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ORIGINAL ARTICLE

Analyzing occupational licensing among the states

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Abstract The study provides new evidence of the influence of occupational regulations on the U.S. economy. Our analysis, unlike previous studies, was able to obtain a representative sample of the population at the state level, which allowed us to estimate the cross-sectional effects of occupational licensing for each state. The state-level analysis demonstrates considerable variation in percentage of the workforce that has attained a license, and unlike minimum wages or unionization, licensing shows no regional patterns in the distribution of occupational licensing. The analysis also shows considerable variation in the influence of licensing on earnings across the states. The national estimates suggest that occupational licensing raises wages by about 11% after controlling for human capital and other observable characteristics. Finally, our analysis shows the influence of occupational regulation on wage inequality across the income distribution.

Keywords Occupational licensing · Wage determination with occupational licensing · Income inequality with occupational licensing

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1 Introduction

The study of occupational regulations has a long and distinguished tradition in economics (Smith 1937). Some economists have viewed such regulations as rent-seeking behavior and have empirically examined the economic effect of occupational licensing within that framework (Friedman and Kuznets 1945; Friedman 1962). In contrast, others have suggested that regulations provide incentives for workers to enhance their human capital through greater investments in their work life by limiting low skilled substitutes (Shapiro 1986).

Occupational licensing has become an increasingly important factor in the regulation of services in the United States. The number of occupations that require licenses from government in order to work has grown since the 1970s, and the percentage licensed has been increasing as well (Greene 1969; Kleiner 2006). The number of studies analyzing the labor market institution of occupational regulation, however, has not been growing proportionately.

One of the largest barriers standing in the way of analyzing occupational regulation has been the absence of well-organized national data available for the examination of the influence of attaining an occupational license on wages. Since governmental occupational regulations are largely at the state level and vary greatly, the purpose of this study is to examine the level and the influence of occupational regulations across states using a representative sample of occupational licensing attainment of the U.S. population specifically collected for this study. Unlike previous surveys, we were able to obtain a representative sample of the population at the state level which allowed us to estimate the cross-sectional effects of occupational licensing on wage determination for each state for the first time.

Initially, we show estimates of licensing attainment on a state by state basis and find that there is considerable variation. Also, we find that licensing raised the earnings of regulated workers in 16 states. Second, the estimates show that the average increase in earnings due to licensing was approximately 11% nationally in 2013. Finally, we show that occupational licensing exacerbates relative income inequality across the wage distribution.

2 Background on occupational licensing

Occupational regulation in the United States generally takes three forms. The least restrictive form is registration, in which individuals file their names, addresses, and qualifications with a government agency before practicing their occupations. The registration process may include posting a bond or filing a fee. In contrast, certification permits any person to perform the relevant tasks, but the government—or sometimes a private nonprofit agency—administers an examination and certifies those who have achieved the level of skill and knowledge for certification. For example, travel agents and car mechanics are generally certified but not licensed. The toughest form of regulation is licensure; this form of regulation is often referred to as "the right to practice."

Occupational licensure is the legal process by which governments (mostly U.S states but also local governments and the federal government) identify the legal qualifications

required to work in a trade or profession, after which only regulated practitioners are allowed by law to receive pay for doing tasks in the occupation. This form of labor market regulation has rapidly become one of the most significant factors affecting labor markets in the United States (Kleiner and Krueger 2010, 2013). Over the past several decades, the share of U.S. workers holding an occupational license has grown sharply. Estimates from a recent White House report suggest that over 1100 occupations are regulated in at least one state, but fewer than 60 are regulated in all 50 states, showing substantial differences in which states chose to regulate occuptions (U.S. Executive Office of the President 2015). As of 2015, about 25% of the U.S. workforce had attained an occupational license, with the vast majority doing so at the state level (U.S. Bureau of Labor Statistics 2016). In contrast, in 1950 only 5 percent of U.S. workers were licensed at the state level (Kleiner and Krueger 2013).

Occupational licensing is usually designed to function as a form of consumer protection, ensuring high quality of service and protecting buyers from adverse health and safety outcomes by regulating out incompetents through limiting providers to those who have attained licensure. However, by establishing minimum qualifications and norms to practice a trade or profession, occupational licensing also may create entry restrictions into these occupations and potential barriers to enter the occupation from other political jurisdictions, thereby reducing the supply of regulated services. The reduction in the supply of labor created by occupational licensing has been shown to increase the price of these services and to generate possible monopoly rents for those in the licensed occupation (Kleiner et al. 2016).[1]

3 Data

One of the major issues facing researchers analyzing the labor market effects of licensing and certification at the state level has been the lack of data on wages and the labor market characteristics of regulated workers. Although occupational associations, such as the American Bar Association and the American Dental Association have started collecting wage and salary data as well as the number of new entrants and pass rates by state as early as in 1980s, such information is no longer generally released to the public or researchers. Moreover, state licensing boards either do not have data on regulation, or if they do, they cannot link it to information on wage or other characteristics of the workers. Consequently, economists or other social scientists interested in studying occupational licensing have to generate their own survey data. For example, Kleiner and Krueger employed Gallup and Westat to conduct smaller surveys to collect data that would allow them to estimate the effects of occupational licensing on wage determination (Kleiner and Krueger 2010, 2013). Although these data sets were representative at the national level, they were too small to be representative at the state level.

[1] The potential rents generated by restricted entry into an occupation have long been recognized by economists. Adam Smith, in his 1776 work *The Wealth of Nations* (Smith 1776), notes that trades conspired to reduce the availability of "skilled craftsmen" in order to raise wages. Friedman and Kuznets and Friedman recognized that members of an occupation worked in their own self-interest to restrict supply, increase demand, and maximize "profits" for members of their occupation (Friedman and Kuznets 1945; Friedman 1962). Empirical estimates for the price effects are summarized in Kleiner (2006, pp. 60–61).

Our analysis was able to obtain a representative sample of the population at the state level. Consequently, we provide an analysis of occupational licensing and certification at the state level for the first time. In order to estimate the influence of occupational regulation on wage determination, we use the results of a workforce survey conducted by Harris Poll Interactive, a subsidiary of the Nielsen Company. The survey asked detailed questions on occupational regulations as well as questions on the labor market status of individuals. The survey questions on occupational licensing were initially developed as part of the Princeton Data Improvement Initiative (PDII) conducted by Westat (see Kleiner and Krueger 2013). These questions probe the kind of government regulations required to perform a job, the process of becoming licensed, and the level of education and tests necessary to become licensed. Results of the Harris Survey, as well as separate validation results from related Westat and Gallup surveys, indicate that occupational licensing can be reasonably well measured by labor force surveys.[2]

4 The survey instrument and design

In 2013, the Harris polling organization conducted an interactive state survey on behalf of the Institute for Justice (IJ) funded by the Templeton Foundation. The IJ provided Harris with a draft of a questionnaire that was patterned after the PDII. The IJ and Harris collaborated in finalizing the questions' order and wording. Several questions regarding the respondents' employers, job activities, and demographics were taken from the CPS. Harris staff pretested the survey with dozens of volunteer respondents from their regular representative sample of the U.S.

Harris conducted the survey in early and mid-2013. Individuals age 18 or older who were in the labor force were eligible for the survey. A total of 9850 individuals were interviewed. We limit our analysis to those who were employed at the time of the survey or had a job during the previous 12 months. The Harris Survey was able to collect a representative sample of the population for each state, and the sample was four times larger than the samples used by Kleiner and Krueger (2010, 2013) in their studies.

Harris developed survey weights to compensate for variation in selection probabilities, differential response rates, and possible under coverage of the sampling frame. The derivation of the sample weights focused primarily on matching the marginal distributions of the CPS by sex, age, educational attainment, census region, urbanization, race, Hispanic ethnicity, employment status, and class of employer (private, government, and so on).

We used a module to assess the accuracy of self-reported occupational licensing and certification. The key questions were as follows:

Question 11. Do you have a license or certification that is required by a federal, state or local government agency to do your job?

YES 1
NO 2
IN PROCESS/WORKING ON IT..... 3

[2] In the Table 11 of "Appendix 1", we show the occupational distribution of individuals in the sample, and it is largely similar to other national surveys such as the American Community Survey.

Question 11a. Would someone who does not have a license or certificate be legally allowed to do your job?

YES 1
NO 2

Question 12. Is everyone who does your job eventually required to have a license or certification by a federal, state or local government agency?

YES 1
NO 2

Those who answered affirmatively to question 11 were asked additional questions about the requirements they needed to satisfy, such as achieving a high school or college degree, passing a test, demonstrating certain skills, or completing an internship or apprenticeship. The objective was to obtain measures of licensing attainment rather than measures for individuals who may be covered by licensing laws, but are not licensed (Gittleman and Kleiner 2016).

The Current Population Survey (CPS) started collecting information on occupational licensing in 2015 (U.S. Bureau of Labor Statistics 2016). Unfortunately there are some potential issues with accuracy of collected data due to the way the questions were asked.

For example, the CPS data does not allow researchers to distinguish between respondents who have earned licenses and respondents who have earned certifications. Both credentials signal a worker's quality to potential employers in markets characterized by asymmetric information. However, as mentioned earlier there is a fundamental difference between these two credentials. By law, only licensed practitioners are allowed to provide licensed services for pay, while certified services could be provided by both certified and uncertified practitioners.

The definition used by the CPS assumes that licensing regulations may require practitioners to obtain only government-issued credentials, and that privately issued credentials may not serve as a legal basis for restricting the right to practice. The assumption is likely invalid for many occupations. One additional disadvantage of this criterion is that the questions only asked respondents about the characteristics of their newest credential. Therefore, the CPS classification will suffer from measurement error because some workers may have obtained both a license and a certification. In addition, some respondents may incorrectly answer that a private entity issued their credentials when in fact it was a government agency, or vice versa. For all these reasons the use of either the Westat Survey or the Harris Survey should provide more precise estimates of licensing attainment. We restrict the sample to respondents who provided valid data on their occupational affiliation.

The results of the analysis are shown in Table 1 and Figs. 1 and 2. We find that 28.43% of the respondents answered that they were either licensed or certified. Approximately 6.75% were individuals who did not have a license, but could do the work, which is the definition of government certification. Another 1.79% stated that all who worked would eventually be required to be certified or licensed, bringing the total that are or eventually must be licensed or certified by government to 30.22%. This value is lower than the 38% found by Kleiner and Krueger (2013) in the survey conducted by Westat in 2008 for workers who are (or eventually must be) licensed or certified.

Table 1 Regulated versus Non-regulated workers

Variable	%	SD(%)
Licensed Workers	21.68	41.21
Certified Workers	6.75	25.08
In Process of Obtaining License	0.39	6.26
In Process of Obtaining Certificate	1.40	11.77
Non-regulated Workers Who do not Plan to Become Regulated	69.78	45.93
Total	100.00	

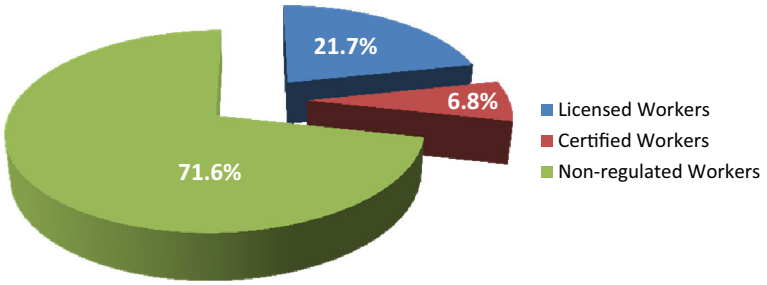

Fig. 1 Licensed, certified, and non-regulated workers

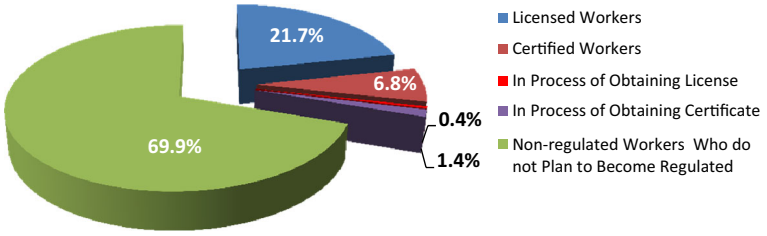

Fig. 2 Licensed, certified, in process of obtaining license, in process of obtaining certificate, and non-regulated workers who do not plan to become regulated

This difference may reflect the larger sample size of the Harris data, which has 9850 relative to the 2449 observations in the Westat or 2037 observations in the Gallup samples that were examined by Kleiner and Krueger (2010, 2013). Or it may reflect the sample selection criteria or the method of data collection (phone survey versus an online survey).

In Table 2 we show the percentage of the workforce that has attained a license or certification and the rank order of the state relative to other states by the percentage that has an occupational license. Iowa has the highest percentage of licensed workers; more than one-third of the workforce has obtained a license from some level of government. Conversely, South Carolina, Rhode Island, New Hampshire, Indiana, and Kansas have the smallest percentage of licensed workers—about 14% in each case. West Virginia and Rhode Island have the highest percentage of certified workers; about 12% of the workforce has this lower level of governmental oversight. In contrast, Wisconsin and

Table 2 State values of percentage licensed, percentage certified, and rank

State	Licensed (%)[a]	Rank	Certified (%)[b]	Rank
Alabama	20.9	29	6.9	24
Alaska	25.5	11	7.3	20
Arizona	22.2	22	8.7	10
Arkansas	20.2	36	5.3	35
California	20.7	30	6.1	27
Colorado	17.2	41	7.4	18
Connecticut	24.6	14	8.8	9
Delaware	15.3	45	3.5	46
District of Columbia	19.7	37	6.9	25
Florida	28.7	4	4.2	39
Georgia	15.7	44	5.9	28
Hawaii	26.6	6	11.3	4
Idaho	22.8	20	8.4	12
Illinois	24.7	13	5.0	37
Indiana	14.9	48	10.8	5
Iowa	33.2	1	5.1	36
Kansas	14.9	47	5.6	31
Kentucky	27.8	5	10.7	6
Louisiana	22.3	21	9.9	8
Maine	20.7	32	7.8	15
Maryland	17.2	40	4.8	38
Massachusetts	21.3	25	3.9	42
Michigan	20.6	34	3.3	49
Minnesota	15.0	46	3.4	48
Mississippi	23.1	18	7.2	21
Missouri	21.3	26	5.4	33
Montana	21.3	27	8.3	14
Nebraska	24.6	15	8.3	13
Nevada	30.7	2	5.4	34
New Hampshire	14.7	49	4.1	41
New Jersey	20.7	31	11.3	3
New Mexico	25.9	9	7.3	19
New York	20.7	33	5.5	32
North Carolina	22.0	23	8.4	11
North Dakota	26.6	7	2.6	50
Ohio	18.1	39	7.5	17
Oklahoma	25.0	12	7.2	23
Oregon	26.1	8	3.8	43
Pennsylvania	20.2	35	7.6	16
Rhode Island	14.5	50	11.8	2

Table 2 continued

State	Licensed (%)[a]	Rank	Certified (%)[b]	Rank
South Carolina	12.4	51	3.5	47
South Dakota	21.8	24	5.6	30
Tennessee	23.1	19	4.2	40
Texas	24.1	16	3.7	44
Utah	23.8	17	5.9	29
Vermont	16.8	43	6.5	26
Virginia	17.2	42	3.7	45
Washington	30.5	3	7.2	22
West Virginia	25.8	10	12.3	1
Wisconsin	18.4	38	1.9	51
Wyoming	21.2	28	10.1	7

[a] Average margin of error is 5.8% at 95% confidence
b Average margin of error is 3.4% at 95% confidence

North Dakota have the lowest percentage of certified workers. These estimates show the wide range of percentages of licensed and certified workers in the United States.

5 Characteristics of licensed workers

To show the basic demographic and economic characteristics of the individuals in our sample, we examine the distribution of licensed and certified practitioners by education, race, union status, public or private sector, and gender in Table 3. The results indicate that licensing rises with education: more than 41% of those with post college education have licenses compared with only 11% for those with less than a high school education. The results in the table also show that union members are more than twice as likely to be licensed, reflecting in part the large number of teachers and nurses who tend to be both union members and licensed workers. Government workers are more likely to have a license than nongovernment workers. We find slightly higher licensing rates for men (24%) relative to women (19%). The licensing rates for whites are 22%, 23% for Hispanics, and 19% for blacks. The table further shows that licensing rises with age and flattens over age 55. Individuals who provide services are almost twice as likely to be licensed compared with those who repair things which reflects the prominence of occupational regulation in the service sector.

In the last three columns of Table 3, we compare our results with an earlier survey by Kleiner and Krueger (K&K) (2013) conducted by Westat and completed in 2008 with a smaller sample size approaching 2500 individuals. Many characteristics have similar values in both surveys. However, as was mentioned earlier, the rate of licensing is higher in their study. This difference could be explained by a higher representation of college and post-college-educated participants, a higher participation of whites, an older population, a higher percentage of individuals who work in the public sector, and a higher representation of individuals who provide services relative to those who

Table 3 Characteristics of licensed, certified, and Not regulated workers

The Harris data										K&K data		
Variable	Licensed	SD	Certified	SD	Not regulated	SD	Total %	Obs.	% Obs.	Licensed	Certified	Not regulated
Gender												
Male	23.9%	42.67%	7.0%	25.45%	69.1%	46.21%	100	3946	40	28.4%	6.7%	64.6%
Female	19.4%	39.51%	6.5%	24.71%	74.1%	43.80%	100	5904	60	28.7%	5.0%	66.0%
Education level												
Less than HS	11.2%	31.71%	10.5%	30.80%	78.2%	41.42%	100	134	1	14.5%	4.0%	81.6%
HS	14.9%	35.59%	6.9%	25.42%	78.2%	41.31%	100	1097	11	19.9%	5.8%	74.0%
Some college	18.7%	38.99%	6.7%	24.96%	74.6%	43.52%	100	3150	32	28.1%	5.9%	65.6%
College	20.4%	40.33%	6.4%	24.40%	73.2%	44.29%	100	3351	34	29.2%	5.9%	64.6%
College +	41.3%	49.24%	6.7%	24.95%	52.1%	49.97%	100	2118	22	44.1%	6.2%	49.5%
Earnings												
Average yearly earnings $	60,581	53,524	47,710	44,173	44,288	41,387	–	9850	–	–	–	–
Average hourly earnings $	33.09	27.28	29.92	28.44	25.71	23.05	–	9850	–	–	–	–
Race												
White	21.8%	41.31%	5.9%	23.60%	72.3%	44.78%	100	7782	79	29.5%	5.8%	64.5%
Hispanic	23.2%	42.28%	10.7%	30.95%	66.0%	47.40%	100	548	6	29.2%	5.6%	65.2%
Black	19.4%	39.54%	9.6%	29.45%	71.1%	45.38%	100	816	8	26.3%	7.0%	66.3%
Other	21.1%	40.86%	7.1%	25.70%	71.8%	45.05%	100	704	7	23.0%	5.1%	70.9%
Age												
≤25	13.5%	34.19%	7.4%	26.21%	79.1%	40.68%	100	1024	10	12.2%	2.7%	84.0%
26–54	22.4%	41.72%	6.8%	25.13%	70.8%	45.48%	100	6475	66	30.0%	6.2%	63.6%
>55	23.4%	42.38%	6.4%	24.43%	70.2%	45.76%	100	2351	24	28.8%	5.8%	65.1%

Table 3 continued

The Harris data										K&K data		
Variable	Licensed	SD	Certified	SD	Not regulated	SD	Total %	Obs.	% Obs.	Licensed	Certified	Not regulated
Union status												
Union	45.3%	49.81%	9.6%	29.42%	45.1%	49.78%	100	1103	11	44.7%	5.0%	49.9%
Non-union	18.6%	38.94%	6.4%	24.45%	75.0%	43.32%	100	8747	89	25.7%	6.0%	68.1%
Private or public												
Private company	19.0%	39.20%	6.2%	24.10%	74.9%	43.39%	100	7950	81	24.8%	5.9%	69.0%
Public company	34.2%	47.44%	9.3%	29.06%	56.5%	49.58%	100	1900	19	44.2%	5.3%	50.3%
Type of work												
Provide services	22.8%	41.96%	6.5%	24.74%	70.7%	45.54%	100	8775	89	31.2%	5.9%	62.7%
Make things	19.2%	39.46%	11.3%	31.71%	69.5%	46.12%	100	389	4	11.4%	5.1%	83.1%
Repair things	11.1%	31.48%	6.1%	24.03%	82.7%	37.83%	100	686	7	22.4%	7.2%	69.0%

Table 4 Requirements for becoming licensed

Variable	The Harris data				K&K data	
	Licensed workers facing requirement		Certified workers facing requirement		Licensed workers facing requirement	
	%	SD (%)	%	SD (%)	%	SD (%)
High school	75.1	43.3	66.6	47.2	31.2	46.4
College	47.7	50.0	28.5	45.2	42.8	49.5
Exam	88.9	31.4	85.9	34.9	85.0	35.8
Performance test	67.8	46.7	61.1	48.8	–	–
Continuing Ed	67.8	46.7	52.9	50.0	69.8	45.9
Internship	46.5	49.9	35.3	47.8	33.6	47.3
License/certificate renewal test	34.5	47.6	33.9	47.4	–	–

make things in the K&K survey, since all of these characteristics of the population contribute to a higher percentage of individuals who are licensed.

Table 4 shows the requirements for becoming licensed using both the Harris Survey and the one developed by Westat and used in the K&K analysis (2013). There are some differences in the questions asked in the two surveys. In the Harris Survey, the question was, "Did you require at least a high school education in order to become licensed?" and the response was 75% of the survey participants required that level of education or higher. In the K&K survey, the question was whether participants had a specific requirement for a high school diploma, and the response was 31 percent. However, most of the other statistics for other requirements necessary for obtaining a license were similar across the two surveys.

To provide a more formal answer to the question of what kind of people tend to become licensed, we estimate two models, a linear probability model and a logistic model. Further, for the logistic model, we calculated the average marginal effects to make the estimates easier to interpret.[3] In these statistical models, the dependent variable is a dummy variable that indicates whether a person is licensed. The set of independent variables includes individual characteristics such as gender, race, age, level of education attainment, union membership status and other observable factors. These estimates are shown in Table 5. Both approaches indicate that females are 3.6% less likely to be licensed than white males. Male Hispanics, African Americans, and others are as likely to be licensed as white males. More highly educated workers, who also have more years of work experience, have a significantly higher probability of attaining an occupational license. Union members are 10 to 15% more likely to be licensed than nonunionized practitioners. In addition, government employees and self-employed workers are 3 and 6% more likely to be licensed than employees of not-for-profit companies. In contrast, employees in for-profit companies are almost 3% less likely to hold licenses than employees of not-for-profit organizations.

[3] The logistic model estimates and corresponding average marginal effects are not shown since both the linear probability and the logistic models produce substantively identical results.

Table 5 Influence of personal and economic characteristics on the likelihood of being licensed

Variables	Linear probability model	
	Coefficients	SE
Constant	0.066	0.215
Female	−0.036***	0.009
Hispanic	0.012	0.020
Black	−0.018	0.019
Other	−0.027	0.022
Education	0.017***	0.003
Age	−0.005	0.004
Age^2	0.000	0.000
Work experience	0.008***	0.003
Work $experience^2$	−0.0001*	0.000
Union member	0.151***	0.020
Work for government	0.032*	0.017
Self employed	0.067***	0.025
Work for for-profit	−0.028*	0.016
Math skills	0.021**	0.010
Reading skills	0.035***	0.011
Children	0.036***	0.011
Divorced	−0.002	0.015
Married	0.014	0.014
Log of real GDP	−0.019	0.015
Occupation fixed effects	Yes	
State fixed effects	Yes	
R-squared	0.310	
Observations	9827	

Robust standard errors clustered at the state level are reported
*** P value < 0.01; ** P value < 0.05; * P value < 0.10;

6 Influence of licensing on earnings

In order to examine the quality of our estimates, we probe whether licensing prevalence is exogenous with respect to other factors that might also affect incomes of the regulated workers. Therefore, we identify the presence of any statistical signals or patterns in the distribution of licensing prevalence that might suggest the existence of these underlying factors.

First, as a check for presence of regional patterns in occupational licensing, we calculated global Moran's I statistic. Global Moran's I test by using information on states geographical location and their corresponding average percentage of licensed population allowed us to check whether there were any clusters of states with statistically similar levels of licensed populations. Null hypothesis of the test was absence of spatial clustering (levels of licensing prevalence were randomly distributed). Permutation procedure was used to estimate test's pseudo significance level. Using 9,999 permutations, the pseudo p-value was estimated to be equal 0.122 ($P = 0.122$). This

p-value did not allow us to reject null hypothesis indicating absence of geographical clustering (Oyana and Margai 2015).

Although licensing prevalence is not correlated with geography, prevalence might be correlated with other factors that could affect our results. Therefore, the next step would be to test whether change in the occupational mix affects the prevalence of licensed professionals across states. We do not perform this type of analysis in our study, but the U.S. Department of the Treasury's Office of Economic Policy, the Council of Economic Advisers, and the Department of Labor (2015) conducted this type of empirical analysis using our estimates of licensing prevalence and data from the Survey of Income and Program Participation. They found that "variation in licensing prevalence appears not to be driven by differences in occupational mix across States."[4]

All of the previous checks for data quality issues show that none of the systematic patterns or underlying factors that might affect the estimates were identified, which suggests that the estimated models allow us to make statistically valid inferences about the effects of occupational regulations on regulated workers' earnings.

Using the data collected by Harris, we estimated how occupational regulations influence hourly earnings. The ordinary least squares results shown in Table 6 and Table 7 suggest that occupational licensing regulations raise mean log hourly earnings by approximately 10.3 to 11.9%.[5] These estimates are lower than the 10 to 15% found by K&K (Kleiner and Krueger 2010, 2013). The estimates in Table 7 show that licensing has a larger influence on earnings than certification. The licensing estimates presented in Tables 6 and 7 largely reflect the monopoly effect that occupational licensing likely creates relative to the signaling or human capital effects of certification.[6] The estimates suggest that licensing is associated with approximately 11% higher earnings even after accounting for human capital, labor market characteristics, and two digit occupation controls.[7] These results are similar to estimates presented by Kleiner using the Census Public-Use Microdata Samples through 2000, and using the Survey of Income and Program Participation (Kleiner 2006; Gittleman et al. 2017). Although the influence of other variables such as age, education, and unionization on hourly earnings is consistent with the economic and policy literature, the coefficients of race variables are not statistically significant. Perhaps this is because of our ability to better control for reading and math skills in our regression estimates (see Neal and Johnson 1996).

[4] Additional details of the analysis can be found in "Occupational Licensing: A Framework for Policymakers".

[5] Tables 6, 7, and 9 report the unadjusted coefficients. Because the dependent variables were in logs, we make the appropriate adjustments in the text when we discuss the magnitude of the economic impact of the dummy variables: $100 \times (\exp(\hat{\beta}) - 1)$.

[6] Occupational licensing could raise wages if the right set of regulations were chosen to restrict supply and limit the tasks of unlicensed workers. Moreover, licensed workers could enhance demand by signaling that they are providing a higher-quality service or greater human capital to consumers (Friedman 1962; Spence 1973).

[7] We use the 2010 Standard Occupational Classification (SOC) system.

Table 6 Estimates of the influence of licensing on hourly earnings (log)

Variables	(1)		(2)		(3)		(4)	
	Coefficients	SE	Coefficients	SE	Coefficients	SE	Coefficients	SE
Constant	3.017***	0.018	−1.623***	0.497	−1.461***	0.307	−1.046***	0.304
Licensed	0.247***	0.024	0.089***	0.019	0.092***	0.019	0.098***	0.023
Female			−0.156***	0.014	−0.155***	0.014	−0.118***	0.015
Hispanic			0.070**	0.031	0.058*	0.034	0.050	0.034
Black			0.011	0.036	0.015	0.033	0.011	0.033
Other			0.024	0.023	0.027	0.026	0.025	0.025
Education			0.066***	0.006	0.065***	0.006	0.055***	0.006
Age			0.026***	0.009	0.026***	0.009	0.020**	0.009
Age^2			−0.0003***	0.000	−0.0004***	0.000	−0.0003***	0.000
Work experience			0.017***	0.005	0.017***	0.005	0.015***	0.005
Work experience^2			−0.0001	0.000	−0.0001	0.000	−0.0001	0.000
Union member			0.115***	0.030	0.102***	0.029	0.180***	0.030
Work for government			0.040	0.027	0.047*	0.026	0.047*	0.026
Self employed			0.197***	0.038	0.196***	0.038	0.192***	0.038
Work for profit			0.123***	0.017	0.120***	0.017	0.077***	0.017
Math skills			0.112***	0.020	0.113***	0.019	0.064***	0.017
Reading skills			0.211***	0.017	0.211***	0.017	0.156***	0.018
Children			0.030	0.020	0.031	0.020	0.035*	0.019
Divorced			−0.005	0.034	−0.005	0.034	−0.024	0.034
Married			0.082***	0.025	0.085***	0.025	0.057**	0.025
Log of real GDP			0.253***	0.042	0.235***	0.020	0.244***	0.022
Occupation fixed effects	No		No		No		Yes	
State fixed effects	No		No		Yes		Yes	
R-squared	0.023		0.282		0.292		0.357	
Observations	9850		9850		9850		9827	

Robust standard errors clustered at the state level are reported
*** P value < 0.01; ** P value < 0.05; * P value < 0.10

Table 7 Estimates of the influence of licensing and certification on hourly earnings (log)

Variables	(1)		(2)		(3)		(4)	
	Coefficients	SE	Coefficients	SE	Coefficients	SE	Coefficients	SE
Constant	3.006***	0.017	−1.645***	0.500	−1.401***	0.315	−1.008***	0.307
Licensed	0.258***	0.024	0.098***	0.020	0.102***	0.019	0.112***	0.023
Certified	0.123***	0.034	0.086**	0.033	0.087**	0.032	0.092***	0.031
Female			−0.155***	0.014	−0.155***	0.014	−0.117***	0.015
Hispanic			0.066**	0.030	0.053	0.033	0.046	0.033
Black			0.008	0.036	0.011	0.034	0.008	0.033
Other			0.023	0.023	0.027	0.025	0.025	0.024
Education			0.066***	0.006	0.065***	0.005	0.054***	0.006
Age			0.026***	0.009	0.026***	0.009	0.020**	0.009
Age^2			−0.0004***	0.000	−0.0004***	0.000	−0.0003***	0.000
Work experience			0.017***	0.005	0.017***	0.005	0.015***	0.005
Work experience^2			−0.0001	0.000	−0.0001	0.000	−0.0001	0.000
Union member			0.111***	0.029	0.098***	0.028	0.176***	0.030
Work for government			0.038	0.027	0.045	0.027	0.043	0.026
Self employed			0.192***	0.039	0.191***	0.039	0.187***	0.039
Work for profit			0.123***	0.017	0.121***	0.017	0.077***	0.017
Math skills			0.110***	0.020	0.112***	0.019	0.062***	0.017
Reading skills			0.209***	0.017	0.210***	0.017	0.154***	0.018
Children			0.029	0.020	0.029	0.020	0.034*	0.019
Divorced			−0.006	0.034	−0.005	0.034	−0.024	0.034
Married			0.081***	0.025	0.084***	0.025	0.056**	0.024
Log of real GDP			0.254***	0.042	0.229***	0.020	0.240***	0.022
Occupation fixed effects	No		No		No		Yes	
State fixed effects	No		No		Yes		Yes	
R-squared	0.026		0.283		0.293		0.358	
Observations	9,850		9,850		9,850		9,827	

Robust standard errors clustered at the state level are reported
*** P value < 0.01; ** P value < 0.05; * P value < 0.10

7 Quantile regression results

The influence of licensing regulations on mean log hourly earnings is informative, but may not reflect the relationship at other points in the hourly earnings distribution. In

Table 8 Estimates of the influence of licensing on earnings (log) by Quantile

Variables	OLS	Q_20	Q_30	Q_40	Q_50	Q_60	Q_70	Q_80	Q_90
A									
Constant	−1.328**	−1.484***	−1.633***	−1.752***	−1.965***	−1.866***	−1.599	−1.160	−0.231
Licensed	0.092***	0.036**	0.051***	0.055***	0.069***	0.080***	0.104***	0.157***	0.235***
Female	−0.155***	−0.132***	−0.126***	−0.139***	−0.161***	−0.178***	−0.186***	−0.175***	−0.183***
Hispanic	0.058	−0.016	0.002	0.003	0.038*	0.040	0.109***	0.118***	0.096***
Black	0.015	−0.002	−0.016	−0.005	0.006	−0.025	−0.002	0.042	0.080***
Other	0.027	−0.023	−0.002	0.043**	0.019	0.004	0.022	0.067**	0.126***
Education	0.065***	0.066***	0.069***	0.071***	0.077***	0.078***	0.079	0.080	0.062
Age	0.026***	0.010*	0.012**	0.013***	0.021***	0.019***	0.031	0.032	0.057
Age^2	−0.0001***	−0.0001***	−0.0001***	−0.0001***	−0.0001***	−0.0001***	−0.0001***	−0.0001***	−0.001***
Work experience	0.017***	0.027***	0.029***	0.031***	0.026***	0.026***	0.019	0.018	−0.004
Work $experience^2$	−0.0001	−0.0001***	−0.0001***	−0.0001***	−0.0001***	−0.0001**	−0.0001	−0.0001***	0.0001
Union member	0.102***	0.108***	0.071***	0.079***	0.060***	0.072***	0.072***	0.127***	0.129***
Work for government	0.047**	0.063***	0.061***	0.056***	0.033*	0.057**	0.045***	0.030	−0.016
Self employed	0.196***	0.004	0.075***	0.101***	0.194***	0.265***	0.287***	0.366***	0.528***
Work in for-profit	0.120***	0.071***	0.078***	0.090***	0.092***	0.130***	0.151	0.171***	0.180
Math skills	0.113***	0.105***	0.120***	0.129***	0.144***	0.142***	0.127	0.144***	0.067
Reading skills	0.211***	0.187***	0.197***	0.214***	0.201***	0.214***	0.226***	0.197	0.183***
Children	0.031*	0.032**	0.044***	0.033**	0.019	0.019	0.034	0.025**	−0.003
Divorced	−0.005	0.005	−0.003	0.011	0.045**	0.043*	0.025	−0.004	−0.068

Table 8 continued

Variables	OLS	Q_20	Q_30	Q_40	Q_50	Q_60	Q_70	Q_80	Q_90
Married	0.085***	0.111***	0.117***	0.124***	0.138***	0.120***	0.103	0.057	−0.001
Log of real GDP	0.223***	0.230***	0.247***	0.255***	0.266***	0.267***	0.231	0.201	0.141
State fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared / pseudo R-squared	0.292	0.205	0.221	0.223	0.220	0.210	0.196	0.171	0.142

Variables	OLS	Q_20	Q_30	Q_40	Q_50	Q_60	Q_70	Q_80
B								
Constant	−0.447	−1.11	−0.546	−1.796	−3.316**	0.559	0.203	−1.067
Licensed	0.098***	0.079***	0.096***	0.090***	0.088***	0.084***	0.076***	0.095***
Female	−0.118***	−0.081***	−0.075***	−0.106***	−0.115***	−0.120***	−0.135***	−0.147***
Hispanic	0.050	0.012	0.001	0.010	0.001	0.035**	0.049***	0.108***
Black	0.011	−0.016	−0.036***	−0.036**	−0.015	−0.033	0.009	0.047***
Other	0.025	−0.012	−0.011	−0.016	−0.016	0.034	0.048*	0.077***
Education	0.055***	0.054	0.056***	0.059***	0.062***	0.069***	0.071***	0.065***
Age	0.020***	0.013	0.011***	0.016***	0.017***	0.021***	0.021***	0.025***
Age^2	−0.0001***	−0.0001***	−0.0001***	−0.0001***	−0.0001***	−0.0001***	−0.0001***	−0.0001***
Work experience	0.015***	0.021	0.023***	0.022***	0.022***	0.019***	0.019***	0.014***
Work $experience^2$	−0.0001	−0.0001***	−0.0001***	−0.0001**	−0.0001**	−0.0001	−0.0001**	−0.0001
Union member	0.180***	0.166***	0.163***	0.162***	0.183***	0.150***	0.151***	0.166***
Work for government	0.047**	0.043***	0.040***	0.033**	0.032**	0.022	0.031**	0.048***
Self employed	0.192***	−0.02	0.044	0.105***	0.165***	0.233***	0.290***	0.322***
Work in for-profit	0.077***	0.012	0.037***	0.037***	0.051***	0.069***	0.091***	0.108***
Math skills	0.064***	0.055	0.058***	0.057***	0.081***	0.074***	0.083***	0.085***

Table 8 continued

Variables	OLS	Q_20	Q_30	Q_40	Q_50	Q_60	Q_70	Q_80
Reading skills	0.156***	0.136***	0.139***	0.142***	0.136***	0.135***	0.145***	0.168***
Children	0.035**	0.027***	0.013	0.016*	0.023**	0.033***	0.029***	0.039***
Divorced	−0.024	−0.023	0.003	0.02	0.014	0.02	−0.018	−0.029
Married	0.057***	0.069***	0.092***	0.095***	0.085***	0.086***	0.059***	0.025**
Log of real GDP	0.187***	0.231	0.187***	0.307***	0.451***	0.079	0.117	0.249
Occupation fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared/pseudo R-squared	0.357	0.263	0.275	0.276	0.270	0.256	0.237	0.209

*** P value < 0.01; ** P value < 0.05; * P value < 0.10;

order to provide an additional perspective on the influence of occupational regulations on earnings, we estimated quantile regressions to measure the influence of licensing across the wage distribution. Table 8A and B show how licensing influences earnings of regulated practitioners across different parts of the earnings distribution. The results in Table 8A are produced without controlling for two digit occupation fixed effects, and the estimates in Table 8B are specified with occupation controls. The results in Table 8A suggest that compared with the overall licensing coefficient in the conditional mean model, which is 9.2%, the coefficient of the conditional median model is lower. This implies that the effect of licensing on the hourly earnings of regulated professionals would not be as large for most of the working population. Table 8A shows that individuals in the lower part of the income distribution— manicurists, for example—are associated with a gain only 3.6 to 5.1% due to licensing, but those in the middle of the income distribution gain 7 to 8%. Further, those individuals in the top 30% of the income distribution gain 10 to 24%. However, once we control for occupation effects, in panel Table 8B, licensing coefficients level out across the income distribution and vary between 7.9% in its lowest part to 9.5 in the top. The results suggest that licensing exacerbates relative income inequality, since higher wage occupations tend to gain more from the regulation relative to lower wage ones. These results underline the importance of examining the licensing effect throughout the earnings distribution, and that occupational licensing may raise wage inequality.

The influence of educational attainment on hourly earnings does not change significantly across the earnings distribution in Table 8A and B. The role of the other two education proxy variables—reading skills and math skills—change by roughly 4% in Table 8A, increasing from 18.7% and 10.5% at lower quantiles to 22.6% and 14.4% at upper quantiles. In Table 8B signs and significance of the education proxy variables are essentially the same, but the values of the coefficients diminish. This is expected since occupation fixed effects also indirectly control for reading skills and math skills. Union membership yields a higher return of 10.8% at the lower end of the hourly wage distribution than at the median, where it is equal to 6% in Table 8A. This result corresponds to earlier findings of the influence of unionization (Freeman 1982; Chamberlain 1994). After controlling for occupation fixed effects the union membership gradient increases to on average 16% and levels out across the income distribution.

The yield from being a government employee gradually decreases from 6.3% at the bottom quantiles to 4.5% at the upper quantiles. The measure of economic returns for being self-employed, increases from roughly 7% at the lower part of the earnings distribution to 28.7% at the 70th quantile and to 53 percent at the 90th quantile. Individuals who work in for-profit companies experience similar changes. Their hourly earnings increase from 7% at the lower end of the distribution to 17% at the upper end. In Table 8B, signs and significance of the different types of employment variables are essentially the same, but the values of the coefficients diminish. Again, this is expected since occupation fixed effects also indirectly control for the influence of these characteristics.

Table 9 State-level estimates of the influence of licensing on hourly earnings (log)

State	Licensing coefficient	SE	R-squared	Observations
Alabama	−0.105	0.129	0.339	173
Alaska	0.044	0.118	0.374	208
Arizona	0.039	0.109	0.299	186
Arkansas	0.226	0.221	0.185	157
California	0.152	0.196	0.298	197
Colorado	0.016	0.147	0.366	167
Connecticut	0.284***	0.097	0.394	216
Delaware	0.248	0.161	0.277	180
District of Columbia	0.195	0.121	0.360	222
Florida	0.304*	0.179	0.319	187
Georgia	0.258*	0.149	0.293	171
Hawaii	0.208*	0.109	0.269	188
Idaho	0.100	0.110	0.255	189
Illinois	0.293**	0.126	0.377	206
Indiana	0.035	0.129	0.288	198
Iowa	0.355**	0.142	0.013	211
Kansas	0.233*	0.140	0.316	206
Kentucky	−0.055	0.137	0.255	210
Louisiana	−0.036	0.116	0.439	186
Maine	0.387***	0.140	0.332	181
Maryland	−0.043	0.148	0.387	205
Massachusetts	0.056	0.134	0.335	212
Michigan	0.264*	0.140	0.335	191
Minnesota	−0.002	0.174	0.328	187
Mississippi	0.161	0.134	0.413	177
Missouri	0.196*	0.117	0.243	186
Montana	0.301**	0.117	0.290	200
Nebraska	0.102	0.160	0.244	201
Nevada	0.314***	0.112	0.315	178
New Hampshire	0.115	0.111	0.321	209
New Jersey	0.103	0.099	0.339	198
New Mexico	−0.025	0.105	0.328	181
New York	−0.155	0.134	0.248	216
North Carolina	−0.080	0.139	0.388	166
North Dakota	0.111	0.098	0.137	213
Ohio	−0.030	0.110	0.418	207
Oklahoma	−0.047	0.102	0.248	211
Oregon	0.152	0.141	0.329	202
Pennsylvania	0.310***	0.114	0.338	211
Rhode Island	0.028	0.103	0.163	203

Table 9 continued

State	Licensing coefficient	SE	R-squared	Observations
South Carolina	0.176	0.175	0.366	194
South Dakota	0.025	0.123	0.186	190
Tennessee	0.239*	0.138	0.238	146
Texas	−0.059	0.120	0.359	168
Utah	−0.026	0.115	0.273	209
Vermont	0.140	0.107	0.278	191
Virginia	−0.187	0.166	0.378	195
Washington	−0.020	0.120	0.387	154
West Virginia	0.232*	0.124	0.321	205
Wisconsin	0.334**	0.133	0.368	198
Wyoming	−0.035	0.095	0.263	207

Robust standard errors are reported
*** P value < 0.01; ** P value < 0.05; * P value < 0.10

8 Estimation of state-level influence of licensing regulations

A unique part of our analysis is the ability to estimate the influence of occupational regulations on hourly earnings at the state level and to develop state level results. Unlike previous surveys, the Harris Survey was able to obtain a representative sample of the population at the state level, which allowed us to estimate the cross-sectional effects of occupational licensing for each state. Our analysis provides the first estimates of the within state influence of occupational licensing.

We estimated a human capital model similar to the one in Table 6 for every state. Given the different social, industry, and economic characteristics of each state, we would expect considerable heterogeneity in the influence of occupational licensing in different institutional settings. Our state-by-state estimates are presented in Table 9.[8] We find that in some states, such as Alabama, occupational licensing has no statistically significant influence on hourly earnings. However, in other states, such as Connecticut, the influence of licensing regulations on earnings is substantial and statistically significant. Our estimates show that licensing has a positive and statistically significant influence on hourly earnings in 16 states and has no significant influence in 35 states, showing the heterogeneity of the institution across different state environments. In no state did occupational licensing reduce earnings by a statistically significant amount, suggesting that the role of licensing is to increase hourly earnings or have no effect.

The results in Table 9 show that the economic returns to licensing in the 16 states where it was statistically significant varies between 21% in Missouri to 47% in Maine. Given the heterogeneity in the returns to licensing, we examined these estimates in more detail. Table 10 provides additional insights on occupational licensing returns

[8] These coefficients are estimated without controlling for occupation fixed effects because the relatively small number of state-level observations does not provide enough degrees of freedom to estimate these parameters.

Table 10 Effect of licensing regulations at different levels of state-level GDP per capita

GDP per capita range	GDP per capita in 2012$	State	Return on licensing %	Average hourly return %	Return on licensing $	Average hourly return $
$35K–$40K	$35,725	West Virginia	26.11		$6.12	
	$39,035	Montana	35.12	30.62	$7.50	$6.81
$40K–$45K	$40,672	Maine	47.26		$9.58	
	$40,913	Florida	35.53		$8.92	
	$41,496	Michigan	30.21		$7.97	
	$43,280	Missouri	21.65		$4.65	
	$43,796	Tennessee	27.00		$6.19	
	$44,322	Georgia	29.43	31.85	$7.00	$7.39
$45K–$50K	$46,210	Wisconsin	39.65		$9.06	
	$47,098	Pennsylvania	36.34		$9.03	
	$48,234	Nevada	36.89		$9.53	
	$48,282	Kansas	26.24		$6.50	
	$49,636	Iowa	42.62	36.35	$10.05	$8.83
$50K–$55K	$52,246	Hawaii	23.12		$6.21	
	$54,255	Illinois	34.04	28.58	$8.66	$7.43
$60K–$65K	$64,570	Connecticut	32.84	32.84	$9.88	$9.88

Because the dependent variables were in logs, we make the appropriate adjustments in the table to show the magnitude of the economic impact of the dummy variables: $100 \times (\exp(\hat{\beta}) - 1)$

from our state-level regression models. In this table we group the 16 states based on their corresponding Gross Domestic Product (GDP) per capita and show their average returns to licensing in relative and real terms. The average real return to licensing, of the grouped state data, increases along with GDP per capita from $6.81 per hour to $9.88 per hour. At the same time, the average relative return on licensing of the state grouped data increases from 30.6% in states with low GDP per capita to its peak of 36.4% in states where GDP per capita ranges from $45,000 to $50,000 a year, and it diminishes in states that have GDP per capita above this threshold to 32.8%.[9] This inverse parabolic pattern suggests that licensing has increasing returns to scale in states with GDP per capita is below the $45,000–$50,000 annual threshold and decreasing returns to scale above this threshold.

Next, we regressed states' relative returns on licensing on their corresponding log(GDP) and $\log(\text{GDP})^2$ to check for the presence of statistically significant evidence of this parabolic curvature. Although, the estimated coefficients had correct signs, these coefficients were not statistically significant. We did not find the inverse parabolic relationship when we extended our results to states where licensing coefficients were not statistically significant.

[9] The last group, with wages ranging from $60,000 to $65,000, has a higher than expected average effect; however, this group is represented by only one state which could be a reason for higher than expected effect.

Beyond the issue of state heterogeneity, another possible reason for the large variance among states is that the relatively small number of state-level observations has resulted in insufficient statistical power to identify the influence of occupational licensing in some states. The number of observations in each state varies from 146 in Tennessee to 222 in the District of Columbia, and it averages 193 per state. Nevertheless, these estimates provide a first approximation of the role of occupational licensing within and across states, which future analysis can probe in greater detail.

The state- and national-level estimates can form the basis of structural simulations of national- and state-level effects of occupational regulations on simulated losses in jobs, loss in output (deadweight loss), and a misallocation of resources. In "Appendix 2" structural models are provided for illustrative purposes. The simulations suggest that such a reduction in occupational regulation could translate into higher employment and higher economic output assuming that there are no overall quality effects of occupational licensing (Kleiner 2000, 2006).

9 Conclusions

This study provides new evidence on the influence of occupational regulations on the U.S. labor market based on a new and updated national survey of the U.S. population. The estimates were developed based on a representative data set of individuals collected by the Harris Survey organization using questions from a survey initially conducted by Westat and the human capital questions that are regularly part of the Current Population Survey. Our sample size was about 4 times as large as the Westat sample and was developed to reflect the demographic composition of each U.S. state. Consequently, we are able to develop estimates of the influence of occupational licensing and certification on wage determination for each of the U.S. states.

Initially we estimated the influence of licensing on hourly earnings nationally. We found that occupational licensing increased wages on average by about 11% in 2013. The hourly earnings distribution across deciles and quartiles shows that higher income regulated occupations gain a larger wage return on licensing in percentage terms relative to lower income licensed occupations. Further, we show for the first time that occupational licensing is heterogeneous across U.S. states. Occupational licensing continues to be an important issue for both jobs and resource allocation in the U.S. economy. We expect that government's new efforts to collect more comprehensive data will enhance economic knowledge about the role of these types of regulations in the labor market as well as the costs and benefits of this growing labor market institution.

Appendices

Appendix 1

See Table 11.

Table 11 Occupational distribution in the Harris survey

SOC	%
Management	7.8
Business and financial operations	11.8
Computer and mathematical	5.4
Architecture and engineering	2.4
Life, physical, and social science	2.6
Community and social services	2.7
Legal	2.0
Education, training, and library	11.0
Arts, design, entertainment, sports, and media	3.3
Healthcare practitioners and technical	5.3
Healthcare support	2.3
Protective service	1.6
Food preparation and serving related	2.8
Building and grounds cleaning and maintenance	1.7
Personal care and service	2.1
Sales and related	9.1
Office and administrative support	17.0
Farming, fishing, and forestry	0.5
Construction and extraction	1.5
Installation, maintenance, and repair	1.7
Production	3.0
Transportation and material moving	2.2
Military specific	0.3
Total	100.0

Appendix 2: Simulated losses as a consequence of occupational regulation

In order to generate simulated effects of occupational licensing on the labor market, we use the Kleiner (2011) example to illustrate this approach. Suppose that the entire 15% wage premium for licensing found in the K&K analysis (2013) was due to monopoly effects (as opposed to productivity gains), labor supply is perfectly elastic, and the labor demand elasticity was 0.5 (Hammermesh 1993). Kleiner estimated that the United States has approximately 38 million licensed workers with average annual earnings of $41,000. Under these assumptions, licensing resulted in 2.8 million fewer jobs with an annual cost to consumers of $203 billion.[10] Using the same approach and a newer and larger sample, we estimate the influence of licensing at the state and national level.

[10] Occupational licensing transfers income from consumers (who pay more in the form of higher prices) to licensed workers (who receive more income in the form of higher wages). In addition, evidence suggests that there can be a loss in overall output of about 0.1% of annual consumption expenditures that stems from the output that is lost as a consequence of occupational licensing (Kleiner 2006).

Table 12 Employment losses, deadweight losses, and misallocation of resources due to occupational licensing

State	Adjusted licensing coefficient	Total workers employed	Average annual earnings of licensed workers	Number of licensed workers	Loss in jobs due to licensing	Deadweight loss (in $M)	Misallocation of resources (in $M)
United States	9.64	133,739,000	$60,581	29,021,363	1,398,319	$3723	$158,255
Connecticut	32.84	1,639,000	$74,619	403,960	66,337	$612	$8064
Florida	35.53	7,400,100	$54,840	2,125,833	377,621	$2714	$33,275
Georgia	29.43	3,952,800	$57,655	620,887	91,376	$599	$8739
Hawaii	23.12	605,300	$74,952	161,234	18,640	$131	$2401
Illinois	34.04	5,744,400	$67,368	1,418,308	241,426	$2065	$26,333
Iowa	42.62	1,508,400	$79,948	501,486	106,862	$1276	$13,257
Kansas	26.24	1,357,800	$64,545	202,415	26,555	$178	$2894
Maine	47.26	597,600	$58,877	123,610	29,206	$276	$2611
Michigan	30.21	4,024,200	$50,054	830,639	125,480	$729	$10,375
Missouri	21.65	2,669,400	$90,071	568,765	61,576	$494	$9612
Montana	35.12	440,500	$59,121	93,786	16,469	$127	$1568
Nevada	36.89	1,142,700	$73,913	351,267	64,789	$645	$7642
Pennsylvania	36.34	5,729,700	$70,676	1,157,784	210,384	$1982	$23,793
Tennessee	27.00	2,714,300	$56,712	626,333	84,548	$510	$8061
West Virginia	26.11	765,300	$46,950	197,739	25,817	$125	$2048
Wisconsin	39.65	2,784,600	$59,235	511,778	101,471	$853	$9461
Total				9,895,824	1,648,558	$13,317	$170,134

Table 13 Three scenarios of potential annual costs of occupational regulations for the U.S

State	Loss in jobs due to licensing	Deadweight loss (In $M)	Misallocation of resources (In $M)
Lower bound (LC = 9.64%)	1,398,319	$3723	$158,255
Sum of state level estimates	1,648,558	$13,317	$170,134
Upper bound (LC = 15%)	2,176,602	$8600	$237,923

Using estimated licensing coefficients, we simulate the employment losses, deadweight losses,[11] and misallocation of resources as a consequence of occupational licensing at the national level and for the 16 states where regulations were significant. These estimates are shown in Table 12 of "Appendix 2".

In Table 13 of "Appendix 3" we present three scenarios of potential annual costs of occupational regulations for the U.S. economy. The lower-bound results were calculated by using the effects of occupational licensing that were estimated based on the parameters generated from the Harris Survey data, and they are smaller than those found in the K&K study. The middle-level results were totals of the effects that were calculated for the 16 states where occupational regulations were statistically significant. We used the same approach for simulating the parameters of interest at the state level as the one that we used for national level. Finally, the upper-bound simulations were calculated by using the Harris data, but with the average licensing effect parameter of 15% that was estimated in the K&K study.

The middle-level simulations from Table 13 of "Appendix 2" show that the job losses due to occupational regulations are about 1.6 million jobs or approximately 1.3% of total nonfarm employment in 2013, and the lost output due to occupational regulation exceeds $13 billion or approximately 1.5% of total household consumption in 2013. The latter simulations can be viewed as a lower bound for the potential economic effects of occupational licensing. We further estimate the Schmidt trapezoid (Schmidt 2012), which takes into account the misallocation of both labor and capital due to the losses that these regulations create beyond the much smaller Harberger triangle. As expected, the simulated economic consequences of regulations are much larger. The calculated misallocation of economic resources due to occupational licensing is more than $170 billion. We consider the estimate of the misallocation of economic resources to be more accurate assessment of the effect that licensing regulations have on the U.S. economy.

[11] This approach was developed and popularized by economist Arnold Harberger (Harberger 1954). Further, using the discussion in Schmidt (2012) we show estimates of both deadweight loss and the misallocation effects.

References

Chamberlain, G. (1994). Quantile regression, censoring, and the structure of wages. In C. A. Sims (Ed.), *Advances in econometrics: Sixth world congress* (Vol. 1, pp. 171–210). Cambridge: Cambridge University Press.

Freeman, R. B. (1982). Union wage practices and wage dispersion within establishments. *Industrial and Labor Relations Review*, *36*(1), 3–21.

Friedman, M. (1962). *Capitalism and freedom*. Chicago: University of Chicago Press.

Friedman, M., & Kuznets, S. (1945). *Income from independent professional practice*. New York: National Bureau of Economic Research.

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

Gittleman, M., Klee, M. A., & Kleiner, M. M. (2017). Analyzing the labor market outcomes of occupational licensing. *Industrial Relations***(forthcoming)**.

Greene, K. (1969). *Occupational licensing and the supply of nonprofessional manpower*. Manpower Research Monograph No. 11. Washington D.C: Manpower Administration (DOL).

Hammermesh, D. (1993). *Labor demand*. Princeton, NJ: Princeton University Press.

Harberger, A. C. (1954). Monopoly and resource allocation. *American Economic Review Papers and Proceedings*, *44*(2), 77–87.

Kleiner, M. M. (2000). Occupational licensing. *Journal of Economic Perspectives*, *14*(4), 189–202.

Kleiner, M. M. (2006). *Licensing occupations: Ensuring quality or restricting competition?*. Kalamazoo, MI: W. E. Upjohn Institute for Employment Research.

Kleiner, M. M. (2011). *Occupational licensing: Protecting the public interest or protectionism?* Policy Paper No. 2011-009. Kalamazoo, MI: W.E. Upjohn Institute for Employment Research. http://dx.doi.org/10.17848/pol2015-009

Kleiner, M. M., & Krueger, A. (2013). Analyzing the extent and influence of occupational licensing on the labor market. *Journal of Labor Economics*, *31*(2), S173–S202.

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

Kleiner, M. M., Marier, A., Won, K. W., & Wing, C. (2016). Relaxing occupational licensing requirements: Analyzing wages and prices for a medical service. *Journal of Law and Economics*, *59*, 261–291.

Neal, D. A., & Johnson, W. R. (1996). The role of premarket factors in black–white wage differences. *Journal of Political Economy*, *104*(5), 869–895.

Oyana, T., & Margai, F. (2015). *Spatial analysis: Statistics, visualization, and computational methods*. Boca Raton: CRC Press.

Schmidt, J. A., Jr. (2012). *New and larger costs of monopoly and tariffs*. Economic Policy Paper 12-5. Federal Reserve Bank of Minneapolis.

Shapiro, C. (1986). Investment, moral hazard and occupational licensing. *Review of Economic Studies*, *53*(5), 843–862.

Smith, A. (1937). The wealth of nations. Modern library edition. New York: Random House. (Orig. pub. 1776.).

Smith, A. (1776). The wealth of nations. University of Chicago Press. Facsimile of 1904 edition (February 15, 1977).

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

U.S. Bureau of Labor Statistics. (2016). *Data on certificates and licensing*. http://www.bls.gov/cps/certifications-and-licenses.htm#highlights.

U.S. Department of the Treasury Office of Economic Policy, Council of Economic Advisers, and the Department of Labor. (2015). *Occupational licensing: A framework for policymakers*. The White House. https://www.whitehouse.gov/sites/default/files/docs/licensing_report_final_nonembargo.pdf.