of all individuals in universally licensed occupations. The sample includes both blue and white-collar occupations and ones that are high, middle, and low income. We limit the analysis to those 13 universally licensed occupations that have sufficient number of state and year observations in the census and were licensed in all states by 2015, the end of our period of analysis. Since there are some differences in the method of data collection from the Census in earlier periods, we use only the ACS from 2001 through 2015 for some of our specifications.

[5] For the additional remaining information on attorneys for 19 states, we contacted the Supreme Court library and Board of Examiners. We managed to obtain responses for 7 states: Arkansas, Delaware, Illinois, Indiana, Maryland, Michigan, and Minnesota. We replaced the average duration with missing values on attorneys for 12 states: Connecticut, Georgia, Missouri, Montana, Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, South Carolina, Utah, and West Virginia, and we denoted with dummy variables in our statistical analysis for completeness (Little and Rubin, 1987).

Figure 1 presents a timeline of state licensures for all 13 occupations we analyze. The sample includes individuals who were either in one of the major universally licensed occupations when it became regulated or in one of the unlicensed occupations during the period. Our analysis is limited because we can only include individuals who are covered by licensing statutes, but some may not have attained a license (Gittleman and Kleiner, 2016). Also, we cannot cover the same individuals over their careers as we can with smaller data sets such as the National Longitudinal Survey of Youth (NLSY). However, we define the appropriate treatment groups and use varied control groups as described in Table 1. We first define individuals who worked in 13 major licensed occupations as a treatment group, and unlicensed individuals in the 13 major licensed occupations prior to the state passing licensing statutes as the control group. As a robustness checks, we compare each universally licensed occupation (or a group of related licensed occupations) to all other occupations within the same two-digit Standard Occupational Classification (SOC) 2000 that were never licensed during our period of study. We also use a propensity matched set of individuals who were in never licensed occupations.

Next, we include standard human capital variables from the census and for more recent years from the ACS, such as gender, age, education, marital status, and potential experience. In order to generate a reliable sample for our analysis, we dropped those individuals whose education is "below 12th grade without a diploma" for dentists, lawyers, accountants, and pharmacists. Also, we dropped those individual whose education level was "below high school diploma" for nurses. For barbers, we screened for those with at most a high school diploma. In

addition, individuals older than 65 or younger than 23 and those with years of potential experience below zero were also deleted.[6]

In addition, hourly real earnings were determined by dividing the annual earnings including profits and dividends from work, by annual hours worked, adjusted by the 2014 consumer price index (CPI). Annual hours worked were calculated by multiplying the usual working hours by the number of weeks for the past 12 months. We restrict our sample to full-time workers by eliminating those individuals who worked less than 30 hours a week and less than 48 weeks a year. We also estimated the model with individuals who worked part time in Appendix Table 15. In addition to these restrictions, the original sample was trimmed by excluding individuals with real hourly wages below the federal minimum wage level in that year and real hourly wages above $450. The resulting sample consists of 840 million observations from 1940 to 2015 using the census and the ACS sample.[7] In Table 2 we show the means and standard deviations of the individuals in the 13 universally licensed occupations with different licensure statute conditions, and individuals in never licensed occupations[8] in our sample with wage data normalized by the 2014 CPI.[9] In addition, we show in Table 3 descriptive statistics for each licensed and unlicensed worker in the occupations that changed their licensing status during the period of our analysis.

[6]We also used individuals with graduate school education for dentists, lawyers, and physicians, and the results were similar. These estimates are available from the authors.

[7] We show the number of observations by year in Appendix Table 1.

[8] We manually determine whether each occupation was ever licensed by verifying licensing status through the variable occ1990. For the 1940 census data which lacks the occ1990 variable, we made a crosswalk between occ1990 and occ1950. Data are weighted using population weights.

[9] As more descriptive information about the data, Appendix Table 2 shows the summary statistics of hourly wages and duration in licensed occupations split by year and regulation status. In addition, we show in Appendix Table 4 descriptive statistics for workers in the universally licensed occupations split by median duration. Appendix Table 3 shows the number of observations split by median duration and year. In Appendix Table 5 we also include summary statistics of hourly wages and duration in licensed occupations split by median duration and year.

Empirically Modeling Duration Effects

In order to empirically model the influence of occupational licensing on wage determination, hours worked, and participation in the labor market, we use a basic difference-in-differences approach. Since states implemented their licensing statutes at different times, we are able to develop an estimate of causal inference for the influence of duration on labor market outcomes. We would expect the relationship to initially move slowly as newer licensed workers enter and fewer grandfathered workers continue to work in the occupation. When grandfathered workers retire or leave the occupation, wages would likely increase more rapidly. Furthermore, wages would likely increase when workers' representatives are more fully in control of the supply of labor by ratcheting up requirements.

To causally link occupational licensing and labor market outcomes, we employ a difference-in-differences (DID) strategy using data on changes to state licensing laws for the 13 universally licensed occupations in our sample. Such changes affect the ability of individuals to work in a licensed occupation in a particular state without needing to fulfill additional regulatory requirements. For estimation purposes, our model takes the following form:

$$Y_{ist} = \alpha + \boldsymbol{\delta} Duration_{ist} + X_{it}\beta + \tau_k + \eta_s + \theta_t + \varepsilon_{ist} \qquad (3)$$

where Y_{ist} is the measure of log hourly wage or annual hours worked of individual *i* in state *s* in census year t. $Duration_{ist}$ is duration of the initial occupational licensing statute. We use two definitions of this key variable to estimate linear and nonlinear duration effects: 1) years from the start of state occupational licensing statute,[10] 2) the eight dummies for duration to examine the nonlinear duration effect: 0-3 years, 4-10 years, 11-20 years, 21-30 years, 31-40 years, 41-50

[10] Since we allow for a one-year lag to ensure the licensing statute was already enacted by the time observation is measured, and both earnings and hours data are based on the previous calendar year, years from the start of state occupational licensing statute are calculated as follows:

$$Duration_{ist} = (\text{Year of the } Data_{it} - 1) - (\text{Year when licensing statute enacted}_{ist} + 1)$$

years, 51-100 years, and greater than or equal to 101 years. For example, the duration dummy for 11-20 equals 1, and the remaining duration dummies equal 0 for individuals in occupations that were licensed for 14 years in 2015. The variable X_{it} represents individual characteristics (years of education, gender, race, potential experience, potential experience squared, and marital status), τ_k represents the three-digit 2010 Standard Occupational Classification (SOC) fixed effects, or a dummy for each universally licensed occupation, η_s includes state fixed effects, and θ_t includes year fixed effects. The variable of interest in this regression is δ(s), the coefficient(s) on the licensing duration variable. We can interpret δ as the DID estimate(s) of the effect of occupational duration on log hourly wage or annual hours worked relative to workers in the same universally licensed occupation prior to states passing licensing statutes:

$$Y_{ist} = \alpha + \boldsymbol{\delta} Duration_{ist} + X_{it}\beta + \tau_k + \eta_s + \theta_t + \varepsilon_{ist} \quad (4)$$

As an additional sensitivity check, we perform a variation of the analysis with a different method of associating control groups. For each universally licensed occupation (or a group of related licensed occupations), we consider our control group to be all other occupations within the same two-digit Standard Occupational Classification (SOC) 2000 that were never licensed during our period of study. In other words, we estimate the model in equation (4) while holding industry constant. As in our previous analysis, δ is the DID estimate of the licensing duration effect, but this time represents the effect on wage and hours worked of the universally licensed occupations relative to that of never licensed occupations within the same two-digit SOC. All other variables have the same definitions as in equation (3).

$$Y_{ost} = \alpha + \boldsymbol{\delta} Duration_{ost} + X_{it}\beta + \gamma Income_{st} + \tau_k + \eta_s + \alpha_t + \varepsilon_{ost} \quad (5)$$

In equation (5) we show our model of licensed worker participation. The variable Y_{ost} is the ratio of the number of workers in universally licensed occupation o in state s in year t over the number of workers in never licensed occupations in the service sector in state s in year t. $Income_{st}$ is per capita mean income in state s in year t. The other variables have the same definitions as in equation (3). We use the DID model by exploiting changes in state licensing laws and requirements over time in each of the tables presented in the rest of the paper.

Our sources of identification are the changers in states that adopted occupational licensing laws over time relative to the non-adopters, individuals who were licensed in the same occupation in comparison to those who did not achieve licensure coverage, and any individual who was licensed relative to those who were not licensed. In order to focus only on changers during the period of analysis, we develop separate estimates for occupations that were licensed during the period 1940–2015. In order to focus on changers in licensing, we also examine by discrete time periods the influence of becoming a licensed occupation on the participation rate in the occupation (Law and Marks, 2013). However, we also present estimates of all 13 occupations in our sample, many of which were initially regulated prior to 1940.[11] Moreover, since we do not assume a linear relationship between licensing adoption and its labor market effects, we present nonlinear estimates in our tables.

In Table 4 we show the influence of duration on wages using clustered standard errors at the state-occupation level. We show both linear and nonlinear specifications in the table. In addition, we show in panel A estimates using all 13 universally licensed occupations in our sample[12]. In panel B, we show estimates for only those occupations that changed their licensing

[11] Occupation codes for barbers and cosmetologists are first identified in 1960, and therefore we include barbers and cosmetologists after 1960 in our sample.

[12] As a further robustness and sensitivity checks, in Appendix Table 13 we include an analysis without the teachers because 35% of universally licensed workers are teachers. We find the robust and consistent results without teachers.

status over the period of our analysis. In columns (4) and (6), we show the influence of the duration on wage determination with a dummy for each universally licensed occupation as a benchmark for our other specifications. The overall influence of occupational licensing is between 4 and 9 percent. The estimates in column (6) in panel B show that wage increases by 5 percent in 4 through 10 years after adoption, and then increases gradually to almost 20 percent for those individuals in occupations that have been licensed for more than 100 years. In column (4), the estimates suggest that for every 10 years that an occupation is licensed, wages increase by a statistically significant 2 percent. Moreover, in column (2), we see that becoming licensed raises earnings by almost 7 percent within our 75-year period of analysis. The estimates are at the lower range of estimates in much of the empirical literature on the effects of licensing on wage determination (Kleiner and Krueger, 2010, Kleiner and Krueger, 2013, Gittleman, Klee and Kleiner, 2018). Our estimates across various specifications and groups of occupations show relatively small differences in wage effects over time across specifications between older regulated occupations and more recently licensed occupations.

As an additional sensitivity and robustness check, in Table 5 we present the licensing duration effects on hourly wage of the universally licensed occupations relative to that of never licensed occupations within the same two-digit SOC. The estimates in Table 5 show that the licensing duration effect varies considerably across the occupational category. For example, the estimates for the health occupations show positive 8 percent effects of licensing on wage determination, with the influence increasing with duration. Similarly, the influence is positive and significant for accountants, and barbers and cosmetologists. However, there are negative effects for architects and teachers. For architects, there may be two potential reasons for the negative influence of regulation. First, although architects are covered by licensing statutes in all

50 states, fewer than half attain a license which reduces the ability to restrict overall supply (Hur et.al.2018). Second, architects have wide variance in earnings, which is largely reputation-based and often national where state licensing has a negative influence. For teachers one potential explanation is the risk aversion of teachers relative to their peers which may help explain their low wages relative to their unregulated comparison group (Lang and Pacalios, 2018). As a robustness test of our estimates across various specifications or groups of occupations, we found considerable heterogeneity across a number of occupations based in part on the controls groups.

In Table 6 we present estimates of the influence of duration of occupational licensing on hours worked per year using clustered standard errors at the state-occupation level. We expect that if an occupation is able to restrict entry and the demand for services in the occupation is constant or rising, then will the incumbent workers change their hours of work? If the income effect is greater than the substitution effect, then as wages grow through occupational licensing, we would expect that these workers will have an incentive to work less hours.

Using a similar approach shown in Table 4, in Table 6 we begin by estimating the influence of duration with a dummy for individuals who are in each universally licensed occupation and linear and nonlinear relationships[13] using duration and duration squared on hours worked per year. We show estimates in the two panels for all 13 universally licensed occupations and separately, for the 7 universally licensed occupations for which some states changed their regulation status over our period of analysis. We find varying effects across different groups and specifications.

In panel A, we show estimates using all 13 universally licensed occupations in our sample. In column (8), we find state licensing is associated with a statistically nonlinear decrease

[13] For analysis for hours worked per year, we include an additional specification with the quadratic duration terms- duration and duration squared- to investigate the nonlinear relationship.

in yearly hours worked throughout the period of analysis. We also find in column (2) that becoming licensed is associated with a statistically significant decrease of about 58 hours worked per year relative to hours worked per year of unlicensed workers in 13 universally licensed occupations.

In panel B, we show the influence of becoming licensed using the occupations that changed regulation status during the period of analysis. In column (2) of panel B, the statistically significant estimates of decreasing the hours worked due to becoming licensed is 63 hours per year for those who were licensed more recently relative to hours worked per year of unlicensed workers in the recently licensed occupations prior to their state passing licensing statutes. Also, the estimates in columns (6) and (8) show the nonlinear duration effects on hours worked per year, suggesting consistent results relative to those in panel A.[14] The resulting decrease in hours worked per year could be due to the income effect of wage increases dominating the substitution effect for the occupations evaluated in our sample. Again, we show the influence of becoming licensed using the occupations that were regulated during the period of analysis and those who were licensed during earlier periods.

Using a similar approach shown in Table 5, we present in Table 7 the licensing duration effects on hours worked per year of the universally licensed occupations relative to that of never licensed occupations within the same two-digit SOC. The estimates in Table 7 show considerable variability across the occupational category.

As a further test of the strength of our findings, we also utilized the coarsened exact matching method in Iacus et al. (2012) with a DID methodology to remove the selection bias caused by endogenous selection into the occupations. Specifically, we performed coarsened

[14] As an additional robustness check, we implemented a two-stage procedure that uses the state as the unit of observation rather than individual characteristics (Hanushek, 1974; Amemiya, 1978; Conley and Taber, 2011). These results are available from the authors.

exact matching on potential experience and marital status, and exact matching on race and gender. We found that the results are robust and consistent with those presented in Tables 4 and 6.[15] These estimates are shown in Appendix Table 10.

To further examine the influence of occupational licensing in the labor market, we also provide basic approximations of the potential rents that occupational licensing provides to individuals who are grandfathered to show the potential incentives for these individuals to promote this type of regulation. To develop these estimates, we use those individuals whose expected tenure in an occupation occurred during the period that the occupation initially became licensed. To illustrate, if an occupational therapist had 10 years of experience and licensing occurred after she had been in the occupation for 5 years, then that person would be considered grandfathered. In this example, individuals with tenure less than 5 years would be considered to have entered the occupation after licensing and would be a new entrant who started after the initial regulation of the occupation. In Table 8, we show descriptive statistics for grandfathered workers and find that about 3 percent of individuals in the 13 universally licensed occupations are grandfathered over the period we examine in our analysis.

In Tables 9 and 10, we show the DID estimates of influence of grandfathering on labor market outcomes. We again show the influence of grandfathering using the occupations that were regulated during the period of analysis, and those who were licensed during earlier periods. The results in Table 9 show that individuals who are grandfathered gained 0.2 percent per year in earnings, and their overall earnings are about between 4 and 6 percent higher than their unlicensed control groups. Table 10 shows that the grandfathering effects on hours worked per year are not statistically significant relative to their unlicensed control group. We also find that

[15] Difference in differences estimates combined with Coarsened Exact Matching are shown in Appendix Table 10 and we find consistent nonlinear duration effects on hourly wage and hours worked per year. In addition, the detailed matching summaries are shown in Appendix Tables 8 and 9.

duration is positively and nonlinearly associated with hourly wage. On the other hand, duration is statistically insignificant and nonlinearly associated with hours worked per year.[16]

In Table 11 we show the earnings effect of grandfathering relative to new entrants into the occupation. In columns (1) and (2), we use ACS data from 2001 to 2015 to provide analysis of grandfathered workers in occupations in states that recently enacted licensing statutes. In this case, new entrants make about 8.2 percent more than grandfathered workers. However, using Oaxaca decomposition analysis, human capital differences widen the wage gap to 10.8 percent because new entrants require substantially higher human capital to obtain occupational licensure (Oaxaca, 1973). But we also find that the unexplained portion—or the potential rents to grandfathered workers—is able to explain about almost 2.6 percent in the wage gap in favor of grandfathered workers. Therefore, occupational licensing offers potential rents to individuals who are grandfathered into occupational licensing relative to unlicensed workers or new licensed entrants with similar observable covariates.

To the extent that an increase in hours worked could reflect a reduction in the number of practitioners, we next turn our attention to Table 12, which focuses on labor market participation of licensed workers. Perhaps one of the most speculated about yet little researched areas of occupational licensing is the role of this regulated institution on the labor supply of regulated practitioners (Law and Marks, 2013). In Table 12 we estimate the influence of the duration of an occupational license statute on labor market participation in universally licensed occupations,

[16] As a further robustness check, we employ the coarsened exact matching method in Iacus et al. (2012) with a DID methodology in order to solve the common support problem and the selection bias problem. The matching methodology pairs each grandfathered worker with an unlicensed worker in the comparison group based on pre-treatment characteristics, so that the comparison group of workers have similar pre-treatment characteristics as the grandfathered workers with whom they are paired. Specifically, we perform coarsened exact matching on education, experience, and marital status, and perform exact matching on race and gender. The results of these estimates are shown in Appendix Table 11.

using different methods of categorizing the occupations in our sample. Unlike our previous analysis, we now include in our sample all individuals in the labor force in order to determine whether licensing affected participation in universally licensed occupations relative to all other occupations. Our estimates in Table 12 shows that licensing is associated with a decrease in the labor market participation of the universally licensed occupations relative to that of never licensed occupations in columns 1 and 2, but when state and year fixed effects are introduced the influence is insignificant. The results in columns 7 and 8 show that there is a decline in participation in the regulated occupations, but when state and year fixed effects are introduced the results for duration go to zero. These estimates are inconclusive on the influence of licensing on entrance into the workforce.

Any DID-type strategy relies on the assumption that treatment and control groups do not follow differential trends over time. In order to provide a further robustness check on the estimates shown in Tables 4, in Figure 2, we check this assumption by including leads and lags of adoption of licensing legislation. Specifically, we add a lead indicator variable for each 3-year interval starting from 15 years before adoption. Similarly for the lags, we add indicator variables for 3-year intervals starting from the year of adoption up to year 32, and an indicator variable for year 33 onward. Of these 16 indicator variables, we note that the first 15 are equal to one only in the respective 3-year interval, while the final variable is equal to one in each year starting with the 33rd year after adoption.

Figure 2 plot estimated licensing effects on hourly wage by including the leads and lags of adoption of licensing legislation. In panel A, we estimate the licensing effects of individuals in the 13 universally licensed occupations relative to the labor market outcome of unlicensed workers in the universally licensed occupations prior to states passing licensing statutes at yearly

intervals in the fifteen years prior through the more than 30 years following the adoption of a licensing requirement. Using an approach similar to that in panel A, panel B shows the licensing effects of licensed individuals in universally occupations that changed regulation status over the period relative to the hourly wage of unlicensed workers in the 7 universally licensed occupations prior to states passing licensing statutes. Figure 2 suggest that the parallel trend assumption is accepted and therefore occupational licensing does affect hourly wage.[17]

To further test the endogeneity in our estimates with the likelihood of passage of laws, we also examine if the laws were passed in states with the greater number of grandfathered workers. We find that the number of grandfathered workers is not associated with the passage of the law, which suggests that the number of grandfathered workers is not a source of bias. These results suggest there is little to no evidence of endogeneity in our estimates with the likelihood of passage of laws[18].

Occupations can have different market and institutional reasons for varying wage effects. For example, dentists usually control the dental licensing boards that determine job requirements for their occupation and auxiliary occupations such as hygienists and assistants. Other occupations such as occupational therapists are under the control of or are dominated by boards of physical therapy and are less able to restrict entry into their occupation. Moreover, physicians have long been licensed and have considerable market power as well as the advantage of having convinced the public and lawmakers of the potential adverse consequences of missed diagnoses and public health effects. In this way, they are able to limit entry and obtain long-run economic

[17] Each point estimate in Figure 2 is shown in Appendix Table12. For hours worked per year, the leads are significant suggesting the difference in difference approach did not meet the assumption of parallel trends prior to the implementation of licensing.

[18] We estimate a hazard model of time to the passage of licensing legislation and find that the number of grandfathered workers is not associated with the passage of the law. These results are available from the authors.

benefits (Ketel, et al., 2016). In Figures 3 and 4 we show estimates for a wide variety of occupations using the various control groups, each of which may have experienced different economic and institutional environments on the road to becoming licensed. In each figure, panel A represents heterogeneous licensure effects over different occupations, and panel B represents average duration effects for each occupation.[19] Considered together, Figures 3 and 4 suggest that the effects are varies by occupation.[20] Specifically, physicians have much higher wages and more hours worked as a consequence of occupational licensing.

In Figures 6 and 7, we show how the churn of licensed workers will be affected by occupational licensing. Our rational is that the existing workers in an occupation leave slowly if the wage rate elevated after licensing legislation. This implies that the churn of workers in a specific occupation is closely related to the licensing effects for that specific occupation. The churn of workers will vary by occupations due to heterogeneous licensure effects over different occupations.

Initially we estimate a "switching-in" regression and "switching-out" regression to show the pattern of the ordinary churn of workers in each universally licensed occupation. We estimate the likelihood of switching into each universally licensed occupation and the likelihood of switching out of each universally licensed occupation using the Current Population Survey

[19] Tables for each occupation are available from the authors.

[20] We would expect that occupations that have been licensed longer and have more members would have more political clout through their ability to fund and lobby the licensing boards and legislature for more favorable treatment. From the occupation's perspective, the ability to limit entry requirements through ratcheting up requirements would influence the supply side. On the demand side the ability to capture the work of either unlicensed workers or through scope of practice rules and regulations, of the work of more recently licensed workers, could raise wages. For example, doctors who have been licensed longer can limit the tasks of more newly licensed occupations such as physical therapists or nurse practitioners. In Appendix Table 16, We order the occupations based on the average length of time the occupation has been licensed.

(CPS).[21] Specifically, we regress an indicator of switchers on an indicator of each universally licensed occupation, income, duration, sex, marital status and year fixed effects. In Figures 5 and 6, we plotted the wage effects and the churn of workers for each occupation to see any pattern between churn of workers and licensing wage effects. We find that churn of workers varies by different occupation. In addition, for all the licensed occupations in our sample, except cosmetologists, they have lower movement into and out of the occupation relative to their unlicensed counterparts. Specifically, physicians which are the most highly paid job have both the fewest new entrants and the fewest leavers.

Our results suggest that occupational licensing works slowly over time as older, less skilled workers retire or move to other occupations and the state boards or legislatures that regulate the professions ratchet up the requirements for entry. Our ability to begin to document these changes shows how important labor market institutions work with deliberate speed to enhance the work and pay arrangements for their members but reduce entry and exit from the regulated occupations, in contrast to policies such as the minimum wage or changes in unemployment insurance policies, whose influence is more immediate (Kleiner, 2015).

Conclusions

Since the implementation of new occupational licensing statutes takes time to fully carry out, duration of occupational statutes should matter in influencing labor market outcomes. For example, states often enact grandfather clauses that allow continuing practitioners to continue working without meeting the new requirements, or they ratchet up the requirements for entry, such as education and reciprocity agreements with other states or nations, that protect existing workers. One implication is that new entrants must have higher regulatory standards than those

[21] We use the monthly Current Population Survey (CPS) data from 1989 to 2018 and track changes in occupations using the Outgoing Rotation Group.

already in the occupation. The process of older, less educated workers leaving and newer workers with higher entry requirements entering the occupation takes time to work its way through the labor market. Our analysis uses a model in which licensed practitioners influence the number and kinds of jobs that they and unregulated workers can do over the long run. We use data for 13 large, diverse licensed occupations covering a 75-year period to examine the labor market effects of initial licensure. Consistent with a theory of regulation, our results show that grandfathered workers' wages rise relative to unlicensed individuals' wages in our two control groups. Moreover, there are incentives for incumbents in the occupation to raise standards because they can get higher wages. Workers are less likely to enter and leave the occupations in our sample. Our study should allow policy analysts and policy makers to develop and implement more informed decisions on the long-run implications of the rapidly growing labor market institution of occupational licensing.

References

Amemiya, Takeshi. 1978. A note on a random coefficients model. *International Economic Review*, 19(3), 793–796.

Beck, Andrew. 2004. The Flexner Report and the standardization of American medical education. *Journal of the American Medical Association*, 29(17), 2139–2140.

Cai, Jing, and Morris M. Kleiner. 2016. The labor market consequences of regulating similar occupations: The licensing of occupational and physical therapists. Upjohn Institute for Employment Research Working Paper 16-259.

Carpenter, Charles, and E. Frank Stephenson. 2006. The 150-hour rule as a barrier to entering public accountancy. *Journal of Labor Research*, 27(1), 115–126.

Conley, Timothy G., and Christopher R. Taber. 2011. Inference with "difference in differences" with a small number of policy changes. *Review of Economics and Statistics*, 93(1), 113–125.

Council of State Governments. 1952. *Occupational Licensing Legislation in the States.* Chicago: Council of State Governments.

Davis, Steven J., and John Haltiwanger. 2014. *Labor market fluidity and economic performance*. No. w20479. National Bureau of Economic Research,

Department of the Treasury Office of Economic Policy, Council of Economic Advisers, and Department of Labor. 2015. *Occupational Licensing: A Framework for Policymakers*. https://www.whitehouse.gov/sites/default/files/docs/licensing_report_final_nonembargo.pdf.

DiNardo John, and David Lee. 2004. Economic impacts of new unionization on private sector employers: 1984–2001. *Quarterly Journal of Economics*, 119(4), 1383–1441.

Freeman, Richard B., and Morris M. Kleiner. 1990. The impact of new unionization on wages and working conditions. *Journal of Labor Economics,* 8(1) Part 2, S8–S25.

Friedman, Milton. 1962. *Capitalism and Freedom*. Chicago: University of Chicago Press.

Friedman, Milton, and Simon Kuznets. 1945. *Income from Independent Professional Practice*. New York: National Bureau of Economic Research.

Gittleman, Maury, and Morris M. Kleiner. 2016. Wage effects of unionization and occupational licensing coverage in the United States. *Industrial and Labor Relations Review*, 69(1), 142–172.

Gittleman, Maury, Mark A. Klee, and Morris M. Kleiner. 2018 Analyzing the labor market outcomes of occupational licensing. *Industrial Relations*, Vol.57, No.1, pp. 57-100.

Hanushek, Eric A. 1974. Efficient estimators for regressing regression coefficients. *American Statistician*, 28(2), 66–67.

Hirsch, Barry T., and Macpherson, David A. 2013.Union membership and coverage database from the CPS. Accessed 10/30/2013 from http://www.unionstats.com/.

Hur, Yoon Sun, Morris M. Kleiner, and Yingchun Wang. 2018. "The Influence of Licensing Engineers on Their Labor Market." *U.S. Engineering in a Global Economy.* ed. Richard Freeman and Hal Salzman, *University of Chicago Press*, pp,217-244.

Hurwicz, Leonid. 1973. The design of mechanisms for resource allocation. *American Economic Review*, 63 (2), 1–30.

Iacus, S. M., Gary King, and Giuseppe Porro. 2012. Causal Inference Without Balance Checking: Coarsened Exact Matching. *Political Analysis*, 1-24.

Ketel, Nadine, Edwin Leuven, Hessel Oosterbeek, *and* Bas van der Klaauw. *2016. American Economic Journal: Applied Economics*, 8(2), 225-254

Kleiner, Morris M. 2006. *Licensing Occupations: Enhancing Quality or Restricting Competition?* Kalamazoo, MI: W.E. Upjohn Institute for Employment Research.

Kleiner, Morris M. 2015. *Guild-Ridden Labor Markets: The Curious Case of Occupational Licensing*. Kalamazoo, MI: W.E. Upjohn Institute for Employment Research.

Kleiner, Morris M., 2013. *Stages of Occupational Regulation: Analysis of Case Studies*. WE Upjohn Institute.

Kleiner, Morris M., and Alan B. Krueger. 2010. The prevalence and effects of occupational licensing. *British Journal of Industrial Relations*, 48(4), 676–687.

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), S173–202.

Kleiner, Morris M., and Evgeny Vorotnikov. 2017. "Analyzing occupational licensing among the states." *Journal of Regulatory Economics* 52.2. 132-158.

Lang, Kevin and Maria Dolores Palacios. 2018. "The Determinants of Teachers' Occupational Choice" NBER Working Paper No. 24883, August.

Law, Marc T., and Mindy S. Marks. 2009. The effects of occupational licensing laws on minorities: Evidence from the Progressive Era." *Journal of Law and Economics* 52(2), 351–366.

Law, Marc T., and Mindy S. Marks. 2013. From certification to licensure: Evidence from registered and practical nurses in the United States, 1950–1970. *European Journal of Comparative Economics*, 10(2), 177–198.

Lee, David S., and Alexandre Mas. 2012. Long-run impacts of unions on firms: New evidence from financial markets, 1961–1999. *Quarterly Journal of Economics*, 127(1), 333–378.

Little, Roderick, and Daniel Rubin, 1987. *Statistical Analysis with Missing Data*. New York: John Wiley.

Meyer, Peter B., and Anastasiya M. Osborne. 2005. Proposed category system for 1960–2000 census occupations. BLS Working Paper WP-383.

North Carolina State Board of Dental Examiners v. Federal Trade Commission No. 15-534, 547 U.S. 2015.

Oaxaca, Ronald., 1973. Male-female wage differentials in urban labor markets. *International Economic Review*, 14(3), 693-709.

Pagliero, Mario. 2010. Licensing exam difficulty and entry salaries in the US market for lawyers. *British Journal of Industrial Relations*, 48(4), 726–739.

Reinhardt, Uwe. 1972. A production function for physician services. *Review of Economics and Statistics*, 54(February), 55–66.

Shavell, Steven. 2007. On optimal legal change, past behavior, and grandfathering. National Bureau of Economic Research Working Paper 13563.

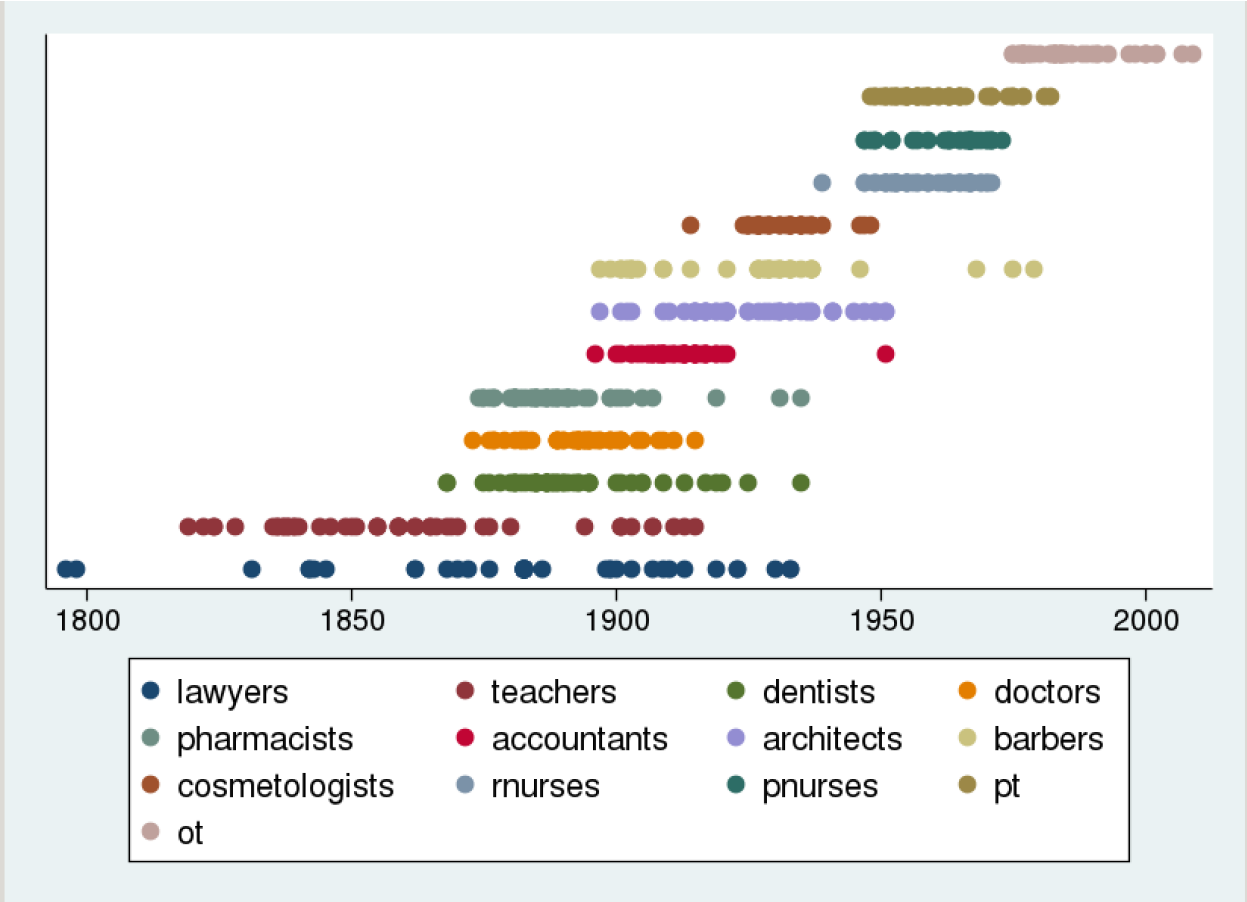
Spence, Michael. 1973. Job market signaling. *Quarterly Journal of Economics*, 87(3), 355–374.

Timmons, Edward J., and Robert J. Thornton. 2010. The licensing of barbers in the USA. *British Journal of Industrial Relations*, 48(4), 740–757.

Timmons, Edward J., and Robert J. Thornton. 2013. Licensing one of the world's oldest professions: Massage. *Journal of Law and Economics*, 56(2), 371–388.

Wheelan, Charles J. 1999. Politics or public interest? An empirical examination of occupational licensure. Unpublished. Accessed October 10, 2017. http://www.worldcat.org/title/empirical-examination-of-the-political-economy-of-occupational-licensure/oclc/40557776.

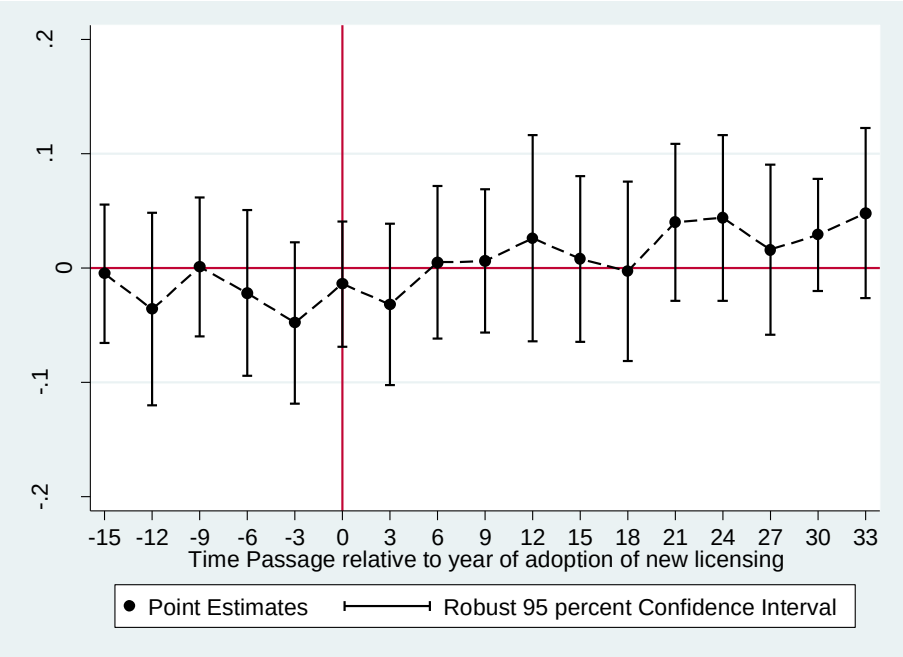
Figure 1. Timeline of When Occupations Became Licensed



Note: Developed from the authors' examination of the initial implementation of occupational licensing using *Occupational Licensing Legislation in the States* (Council of State Governments, 1952) and LexisNexis legal data services.

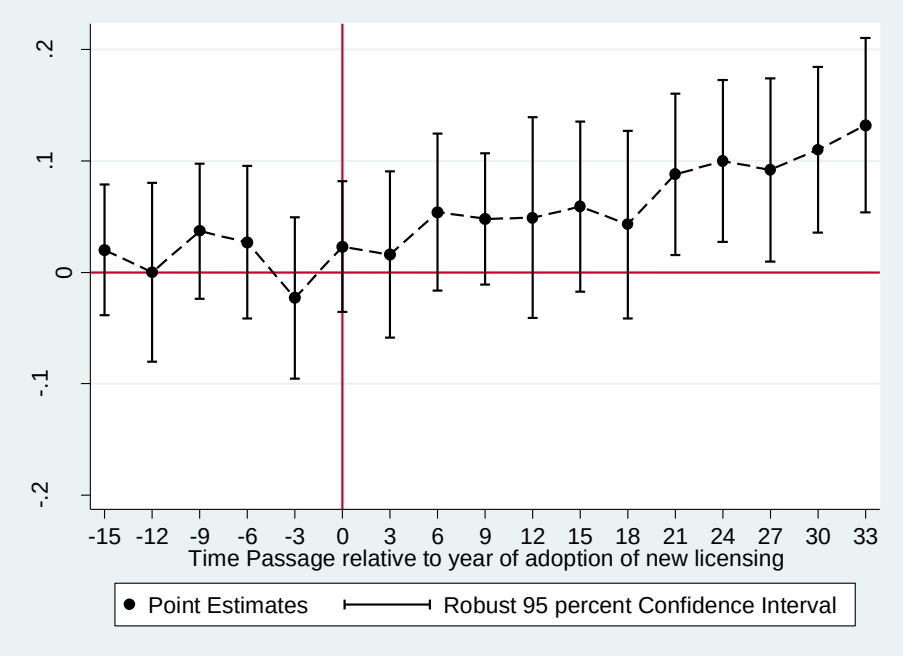
Figure 2. Estimated Licensing Effects on Log Hourly Wage before, and after Licensing Statutes relative to Individuals in Universally Licensed Occupations Prior to States Passing Licensing Statutes

Panel A. 13 Universally Licensed Occupations



Note: Vertical bands represent ± 1.96 times the standard error of each point estimate.

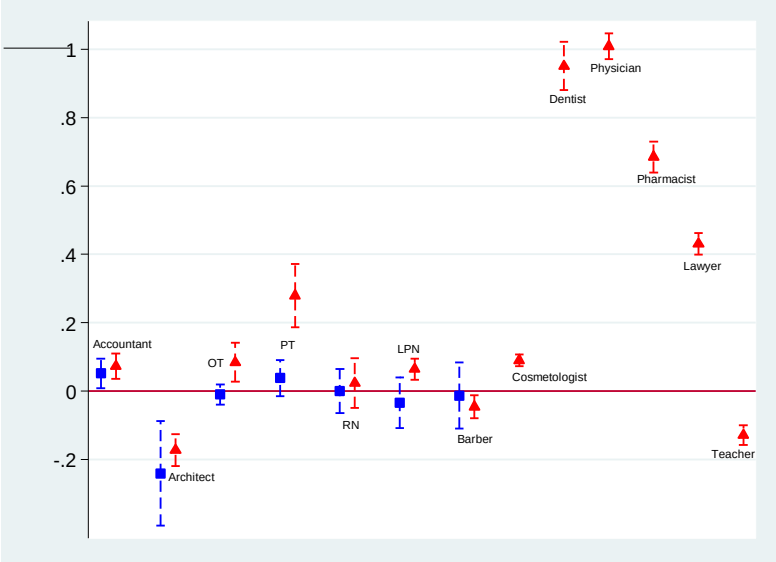
Panel B. Occupations that Changed Their Regulation Status over the Period of Our Analysis



Note: Vertical bands represent ± 1.96 times the standard error of each point estimate.

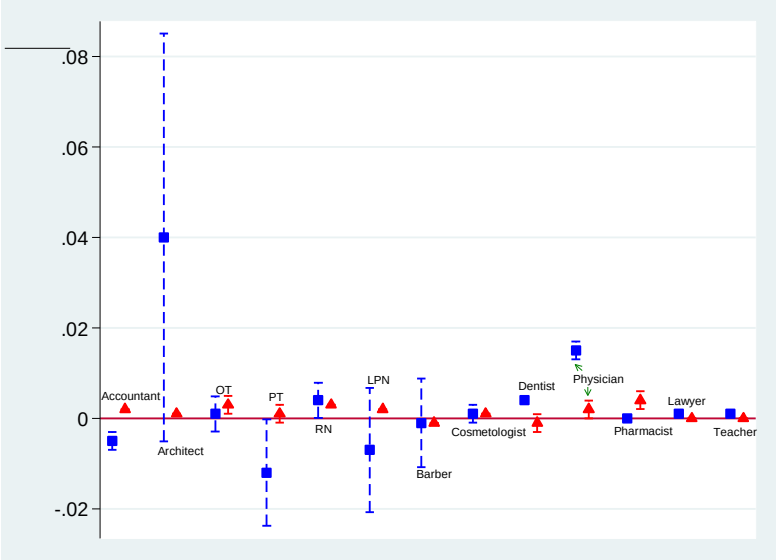
Figure 3. Heterogeneity of the Influence of Licensing and Licensing Duration on Hourly Wage Determination

A. Licensing Effects on Hourly Wage



Note: Point estimate ■ represents the licensing effect relative to hourly wage of individuals in the same occupation prior to states passing licensing statutes. Point estimate ▲ represents the licensing effect relative to hourly wage of individuals in occupations with the same 2-digit SOC 2000 that are unlicensed throughout our period of analysis. Point estimates ▲ for cosmetologist, dentist, pharmacist, physician, teacher, and lawyer represent the average licensing effects within each universally licensed occupation and occupations with the same 2-digit SOC 2000 that are unlicensed throughout our period of analysis.

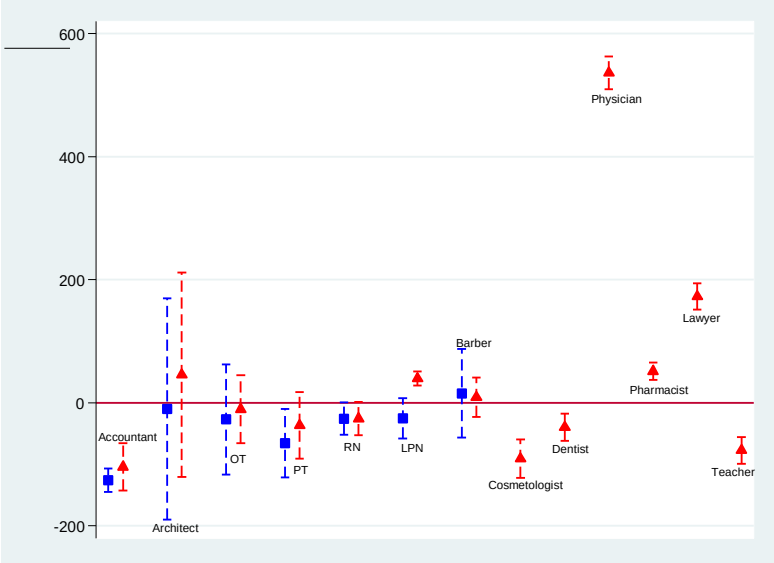
B. Duration Effects on Hourly Wage



Note: Point estimate ■ represents the duration effect relative to hourly wage of individuals in the same occupation prior to states passing licensing statutes. Point estimate ▲ represents the duration effect relative to hourly wage of individuals in occupations with the same 2-digit SOC 2000 that are unlicensed throughout our period of analysis. Point estimates ■ for cosmetologist, dentist, pharmacist, physician, and lawyer represent the average duration effect within each universally licensed occupation while point estimates ▲ for cosmetologist, dentist, pharmacist, physician, teacher, and lawyer represent the average duration effects within each universally licensed occupation and occupations with the same 2-digit SOC 2000 that are unlicensed throughout our period of analysis.

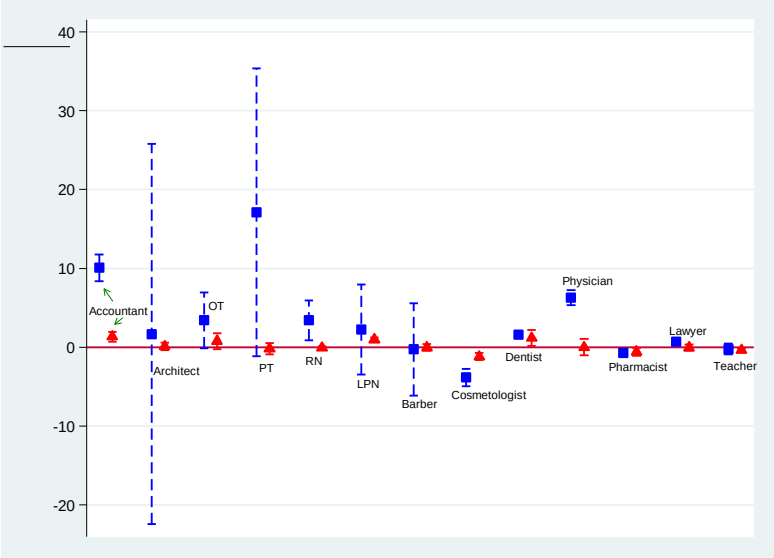
Figure 4. Heterogeneity of the Influence of Licensing and Licensing Duration on Hours Worked per Year

A. Licensing Effects on Hours Worked per Year



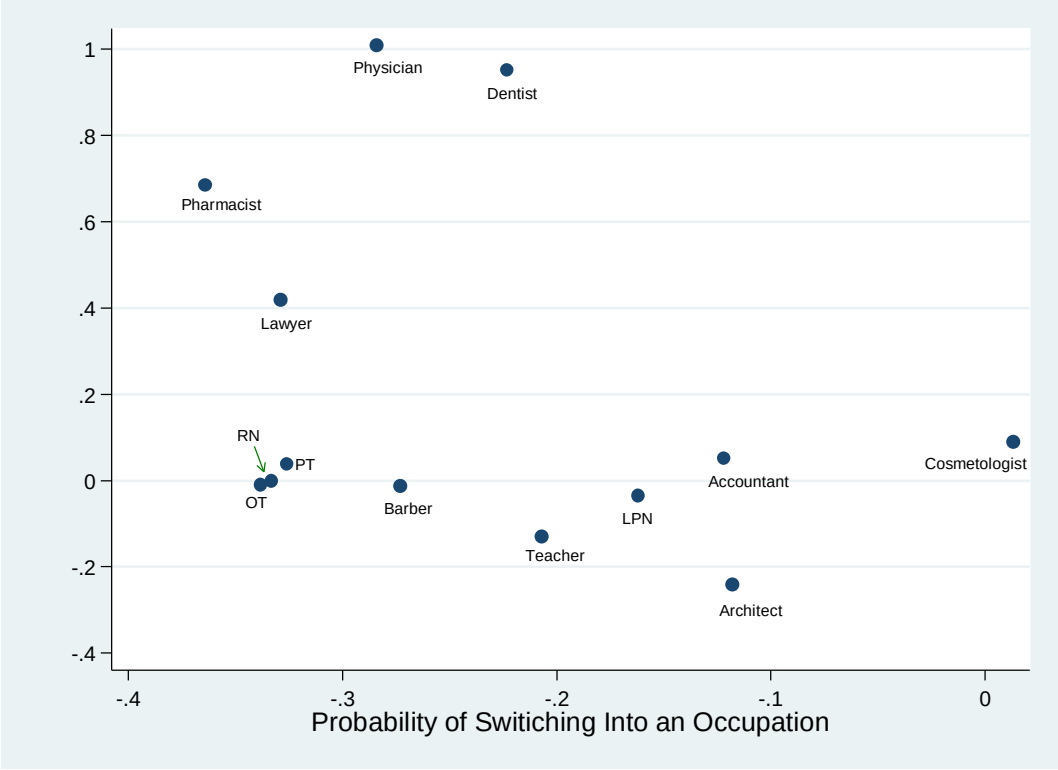
Note: Point estimate ■ represents the licensing effect relative to hours worked per year of individuals in the same occupation prior to states passing licensing statutes. Point estimate ▲ represents the licensing effect relative to hours worked per year of individuals in occupations with the same 2-digit SOC 2000 that are unlicensed throughout our period of analysis. Point estimates ▲ for cosmetologist, dentist, pharmacist, physician, teacher, and lawyer represent the average licensing effects within each universally licensed occupation and occupations with the same 2-digit SOC 2000 that are unlicensed throughout our period of analysis.

B. Duration Effects on Hours Worked per Year



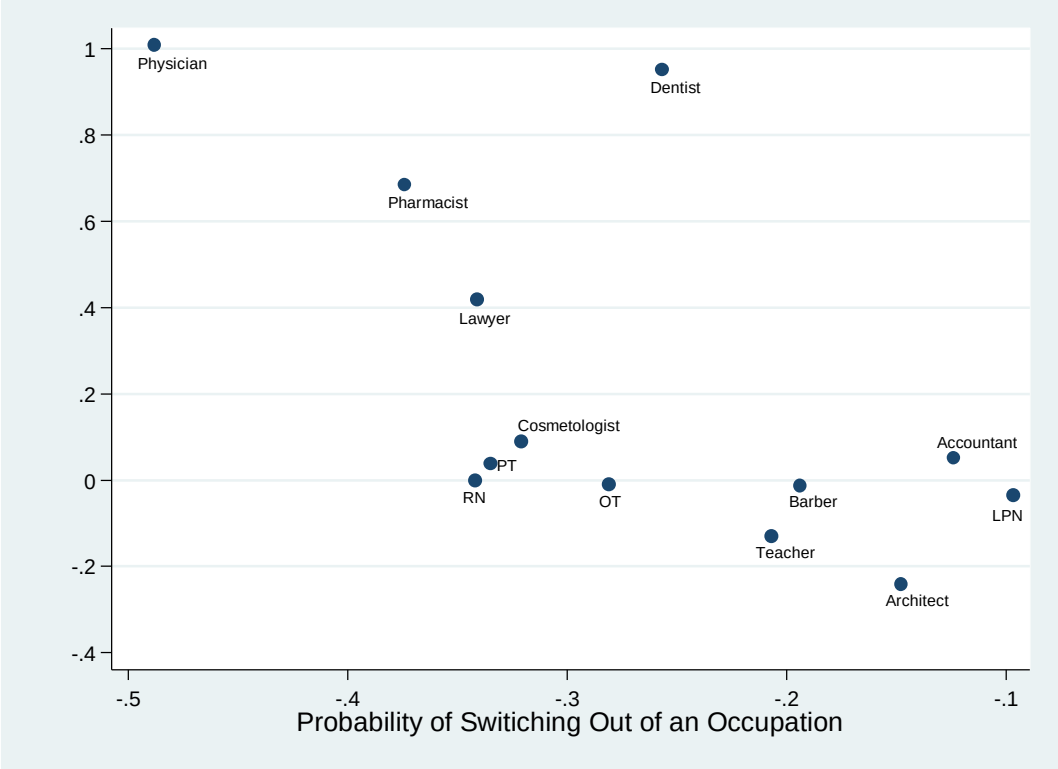
Note: Point estimate ■ represents the duration effect relative to hours worked per year of individuals in the same occupation prior to states passing licensing statutes. Point estimate ▲ represents the duration effect relative to hours worked per year of individuals in occupations with the same 2-digit SOC 2000 that are unlicensed throughout our period of analysis. Point estimates ■ for cosmetologist, dentist, pharmacist, physician, teacher, and lawyer represent the average duration effect within each universally licensed occupation while point estimates ▲ for cosmetologist, dentist, pharmacist, physician, teacher, and lawyer represent the average duration effects within each universally licensed occupation and occupations with the same 2-digit SOC 2000 that are unlicensed throughout our period of analysis.

Figure 5. Licensing Wage Effects and the Probability of Switching into an Occupation



Note: We estimate the likelihood of switching into each universally licensed occupation Specifically, we regress indicator of switcher on indicator of each universally licensed occupation, income, categorical duration, sex, marital status and year fixed effects. Next, we plotted the licensing wage effects and the churn of workers for each occupation to see any pattern between churn of workers and licensing wage effects.

Figure 6. Licensing Wage Effects and the Probability of Switching out of an Occupation



Note: We estimate the likelihood of switching out of each universally licensed occupation. Specifically, we regress indicator of switcher on indicator of each universally licensed occupation, income, categorical duration, sex, marital status and year fixed effects. Next, we plotted the licensing wage effects and the churn of workers for each occupation to see any pattern between churn of workers and licensing wage effects.

Table 1. Control and Treatment Groups: Composition of Occupations

	Treatment Group	Control Group
Sample Construction I	Licensed workers in the 13 universally licensed occupations between 1940 and 2015: architects, accountants, barbers, cosmetologists, dentists, occupational therapists, physical therapists, practical nurses, registered nurses, pharmacists, physicians, lawyers, and teachers	Unlicensed workers in the same occupations as the treatment group: architects, accountants, barbers, cosmetologists, dentists, occupational therapists, physical therapists, practical nurses, registered nurses, pharmacists, physicians, lawyers, and teachers prior to their becoming licensed
Sample Construction II	Workers in each universally licensed occupation (or set of related licensed occupations) between 1940 and 2015: architects, accountants, barbers, cosmetologists, dentists, occupational therapists, physical therapists, practical nurses, registered nurses, pharmacists, physicians, lawyers, and teachers	Workers in all other occupations within the same 2-digit Standard Occupational Classification (SOC) 2000 that were never licensed during our period of study.
Sample Construction III[1]	Licensed workers in occupations that were licensed between 1940 and 2015: architects, accountants, barbers, occupational therapists, physical therapists, practical nurses, and registered nurses.	Unlicensed workers in the same occupations as the treatment group: architects, accountants, barbers, occupational therapists, physical therapists, practical nurses, and registered nurses prior to their becoming licensed
Sample Construction IV[2]	Workers in each occupation (or set of related licensed occupations) that were licensed between 1940 and 2015: architects, accountants, barbers, occupational therapists, physical therapists, practical nurses, and registered nurses.	Workers in all other occupations within the same 2-digit SOC 2000 that were never licensed during our period of study.

Note: 1. Sample construction III drops the universally licensed occupations that did not change regulation status throughout our period of analysis and compares individuals in the 7 universally licensed occupations that changed regulation status with individuals in the 7 universally licensed occupations prior to states passing licensing statutes.

2. Sample construction IV drops the universally licensed occupations that did not change regulation status throughout our period of analysis and compares individuals in the 7 universally licensed occupations that changed regulation status with individuals in all other occupations within the same 2-digit SOC 2000 that were never licensed during our period of study.

Table 2. Means and Standard Deviation of Licensed and Unlicensed Occupations: By Regulation Status

VARIABLES	13 Universally Licensed Occupations		Occupations That Are Unlicensed Throughout Our Period of Analysis
	Licensed Workers	Unlicensed Workers Prior to States Passing Licensing Statutes	
White	0.809	0.926	0.794
	(0.393)	(0.262)	(0.405)
Male	0.338	0.076	0.532
	(0.473)	(0.265)	(0.499)
Potential Experience	20.221	17.957	22.327
	(11.089)	(11.157)	(11.458)
Years of Education	16.025	13.942	13.450
	(1.979)	(2.087)	(2.359)
Married	0.640	0.463	0.589
	(0.480)	(0.499)	(0.492)
Licensure	1.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Duration	103.827	0.000	0.000
	(46.968)	(0.000)	(0.000)
Hourly Wage (2014 CPI)	35.807	16.228	25.792
	(31.587)	(9.801)	(22.683)
Weeks per Year	51.248	51.253	51.325
	(0.833)	(0.991)	(0.814)
Hours per Week	43.644	42.870	42.977
	(8.948)	(6.014)	(7.681)
Hours per Year	2236.727	2197.585	2206.053
	(460.359)	(313.948)	(397.182)
Observations	1,992,403	4,639	9,243,914
Weighted Observations	152,158,114	366,721	687,525,536

Note: The 13 universally licensed occupations include architects, accountants, barbers, cosmetologists, dentists, occupational therapists, physical therapists, practical nurses, physicians, pharmacists, registered nurses, lawyers, and teachers. We manually determine whether each occupation was ever licensed by verifying licensing status through the variable occ1990. For the 1940 census data which lacks the occ1990 variable, we made a crosswalk between occ1990 and occ1950. Data are weighted using population weights.

Table 3. Means and Standard Deviation of Licensed and Unlicensed Occupations: By Regulations Status for Those Whose Licensing Status Changed

VARIABLES	13 Universally Licensed Occupations			Occupations That Are Unlicensed Throughout Our Period of Analysis
	Occupations that Did Not Change Their Regulations Status	Occupations that Changed Their Regulation Status		
	Licensed Workers	Licensed Workers	Unlicensed Workers Prior to States Passing Licensing Statutes	
White	0.827	0.787	0.926	0.794
	(0.378)	(0.409)	(0.262)	(0.405)
Male	0.401	0.265	0.076	0.532
	(0.490)	(0.442)	(0.265)	(0.499)
Potential Experience	19.392	21.195	17.957	22.327
	(10.921)	(11.204)	(11.157)	(11.458)
Years of Education	16.679	15.255	13.942	13.450
	(1.880)	(1.808)	(2.087)	(2.359)
Married	0.662	0.614	0.463	0.589
	(0.473)	(0.487)	(0.499)	(0.492)
Licensure	1.000	1.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Duration	136.617	65.281	0.000	0.000
	(33.568)	(26.925)	(0.000)	(0.000)
Hourly Wage (2014 CPI)	38.833	32.248	16.228	25.792
	(38.408)	(20.325)	(9.801)	(22.683)
Weeks per Year	51.199	51.305	51.253	51.325
	(0.865)	(0.79)	(0.991)	(0.814)
Hours per Week	45.179	41.839	42.870	42.977
	(10.014)	(7.09)	(6.014)	(7.681)
Hours per Year	2313.290	2146.723	2197.585	2206.053
	(515.078)	(366.326)	(313.948)	(397.182)
Observations	1,062,022	930,381	4,639	9,243,914
Weighted Observations	82,218,341	69,939,773	366,721	687,525,536

Note: Occupations that did not change their regulations status include cosmetologists, dentists, physicians, pharmacists, teachers, and lawyers. Occupations that changed their regulation status include architects, accountants, barbers, occupational therapists, physical therapists, practical nurses, and registered nurses. We manually determine whether each occupation was ever licensed by verifying licensing status through the variable occ1990. For the 1940 census data which lacks the occ1990 variable, we made a crosswalk between occ1990 and occ1950. Data are weighted using population weights.

Table 4. Effects of Licensing Duration on Log Hourly Earnings

Panel A. 13 Universally Licensed Occupations

	(1)	(2)	(3)	(4)	(5)	(6)
Control Group:	Relative to Unlicensed Workers in Universally Licensed Occupations Prior to States Passing Licensing Statutes					
Licensure	0.092***	0.037*				
	(0.026)	(0.022)				
Duration			0.003***	0.001*		
			(0.000)	(0.000)		
Duration Dummies:						
Duration ∈ [0.3]					0.009	-0.005
					(0.022)	(0.020)
Duration ∈ [4.10]					0.042**	0.020
					(0.017)	(0.017)
Duration ∈ [11.20]					0.051**	0.034
					(0.024)	(0.024)
Duration ∈ [21.30]					0.078***	0.049**
					(0.023)	(0.024)
Duration ∈ [31.40]					0.111***	0.065**
					(0.027)	(0.028)
Duration ∈ [41.50]					0.131***	0.069**
					(0.027)	(0.029)
Duration ∈ [51.100]					0.236***	0.079**
					(0.031)	(0.031)
Duration > 100					0.359***	0.087***
					(0.031)	(0.033)
Individual Covariates	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
State FE	YES	YES	YES	YES	YES	YES
3-digit SOC 2000	YES	NO	YES	NO	YES	NO
13 Occupational Dummies	NO	YES	NO	YES	NO	YES
H_0: All Duration Dummies=0					0	0.0797
R-squared	0.439	0.456	0.450	0.456	0.448	0.456
Observations	1,997,042	1,997,042	1,997,042	1,997,042	1,997,042	1,997,042

Note: All models include indicators for gender, race (white vs. others), dummies for marital status (married vs. unmarried), years of education, potential experience and a quadratic function in potential experience; *** significant at the 0.01 level; ** significant at the 0.05 level; * significant at the 0.1 level; standard errors are constructed using the heteroscedasticity robust covariance matrix that allows for clustering at the state-occupation level.

B. Occupations that Changed Their Regulation Status over the Period of Our Analysis

	(1)	(2)	(3)	(4)	(5)	(6)
Control Group:	Relative to Unlicensed Workers in Universally Licensed Occupations Prior to States Passing Licensing Statutes					
Licensure	0.080***	0.073***				
	(0.023)	(0.025)				
Duration			0.002***	0.002***		
			(0.000)	(0.000)		
Duration Dummies:						
Duration ∈ [0.3]					0.016	0.019
					(0.023)	(0.022)
Duration ∈ [4.10]					0.047**	0.049***
					(0.019)	(0.018)
Duration ∈ [11.20]					0.059**	0.068***
					(0.026)	(0.026)
Duration ∈ [21.30]					0.093***	0.109***
					(0.027)	(0.028)
Duration ∈ [31.40]					0.119***	0.141***
					(0.029)	(0.031)
Duration ∈ [41.50]					0.131***	0.155***
					(0.029)	(0.032)
Duration ∈ [51.100]					0.160***	0.185***
					(0.028)	(0.030)
Duration > 100					0.173***	0.199***
					(0.032)	(0.035)
Individual Covariates	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
State FE	YES	YES	YES	YES	YES	YES
3-digit SOC 2000	YES	NO	YES	NO	YES	NO
7 Occupational Dummies	NO	YES	NO	YES	NO	YES
H_0: All Duration Dummies=0					0.000	0.000
R-squared	0.295	0.295	0.296	0.296	0.296	0.296
Observations	935,020	935,020	935,020	935,020	935,020	935,020

Note: All models include indicators for gender, race (white vs. others), dummies for marital status (married vs. unmarried), years of education, potential experience and a quadratic function in potential experience; *** significant at the 0.01 level; ** significant at the 0.05 level; * significant at the 0.1 level; standard errors are constructed using the heteroscedasticity robust covariance matrix that allows for clustering at the state-occupation level.

Table 5. Effects of Licensing Duration on Log Hourly Earnings

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Accountants		Architects		Teachers		OTs, PTs, Dentists, Pharmacists, Registered Nurses, Practical Nurses, and Physicians		Barbers, and Cosmetologists	
Control Group:	Relative to Workers in all other occupations within the same 2-digit SOC 2000 that were never licensed during our period of study									
	2-digit SOC: 13		2-digit SOC: 17		2-digit SOC: 25		2-digit SOC: 29		2-digit SOC: 39	
Licensure	0.073***		-0.173***		-0.129***		0.076***		0.075***	
	(0.019)		(0.024)		(0.015)		(0.014)		(0.009)	
Duration Dummies:										
Duration ∈ [0.3]				-0.300***				-0.005		0.053
				(0.036)				(0.020)		(0.035)
Duration ∈ [4.10]		-0.008		-0.210				0.018		0.083*
		(0.023)		(0.218)				(0.019)		(0.045)
Duration ∈ [11.20]		0.037*		-0.294***				0.020		-0.026
		(0.019)		(0.099)				(0.017)		(0.047)
Duration ∈ [21.30]		0.069**		-0.200***		-0.277***		0.031*		0.009
		(0.027)		(0.044)		(0.069)		(0.017)		(0.023)
Duration ∈ [31.40]		0.101***		-0.217***		-0.106**		0.042**		0.034*
		(0.020)		(0.038)		(0.052)		(0.018)		(0.017)
Duration ∈ [41.50]		0.075***		-0.237***		-0.079*		0.051***		0.055***
		(0.018)		(0.024)		(0.040)		(0.017)		(0.020)
Duration ∈ [51.100]		0.114***		-0.166***		-0.128***		0.132***		0.078***
		(0.030)		(0.024)		(0.017)		(0.019)		(0.009)
Duration > 100		0.138***		-0.128***		-0.130***		0.440***		-0.054**
		(0.031)		(0.025)		(0.016)		(0.023)		(0.022)
Individual Covariates	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
State FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
3-digit SOC 2000	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
H_0: All Duration Dummies=0		0.000		0.000		0.000		0.000		0.000
R-squared	0.325	0.325	0.262	0.262	0.343	0.343	0.419	0.447	0.220	0.220
Observations	633,087	633,087	215,530	215,530	675,773	675,773	803,634	803,634	206,831	206,831

Note: All models include indicators for gender, race (white vs. others), dummies for marital status (married vs. unmarried), years of education, potential experience and a quadratic function in potential experience; *** significant at the 0.01 level; ** significant at the 0.05 level; * significant at the 0.1 level; standard errors are constructed using the heteroscedasticity robust covariance matrix that allows for clustering at the state-occ level.

Table 6. Effects of Licensing Duration on Total Worked Hours per Year

Panel A. 13 Universally Licensed Occupations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Control Group:	Relative to Unlicensed Workers in Universally Licensed Occupations Prior to States Passing Licensing Statutes							
Licensure	8.281	-58.450***						
	(29.418)	(14.268)						
Duration			2.933***	-0.385	9.163***	0.938**		
			(0.413)	(0.242)	(1.032)	(0.466)		
$Duration^2$					-0.031***	-0.005**		
					(0.004)	(0.002)		
Duration Dummies:								
Duration ∈ [0.3]							-21.067	-35.724**
							(16.935)	(15.847)
Duration ∈ [4.10]							-24.083	-49.939***
							(16.414)	(13.802)
Duration ∈ [11.20]							-6.979	-37.734**
							(16.787)	(15.200)
Duration ∈ [21.30]							-3.032	-58.725***
							(16.449)	(15.247)
Duration ∈ [31.40]							10.490	-73.464***
							(17.913)	(17.391)
Duration ∈ [41.50]							24.370	-80.968***
							(19.652)	(18.398)
Duration ∈ [51.100]							150.584***	-65.867***
							(29.007)	(21.803)
Duration > 100							311.676***	-56.568**
							(43.538)	(27.868)
Individual Covariates	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
State FE	YES	YES	YES	YES	YES	YES	YES	YES
3-digit SOC 2000	YES	NO	YES	NO	YES	NO	YES	NO
13 Occupational Dummies	NO	YES	NO	YES	NO	YES	NO	YES
H_0: All Duration Dummies=0							0.000	0.000
R-squared	0.112	0.194	0.132	0.194	0.142	0.194	0.136	0.194
Observations	1,997,042	1,997,042	1,997,042	1,997,042	1,997,042	1,997,042	1,997,042	1,997,042

Note: All models include indicators for gender, race (white vs. others), dummies for marital status (married vs. unmarried), years of education, potential experience and a quadratic function in potential experience; *** significant at the 0.01 level; ** significant at the 0.05 level; * significant at the 0.1 level; standard errors are constructed using the heteroscedasticity robust covariance matrix that allows for clustering at the state-occupation level.

B. Occupations that Changed Their Regulation Status over the Period of Our Analysis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Control Group:	Relative to Unlicensed Workers in Universally Licensed Occupations Prior to States Passing Licensing Statutes							
Licensure	-48.987***	-63.332***						
	(17.268)	(14.164)						
Duration			0.521***	0.349***	-1.193***	-1.898***		
			(0.103)	(0.134)	(0.331)	(0.364)		
$Duration^2$					0.014***	0.018***		
					(0.002)	(0.002)		
Duration Dummies:								
Duration ∈ [0.3]							-39.612**	-43.701***
							(18.117)	(15.850)
Duration ∈ [4.10]							-45.105***	-49.541***
							(16.269)	(13.500)
Duration ∈ [11.20]							-27.586	-43.695***
							(19.073)	(15.013)
Duration ∈ [21.30]							-42.592**	-68.183***
							(19.255)	(14.260)
Duration ∈ [31.40]							-50.407**	-89.026***
							(19.925)	(16.267)
Duration ∈ [41.50]							-55.801***	-97.961***
							(19.967)	(16.671)
Duration ∈ [51.100]							-49.722**	-94.519***
							(20.746)	(17.815)
Duration > 100							-30.145	-79.206***
							(21.637)	(18.802)
Individual Covariates	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
State FE	YES	YES	YES	YES	YES	YES	YES	YES
3-digit SOC 2000	YES	NO	YES	NO	YES	NO	YES	NO
7 Occupational Dummies	NO	YES	NO	YES	NO	YES	NO	YES
H_0: All Duration Dummies=0							0.000	0.000
R-squared	0.075	0.075	0.075	0.075	0.075	0.076	0.075	0.075
Observations	935,020	935,020	935,020	935,020	935,020	935,020	935,020	935,020

Note: All models include indicators for gender, race (white vs. others), dummies for marital status (married vs. unmarried), years of education, potential experience and a quadratic function in potential experience; *** significant at the 0.01 level; ** significant at the 0.05 level; * significant at the 0.1 level; standard errors are constructed using the heteroscedasticity robust covariance matrix that allows for clustering at the state-occupation level.

Table 7. Effects of Licensing Duration on Total Worked Hours per Year

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Accountants		Architects		Teachers		OTs, PTs, Dentists, Pharmacists, Registered Nurses, Practical Nurses, and Physicians		Barbers, and Cosmetologists	
Control Group:	Relative to Workers in all other occupations within the same 2-digit SOC 2000 that were never licensed during our period of study									
	2-digit SOC: 13		2-digit SOC: 17		2-digit SOC: 25		2-digit SOC: 29		2-digit SOC: 39	
Licensure	-104.168***		45.277		-77.379***		74.175***		-81.496***	
	(19.738)		(84.798)		(11.091)		(15.053)		(14.543)	
Duration Dummies:										
Duration ∈ [0.3]				39.847				-43.426**		221.858***
				(86.056)				(19.079)		(70.323)
Duration ∈ [4.10]		-125.275***		-75.909				-42.776**		100.104
		(18.142)		(97.121)				(19.976)		(66.982)
Duration ∈ [11.20]		-30.336		22.884				-37.312**		-98.609
		(20.912)		(93.768)				(15.110)		(74.404)
Duration ∈ [21.30]		-69.012***		25.521		-111.888**		-2.370		-30.108
		(21.391)		(82.594)		(43.464)		(13.592)		(36.099)
Duration ∈ [31.40]		-117.918***		-0.549		38.634		49.541***		-49.388**
		(23.041)		(92.426)		(46.390)		(13.502)		(20.183)
Duration ∈ [41.50]		-115.353***		26.602		-54.087		75.095***		-47.959***
		(20.642)		(94.210)		(34.116)		(13.149)		(13.747)
Duration ∈ [51.100]		-81.989***		54.089		-80.778***		135.632***		-83.631***
		(20.203)		(84.632)		(14.433)		(22.590)		(14.965)
Duration > 100		-55.909***		40.059		-76.977***		458.208***		-30.280
		(19.838)		(84.567)		(11.027)		(38.616)		(35.216)
Individual Covariates	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
State FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
3-digit SOC 2000	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
H_0: All Duration Dummies=0		0.000		0.010		0.000		0.000		0.000
R-squared	0.066	0.066	0.048	0.049	0.063	0.063	0.160	0.207	0.070	0.071
Observations	633,087	633,087	215,530	215,530	675,773	675,773	803,634	803,634	206,831	206,831

Note: All models include indicators for gender, race (white vs. others), dummies for marital status (married vs. unmarried), years of education, potential experience and a quadratic function in potential experience; *** significant at the 0.01 level; ** significant at the 0.05 level; * significant at the 0.1 level; standard errors are constructed using the heteroscedasticity robust covariance matrix that allows for clustering at the state-occupation level.

Table 8. Descriptive Statistics for Grandfathered Workers

VARIABLES	13 Universally Licensed Occupations			Occupations That Are Unlicensed Throughout Our Period of Analysis
	Grandfathered Workers	New Entrants	Unlicensed Workers Prior to States Passing Licensing Statutes	
White	0.851	0.808	0.926	0.794
	(0.356)	(0.394)	(0.262)	(0.405)
Male	0.105	0.342	0.076	0.532
	(0.307)	(0.474)	(0.265)	(0.499)
Potential Experience	32.991	20.012	17.957	22.327
	(9.301)	(10.993)	(11.157)	(11.458)
Years of Education	14.027	16.057	13.942	13.450
	(2.058)	(1.961)	(2.087)	(2.359)
Married	0.598	0.641	0.463	0.589
	(0.490)	(0.480)	(0.499)	(0.492)
Licensure	1.000	1.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Duration	24.156	105.131	0.000	0.000
	(11.720)	(46.199)	(0.000)	(0.000)
Hourly Wage (2014 CPI)	26.185	35.964	16.228	25.792
	(13.144)	(31.776)	(9.801)	(22.683)
Weeks per Year	51.399	51.245	51.253	51.325
	(0.937)	(0.831)	(0.991)	(0.814)
Hours per Week	40.881	43.689	42.870	42.977
	(6.442)	(8.976)	(6.014)	(7.681)
Hours per Year	2101.388	2238.942	2197.585	2206.053
	(334.474)	(461.804)	(313.948)	(397.182)
Observations	54,666	1,937,737	4,639	9,243,914
Weighted Observations	2,449,380	149,708,734	366,721	687,525,536

Note: The 13 universally licensed occupations include architects, accountants, barbers, cosmetologists, dentists, occupational therapists, physical therapists, practical nurses, physicians, pharmacists, registered nurses, lawyers, and teachers. We manually determine whether each occupation was ever licensed by verifying licensing status through the variable occ1990. For the 1940 census data which lacks the occ1990 variable, we made a crosswalk between occ1990 and occ1950. Data are weighted using population weights.

Table 9. Estimates of the Influence of Grandfathering on Hourly Wage

A. 13 Universally Licensed Occupations

	(1)	(2)	(3)	(4)	(5)	(6)
Control Group:	Relative to Unlicensed Workers in Universally Licensed Occupations Prior to States Passing Licensing Statutes					
Licensure	0.058***	0.041***				
	(0.012)	(0.012)				
Duration			0.002***	0.002**		
			(0.001)	(0.001)		
Duration Dummies:						
Duration ∈ [0.3]					0.039***	0.034**
					(0.014)	(0.014)
Duration ∈ [4.10]					0.053***	0.047***
					(0.012)	(0.014)
Duration ∈ [11.20]					0.066***	0.057***
					(0.015)	(0.018)
Duration ∈ [21.30]					0.074***	0.062***
					(0.018)	(0.022)
Duration ∈ [31.40]					0.106***	0.088***
					(0.023)	(0.029)
Duration ∈ [41.50]					0.124***	0.102***
					(0.029)	(0.036)
Individual Covariates	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
State FE	YES	YES	YES	YES	YES	YES
3-digit SOC 2000	YES	NO	YES	NO	YES	NO
13 Occupational Dummies	NO	YES	NO	YES	NO	YES
H_0: All Duration Dummies=0					0.000	0.016
R-squared	0.494	0.496	0.494	0.496	0.495	0.496
Observations	59,305	59,305	59,305	59,305	59,305	59,305

Note: All models include indicators for gender, race (white vs. others), dummies for marital status (married vs. unmarried), years of education, potential experience and a quadratic function in potential experience; *** significant at the 0.01 level; ** significant at the 0.05 level; * significant at the 0.1 level; standard errors are constructed using the heteroscedasticity robust covariance matrix that allows for clustering at the state-occupation level.

B. Occupations that Changed Their Regulation Status over the Period of Our Analysis

	(1)	(2)	(3)	(4)	(5)	(6)
Control Group:	Relative to Unlicensed Workers in Universally Licensed Occupations Prior to States Passing Licensing Statutes					
Licensure	0.053***	0.040***				
	(0.012)	(0.012)				
Duration			0.002***	0.002**		
			(0.001)	(0.001)		
Duration Dummies:						
Duration ∈ [0.3]					0.036**	0.034**
					(0.014)	(0.014)
Duration ∈ [4.10]					0.049***	0.046***
					(0.012)	(0.014)
Duration ∈ [11.20]					0.059***	0.054***
					(0.016)	(0.018)
Duration ∈ [21.30]					0.066***	0.059***
					(0.019)	(0.022)
Duration ∈ [31.40]					0.096***	0.084***
					(0.023)	(0.029)
Duration ∈ [41.50]					0.117***	0.102***
					(0.030)	(0.037)
Individual Covariates	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
State FE	YES	YES	YES	YES	YES	YES
3-digit SOC 2000	YES	NO	YES	NO	YES	NO
7 Occupational Dummies	NO	YES	NO	YES	NO	YES
H_0: All Duration Dummies=0					0.000	0.016
R-squared	0.495	0.496	0.496	0.496	0.496	0.496
Observations	58,657	58,657	58,657	58,657	58,657	58,657

Note: All models include indicators for gender, race (white vs. others), dummies for marital status (married vs. unmarried), years of education, potential experience and a quadratic function in potential experience; *** significant at the 0.01 level; ** significant at the 0.05 level; * significant at the 0.1 level; standard errors are constructed using the heteroscedasticity robust covariance matrix that allows for clustering at the state-occupation level.

Table 10. Estimates of the Influence of Grandfathering on Hours Worked per Year

A. 13 Universally Licensed Occupations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Control Group:	Relative to Unlicensed Workers in Universally Licensed Occupations Prior to States Passing Licensing Statutes							
Licensure	-19.738	-19.928						
	(15.774)	(15.737)						
Duration			0.101	0.100	1.172	0.981		
			(0.390)	(0.390)	(1.001)	(0.972)		
Duration^2					-0.026	-0.025		
					(0.024)	(0.023)		
Duration Dummies:								
Duration ∈ [0.3]							-24.130	-24.337
							(18.198)	(18.107)
Duration ∈ [4.10]							-25.930	-26.018
							(15.819)	(15.822)
Duration ∈ [11.20]							-16.271	-16.486
							(15.456)	(15.430)
Duration ∈ [21.30]							-5.300	-5.536
							(17.658)	(17.671)
Duration ∈ [31.40]							-9.475	-9.695
							(20.061)	(19.973)
Duration ∈ [41.50]							-31.883	-32.111
							(25.135)	(25.138)
Individual Covariates	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
State FE	YES	YES	YES	YES	YES	YES	YES	YES
2-digit SOC 2000	YES	NO	YES	NO	YES	NO	YES	NO
3-digit SOC 2000	NO	YES	NO	YES	NO	YES	NO	YES
H_0: All Duration Dummies=0							0.174	0.178
R-squared	0.072	0.072	0.072	0.072	0.074	0.077	0.073	0.073
Observations	59,305	59,305	59,305	59,305	59,305	59,305	59,305	59,305

Note: All models include indicators for gender, race (white vs. others), dummies for marital status (married, married but absent, separated/divorced/widowed vs. unmarried), years of education, potential experience and a quadratic function in potential experience; *** significant at the 0.01 level; ** significant at the 0.05 level; * significant at the 0.1 level; standard errors are constructed using the heteroscedasticity robust covariance matrix that allows for clustering at the state-occupation level.

B. Occupations that Changed Their Regulation Status over the Period of Our Analysis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Control Group:	Relative to Unlicensed Workers in Universally Licensed Occupations Prior to States Passing Licensing Statutes							
Licensure	-19.190	-19.356						
	(16.389)	(16.387)						
Duration			0.194	0.193	1.001	0.804		
			(0.406)	(0.406)	(0.990)	(0.995)		
Duration^2					-0.018	-0.019		
					(0.024)	(0.024)		
Duration Dummies:								
Duration ∈ [0.3]							-23.935	-24.097
							(18.137)	(18.071)
Duration ∈ [4.10]							-25.329	-25.405
							(15.886)	(15.902)
Duration ∈ [11.20]							-15.902	-16.077
							(16.246)	(16.281)
Duration ∈ [21.30]							-4.479	-4.679
							(19.011)	(19.107)
Duration ∈ [31.40]							-5.254	-5.445
							(21.759)	(21.752)
Duration ∈ [41.50]							-23.534	-23.738
							(25.734)	(25.812)
Individual Covariates	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
State FE	YES	YES	YES	YES	YES	YES	YES	YES
2-digit SOC 2000	YES	NO	YES	NO	YES	NO	YES	NO
3-digit SOC 2000	NO	YES	NO	YES	NO	YES	NO	YES
H_0: All Duration Dummies=0							0.131	0.137
R-squared	0.073	0.073	0.073	0.073	0.074	0.075	0.073	0.073
Observations	58,657	58,657	58,657	58,657	58,657	58,657	58,657	58,657

Note: All models include indicators for gender, race (white vs. others), dummies for marital status (married, married but absent, separated/divorced/widowed vs. unmarried), years of education, potential experience and a quadratic function in potential experience; *** significant at the 0.01 level; ** significant at the 0.05 level; * significant at the 0.1 level; standard errors are constructed using the heteroscedasticity robust covariance matrix that allows for clustering at the state-occupation level.

Table 11. Oaxaca Decomposition Analysis of New Entrants Relative to Grandfathered Workers

	(1)	(2)
Sample:	The ACS 2001-2015	
Labor Market Outcome:	Hourly Wage	Hour Worked Per Year
New Entrants	3.387***	2137.100***
	(0.001)	(0.511)
Grandfathered	3.305***	2079.125***
	(0.004)	(3.506)
Difference	0.082***	57.976***
	(0.004)	(3.543)
Explained	0.108***	69.274***
	(0.003)	(2.008)
Unexplained	-0.026***	-11.298***
	(0.004)	(4.039)
Observations	531,226	531,226

Note: Columns (3) and (4) use the ACS from 2001 to 2005 in order to provide analysis of individuals in occupations that states recently enacted licensing statutes. Differences between the wages/hours between grandfathered workers and new entrants can be explained by human capital characteristics and individual contributions such as gender, race (white vs. others), marital status (married vs. unmarried), years of education, potential experience, state fixed effects, year fixed effects, and three-digit SOC.

Table 12. Effects of Licensing Duration on Labor Market Participation using ACS 2001-2015
Panel A. 13 Universally Licensed Occupations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Control Group:	Relative to Unlicensed Workers in Universally Licensed Occupations Prior to States Passing Licensing Statutes								
Licensure	-0.001***	-0.001***	-0.001						
	(0.000)	(0.000)	(0.001)						
Duration				0.000	-0.000	0.000			
				(0.000)	(0.000)	(0.000)			
Duration Dummies:									
Duration ∈ [0.3]							-0.001*	-0.001	-0.001
							(0.000)	(0.000)	(0.001)
Duration ∈ [4.10]							-0.001***	-0.001***	-0.001
							(0.000)	(0.000)	(0.001)
Duration ∈ [11.20]							-0.001***	-0.001***	-0.000
							(0.000)	(0.000)	(0.001)
Duration ∈ [21.30]							-0.001***	-0.001***	-0.001
							(0.000)	(0.000)	(0.001)
Duration ∈ [31.40]							-0.002***	-0.002***	-0.001
							(0.000)	(0.000)	(0.001)
Duration ∈ [41.50]							-0.002***	-0.002***	-0.001
							(0.001)	(0.001)	(0.001)
Duration ∈ [51.100]							-0.003**	-0.003**	-0.001
							(0.001)	(0.001)	(0.001)
Duration > 100							-0.002	-0.002*	0.000
							(0.001)	(0.001)	(0.001)
State-level Covariates	YES	YES	YES	YES	YES	YES	YES	YES	YES
13 Occupational Dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	NO	YES	YES	NO	YES	YES	NO	YES	YES
State FE	NO	NO	YES	NO	NO	YES	NO	NO	YES
H_0: All Duration Dummies=0							0.000	0.000	0.612
R-squared	0.958	0.958	0.963	0.958	0.958	0.963	0.958	0.958	0.963
Observations	9,604	9,604	9,604	9,604	9,604	9,604	9,604	9,604	9,604

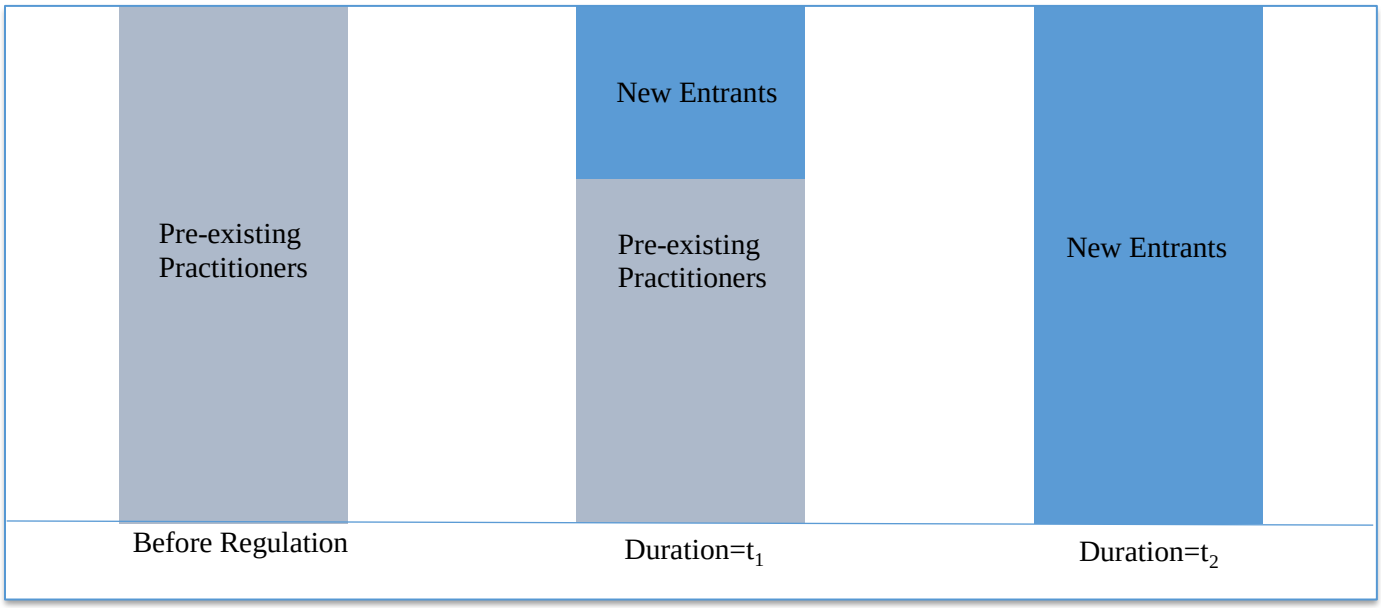
*** significant at the 0.01 level; ** significant at the 0.05 level; * significant at the 0.1 level; standard errors are constructed using the heteroscedasticity robust covariance matrix that allows for clustering at the state-occupation level.

Panel B. Occupations that Changed Their Regulation Status over the Period of Our Analysis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Control Group:	Relative to Unlicensed Workers in Universally Licensed Occupations Prior to States Passing Licensing Statutes								
Licensure	-0.001***	-0.001***	-0.000						
	(0.000)	(0.000)	(0.001)						
Duration				-0.000	-0.000	0.000			
				(0.000)	(0.000)	(0.000)			
Duration Dummies:									
Duration ∈ [0.3]							-0.001*	-0.001*	0.000
							(0.000)	(0.000)	(0.001)
Duration ∈ [4.10]							-0.001***	-0.001***	0.000
							(0.000)	(0.000)	(0.001)
Duration ∈ [11.20]							-0.001***	-0.001***	0.001
							(0.000)	(0.000)	(0.001)
Duration ∈ [21.30]							-0.001***	-0.001***	-0.000
							(0.000)	(0.000)	(0.001)
Duration ∈ [31.40]							-0.002***	-0.002***	-0.000
							(0.000)	(0.000)	(0.001)
Duration ∈ [41.50]							-0.002**	-0.002***	0.000
							(0.001)	(0.001)	(0.001)
Duration ∈ [51.100]							-0.003**	-0.003**	-0.000
							(0.001)	(0.001)	(0.001)
Duration > 100							-0.001	-0.001	0.002
							(0.001)	(0.001)	(0.002)
State-level Covariates	YES	YES	YES	YES	YES	YES	YES	YES	YES
13 Occupational Dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	NO	YES	YES	NO	YES	YES	NO	YES	YES
State FE	NO	NO	YES	NO	NO	YES	NO	NO	YES
H_0: All Duration Dummies=0							0.000	0.000	0.150
R-squared	0.929	0.929	0.938	0.929	0.929	0.938	0.929	0.930	0.939
Observations	5,046	5,046	5,046	5,046	5,046	5,046	5,046	5,046	5,046

*** significant at the 0.01 level; ** significant at the 0.05 level; * significant at the 0.1 level; standard errors are constructed using the heteroscedasticity robust covariance matrix that allows for clustering at the state-occupation level.

Appendix Figure 1. Potential Influence of the Grandfathering of New Regulations



Appendix Table 1: Number of Observations by year and Occupations with Regulation Status

Year	**13 Universally Licensed Occupations**				**Never Licensed Occupations**	Total Observations
	Occupations that changed regulation status		Occupations that did not change regulation status			
	Unlicensed	Licensed	Unlicensed	Licensed		
1940	93,966	537,974	0	267,412	6,036,688	6,936,040
1950	67,890	106,872	0	144,134	3,382,879	3,701,775
1960	91,749	531,652	0	642,312	10,552,008	11,817,721
1970	49,050	868,550	0	1,003,150	14,281,550	16,202,300
1980	7,700	1,593,400	0	1,777,500	20,465,580	23,844,180
1990	7,178	2,671,911	0	2,701,919	28,861,852	34,242,860
2000	8,271	3,406,307	0	3,448,492	36,308,923	43,171,993
2001	7,687	3,294,787	0	3,667,307	37,471,570	44,441,351
2002	4,945	3,402,504	0	3,740,413	37,202,834	44,350,696
2003	5,225	3,606,900	0	3,952,974	36,910,947	44,476,046
2004	2,498	3,628,906	0	3,979,782	37,171,050	44,782,236
2005	4,079	3,765,824	0	4,101,747	37,426,947	45,298,597
2006	2,926	3,879,745	0	4,116,767	38,177,556	46,176,994
2007	3,931	4,004,005	0	4,320,570	38,545,224	46,873,730
2008	5,049	4,267,855	0	5,503,612	40,437,441	50,213,957
2009	2,273	4,281,765	0	5,487,982	38,491,924	48,263,944
2010	2,304	4,162,688	0	5,461,085	37,087,251	46,713,328
2011	0	4,280,152	0	5,427,271	36,558,896	46,266,319
2012	0	4,387,925	0	5,508,042	37,268,301	47,164,268
2013	0	4,312,260	0	5,599,523	37,718,347	47,630,130
2014	0	4,437,223	0	5,641,244	38,147,423	48,225,890
2015	0	4,510,568	0	5,725,103	39,020,345	49,256,016

Note: Occupations that changed their regulation status include architects, accountants, barbers, occupational therapists, physical therapists, practical nurses, and registered nurses. Occupations that did not change their regulations status include cosmetologists, dentists, physicians, pharmacists, lawyers, and teachers. We manually determine whether each occupation was ever licensed by verifying licensing status through the variable occ1990. For the 1940 census data which lacks the occ1990 variable, we made a crosswalk between occ1990 and occ1950. Data are weighted using population weights.

Appendix Table 2: Mean of Hourly Wage and Duration by year and Regulation Status for Those Whose Licensing Status Changed

	13 Universally Licensed Occupations					**Never Licensed Occupations**
	Occupations that did not change regulation status		Occupations that changed regulation status			
	Licensed		Licensed		Unlicensed	
Year	Wage	Duration	Wage	Duration	Wage	Wage
1940	17.835 (9.908)	74.666 (30.267)	12.402 (6.840)	31.559 (6.735)	9.540 (4.965)	11.969 (6.316)
1950	17.653 (8.447)	86.951 (29.584)	18.459 (7.832)	39.145 (11.368)	12.026 (4.454)	13.781 (6.489)
1960	25.045 (14.856)	90.875 (33.918)	23.240 (10.925)	38.795 (20.173)	15.416 (4.986)	20.120 (9.709)
1970	32.026 (20.557)	101.495 (33.883)	28.841 (13.787)	41.907 (24.132)	19.661 (5.988)	25.496 (14.325)
1980	31.701 (21.738)	109.630 (32.881)	25.846 (11.933)	43.606 (26.008)	22.377 (8.045)	23.984 (13.584)
1990	36.670 (32.466)	117.555 (33.145)	28.051 (14.953)	53.314 (26.211)	25.956 (9.928)	23.517 (16.906)
2000	40.308 (41.713)	129.115 (32.238)	30.436 (19.822)	60.343 (25.979)	32.299 (20.232)	26.354 (24.254)
2001	39.399 (40.879)	130.766 (31.894)	30.260 (18.462)	61.072 (26.097)	28.570 (8.816)	26.252 (24.026)
2002	40.489 (41.830)	131.590 (32.198)	31.657 (19.935)	61.723 (26.203)	27.571 (7.415)	26.152 (23.295)
2003	39.829 (38.894)	133.292 (31.928)	32.079 (19.050)	63.274 (26.196)	26.042 (7.751)	26.081 (22.188)
2004	37.983 (30.836)	133.594 (32.105)	32.865 (18.228)	63.964 (26.302)	32.144 (12.545)	26.233 (21.066)
2005	41.174 (41.021)	133.955 (32.015)	32.789 (20.162)	65.045 (26.186)	31.749 (11.718)	26.284 (23.806)
2006	40.960 (40.853)	135.086 (32.112)	32.845 (20.730)	65.963 (26.296)	29.949 (7.854)	25.911 (23.475)
2007	40.584 (41.267)	136.110 (32.026)	33.379 (21.907)	67.167 (26.165)	30.011 (9.214)	26.031 (24.094)
2008	39.054 (40.262)	140.097 (31.763)	34.274 (22.834)	67.933 (26.158)	31.987 (8.123)	26.358 (24.696)
2009	38.606 (38.294)	141.048 (31.605)	33.709 (21.357)	68.453 (25.961)	29.885 (7.520)	25.900 (23.366)
2010	38.955 (36.785)	142.128 (31.504)	34.187 (20.992)	69.150 (26.092)	41.967 (32.761)	26.262 (22.619)
2011	39.523 (37.660)	142.903 (31.432)	34.320 (21.404)	69.679 (26.186)	0.000 (0.000)	26.709 (23.085)
2012	38.689 (37.246)	143.642 (31.478)	33.444 (21.001)	70.837 (26.165)	0.000 (0.000)	26.241 (22.878)
2013	38.822 (39.350)	144.583 (31.591)	33.252 (21.204)	71.681 (26.109)	0.000 (0.000)	26.316 (23.941)
2014	38.603 (39.681)	145.733 (31.694)	32.659 (20.629)	70.968 (25.607)	0.000 (0.000)	26.599 (24.388)
2015	38.981 (41.032)	146.422 (31.791)	32.761 (21.681)	71.996 (25.655)	0.000 (0.000)	26.699 (25.126)

Note: Occupations that changed their regulation status include architects, accountants, barbers, occupational therapists, physical therapists, practical nurses, and registered nurses. Occupations that did not change their regulations status include cosmetologists, dentists, physicians, pharmacists, lawyers, and teachers. We manually determine whether each occupation was ever licensed by verifying licensing status through the variable occ1990. For the 1940 census data which lacks the occ1990 variable, we made a crosswalk between occ1990 and occ1950. Hourly real earnings were adjusted by the 2014 consumer price index (CPI). Data are weighted using population weights.

Appendix Table 3: Number of Observations by year and Median Duration

Year	**13 Universally Licensed Occupations**			**Never Licensed Occupations**	Total Observations
	Unlicensed Workers	Licensed Workers			
		≤ Median Duration	> Median Duration		
1940	93,966	711,969	93,417	6,036,688	6,936,040
1950	67,890	192,119	58,887	3,382,879	3,701,775
1960	91,749	844,348	329,616	10,552,008	11,817,721
1970	49,050	1,298,550	573,150	14,281,550	16,202,300
1980	7,700	2,281,220	1,089,680	20,465,580	23,844,180
1990	7,178	3,465,086	1,908,744	28,861,852	34,242,860
2000	8,271	3,946,757	2,908,042	36,308,923	43,171,993
2001	7,687	3,612,505	3,349,589	37,471,570	44,441,351
2002	4,945	3,745,651	3,397,266	37,202,834	44,350,696
2003	5,225	3,701,336	3,858,538	36,910,947	44,476,046
2004	2,498	3,705,699	3,902,989	37,171,050	44,782,236
2005	4,079	3,789,007	4,078,564	37,426,947	45,298,597
2006	2,926	3,820,771	4,175,741	38,177,556	46,176,994
2007	3,931	3,803,253	4,521,322	38,545,224	46,873,730
2008	5,049	3,948,385	5,823,082	40,437,441	50,213,957
2009	2,273	3,762,995	6,006,752	38,491,924	48,263,944
2010	2,304	3,564,939	6,058,834	37,087,251	46,713,328
2011	0	3,629,531	6,077,892	36,558,896	46,266,319
2012	0	3,749,062	6,146,905	37,268,301	47,164,268
2013	0	3,494,209	6,417,574	37,718,347	47,630,130
2014	0	3,708,333	6,370,134	38,147,423	48,225,890
2015	0	3,452,373	6,783,298	39,020,345	49,256,016

Note: The 13 universally licensed occupations include architects, accountants, barbers, cosmetologists, dentists, occupational therapists, physical therapists, practical nurses, physicians, pharmacists, registered nurses, lawyers, and teachers. We manually determine whether each occupation was ever licensed by verifying licensing status through the variable occ1990. For the 1940 census data which lacks the occ1990 variable, we made a crosswalk between occ1990 and occ1950. Data are weighted using population weights.

Appendix Table 4. Means and Standard Deviation of Licensed and Unlicensed Occupations: By Median Duration

VARIABLES	13 Universally Licensed Occupations			Never Licensed Occupations
	Licensed Workers		Unlicensed Workers	
	< Median Duration	≥ Median Duration		
White	0.807	0.810	0.926	0.794
	(0.394)	(0.392)	(0.262)	(0.405)
Male	0.255	0.406	0.076	0.532
	(0.436)	(0.491)	(0.265)	(0.499)
Potential Experience	21.096	19.510	17.957	22.327
	(11.130)	(11.004)	(11.157)	(11.458)
Years of Education	15.153	16.733	13.942	13.450
	(1.988)	(1.664)	(2.087)	(2.359)
Married	0.618	0.657	0.463	0.589
	(0.486)	(0.475)	(0.499)	(0.492)
Licensure	1.000	1.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Duration	60.404	139.127	0.000	0.000
	(22.392)	(28.512)	(0.000)	(0.000)
Hourly Wage (2014 CPI)	31.641	39.193	16.228	25.792
	(21.947)	(37.306)	(9.801)	(22.683)
Weeks per Year	51.325	51.185	51.253	51.325
	(0.839)	(0.823)	(0.991)	(0.814)
Hours per Week	41.875	45.081	42.870	42.977
	(7.556)	(9.702)	(6.014)	(7.681)
Hours per Year	2149.560	2307.588	2197.585	2206.053
	(391.262)	(498.567)	(313.948)	(397.182)
Accountants	0.224	0.143	0.024	0.000
	(0.417)	(0.350)	(0.153)	(0.000)
Architects	0.026	0.007	0.002	0.000
	(0.158)	(0.081)	(0.049)	(0.000)
Barbers	0.007	0.001	0.015	0.000
	(0.084)	(0.028)	(0.121)	(0.000)
Cosmetologists	0.064	0.000	0.000	0.000
	(0.244)	(0.015)	(0.000)	(0.000)
Lawyers	0.036	0.111	0.000	0.000
	(0.187)	(0.314)	(0.000)	(0.000)
Occupational Therapists	0.012	0.000	0.173	0.000
	(0.109)	(0.000)	(0.378)	(0.000)
Physical Therapists	0.031	0.000	0.001	0.000
	(0.173)	(0.000)	(0.026)	(0.000)
Practical Nurses	0.076	0.000	0.081	0.000
	(0.265)	(0.000)	(0.272)	(0.000)
Registered Nurses	0.464	0.000	0.705	0.000
	(0.499)	(0.000)	(0.456)	(0.000)
Dentists	0.003	0.016	0.000	0.000
	(0.058)	(0.124)	(0.000)	(0.000)
Physicians	0.012	0.115	0.000	0.000
	(0.110)	(0.320)	(0.000)	(0.000)
Pharmacists	0.008	0.032	0.000	0.000
	(0.090)	(0.177)	(0.000)	(0.000)
Teachers	0.037	0.575	0.000	0.000
	(0.188)_	(0.494)	(0.000)	(0.000)
Observations	986,814	1,005,589	4,639	9,243,914
Weighted Observations	68,228,098	83,930,016	366,721	687,525,536

Note: The 13 universally licensed occupations include architects, accountants, barbers, cosmetologists, dentists, occupational therapists, physical therapists, practical nurses, physicians, pharmacists, registered nurses, lawyers, and teachers. We manually determine whether each occupation was ever licensed by verifying licensing status through the variable occ1990. For the 1940 census data which lacks the occ1990 variable, we made a crosswalk between occ1990 and occ1950. Data are weighted using population weights.

Appendix Table 5: Mean of Hourly Wage and Duration by year and Median Duration

	13 Universally Licensed Occupations					**Never Licensed Occupations**
	Licensed < Median Duration		Licensed ≥ Median Duration		Unlicensed	
Year	Wage	Duration	Wage	Duration	Wage	Wage
1940	13.777 (8.167)	37.630 (15.740)	17.475 (9.297)	108.686 (9.181)	9.540 (4.965)	11.969 (6.316)
1950	18.166 (8.581)	51.339 (20.875)	17.443 (6.778)	116.372 (9.935)	12.026 (4.454)	13.781 (6.489)
1960	24.832 (14.433)	47.167 (23.558)	22.679 (9.409)	118.835 (13.261)	15.416 (4.986)	20.120 (9.709)
1970	31.636 (19.655)	50.497 (25.949)	28.083 (12.324)	126.740 (14.735)	19.661 (5.988)	25.496 (14.325)
1980	29.069 (18.069)	53.079 (27.810)	28.649 (17.939)	131.475 (18.317)	22.377 (8.045)	23.984 (13.584)
1990	30.177 (21.813)	58.643 (26.059)	36.392 (31.123)	134.576 (21.696)	25.956 (9.928)	23.517 (16.906)
2000	31.285 (24.590)	62.614 (25.045)	40.990 (41.305)	138.815 (24.807)	32.299 (20.232)	26.354 (24.254)
2001	30.601 (22.899)	61.333 (24.365)	39.899 (39.972)	137.095 (26.112)	28.570 (8.816)	26.252 (24.026)
2002	32.027 (24.340)	62.092 (24.426)	40.974 (40.869)	138.241 (26.277)	27.571 (7.415)	26.152 (23.295)
2003	32.673 (24.106)	61.245 (23.566)	39.449 (36.585)	136.952 (27.261)	26.042 (7.751)	26.081 (22.188)
2004	33.098 (20.748)	61.655 (23.469)	37.863 (29.520)	137.156 (27.438)	32.144 (12.545)	26.233 (21.066)
2005	33.231 (24.125)	62.168 (23.083)	40.811 (39.155)	137.019 (27.504)	31.749 (11.718)	26.284 (23.806)
2006	33.300 (24.686)	62.355 (22.892)	40.429 (38.656)	137.411 (27.809)	29.949 (7.854)	25.911 (23.475)
2007	32.959 (23.741)	62.261 (22.142)	40.618 (39.691)	137.176 (28.188)	30.011 (9.214)	26.031 (24.094)
2008	33.752 (25.589)	62.050 (21.596)	39.146 (38.313)	140.127 (28.728)	31.987 (8.123)	26.358 (24.696)
2009	32.280 (20.913)	60.820 (20.310)	39.078 (37.186)	139.561 (29.271)	29.885 (7.520)	25.900 (23.366)
2010	32.267 (19.700)	60.526 (19.734)	39.614 (35.818)	140.002 (29.492)	41.967 (32.761)	26.262 (22.619)
2011	32.291 (19.757)	60.778 (19.677)	40.178 (36.653)	140.380 (29.592)	0.000 (0.000)	26.709 (23.085)
2012	31.496 (19.351)	62.163 (19.776)	39.332 (36.293)	141.365 (29.454)	0.000 (0.000)	26.241 (22.878)
2013	31.298 (19.424)	60.999 (18.207)	39.176 (37.917)	141.106 (30.058)	0.000 (0.000)	26.316 (23.941)
2014	31.029 (19.334)	61.368 (17.822)	38.872 (38.268)	142.767 (30.050)	0.000 (0.000)	26.599 (24.388)
2015	31.007 (19.217)	59.069 (14.774)	38.903 (39.230)	141.391 (30.886)	0.000 (0.000)	26.699 (25.126)
Mean	31.641 (21.947)	60.404 (22.392)	39.193 (37.306)	139.127 (28.512)	16.228 (9.801)	25.792 (22.683)

Note: The 13 universally licensed occupations include architects, accountants, barbers, cosmetologists, dentists, occupational therapists, physical therapists, practical nurses, physicians, pharmacists, registered nurses, lawyers, and teachers. We manually determine whether each occupation was ever licensed by verifying licensing status through the variable occ1990. For the 1940 census data which lacks the occ1990 variable, we made a crosswalk between occ1990 and occ1950. Hourly real earnings were adjusted by the 2014 consumer price index (CPI). Data are weighted using population weights.

Appendix Table 6. Estimates of the Influence of Grandfathering on Hourly Wage

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Accountants		Architects		Teachers		OTs, PTs, Dentists, Pharmacists, Registered Nurses, Practical Nurses, and Physicians		Barbers, and Cosmetologists	
Control Group:	Relative to Workers in all other occupations within the same 2-digit SOC 2000 that were never licensed during our period of study									
	2-digit SOC: 13		2-digit SOC: 17		2-digit SOC: 25		2-digit SOC: 29		2-digit SOC: 39	
Licensure	0.158***		-0.306***		-0.090**		0.065***		-0.009	
	(0.047)		(0.071)		(0.046)		(0.014)		(0.027)	
Duration Dummies:										
Duration ∈ [0.3]				-0.308***				0.011		0.030
				(0.030)				(0.016)		(0.045)
Duration ∈ [4.10]		0.065		-0.192				0.031*		0.053
		(0.043)		(0.248)				(0.018)		(0.055)
Duration ∈ [11.20]		0.078**		-0.366**				0.021		-0.040
		(0.035)		(0.149)				(0.016)		(0.040)
Duration ∈ [21.30]		0.154***		-0.287***		-0.074		0.036**		-0.013
		(0.047)		(0.095)		(0.167)		(0.017)		(0.035)
Duration ∈ [31.40]		0.198***		-0.296***		-0.128		0.116***		0.005
		(0.058)		(0.093)		(0.120)		(0.018)		(0.043)
Duration ∈ [41.50]		0.232**		-0.631***				0.153***		-0.003
		(0.103)		(0.169)				(0.023)		(0.051)
Individual Covariates	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
State FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
3-digit SOC 2000	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
H_0: All Duration Dummies=0		0.000		0.000		0.531		0.000		0.748
R-squared	0.317	0.317	0.214	0.214	0.482	0.482	0.277	0.279	0.268	0.268
Observations	266,762	266,762	184,083	184,083	25,665	25,665	110,842	110,842	145,204	145,204

Note: All models include indicators for gender, race (white vs. others), dummies for marital status (married vs. unmarried), years of education, potential experience and a quadratic function in potential experience; *** significant at the 0.01 level; ** significant at the 0.05 level; * significant at the 0.1 level; standard errors are constructed using the heteroscedasticity robust covariance matrix that allows for clustering at the state-occupation level.

Appendix Table 7. Estimates of the Influence of Grandfathering on Hours Worked per Year

VARIABLES	(1)	(2) Accountants	(3)	(4) Architects	(5)	(6) Teachers	(7)	(8) OTs, PTs, Dentists, Pharmacists, Registered Nurses, Practical Nurses, and Physicians	(9)	(10) Barbers, and Cosmetologists
Control Group:	Relative to Workers in all other occupations within the same 2-digit SOC 2000 that were never licensed during our period of study									
	2-digit SOC: 13		2-digit SOC: 17		2-digit SOC: 25		2-digit SOC: 29		2-digit SOC: 39	
Licensure	-69.959***		-7.565		351.305***		15.043*		-6.446	
	(25.776)		(93.248)		(54.392)		(8.906)		(44.996)	
Duration Dummies:										
Duration ∈ [0.3]				39.567				-4.950		242.274***
				(84.319)				(13.562)		(70.957)
Duration ∈ [4.10]		-155.401***		-54.422				-9.156		108.896*
		(28.078)		(101.522)				(9.044)		(60.830)
Duration ∈ [11.20]		-16.505		-18.517				-1.507		-105.318**
		(25.713)		(102.968)				(9.139)		(50.433)
Duration ∈ [21.30]		-65.193**		25.662		105.850**		15.386		11.990
		(28.163)		(110.717)		(42.775)		(10.552)		(44.452)
Duration ∈ [31.40]		-84.667**		-52.160		-26.628		35.205***		-0.470
		(34.046)		(97.104)		(61.659)		(10.958)		(49.595)
Duration ∈ [41.50]		-132.299*		-84.086				37.783**		-44.003
		(69.505)		(135.542)				(18.407)		(29.118)
Individual Covariates	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
State FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
3-digit SOC 2000	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
H_0: All Duration Dummies=0		0.000		0.398		0.025		0.002		0.000
R-squared	0.073	0.073	0.027	0.027	0.194	0.194	0.058	0.059	0.061	0.061
Observations	266,762	266,762	184,083	184,083	25,665	25,665	110,842	110,842	145,204	145,204

Note: All models include indicators for gender, race (white vs. others), dummies for marital status (married vs. unmarried), years of education, potential experience and a quadratic function in potential experience; *** significant at the 0.01 level; ** significant at the 0.05 level; * significant at the 0.1 level; standard errors are constructed using the heteroscedasticity robust covariance matrix that allows for clustering at the state-occupation level.

Appendix 8. Table. Matching Summary-Licensure Effects

Panel A. 13 Universally Licensed Occupations

Control Group	Relative to Unlicensed Workers in Universally Licensed Occupations Prior to States Passing Licensing Statutes		Relative to Individuals in Never Licensed Occupations Throughout Our Period of Analysis	
Number of Strata	88		88	
Number of Matched Strata	71		87	
	Control	Treated	Control	Treated
All	4639	1992462	9,249,014	1,992,462
Matched	4639	1975526	9,249,014	1,992,462
Unmatched	0	16936	0	0

Note: The models perform coarsened exact matching on experience and marital status, and perform exact matching on race (white vs. others) and gender.

Panel B. Occupations that Changed Regulation Status over the Period of Our Analysis

Control Group	Relative to Unlicensed Workers in Universally Licensed Occupations Prior to States Passing Licensing Statutes		Relative to Individuals in Never Licensed Occupations Throughout Our Period of Analysis	
Number of Strata	87		88	
Number of Matched Strata	71		86	
	Control	Treated	Control	Treated
All	4,639	930,409	9,249,014	930,409
Matched	4,639	923,629	9,248,502	930,409
Unmatched	0	6,780	512	0

Note: The models perform coarsened exact matching on experience and marital status, and perform exact matching on race (white vs. others) and gender.

Panel C. Grandfathering

Control Group	Relative to Unlicensed Workers in Universally Licensed Occupations Prior to States Passing Licensing Statutes		Relative to Individuals in Never Licensed Occupations Throughout Our Period of Analysis	
Number of Strata	219		232	
Number of Matched Strata	141		212	
	Control	Treated	Control	Treated
All	4,639	54,667	9,249,014	54,667
Matched	4,622	53,410	9,071,839	54,667
Unmatched	17	1,257	177,175	0

Note: The models perform coarsened exact matching on education, experience, and marital status, and perform exact matching on race (white vs. others) and gender.

Appendix Table 9. Matching Summary-Duration Effects

Panel A. 13 Universally Licensed Occupations

Control Group	Relative to Unlicensed Workers in Universally Licensed Occupations Prior to States Passing Licensing Statutes								
Number of Strata	88								
Number of Matched Strata	66								
	Control	[0,3]	[4,10]	[11,20]	[21,30]	[31,40]	[41,50]	[51,100]	≥101
All	4,639	2,624	9,004	29,309	66,334	142,370	153,588	635,716	953,517
Matched	4,632	2,616	8,978	29,218	66,034	141,608	152,544	627,578	939,399
Unmatched	7	8	26	91	300	762	1,044	8,138	14,118

Note: The models perform coarsened exact matching on experience and marital status, and perform exact matching on race (white vs. others) and gender.

Control Group	Relative to Individuals in Never Licensed Occupations Throughout Our Period of Analysis								
Number of Strata	88								
Number of Matched Strata	72								
	Control	[0,3]	[4,10]	[11,20]	[21,30]	[31,40]	[41,50]	[51,100]	≥101
All	9,249,014	2,624	9,004	29,309	66,334	142,370	153,588	635,716	953,517
Matched	9,123,248	2,624	8,993	29,267	66,197	142,049	153,144	632,601	949,260
Unmatched	125,766	0	11	42	137	321	444	3,115	4,257

Note: The models perform coarsened exact matching on experience and marital status, and perform exact matching on race (white vs. others) and gender.

Panel B. Occupations that Changed Regulation Status over the Period of Our Analysis

Control Group	Relative to Unlicensed Workers in Universally Licensed Occupations Prior to States Passing Licensing Statutes								
Number of Strata	86								
Number of Matched Strata	66								
	Control	[0,3]	[4,10]	[11,20]	[21,30]	[31,40]	[41,50]	[51,100]	≥101
All	4,639	2,622	8,983	29,178	65,550	140,246	147,330	443,208	93,292
Matched	4,632	2,614	8,958	29,090	65,253	139,497	146,318	437,327	90,920
Unmatched	7	8	25	88	297	749	1,012	5,881	2,372

Note: The models perform coarsened exact matching on experience and marital status, and perform exact matching on race (white vs. others) and gender.

Control Group	Relative to Individuals in Never Licensed Occupations Throughout Our Period of Analysis								
Number of Strata	88								
Number of Matched Strata	72								
	Control	[0,3]	[4,10]	[11,20]	[21,30]	[31,40]	[41,50]	[51,100]	≥101
All	9,249,014	2,622	8,983	29,178	65,550	140,246	147,330	443,208	93,292
Matched	9,123,248	2,622	8,973	29,136	65,415	139,932	146,905	440,884	92,457
Unmatched	125,766	0	10	42	135	314	425	2,324	835

Note: The models perform coarsened exact matching on experience and marital status, and perform exact matching on race (white vs. others) and gender.

Panel C. Grandfathering

Control Group	Relative to Unlicensed Workers in Universally Licensed Occupations Prior to States Passing Licensing Statutes						
Number of Strata	219						
Number of Matched Strata	10						
	Control	[0,3]	[4,10]	[11,20]	[21,30]	[31,40]	[41,50]
All	4,639	2,503	6,533	14,887	16,925	12,745	1,074
Matched	121	122	275	924	1,645	4,225	948
Unmatched	4,518	2,381	6,258	13,963	15,280	8,520	126

Note: The models perform coarsened exact matching on education, experience, and marital status, and perform exact matching on race (white vs. others) and gender.

Control Group	Relative to Individuals in Never Licensed Occupations Throughout Our Period of Analysis						
Number of Strata	232						
Number of Matched Strata	12						
	Control	[0,3]	[4,10]	[11,20]	[21,30]	[31,40]	[41,50]
All	9,249,014	2,503	6,533	14,887	16,925	12,745	1,074
Matched	415,831	124	278	930	1,665	4,258	967
Unmatched	8,833,183	2,379	6,255	13,957	15,260	8,487	107

Note: The models perform coarsened exact matching on education, experience, and marital status, and perform exact matching on race (white vs. others) and gender.

Appendix Table 10. Difference-in-Differences Coarsened Exact Matching Estimate of Effects of Occupational Licensing Duration
Panel A. 13 Universally Licensed Occupations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Control Group:	Relative to Unlicensed Workers in Universally Licensed Occupations Prior to States Passing Licensing Statutes				Relative to Individuals in Never Licensed Occupations Throughout Our Period of Analysis			
VARIABLES	Wage		Hour		Wage		Hour	
Licensure	0.0942***		9.7145		0.1603***		-26.2131**	
	(0.035)		(38.126)		(0.034)		(11.257)	
Duration ∈ [0.3]		0.0369		-18.7743		0.0098		-27.3310*
		(0.028)		(18.565)		(0.022)		(14.101)
Duration ∈ [4.10]		0.0626***		-6.7985		0.0505***		-40.2615***
		(0.023)		(18.009)		(0.017)		(11.631)
Duration ∈ [11.20]		0.0711**		6.4769		0.0879***		-24.8470**
		(0.031)		(17.366)		(0.029)		(11.703)
Duration ∈ [21.30]		0.1192***		31.1209*		0.1458***		-40.2732***
		(0.031)		(17.440)		(0.027)		(10.597)
Duration ∈ [31.40]		0.1674***		58.6464***		0.2249***		-52.3240***
		(0.035)		(19.467)		(0.028)		(11.065)
Duration ∈ [41.50]		0.1989***		78.9447***		0.2320***		-64.4307***
		(0.035)		(21.442)		(0.026)		(10.242)
Duration ∈ [51.100]		0.3319***		226.6318***		0.2624***		-54.2486***
		(0.039)		(32.307)		(0.025)		(11.189)
Duration > 100		0.4913***		417.5863***		0.2863***		-44.7658***
		(0.039)		(48.219)		(0.027)		(14.047)
Individual Covariates	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
State FE	YES	YES	YES	YES	YES	YES	YES	YES
13 Occupational Dummies	NO	NO	NO	NO	YES	YES	YES	YES
3-digit SOC 2000	YES	YES	YES	YES	YES	YES	YES	YES
H_0: All Duration Dummies=0		0.000		0.000		0.000		0.000
R-squared	0.418	0.426	0.081	0.117	0.441	0.426	0.134	0.117
Observations	1,980,108	1,972,551	1,980,108	1,972,551	11,240,956	11,106,872	11,240,956	11,106,872

Note: All models perform coarsened exact matching on experience and marital status, and perform exact matching on race (white vs. others) and gender. Since some imbalances may still exist because we used only a few variables in the exact matching, we try to adjust for the remaining imbalances by controlling for actual values of the covariates in a regression.; *** significant at the 0.01 level; ** significant at the 0.05 level; * significant at the 0.1 level; standard errors are constructed using the heteroscedasticity robust covariance matrix that allows for clustering at the state-occupation level.

Panel B. Occupations that Changed Regulation Status over the Period of Our Analysis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Control Group:	Relative to Unlicensed Workers in Universally Licensed Occupations Prior to States Passing Licensing Statutes				Relative to Individuals in Never Licensed Occupations Throughout Our Period of Analysis			
VARIABLES	Wage		Hour		Wage		Hour	
Licensure	0.0989***		-40.6141**		0.1763***		-26.1576**	
	(0.028)		(16.415)		(0.035)		(11.573)	
Duration ∈ [0.3]		0.0375		-36.9260**		0.0117		-31.1140**
		(0.028)		(16.967)		(0.022)		(14.328)
Duration ∈ [4.10]		0.0624**		-34.8936**		0.0509***		-41.4121***
		(0.025)		(15.432)		(0.018)		(11.715)
Duration ∈ [11.20]		0.0755**		-18.5412		0.0884***		-27.6281**
		(0.033)		(17.504)		(0.029)		(11.816)
Duration ∈ [21.30]		0.1287***		-21.8087		0.1467***		-44.6546***
		(0.034)		(16.949)		(0.027)		(10.929)
Duration ∈ [31.40]		0.1667***		-21.3510		0.2298***		-56.7624***
		(0.036)		(17.634)		(0.028)		(11.226)
Duration ∈ [41.50]		0.1844***		-25.7836		0.2359***		-68.5525***
		(0.036)		(17.540)		(0.026)		(10.320)
Duration ∈ [51.100]		0.2161***		-18.0625		0.2722***		-59.1496***
		(0.035)		(18.192)		(0.025)		(11.095)
Duration > 100		0.2268***		0.6907		0.2960***		-42.7934***
		(0.040)		(19.161)		(0.027)		(12.232)
Individual Covariates	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
State FE	YES	YES	YES	YES	YES	YES	YES	YES
7 Occupational Dummies	NO	NO	NO	NO	YES	YES	YES	YES
3-digit SOC 2000	YES	YES	YES	YES	YES	YES	YES	YES
H_0: All Duration Dummies=0		0.000		0.000		0.000		0.000
R-squared	0.273	0.262	0.060	0.056	0.407	0.409	0.104	0.094
Observations	928,241	924,582	928,241	924,582	10,178,422	10,049,091	10,178,422	10,049,091

Note: All models perform coarsened exact matching on experience and marital status, and perform exact matching on race (white vs. others) and gender. Since some imbalances may still exist because we used only a few variables in the exact matching, we try to adjust for the remaining imbalances by controlling for the actual values of the covariates in a regression.; *** significant at the 0.01 level; ** significant at the 0.05 level; * significant at the 0.1 level; standard errors are constructed using the heteroscedasticity robust covariance matrix that allows for clustering at the state-occupation level.

Appendix Table 11. Difference-in-Differences Coarsened Exact Matching Estimate of Grandfathering

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Control Group:	Relative to Unlicensed Workers in Universally Licensed Occupations Prior to States Passing Licensing Statutes				Relative to Individuals in Never Licensed Occupations Throughout Our Period of Analysis			
VARIABLES	Wage		Hour		Wage		Hour	
Licensure	0.0769**		-16.8276		0.2043***		-23.9352	
	(0.033)		(16.222)		(0.031)		(14.729)	
Duration ∈ [0.3]		0.1234***		-50.3700		0.0576		-55.6863
		(0.046)		(40.141)		(0.047)		(45.397)
Duration ∈ [4.10]		0.1481***		-10.6997		0.1199**		-11.0775
		(0.049)		(33.169)		(0.048)		(50.427)
Duration ∈ [11.20]		0.1405***		-67.9066*		0.1152**		-53.2871
		(0.040)		(37.254)		(0.047)		(42.437)
Duration ∈ [21.30]		0.1937***		-62.8947		0.2348***		-62.5876*
		(0.050)		(39.416)		(0.039)		(37.213)
Duration ∈ [31.40]		0.2483***		-39.3695		0.3861***		-49.5918
		(0.056)		(41.315)		(0.045)		(39.577)
Duration ∈ [41.50]		0.2672***		-62.7987		0.3860***		-74.5001
		(0.067)		(53.897)		(0.045)		(45.556)
Individual Covariates	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
State FE	YES	YES	YES	YES	YES	YES	YES	YES
13 Occupational Dummies	NO	NO	NO	NO	YES	YES	YES	YES
3-digit SOC 2000	YES	YES	YES	YES	YES	YES	YES	YES
H_0: All Duration Dummies=0		0.002		0.329		0.000		0.165
R-squared	0.431	0.261	0.046	0.027	0.317	0.219	0.098	0.067
Observations	58,031	8,259	58,031	8,259	9,126,061	424,040	9,126,061	424,040

Note: All models perform coarsened exact matching on education, experience, and marital status, and perform exact matching on race (white vs. others) and gender. Since some imbalances may still exist because we used only a few variables in the exact matching, we try to adjust for the remaining imbalances by controlling for the actual values of the covariates in a regression.; *** significant at the 0.01 level; ** significant at the 0.05 level; * significant at the 0.1 level; standard errors are constructed using the heteroscedasticity robust covariance matrix that allows for clustering at the state-occupation level.

Appendix Table 12. The Estimated Impact of Occupational Licensing on Hourly Wage

Panel A.13 Universally Licensed occupations

VARIABLES	(1) Hourly Wage	(2) Hourly Wage	(3) Hours Worked per Year	(4) Hours Worked per Year
Leads and Lags:				
$Licensure_{t+15,t+13}$	0.011	-0.008	18.931	-12.948
	(0.031)	(0.032)	(42.096)	(32.297)
$Licensure_{t+12,t+10}$	-0.034	-0.036	-26.670	-35.810
	(0.039)	(0.044)	(37.808)	(25.494)
$Licensure_{t+9,t+7}$	0.010	0.001	-86.538***	-89.236***
	(0.032)	(0.032)	(26.704)	(23.136)
$Licensure_{t+6,t+4}$	-0.030	-0.022	-157.517***	-106.120***
	(0.038)	(0.037)	(42.001)	(32.578)
$Licensure_{t+3,t+1}$	-0.044	-0.048	-94.897***	-99.799***
	(0.037)	(0.036)	(27.279)	(20.357)
$Licensure_{t,t-2}$	-0.008	-0.014	-97.623***	-106.360***
	(0.027)	(0.028)	(33.289)	(22.625)
$Licensure_{t-3,t-5}$	-0.034	-0.032	-161.304***	-136.146***
	(0.036)	(0.036)	(34.263)	(22.513)
$Licensure_{t-6,t-8}$	0.016	0.006	-126.498***	-132.923***
	(0.036)	(0.034)	(31.815)	(20.097)
$Licensure_{t-9,t-11}$	0.006	0.006	-118.614***	-119.674***
	(0.031)	(0.032)	(33.754)	(21.136)
$Licensure_{t-12,t-14}$	0.037	0.026	-86.437**	-103.890***
	(0.048)	(0.046)	(40.335)	(24.025)
$Licensure_{t-15,t-17}$	0.017	0.008	-115.655***	-131.849***
	(0.037)	(0.037)	(39.016)	(22.331)
$Licensure_{t-18,t-20}$	-0.001	-0.004	-120.473***	-124.081***
	(0.037)	(0.040)	(39.732)	(23.559)
$Licensure_{t-21,t-23}$	0.053	0.039	-102.160***	-127.835***
	(0.035)	(0.036)	(35.966)	(20.839)
$Licensure_{t-24,t-26}$	0.042	0.042	-122.565***	-123.832***
	(0.037)	(0.037)	(39.715)	(22.521)
$Licensure_{t-27,t-29}$	0.028	0.015	-123.347***	-152.782***
	(0.036)	(0.038)	(38.640)	(23.662)
$Licensure_{t-30,t-32}$	0.047	0.027	-124.300***	-163.629***
	(0.034)	(0.036)	(36.054)	(22.129)
$Licensure_{t-33\ forward}$	0.141***	0.047	-36.381	-168.112***
	(0.036)	(0.038)	(38.925)	(22.650)
3-digit SOC 2000	YES	NO	YES	NO
13 Occupational Dummies	NO	YES	NO	YES
Year FE	YES	YES	YES	YES
State FE	YES	YES	YES	YES
H_0: Lags = 0	0.000	0.007	2.02e-07	0
H_0: Leads = 0	0.216	0.723	4.06e-05	7.52e-10
R-squared	0.440	0.455	0.112	0.194
Observations	1,997,042	1,997,042	1,997,042	1,997,042

Note: All models include indicators for gender, race (white vs. others), dummies for marital status (married vs. unmarried), years of education, potential experience and a quadratic function in potential experience; *** significant at the 0.01 level; ** significant at the 0.05 level; * significant at the 0.1 level; standard errors are constructed using the heteroscedasticity robust covariance matrix that allows for clustering at the state-occupation level.

Panel B. Occupations that Changed Their Regulation Status over the Period of Our Analysis

VARIABLES	(1) Hourly Wage	(2) Hourly Wage	(3) Hours Worked per Year	(4) Hours Worked per Year
Leads and Lags:				
$Licensure_{t+15,t+13}$	0.017	0.020	-17.768	-26.559
	(0.030)	(0.030)	(31.291)	(31.403)
$Licensure_{t+12,t+10}$	0.001	0.000	-44.822*	-41.531*
	(0.041)	(0.041)	(23.141)	(22.182)
$Licensure_{t+9,t+7}$	0.038	0.037	-92.462***	-88.963***
	(0.031)	(0.031)	(22.959)	(22.826)
$Licensure_{t+6,t+4}$	0.034	0.027	-133.442***	-108.470***
	(0.036)	(0.035)	(36.855)	(34.730)
$Licensure_{t+3,t+1}$	-0.024	-0.023	-112.346***	-114.919***
	(0.037)	(0.037)	(18.423)	(19.336)
$Licensure_{t,t-2}$	0.022	0.023	-124.009***	-126.015***
	(0.030)	(0.030)	(25.174)	(22.659)
$Licensure_{t-3,t-5}$	0.018	0.016	-150.797***	-139.042***
	(0.039)	(0.038)	(24.456)	(22.431)
$Licensure_{t-6,t-8}$	0.051	0.054	-131.004***	-135.376***
	(0.036)	(0.036)	(21.390)	(19.239)
$Licensure_{t-9,t-11}$	0.045	0.048	-106.312***	-118.710***
	(0.030)	(0.030)	(24.944)	(21.821)
$Licensure_{t-12,t-14}$	0.046	0.049	-114.420***	-120.387***
	(0.046)	(0.046)	(24.947)	(22.929)
$Licensure_{t-15,t-17}$	0.054	0.059	-130.672***	-143.898***
	(0.038)	(0.039)	(24.946)	(21.283)
$Licensure_{t-18,t-20}$	0.040	0.043	-119.818***	-132.738***
	(0.042)	(0.043)	(26.228)	(22.714)
$Licensure_{t-21,t-23}$	0.081**	0.088**	-121.543***	-142.637***
	(0.036)	(0.037)	(25.446)	(21.189)
$Licensure_{t-24,t-26}$	0.093**	0.100***	-127.590***	-134.836***
	(0.037)	(0.037)	(27.122)	(22.758)
$Licensure_{t-27,t-29}$	0.082**	0.092**	-136.743***	-162.922***
	(0.040)	(0.042)	(25.473)	(22.454)
$Licensure_{t-30,t-32}$	0.100***	0.110***	-142.825***	-176.339***
	(0.035)	(0.038)	(25.738)	(22.428)
$Licensure_{t-33\ forward}$	0.121***	0.132***	-146.561***	-185.472***
	(0.037)	(0.040)	(25.810)	(22.801)
3-digit SOC 2000	YES	NO	YES	NO
Occupational Dummies	NO	YES	NO	YES
Year FE	YES	YES	YES	YES
State FE	YES	YES	YES	YES
H_0: Lags = 0	0.000	1.09e-08	6.96e-09	0.000
H_0: Leads = 0	0.447	0.511	0.000	0.000
R-squared	0.296	0.296	0.075	0.075
Observations	935,020	935,020	935,020	935,020

Note: All models include indicators for gender, race (white vs. others), dummies for marital status (married vs. unmarried), years of education, potential experience and a quadratic function in potential experience; *** significant at the 0.01 level; ** significant at the 0.05 level; * significant at the 0.1 level; standard errors are constructed using the heteroscedasticity robust covariance matrix that allows for clustering at the state-occupation level.

Appendix Table 13. Effects of Licensing Duration on Log Hourly Earnings and Annual Hours Worked of Non-Teachers: 12 Universally Licensed Occupations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Non-Teachers: 12 Universally Licensed Occupations							
	Hourly Wage				Hours Worked per Year			
Licensure	0.081***	0.034			-6.976	-68.416***		
	(0.023)	(0.023)			(32.207)	(14.873)		
Duration Dummies:								
Duration ∈ [0.3]			0.023	0.001			-16.807	-43.731***
			(0.026)	(0.023)			(18.652)	(16.758)
Duration ∈ [4.10]			0.049***	0.023			-25.124	-57.333***
			(0.019)	(0.018)			(18.638)	(14.568)
Duration ∈ [11.20]			0.060**	0.038			-7.917	-50.246***
			(0.025)	(0.024)			(18.031)	(15.668)
Duration ∈ [21.30]			0.081***	0.050**			-9.383	-74.287***
			(0.026)	(0.025)			(18.132)	(16.172)
Duration ∈ [31.40]			0.108***	0.058*			9.784	-91.144***
			(0.030)	(0.031)			(19.406)	(18.090)
Duration ∈ [41.50]			0.134***	0.061*			33.759	-97.927***
			(0.031)	(0.032)			(22.275)	(19.048)
Duration ∈ [51.100]			0.242***	0.079**			143.840***	-94.672***
			(0.034)	(0.034)			(30.378)	(21.413)
Duration > 100			0.383***	0.090**			319.237***	-92.813***
			(0.038)	(0.043)			(46.042)	(26.839)
Individual Covariates	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
State FE	YES	YES	YES	YES	YES	YES	YES	YES
13 Occupational Dummies	NO	YES	NO	YES	NO	YES	NO	YES
3-digit SOC 2000	YES	NO	YES	NO	YES	NO	YES	NO
H_0: All Duration Dummies=0			0.000	0.169			0.000	0.000
R-squared	0.404	0.424	0.416	0.424	0.143	0.243	0.171	0.243
Observations	1,346,917	1,346,917	1,346,917	1,346,917	1,346,917	1,346,917	1,346,917	1,346,917

Note: All models include indicators for gender, race (white vs. others), dummies for marital status (married vs. unmarried), years of education, potential experience and a quadratic function in potential experience; *** significant at the 0.01 level; ** significant at the 0.05 level; * significant at the 0.1 level; standard errors are constructed using the heteroscedasticity robust covariance matrix that allows for clustering at the state-occupation level.

Appendix Table 14. Teacher's Regulation Data

State Name	Year of Initial Licensure	Statute/Source
Alabama	1822	AL. General Assembly, 4th Annual Session 1822, pp. 73
Alaska	1962	AK. 2nd Legislature, 2nd Session 1962, Ch. 76, S.B. 188
Arizona	1901	AZ. 21st Legislative Assembly, Title 19, Ch. XII, pp. 607.
Arkansas	1866	AR. 16th General Assembly, Regular Session 1866, Act 160
California	1851	CA. 2nd Session 1851, Ch. 126
Colorado	1859	CO. 1st and Called Sessions 1859, Ch. 1
Connecticut	1839	CT. May Session, Public Acts 1839, Ch. 1
Delaware	1875	DE. General Assembly, Regular Session 1875
District of Columbia	1906	34 Stat. 316
Florida	1903	FL. 9th Regular Session 1903. Ch. 5204, No. 99.
Georgia	1859	GA. Annual Session 1859, Act 118
Hawaii	1920	HI. 11th Legislature, 1920 Special Session, Act 36, S.B. 18
Idaho	1865	ID. 3rd Session 1865, Title VI
Illinois	1836	IL. 10th General Assembly, 1st Session 1836,
Indiana	1824	IN. General Laws, 8th Session 1824, Ch. XCVII
Iowa	1862	IA. 9th General Assembly, Regular Session 1862, Ch. 172
Kansas	1855	KS. 1st Session 1855, Article II
Kentucky	1837	KY. General Assembly, Regular Session 1837, Ch. 808.
Louisiana	1870	LA. 1st Legislature, Extraordinary Session, Act 6.
Maine	1849	ME. 27th Legislature, Regular Session 1849, Ch. 25.
Maryland	1865	MD. General Assembly, January Session 1865, Ch. 160.
Massachusetts	1894	MA. Acts & Resolves, January Session 1894, Ch. 329.
Michigan	1837	MI. Annual Session 1837, Act No. LXIII.
Minnesota	1859	MN. General Laws, 2nd Session, Ch. XLVI.
Mississippi	1846	MS. Regular Session 1846, Ch. 2.
Missouri	1838	MO. 10th General Assembly, 1st Session, Art. III.
Montana	1901	MT. 7th Regular Assembly, Regular Session 1901, H.B. 177
Nebraska	1855	NE. 2nd Session 1855, Ch. XVIII.
Nevada	1862	NV. 2nd Regular Session 1862, Ch. CI.
New Hampshire	1836	NH. November Session 1836, Ch. CCCXI.
New Jersey	1828	NJ. 53rd General Assemly, 2nd Sitting, pp. 105.
New Mexico	1907	NM. 37th Legislative Assembly 1907, Ch. 97.
New York	1819	NY. 42nd Legislature, 1819, Ch. CLXI.
North Carolina	1855	NC. Public Laws, Regular Session 1855, Ch. 27
North Dakota	1911	ND. 12th Session 1911, Ch. 266, S.B. 60
Ohio	1824	OH. 23rd General Assembly, General Acts 1824, pp. 36
Oklahoma	1915	OK. 5th Legislature, Regular Session 1915, Ch. 114
Oregon	1850	OR. General Laws, 2nd Regular Session 1850, pp. 66
Pennsylvania	1840	PA. General Laws 1840, Ch. DIV.
Rhode Island	1907	RI. January Session 1907, Ch. 1468
South Carolina	1835	SC. Regular Session 1835, Ch. IV
South Dakota	1901	SD. 7th Legislative Session 1901, Ch. VI.

Tennessee	1913	TN. 58th General Assembly, Public Acts, 1913, Ch. 40, H.B. 174
Texas	1839	TX. 4th Republic Congress, 1st Session 1839, pp. 148
Utah	1876	UT. Compiled Laws, 22nd Session 1876, Ch. II
Vermont	1880	VT. 6th Biennial Session 1880, Act 100
Virginia	1844	VA. 1844-1845 Session, Ch. 26
Washington	1859	WA. 7th Regular Session 1859, Ch. III
West Virginia	1868	WV. 1st Legislature, Regular Session 1868, Ch. 187
Wisconsin	1838	WI. 2nd Legislature, 1st Session 1838, pp.137
Wyoming	1869	WY. 1st Legislative Assembly 1869, Ch. 7

Appendix Table 15. Effects of Licensing Duration on Labor Market Outcomes of Part-time and Full-time Workers

Panel A. 13 Universally Licensed Occupations

	(1)	(2)	(3)	(4)	(5)	(6)
Control Group:	Relative to Unlicensed Workers in Universally Licensed Occupations Prior to States Passing Licensing Statutes					
	Hourly Wage			Hours Worked per Year		
Licensure	0.064**			26.493		
	(0.032)			(33.962)		
Duration		0.003***			2.862***	
		(0.000)			(0.399)	
Duration Dummies:						
Duration ∈ [0.3]			-0.018			-28.581
			(0.019)			(17.657)
Duration ∈ [4.10]			0.016			-34.918**
			(0.017)			(17.254)
Duration ∈ [11.20]			0.037*			-15.902
			(0.022)			(17.922)
Duration ∈ [21.30]			0.061***			26.548
			(0.021)			(19.634)
Duration ∈ [31.40]			0.094***			71.537***
			(0.023)			(19.253)
Duration ∈ [41.50]			0.124***			73.312***
			(0.024)			(20.979)
Duration ∈ [51.100]			0.222***			196.424***
			(0.027)			(29.867)
Duration > 100			0.341***			351.375***
			(0.028)			(43.762)
Individual Covariates	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
State FE	YES	YES	YES	YES	YES	YES
3-digit SOC 2000	YES	YES	YES	YES	YES	YES
H_0: All Duration Dummies=0			0.000			0.000
R-squared	0.399	0.408	0.407	0.137	0.149	0.150
Observations	2,859,159	2,859,159	2,859,159	2,859,159	2,859,159	2,859,159

Note: All models include indicators for gender, race (white vs. others), dummies for marital status (married vs. unmarried), years of education, potential experience and a quadratic function in potential experience; *** significant at the 0.01 level; ** significant at the 0.05 level; * significant at the 0.1 level; standard errors are constructed using the heteroscedasticity robust covariance matrix that allows for clustering at the state-occupation level.

Panel B. Occupations that Changed Their Regulation Status over the Period of Our Analysis

	(1)	(2)	(3)	(4)	(5)	(6)
Control Group:	Relative to Unlicensed Workers in Universally Licensed Occupations Prior to States Passing Licensing Statutes					
	Hourly Wage			Hours Worked per Year		
Licensure	0.045*			-21.974		
	(0.023)			(23.238)		
Duration		0.002***			1.139***	
		(0.000)			(0.163)	
Duration Dummies:						
Duration ∈ [0.3]			-0.017			-39.460*
			(0.022)			(21.877)
Duration ∈ [4.10]			0.018			-43.558**
			(0.019)			(18.730)
Duration ∈ [11.20]			0.036			-25.765
			(0.023)			(20.418)
Duration ∈ [21.30]			0.069***			-11.141
			(0.025)			(21.868)
Duration ∈ [31.40]			0.092***			8.431
			(0.025)			(22.341)
Duration ∈ [41.50]			0.102***			9.174
			(0.026)			(23.338)
Duration ∈ [51.100]			0.131***			21.577
			(0.024)			(24.218)
Duration > 100			0.139***			43.128*
			(0.031)			(25.452)
Individual Covariates	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
State FE	YES	YES	YES	YES	YES	YES
3-digit SOC 2000	YES	YES	YES	YES	YES	YES
H_0: All Duration Dummies=0			0.000			0.000
R-squared	0.274	0.274	0.274	0.091	0.091	0.091
Observations	1,134,822	1,134,822	1,134,822	1,134,822	1,134,822	1,134,822

Note: All models include indicators for gender, race (white vs. others), dummies for marital status (married vs. unmarried), years of education, potential experience and a quadratic function in potential experience; *** significant at the 0.01 level; ** significant at the 0.05 level; * significant at the 0.1 level; standard errors are constructed using the heteroscedasticity robust covariance matrix that allows for clustering at the state-occupation level.

Appendix Table 16. Heterogeneous Licensure Wage Effects Across Different Occupations and Median Years of Initial Licensure

Occupation	Licensure Wage Effect	Median Year of Initial Licensure	Mean Years of Duration	Number of Workers in Each Occupation in ACS 2015
Teacher	-0.129	1859	152.268	3,661,747
Lawyer	0.419	1882	121.489	777,598
Pharmacist	0.685	1887	111.730	218,885
Dentist	0.951	1888	115.061	96,112
Physician	1.009	1893	116.165	695,195
Accountant	0.052	1912	91.855	1,518,308
Architect	-0.241	1925	83.927	128,051
Barber	-0.013	1929	67.954	28,884
Cosmetologist	0.090	1931	70.984	275,566
Registered Nurse	0.000	1958	46.735	2,227,736
Physical Therapist	0.038	1958	44.712	170,138
Practical Nurse	-0.034	1966	42.380	365,627
Occupational Therapist	-0.010	1984	19.723	71,824

Note: Occupations are ordered by the median year of initial licensure. "Median Year of Initial Licensure" is the median year of initial licensure across all 50 states for each occupation. "Mean Years of Duration" is the mean years of duration across individuals for each occupation in our main sample.