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Occupational Licensing and Injuries and Death in Construction: An Analysis of Electricians and Plumbers

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Abstract

Despite the growth of occupational licensing as an important labor market institution there has been little empirical work on the influence of occupational regulation on workplace injuries and deaths. Our analysis focuses on two major construction occupations, electricians and plumbers, in the U.S. The industry and occupations we study have a relatively large number of deaths and injuries in comparison to other industries, and have also recently experienced an upsurge in occupational regulation. Specifically, we examine how the implementation or changes in occupational requirements, apprenticeships and higher-quality training programs by state government through occupational licensing's influence both on the occurrence and severity of injuries and deaths using proprietary data from the Survey of Occupational Injury and Illness (SOII) data and the Census of Fatal Occupational Injuries (CFOI) from 1992 to 2007. We find little influence of occupational licensing on the measures of death and injuries in the data we examine from the Bureau of Labor Statistics.

Five Key Findings of our Research

1. **Strengthening Regulations:** From 1992 to 2007 both electricians and plumbers experienced growth in regulations governing entry and training requirements. While the growth in the level of regulation was higher for electricians than for plumbers, the overall level of regulation was higher for plumbers than electricians both in 1992 and in 2007.
   Most states have switched to state regulation from local or no control of the licensing provisions for both occupations. Finally, occupational licensing provisions are becoming more rigorous by requiring more education and training in order to meet the requirements for entry into the occupation.

2. We show that although there has been a downward trend in the injury rate for both plumbers and electricians from the early 1990s, the decline has been much smaller in 2000s.

3. We find that the overall index for occupational licensing is not statistically significant on wages for either electricians or plumbers.

4. We find mixed results for the overall influence of licensing on the injury incidence rates for electricians and plumbers, with the most rigorous statistical tests showing some reduction in injury rates. We find that only continuing education reduced days away from work for electricians. Overall, occupational regulation does not seem to impact the severity of injuries for either electricians or plumbers.

5. Finally, we find that measures of occupational regulation have little influence on the death rates in the construction industry of electricians and plumbers.

6. The general issue of occupational regulation has particular relevance to the potential health and safety of construction workers, which is the occupational group that had the

largest number of occupational deaths of any blue collar occupational category (Bureau of Labor Statistics, 2006a). In addition, construction occupations also are among the ones that suffer the highest injury rates (Bureau of Labor Statistics, 2007). The main focus of our research has been the development of new data that has the potential to be implemented further in a modeling framework beyond our preliminary multivariate estimates. Nevertheless, we provide basic estimates that can serve as the starting point for future research. Where possible, we provide multivariate estimates linking various levels of state or local occupational regulation to the level and changes of occupational injuries and deaths of electricians and plumbers.

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 occupation. 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." Under licensure laws, working in an occupation for compensation without first meeting government standards is illegal. According to the Council of State Governments in 1992, more than 800 occupations were licensed in at least one state, and more than 1,100 occupations were licensed, certified, or registered (Brinegar and Schmitt, 1992).

During the early 1950s, less than 5 percent of the U.S. workforce was in occupations covered by licensing laws at the state level (Council of State Governments, 1952). That number grew to almost 18 percent by the 1980s—with an even larger number if federal, city, and county occupational licensing were included. By 2000, according to data gathered from the Department of Labor and the 2000 Census, the percentage of the workforce in occupations licensed by states was at least 20 percent. In contrast to the state level occupational licensing, during this period no systematic attempts were made to gather information on licensing or its wage or employment effects at the federal or local level.

As employment in the United States shifted from manufacturing to service industries, which typically have lower union representation, the members of the occupations established a formal set of standards that governed members of the occupation. For a professional association, obtaining licensing legislation meant raising funds from members to lobby the state legislature, particularly the chairs of appropriate committees. In addition, the occupation association often solicits volunteers from its membership to work on legislative campaigns. With both financial contributions and volunteers, the occupational association has a significant ability to influence legislation and its administration, especially when opposition to regulatory legislation is absent or minimal (Wheelan, 1998). The large potential gain from regulation through increased demand for the service, enhanced earnings, and the ability to restrict supply outweighs the potential losses to consumers of potentially higher prices for the regulated services.

Figure 1 shows trends in the growth of occupational licensing and unionization from 1950 to 2008. Licensing data for earlier periods are available only at the state/occupational level; the data gathered through the Gallup and Westat surveys for 2006 and 2008 are denoted with a dashed line in the figure. Despite possible problems in both data series, occupational licensing clearly is rising and unionization is declining. By 2008, approximately 29 percent of workers polled in the Westat survey said they were required to have a government-issued license to do their job, compared with about 12.4 percent who said they were union members in the Current Population Survey (CPS) for the same year.

Injuries and Deaths in Construction

We examine the relationship between occupational regulation and death and injuries focusing on two occupations in the construction industry, electricians and plumbers. Our hypothesis is that licensing would reduce the number of individuals in the occupations that were either unable due to their ability to complete the course of study to enter one of the occupations, and would eliminate those who were unscrupulous in their business dealings. Further policies that require continuing education would contain some aspects of health and safety that may reduce accidents at the workplace. In order to examine the potential relationship, we analyze information from two confidential data sets, the Survey of Occupational Injuries and Illnesses (SOII) and the Census of Fatal Occupational Injuries (CFOI), with Bureau of Labor Statistics (BLS) supervision (For detailed information, see http://www.bls.gov/iif/). Tables 1A and 1B give key descriptions for the two data sets, as well as the major changes in the industry and occupation codes within the datasets for electricians and plumbers.

To examine the role of occupational licensing in potentially reducing serious nonfatal injuries, we use the SOII, a confidential establishment-level survey for nonfatal injury data administered by the BLS. The SOII reports nonfatal injuries reported by establishments in the private sector for 39 states between 1992 and 2007. While injuries are divided into three categories,[1] we focus on the cases involving injuries causing an absence from work, measured by "days away from work". Table 1A describes key characteristics of the SOII.

Table 1A also gives information on the CFOI that we will use to show the number and the rates of death in the construction industry for workers who were classified as either plumbers or electricians. The CFOI is a federal-state cooperative program that has been implemented in all 50 states and the District of Columbia since 1992. While the SOII provides injury estimates for the national or state injury rates, the CFOI provides complete counts of death. The CFOI compiles deaths resulting from injuries from death certificates, workers' compensation reports, OSHA reports, medical examiner reports, newspaper articles, and other sources. Both the death and the work-relatedness of the death must be corroborated by at least two data sources or one data source and a follow-up questionnaire. Deaths occurring during a commute to or from work are not considered work related, but vehicle-related deaths during the course of work are included.

[1] The three categories are injuries that cause an absence from work, injuries that cause a restriction of work or job transfer; and injuries that do not affect working capacity (http://www.bls.gov/iif/).

The two data sets have gone through important changes in the listing of categories that constitute the occupations of electricians and plumbers in the construction industry. Table 1B summarizes the main changes of the data sets pertinent to our sample selection. Since year 2003, the SOII and CFOI adopted the 2000 Standard Occupational Classification system and 2002 NAICS to classify occupations and industries. Specifically, from 1992 to 2002, they categorized the construction industry using the 1987 Standard Industrial Classification (SIC) categories numbered 1500 to 1799. After 2003, however, they coded the construction industry as 23600 to 23899 using the North American Industry Classification System (NAICS). As for the occupation classification, they categorized electricians and plumbers using the 1990 Census Occupational Classification System between 1992 and 2002, but then switched to using the 2000 Standard Occupational Classification system.. The change resulted in broad categorization of each occupation. For example, Supervisors who are relatively risk-free are not separately categorized from electricians, plumbers, and apprentices. Also, pipe layers were newly included in the 2000 Standard Occupational Classification system. Although the listing of the kinds of occupations that were included from 1992 to 2002 and from 2003 to 2007 changed, we believe that these categories did not substantially alter the groups in each category for either electricians or plumbers.

In addition, starting in 2002 data, the SOII does not report injuries separate from illnesses. Following CPWR (2005), we analyze injuries that cause an absence from work with “days away from work” for injuries and illnesses, which has remained unchanged since 1992.[2]

Measuring Injuries and Deaths for Electricians and Plumbers

Because the SOII and CFOI do not have the employment information, one important issue in building an uninterrupted time series for our analysis is to compute both the injury rates and death rates at the workplace, in particular to estimate the denominator (i.e., the employment of the occupations within states in a given year). Thus, we extrapolate estimates on the employment for the two occupations in a state in a given year as the denominator using the Current Population Survey (CPS) Merged Outgoing Rotation Group (MORG) data, which is extracts of the CPS’s Basic Monthly Data during the household's fourth and eighth month in the survey.

To accurately describe the injury and death rates for the occupations, we make sure that the numerator (injuries or deaths of electricians and plumbers in the SOII and CFOI) and the denominator (estimates on employment in the CPS MORG) are based on the same group of workers. However, since we solely base an estimate on employment on the CPS MORG, the injury and death rates differ from those in some BLS publications.[3]

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[2] The change in the measure should have not affected our analysis because illnesses have accounted for less Illnesses have accounted for less than 2% of nonfatal injuries and illness in BLS reports (CPWR, 2005).

[3] For example, death rates published by the BLS were calculated using estimates of employed civilian workers (age 16 and older) from the CPS supplemented with counts for resident armed forces provided by the Department of Defense (DOD) (Bureau of Labor Statistics, 2006b).

Specifically, injury rates, expressed as the number of work injuries per 100 workers, were calculated as follows:

1) $\text{Injury Rates}_{st}^{E/P} = (N / W) \times 100,$

where N is the nationally weighted number of nonfatal injuries for Electricians (E) or Plumbers (P) in state s in year t from the SOII; and W is the employment of Electricians (E) or Plumbers (P) in state s in year t, which is estimated from electricians and plumbers who work for private industry with the exclusion of the self-employed, farms with fewer than 11 employees, private households, federal, state and local government agencies from the CPS MORG data.[4]

The death rates, expressed as the number of fatal work injuries per 10,000 workers, were calculated as follows:

2) $\text{Death Rates}_{st}^{E/P} = (N / W) \times 10{,}000$

where N is the number of deaths for Electricians (E) or Plumbers (P) who worked in the private sectors in state s in year t with an exclusion of the self-employed, farms with fewer than 11 employees, private households, federal, state and local government agencies from the CFOI; and W is the employment of Electricians (E) or Plumbers (P) in state s in year t, which is estimated from electricians and plumbers who work for private industry with the exclusion of the self-employed, farms with fewer than 11 employees, private households, federal, state and local government agencies from the CPS MORG data.

There are a number of limitations to these fatality rates to be acknowledged (Bureau of Labor Statistics, 2006b). First, the CPS MORG data used to estimate employment are based upon a sample rather than a complete count of employment. Therefore, the CPS MORG estimates and the injury and death rates have sampling errors. The figures obtained for the rates may differ from figures that would have been obtained if it had been possible to take a census of employed persons. Second, the CPS categorizes workers according to their primary job, which may differ from the job the deceased was working in when fatally injured as reported in the Census of Fatal Occupational Injuries. Finally, the rates are based on employment. The employment-based measure does not take into account differences in the number of hours worked. Although hours-based rates, which are adopted by recent publications by the BLS adopted, are generally considered more accurate, the employment-based rates are used in the analysis because of limitations in the availability of data for hours worked.

This case study can illuminate the potential economic and "life and limb" policy issues of the increased regulation of occupations in the U.S. labor market. This report fills a gap since there has been little analysis of the issue (Shimberg, Esser, and Kruger, 1973; Perloff, 1980). We also plan to examine the impact of occupational regulation on wages to provide a preliminary examination if there are any compensating differentials of wages for more rigorous occupational licensing statutes. The key data we use for the analysis is the CPS Merged Outgoing Rotation Group (MORG) data for 1992-2007 and state statutes and controls. This is mainly because the SOII and CFOI do not survey information on wages and union membership of the injured and deceased construction workers.

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[4] In this report we present empirical analyses using the nationally weighted estimates of nonfatal injuries from the CFOI. The analyses are almost identical when we used the state weighted estimates of nonfatal injuries.

In order to examine occupations in our analysis we show the categories or stages to work in the occupation. The general categories of construction worker hierarchy that are required to have some form of licensing are the following categories:

- Journeyman
- Master
- Maintenance Plumber or Electrician
- Contractor

The licensing of workers in construction generally takes place at the state or local level. The licensing of workers in construction generally takes place at the state or local level. To illustrate, New York City did not have a licensing board well into the 1970s, to regulate journeyman plumbers and electricians. In contrast, Chicago had a 3 person board to license plumbers but no board for licensing electrical contractors in order to substitute for the lack of licensing at the state level. The pass rates for electricians in Chicago were lower than passing the state of Illinois bar exam or dental licensing exam (Shimberg et. al. 1973).

Trends in Injuries and Deaths for Electricians and Plumbers

From the early 1990s there has been a downward trend in the injury rate for plumbers and electricians. Figure 2 shows the trend in injuries using data from the SOII. However, from about 2000 the decline has been much smaller. In contrast, the death rate as a result of work-related injuries has shown a decline for electricians in Figure 3, but the death rate for plumbers due to work related injuries has remained largely flat from the early 1990s to the present. The estimates from these figures show some decline during the early period of the estimates, but a slow, if any, decline in death and injuries for these two kinds of construction workers from 2005 to 2007. Whether this is due to public policy changes or that given the type of work these two occupations perform, and their inherent danger, that further reductions are hard to obtain, without major technological changes, is difficult to ascertain through these data. Finally, in appendix 1 and 2 we give five main events causing nonfatal injuries for electricians and plumbers and deaths for electricians, respectively.

Evolution and Anatomy of State Licensing of Electricians and Plumbers

The Department of Labor was among the first group to examine the role of occupational regulation in construction. In a study commissioned by the Department's office of research, a study by Shimberg, Esser, and Kruger in 1973 discussed the role of occupational regulation in construction and mentioned the difficulties of health and safety issues in the construction industry. The key elements of their findings were on the process of licensing not on the outcomes. They focused on who is on the licensing boards and are they state and or local boards? They also examined whether the board was composed of political appointees, if the pay is low, and whether they were dominated by members of the occupation and if they had public members.

The basic theory of the licensing and health and safety suggests the following set of issues:

- Licensing introduces standardization in occupation specific training (apprenticeships), education, and procedures which would reduce death and injuries
- Eliminates lowest part of the quality distribution within the occupation through education and testing and reduces death & injuries.
- Maintains quality and time and money attachment to the occupation through continuing education that reduces death & injuries.
- Reduces innovation in safety and health procedures that may raise death & injuries.

In order to examine which of these occupational issues dominates in the determination of health and safety for plumbers and electricians, we developed a regulatory index which captures the major elements of the statutes across states. Table 2 gives the key elements (and their operational definition) of the licensing provisions in the statutes and administrative provisions that we plan to examine for each of the states in our sample for electricians and plumbers. In Appendix 3 we present our survey of the various licensing statutes regulating the occupations over time by state.[5] It tabulates only the changes in occupational regulations in state statutes. For example, electricians in Alaska were licensed at the state level and the five key elements of the licensing provisions did not change between 1992 and 2007. In contrast, plumbers in Alaska were not licensed as of year 1992, but were required to be licensed at the state level in 2005.

Table 3 shows the changes that have occurred in the statutes over time by state, and those states that have switched from local to state control of the licensing provisions for electricians. Figure 4 provides a Box and Whisker plot of the changes in the provisions of the licensing statutes for electricians over time from the 1992 to 2007. Overall, the plot shows a generally upward trend in the major components of the regulatory provisions of the licensing statues. This suggests that the licensing statutes are at the state level rather than at the city or county governmental venues, and that they are becoming more rigorous by requiring more education and training in order to meet the requirements for entry into the occupation.

Table 4 gives the changes in the statutes for the period 1992 through 2007 for plumbers. The results show that a number of states had local regulation of the construction occupation. However, both South Dakota and Virginia moved to state licensing from local regulations, but Idaho moved to state certification from local regulations. Nebraska remained as the only state with no regulations for the occupation, Alaska, North Dakota and Tennessee all moved to state licensing from not having any regulation during the period we examined.

Figure 5 presents the Box and Whisker plot for regulation from 1992 through 2007 for plumbers. Again, the results show an upward trend in the amount of state regulation and the toughness of those regulations. Similar to electricians, regulations appear to be getting more stringent by measures of education and training for plumbers as well.

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[5] While we could track the changes in the licensing provisions in the statutes and administrative provisions when these occupations are licensed at the state level, we could not track such changes when these occupations are licensed at the local level, such as city and county. As a consequence, we have complete information on whether or not these occupations are licensed at the state or local level, but do have partial information on specific provisions of some key elements of the occupational regulations for these occupations that are licensed at the state level.

Table 5 gives the growth in the statutes over the period from 1992 through 2007. The results show that both occupations experienced growth in regulations governing the entry and training requirements. The growth in the level of regulation was higher for electricians than for plumbers. However, the overall level of regulation was higher for plumbers than electricians both in 1992 and in 2007.

Empirical Strategy for Estimating the Role of Regulations on Labor Market Outcomes and Health and Safety

The empirical analysis is divided into two sections, each of which examines a different set of outcomes. First, we will use our measures of occupational regulations to examine the influence of the measures of restrictiveness on the labor market outcomes for electricians and plumbers, using wages as a measure of labor market outcomes. Next we will analyze the role of the regulations on measures of injury and death on the job. As background we give the rankings of the top five and bottom five states by their ranking on measures of regulatory restrictiveness in 2007. Table 6 presents the results for electricians, while Table 7 shows the results for plumbers. Although no clear pattern emerges for both occupations, states in the Southeast appear to have few measurable regulations on entry for both plumbers and electricians.

In the following section, we present multivariate analyses focusing on the type of occupational regulations, and three specific components (i.e., apprenticeship, exam requirements, and continuing education).

Testing the Wage Models with Licensing Regulations

A key part of our examination of the influence of regulation is the data from the Current Population Merged Outgoing rotation group (MORG). Table 8 presents the basic information that we used for our analysis. These variables include the standard variables from the MORG to include human capital variables such as gender, age, experience, education, rate, part-time employment, union membership, and sector for both electricians and plumbers. The earnings of both occupations are similar as is union membership. The two occupations are similar in human capital, social and demographic characteristics.

Initially we examine and estimate an earnings model with licensing regulations. The basic model is specified as follows:

3) $$\ln(\text{Earnings}_{ist}^{E/P}) = \alpha + \beta R_{st} + \gamma X_{ist} + \delta_s + \theta_t + \varepsilon_{ist},$$

where $Earnings_{ist}$ is the hourly earnings of Electricians (E) or Plumbers (P) i at state s in time period t; R_{st} is the licensing occupational regulations and components of the regulation in person i's state s in time period t; $\boldsymbol{X}_{ist}$ is the vector includes covariates measuring characteristics of each person; δ and η are state and year fixed effects, respectively; and ε_{ist} is the error term.

In Table 9 we show the estimates from the above model for electricians of the influence of licensing on wages. The results show no statistically significant impact of the overall index of licensing on earnings. Further local versus state licensing also did not have major impacts. However, apprenticeships, exam requirements, and continuing education mattered in its influence on wage determination. The magnitude of the impact was small ranging from 6 to 7

percent on hourly earnings. In contrast, the results from the table show the influence of unions on hourly earnings to be between a statistically significant 27 and 32 percent.

The wage effects shown in Table 10 for plumbers are not nearly as clear or robust for as the wage effects on licensing. Similar to electricians the influence of the overall index for licensing is not statistically significant. Moreover, there is no clear pattern of the influence of having regulation at the state or local level having an influence on wage determination. Unlike the influence of apprenticeships, exam requirements, and continuing education requirements for electricians, there was if anything, a small negative influence of these required policies on wage determination for plumbers. There may be some substitution for low quality plumbers who do have these requirements that are getting more work in the construction industry. Moreover, given the lack of variation in the data for plumbers there may be more noise in the wage data for this occupation.[6]

Testing the Health and Safety Models with Licensing Regulations[7]

The main part of our analysis focuses on the incidence of injuries at the state level. This uses two main measures of the severity of injuries: days away from work due to injury/illness and the death incidence rates at the state level. The basic model for the injury incidence rate can be stated as follows:

4) $$\text{Injury Rates}_{st}^{E/P} = \alpha + \beta R_{st} + \gamma X_{st} + \delta_s + \theta_t + \varepsilon_{st},$$

where *Injury Rates*$_{st}$ is the injury incidents rates of Electricians (E) or Plumbers (P) at state *s* in time period *t*; R_{st} is the licensing occupational regulations and components of the regulation in state *s* in time period *t*; $\boldsymbol{X}_{st}$ is the vector includes covariates measuring characteristics of each state *s*; δ and η are state and year fixed effects, respectively; and ε_{st} is the error term.[8]

Table 11 shows the influence of occupational regulation on the injury incidence rates for electricians. The results show mixed results for the overall influence of licensing on the injury incidence rates for electricians, with the most rigorous test using state fixed effects showing somewhat of a reduction in injury rates. None of the specific requirements such as apprenticeships, exam requirements, and continuing education is consistent in their impact. Similarly, the results for plumbers of the influence of occupational regulation on the incidence of injury rates for plumbers are inconclusive. In Table 12 none of the regulation variables are statistically significant for the incidence of occupational injuries.

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[6] We also conducted the same analysis using information from the American Community Survey (ACS) as a further test of the role of occupational licensing provisions on wages. The results from the ACS were generally consistent with those for electricians in this report, but not for plumbers. We do not present the results from the ACS in this report, because the ACS partially covers our sample period (i.e., year 2000 and since then) and does not have information on union membership. However, the results are available upon request to the authors.

[7] Our empirical analyses from the health and safety models with licensing regulations do not include states that regulate the occupations at the local level.

[8] The state-level control variables were aggregated using the individual variables shown in Table 9 and 10 from the CPS MORG data. The same state- level control variables are also included in empirical analyses for the state death rates shown in Table 15 and 16.

In the next section of the analysis of injuries and occupational regulation we examine severity of injuries at the individual level using the same data and a similar model. The severity of injury model can be stated as follows:

5) $$\text{Severity of Injury}_{ist}^{E/P} = \alpha + \beta R_{st} + \gamma X_{ist} + \delta_s + \theta_t + \varepsilon_{ist},$$

where *Severity of Injury*$_{ist}$ is the days away from work due to injury/illness of individual Electricians (E) or Plumbers (P) i at state s in time period t; R_{st} is the licensing occupational regulations and components of the regulation in person i's state s in time period t; $\boldsymbol{X}_{ist}$ is the vector includes covariates measuring characteristics of each injured/ill person; δ and η are state and year fixed effects, respectively; and ε_{ist} is the error term.[9]

The estimates for severity of injuries for electricians from negative binomial regressions are presented in Table 13. The estimate of the incidence rate ratio of continuing education indicates a 0.361 times reduction in days lost of .70 as a result of having this provision in an occupational licensing law, relative to no requirement of continuing education. None of the other provisions are statistically significant. Similarly, Table 14 gives the estimates of the influence of occupational regulation for plumbers' severity of injuries. Except for the role of the exam requirement which has a counterintuitive sign, all the other results are not statistically significant. Overall the role of occupational regulation does not seem to impact the severity of injuries for either electricians or plumbers.

Our final model tests for the role occupational regulation on the incidence of death rates for both plumbers and electricians. The basic specification follows our earlier models and is presented as follows:

6) $$\text{Death Rates}_{st}^{E/P} = \alpha + \beta R_{st} + \gamma X_{st} + \delta_s + \theta_t + \varepsilon_{st},$$

where *Death Rates*$_{st}$ is the death incidence rates of Electricians (E) or Plumbers (P) at state s in time period t; R_{st} is the licensing occupational regulations and components of the regulation in state s in time period t; $\boldsymbol{X}_{st}$ is the vector includes covariates measuring characteristics of each state s; δ and η are state and year fixed effects, respectively; and ε_{st} is the error term.

Tables 15 and 16 present the estimates of the statistical model for each occupation separately. The results are consistent with those shown in the earlier estimates presented in this report. We find that measure of occupational regulation have little influence on the death rates in construction of electricians and plumbers. Perhaps the influence of licensing is small because of incentives for adhering to the regulations are small, or because the requirements are not significant barriers to entry into the occupation to keep out individuals who behave in unsafe ways? Further our analysis does not take into account the employer who may require unsafe methods of doing work, and that their requirements may also differ by state. Nevertheless, our analysis across incidence of injury, severity of injury, rates of death of these two highly visible occupations in construction show little influence of occupations regulation on health and safety of these workers.

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[9] We run specification (5) using negative binomial regression, because the severity of injuries is measured by a count using "days away from work". Also this analysis is based on information on injured/ill individuals in the SOII. Therefore, we used all the possible information on these individuals from the SOII to create the control variables, which are different from those in the wage model in Table 9 and 10. For the control variables we include, see *Note* in Table 13 and 14.

Conclusions

The general issue of occupational regulation has particular relevance to the potential health and safety of plumbers and electricians, which is the occupational group that had the largest number of occupational deaths of any blue collar occupational. In addition, construction occupations also are among the ones that suffer the highest injury rates. The main focus of our research has been the development of the first analysis in a modeling framework of how licensing influences health and safety at the workplace. We provide multivariate estimates linking various levels of state or local occupational regulation to levels and changes of occupational injuries and deaths of plumbers and electricians.

We find that there has been significant growth of licensing for both occupations at the state level from 1992 to 2007. We first document that growth by states for both occupations has been growing. Next we show wage estimates of the impact of occupational regulation on wages for both occupations. Our results show that the influence of occupational regulation has been much greater on wage determination for electricians than for plumbers. We think this is due in part to the higher requirements and greater variation in state and local regulations for electricians relative to plumbers.

Finally, our results for death and injury rates show that the impact of occupational regulation for death and injuries is statistically insignificant or murky in our multivariate analysis. In further work in this area we plan to examine the following research topics: Are there compensating differentials between licensing, higher wages, and death and injuries? Do unions serve as substitutes for licensing when there are potential deaths and injuries? Are there spillovers to other occupations in construction such as laborers or carpenters who are not regulated by the state? The results presented in this report provide a first approximation and new data for the relationship between occupational licensing and death and injuries for two important occupations in the construction industry.

References

Brinegar, P. and Schmitt, K. 1992. ”State Occupational and Professional Licensure,” *The Book of the States, 1992–1993*. Lexington, KY: Council of State Governments, pp. 567–80.

Bureau of Labor Statistics. 2006a. “National Census of Fatal Occupational Injuries in 2005,” Washington, D.C.: U.S. Department of Labor, Bureau of Labor Statistics.

Bureau of Labor Statistics. 2006b. “Fatality Rates Technical Notes, Census of Fatal Occupational Injuries (CFOI),” Washington, D.C.: U.S. Department of Labor, Bureau of Labor Statistics.

Bureau of Labor Statistics. 2007. http://data.bls.gov/GQT/servlet/InitialPage, Bureau of Labor Statistics, Washington, D.C., accessed November 19, 2007.

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

Kleiner, M. M. (2006). *Licensing Occupations: Ensuring Quality or Restricting Competition?* Kalamazoo: W.E. Upjohn Institute.

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

Kleiner, Morris M., and Alan B. Krueger. 2010.“The Prevalence and Effects of Occupational Licensing.” *British Journal of Industrial Relations*, forthcoming in 48(4). December.

Perloff, J.M. 1980. “The Impact of Licensing Laws on Wage Changes in the Construction Industry,” *Journal of Law and Economics* 23: 409-28.

Shimberg, Benjamin, Barbara Esser, and Daniel Kruger. 1973. *Occupational Licensing: Practices and Policies*. Washington, D.C.: Public affairs Press.

Wheelan, C. J. 1998. *Politics or Public Interest? An Empirical Examination of Occupational Licensure*, Unpublished manuscript. Chicago: University of Chicago.

The Center to Protect Workers’ Rights. 2005. *Work-Related Fatal and Nonfatal Injuries among U.S. Construction Workers, 1992-2003*. Silver Spring, MD.

Appendix 1: Five Main Events Causing Workplace Non-Fatal injuries, 1992-2007

	Electricians				Plumbers		
Events (Code)	Actual Occurrence	Estimated Occurrences	% of Estimated Occurrences	Events (Code)	Actual Occurrence	Estimated Occurrences	% of Estimated Occurrences
Overexertion in lifting (221)	2,031	12,411	9.05	Overexertion in lifting (221)	2,212	17,100	14.05
Fall from ladder (113)	1,519	11,625	8.48	Bending, climbing, crawling, reaching, twisting (211)	914	7,742	6.36
Bending, climbing, crawling, reaching, twisting (211)	1,233	8,608	6.28	Struck by falling object (021)	915	6,406	5.26
Struck against stationary object (012)	972	7,405	5.40	Fall to floor, walkway, or other surface (131)	865	6,858	5.63
Struck by slipping handheld object (0232)	875	7,267	5.30	Fall from ladder (113)	785	6,061	4.98
Others	13,878	89,788	65.49	Others	9,692	77,552	63.71
Total	20,508	137,104	100	Total	15,383	121,719	14.05

Source: The SOII and CFOI from 1992 to 2002.

Appendix 2: Five Main Events Causing Workplace Deaths for Electricians, 1992-2007

Events (Code)	Electricians	
	Actual Occurrence	%
Contact with wiring, transformers, or other electrical components (3120)	351	30.08
Contact with overhead power lines (3130)	144	12.34
Fall from ladder (1130)	88	7.54
Contact with electric current of machine, tool, appliance, or light fixture (3110)	80	6.86
Contact with electric current, unspecified (3100)	30	2.57
Others	474	40.62
Total	1,167	100

Source: The SOII and CFOI from 1992 to 2002.

Appendix 3: Adoption of Occupational Regulations in State Statute by State, 1992-2007

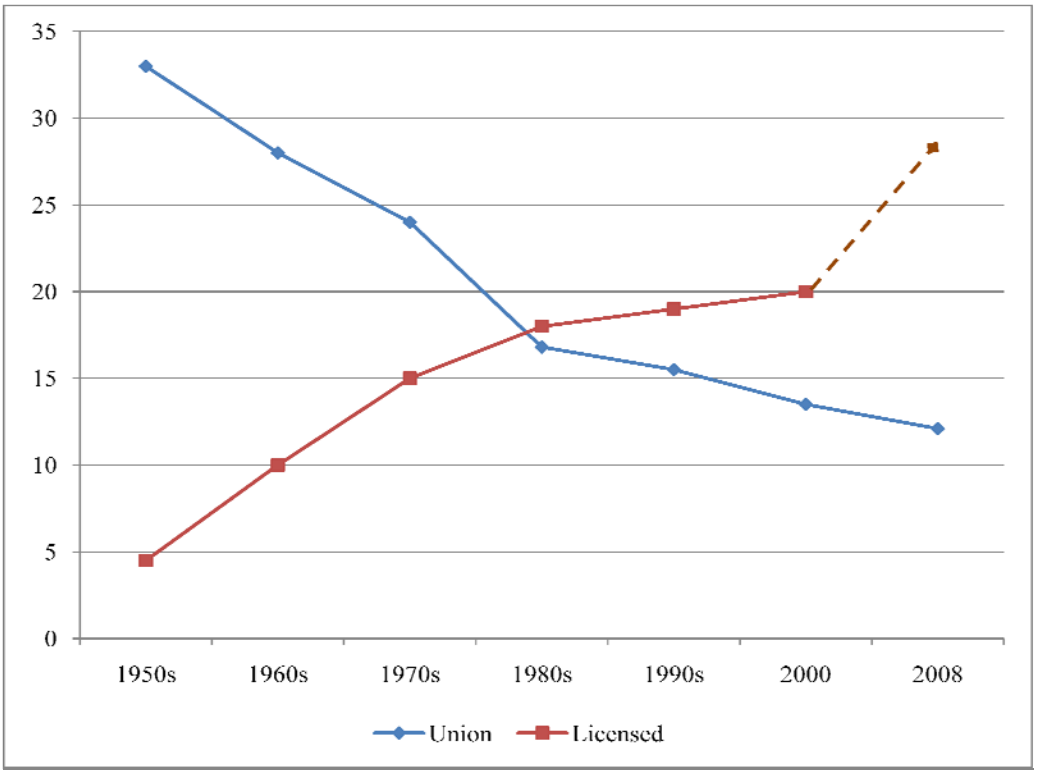
		Electricians						Plumbers					
State	Year	Type of License	General Rqmt	Apprentice ship	Written Exam	Perf. Exam	Cont. Edu	Type of License	General Rqmt	Apprentice-ship	Written Exam	Perf. Exam	Cont. Edu
Alaska	1992	S	0	1	0	0	0	N					
	2005							S	0	1	1	0	0
Alabama	1992	S	0	1	1	1	0	S	0	1*	1	0	0
Arizona	1992	S	1	1	1	1	1	S	1	1	1	0	0
Arkansas	1992	S	0	1*	1	0	0	S	0	1*	1	0	0
California	1992	S	1	1	1	0	0	S	0	0	1	0	0
Colorado	1992	S	0	1*	1	0	0	S	0	1*	1	1	0
Connecticut	1992	S	1	1	1	0	0	S	1	1	1	1	0
Delaware	1992	L						S	0	0	1	0	0
	2000	S	0	1	1	0	1						
District of	1992	S	0	0	0	0	0	S	0	0	1	0	1
Columbia	1999	S	0	1	1	0	0	S	0	0	0	0	0
Florida	1992	S	1	1	1	0	0	S	1	1	1	0	0
Georgia	1992	S	1	1	1	0	0	S	1	1*	1	0	0
Hawaii	1992	S	1	1	1	0	0	S	1	1*	1	0	1
Idaho	1992	S	0	1	1	0	0	C					
	1996							S	1	1	1	1	0
	1999	S	1	1	1	0	0						
Illinois	1992	L						S	1	1	1	0	0
Indiana	1992	N						S	1	1	1	1	0
Iowa	1992	L						L					
	2007	S	0	1	1	0	0						
Kansas	1992	L						L					
Kentucky	1992	L						S	1	1	0	1	1
	2001	S	0	1*	0	0	0						
Louisiana	1992	N						S	0	1*	1	1	0
	2004	S	0	0	1	0	0						
Maine	1992	S	0	1	1	0	0	S	0	1	1	0	0
Maryland	1992	S	1	1*	1	0	0	S	0	1	1	0	0
Massachusetts	1992	N						L					
	2007	S	1	1	1	0	1						
Michigan	1992	S	1	1	1	0	0	S	1	1	1	1	0
Minnesota	1992	S	0	1	1	0	0	S	0	1	1	0	0
Mississippi	1992	S	0	0	1	0	0	L					
Missouri	1992	L						S	0	1*	1	1	0
Montana	1992	S	0	1*	1	0	0	S	0	1	1	0	0
Nebraska	1992	S	0	1	0	0	0	N					
Nevada	1992	S	1	1	1	0	0	S	1	1	1	0	0
New Hampshire	1992	S	0	1*	1	0	0	S	0	1	1	0	0
New Jersey	1992	S	0	0	0	0	0	S	0	0	0	0	0
	2003	S	1	1	1	0	0	S	0	1	1	0	0

Appendix 3: Continued

		Electricians						Plumbers					
state	Year	Type of License	General Rqmt	Apprentice ship	Written Exam	Perf. Exam	Cont. Edu	Type of License	General Rqmt	Apprentice-ship	Written Exam	Perf. Exam	Cont. Edu
New Mexico	1992	S	1	1	1	0	0	S	1	1	1	0	0
New York	1992	L						L					
North Carolina	1992	S	1	1*	0	0	0	S	0	1	1	0	1
	2001							S	1	1	1	0	1
North Dakota	1992	S	0	1*	1	0	0	N					
	1993							S	1	1	1	0	1
Ohio	1992	S	1	1	1	0	0	S	1	1	1	0	1
Oklahoma	1992	S	1	0	1	0	0	S	1	0	1	0	0
	2002	S	1	1*	1	0	0	S	1	1	1	0	0
Oregon	1992	S	0	1	0	0	0	S	0	1	1	1	0
Pennsylvania	1992	L						L					
Rhode Island	1992	S	0	0	1	0	0	S	0	1	1	0	0
	1998	S	1	1*	1	0	0						
South Carolina	1992	S	0	0	1	0	0	S	0	0	1	0	0
South Dakota	1992	S	0	1	1	0	0	L					
	1999							S	0	1	1	0	0
Tennessee	1992	N						N					
	2000	S	0	0	1	0	0						
	2006							S	0	1	1	0	0
Texas	1992	L						S	0	1*	1	0	0
	2003	S	0	1	1	0	0						
Utah	1992	S	0	1	1	0	0	S	0	1	1	0	0
	2000	S	0	1*	1	0	0						
Vermont	1992	S	0	1	1	0	0	S	0	1*	1	1	0
Virginia	1992	S	0	0	1	0	0	L					
	1995	S	1	1*	1	0	0	S	1	1*	1	0	0
Washington	1992	S	0	1	1	0	1	S	0	1	1	0	0
	1999	S	0	1	1	0	0						
West Virginia	1992	S	0	1	1	0	0	N					
	1994	S	1	1*	1	0	0						
Wisconsin	1992	S	0	1	1	0	0	S	1	1	1	0	0
Wyoming	1992	S	0	1*	1	0	0	L					
	1994	S	1	1*	1	0	1						

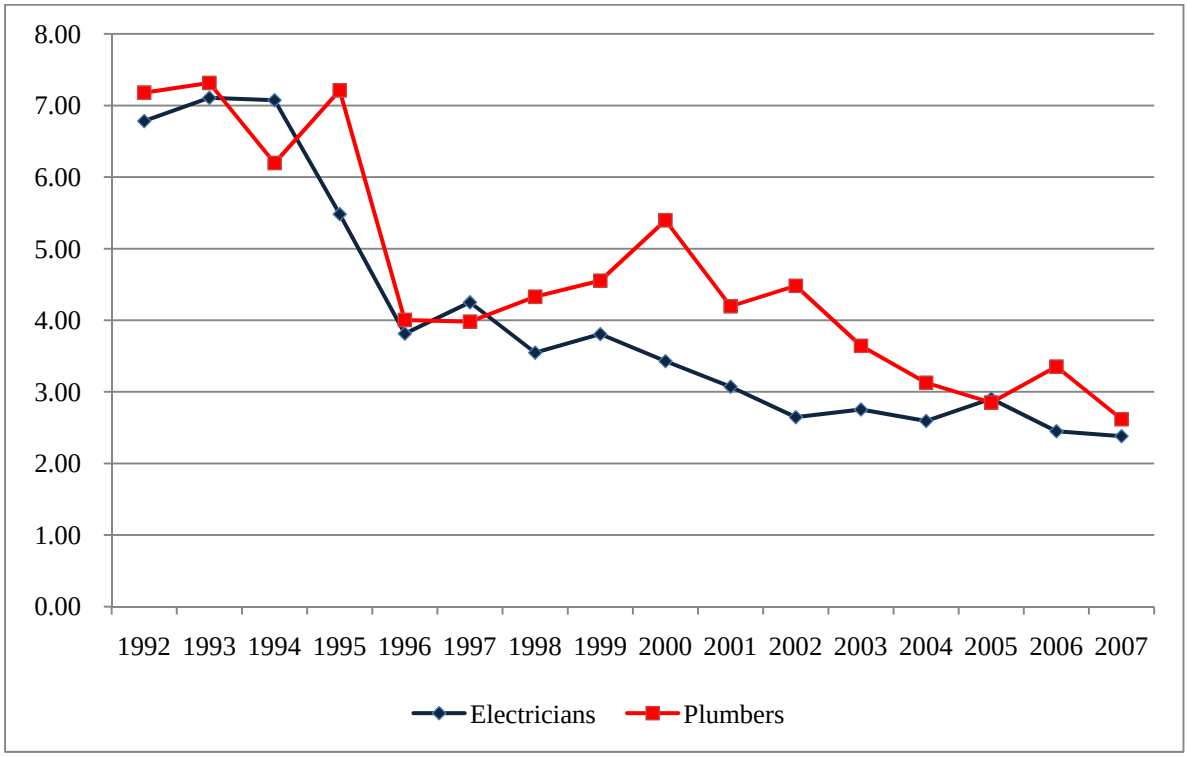
Note: S, L, C, and N in Column "Type of License" refer to State, Local, Certification, and No license requirement, respectively; definitions of specific components and their values are shown in Table 2; and * in apprenticeship indicates higher occupation-specific experiences than apprenticeship (e.g., journeyman) required.

Figure 1: Comparisons in the Time-Trends of Two Labor Market Institutions: Licensing and Unionization



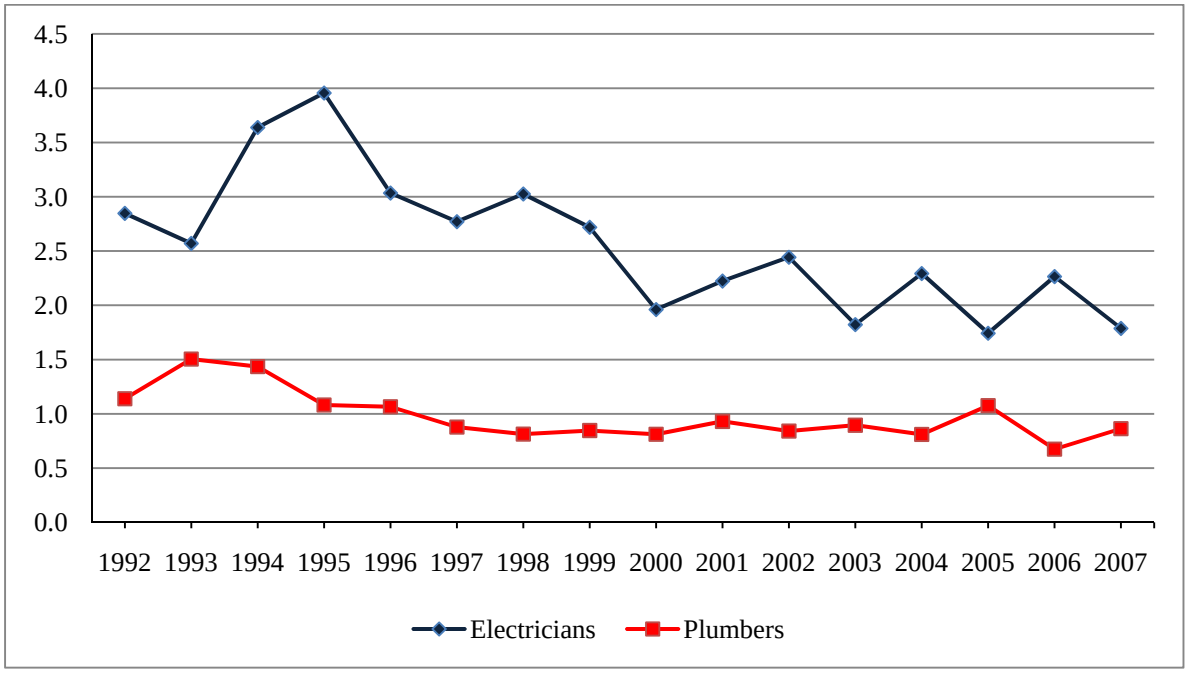
Note: Dashed line shows the value from state estimates of licensing to the Gallup Survey and Westat Survey results, and the union membership estimates are from the CPS.

Figure 2: Injuries Rates for Electricians and Plumbers, 1992-2007



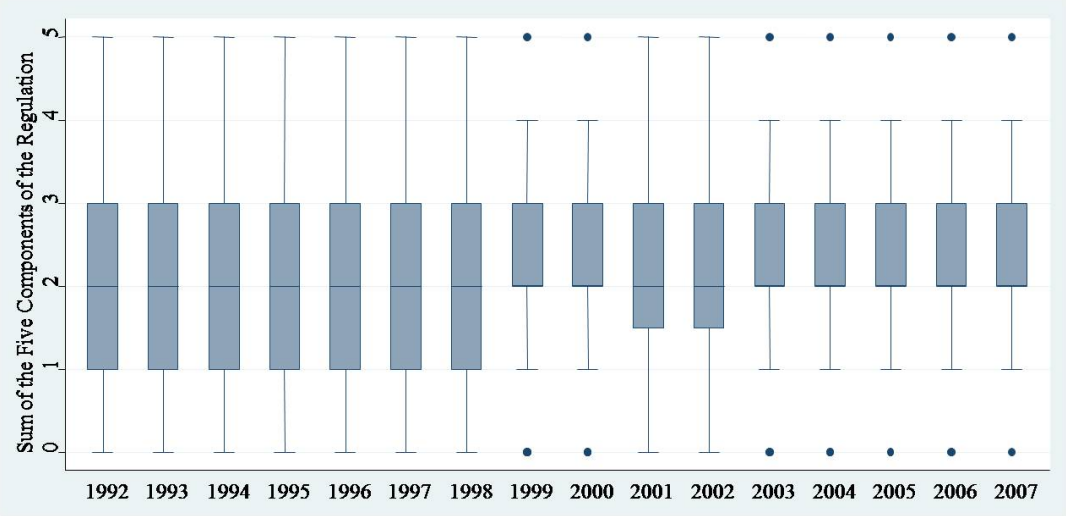
Note: Injury rate = (Estimated Injuries from the SOII using the weight for the national estimate/Estimated number of employment in each occupation from the MORG) ×100.

Figure 3: Death Rates for Electricians and Plumbers, 1992-2007



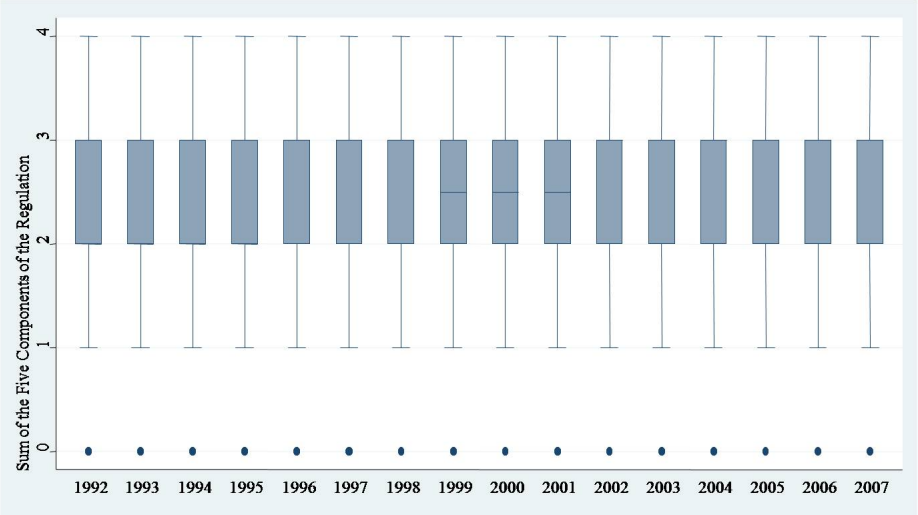
Note: Death rate = (Actual Number of Deaths/Estimated Number of Employment in each occupation from the MORG) ×10,000.

Figure 4: Box and Whisker Graph of the Sum of the Five Key Components of the Licensing Regulations for Electricians, 1992-2007



Source: The authors' survey of licensing statutes for electricians and plumbers by state from 1992 to 2007 in Appendix 3.

Figure 5: Box and Whisker Graph of the Sum of the Five Key Components of the Licensing Regulations for Plumbers, 1992-2007



Source: The authors' survey of licensing statutes for electricians and plumbers by state from 1992 to 2007 in Appendix 3.

Table 1A: Key Descriptions of the SOII and CFOI

	Survey of Occupational Injuries and Illnesses (SOII)	Census of Fatal Occupational Injuries (CFOI)
Sampling	✓ 39 States ✓ Nonfatal injuries and illnesses for private industry only ✓ Excludes the self-employed, farms with fewer than 11 employees, private households, federal government agencies ✓ Includes employees in state and local government agencies for national estimates only	✓ 50 States + D.C. ✓ Includes private and federal, state, and local government agencies ✓ Data on deaths are compiled from death certificates, workers' compensation reports, OSHA reports, medical examiner reports, newspaper articles, and other sources.
Important changes	✓ Change in the standard occupational classification (SOC) system and the standard industry codes (SIC) system in 2003 ✓ No longer reports on injuries separate from illness starting with the 2002 data	✓ Change in the standard occupational classification (SOC) system and the standard industry codes (SIC) system in 2003

Table 1B: Changes in Industry and Occupation Codes for Electricians and Plumbers

	1992-2002	2003-2007
Industry	1987 SIC: 1500~1799	2003 NAICS: 23; 23600~23899
Occupation	*Electricians*	
	555 Supervisors: electricians and power transmission installers; 575 Electricians; and 576 Electricians apprentices	47-2111 Electricians; and 47-3013 Helpers - Electricians
	Plumbers	
	557 Supervisors: Plumbers, pipefitters, and steamfitters; 585 Plumbers, pipefitters, and steamfitters; and 576 Plumbers, pipefitters, and steamfitters apprentices	47-2151 Pipe layers; 47-2152 Plumbers, pipefitters, and steamfitters; and 47-3015 Helpers - Pipe layers, plumbers, pipefitters, and steamfitters

Table 2: Key Elements and Definitions of Regulatory Variables

Variable	Definition
License	We coded 1 if either license is required by state statute or local statute; otherwise 0.
State license	We coded 1 if license is required by state statute
Local license	We coded 1 if license is required by statute of local municipality
Five major components	
General requirements	We coded 1 if either a minimum level of education or age are required to be licensed; otherwise 0.
Apprentice codes	We coded 1 if an occupation-specific experience as apprentice (or equivalent years of education) is required to be licensed; otherwise 0.
Written exam	We coded 1 if a written exam is required to be licensed; otherwise 0.
Performance exam	We coded 1 if a performance exam is required to be licensed; otherwise 0.
Continuing education	We coded 1 if state has any requirement for license renewal; otherwise 0.

Table 3: Stayers and Switchers in Occupational Regulation of Electricians, 1992-2007

	State Licensing	Local Licensing	No Licensing
Stayers	All other states	Illinois, Kansas, Missouri, New York, Pennsylvania	Indiana
Switchers		Delaware (to state licensing from 2000); Iowa (to state licensing from 2007); Kentucky (to state licensing from 2001); Texas (to state licensing from 2003)	Louisiana (to state licensing from 2004); Massachusetts (to state licensing from 2007); Tennessee (to state licensing from 2000)

Source: The authors' survey of licensing statutes for electricians and plumbers by state from 1992 to 2007 in Appendix 3.

Table 4: Stayers and Switchers in Occupational Regulation of Plumbers, 1992-2007

	State Licensing	Local Licensing	Certification	No Licensing
Stayers	All other States	Iowa; Kansas; Massachusetts; Mississippi; New York; Pennsylvania; Wyoming		Nebraska; West Virginia
Switchers		South Dakota (to state licensing in 1999); Virginia (to state licensing in 1995)	Idaho (to state licensing from 1996)	Alaska (to state licensing from 2005); North Dakota (to state licensing from 1993); Tennessee (to state licensing from 2006)

Source: The authors' survey of licensing statutes for electricians and plumbers by state from 1992 to 2007 in Appendix 3.

Table 5: Changes in the Index of Regulation for Electricians and Plumbers, 1992-2007

	Electricians			Plumbers		
Year	# of States	Mean	S.D.	# of States	Mean	S.D.
1992	42	1.90	1.12	42	2.24	1.21
1993	42	1.90	1.12	42	2.33	1.18
1994	42	1.98	1.18	42	2.33	1.18
1995	42	2.02	1.18	43	2.35	1.17
1996	42	2.02	1.18	43	2.42	1.18
1997	42	2.02	1.18	43	2.42	1.18
1998	42	2.07	1.18	43	2.42	1.18
1999	42	2.12	1.13	44	2.36	1.22
2000	43	2.16	1.09	44	2.39	1.20
2001	44	2.14	1.09	44	2.41	1.23
2002	44	2.16	1.10	44	2.43	1.23
2003	45	2.22	1.04	44	2.50	1.17
2004	45	2.22	1.04	44	2.50	1.17
2005	45	2.24	1.00	44	2.55	1.11
2006	45	2.24	1.00	44	2.61	1.06
2007	46	2.33	0.97	44	2.61	1.06
Total	693	2.11	1.10	694	2.43	1.16

Source: The authors' survey of licensing statutes for electricians and plumbers by state from 1992 to 2007 in Appendix 3.

Table 6: Regulation Rankings of the Top and Bottom Grouping of States in 2007 for Electricians

Top States		Bottom States	
State	Sum of the five Requirements	State	Sum of the five Requirements
Arizona	5	Alaska	1
Massachusetts	4	Kentucky	1
Wyoming	4	Louisiana	1
Alabama and 17 States	3	Mississippi	1

Source: The authors' survey of licensing statutes for electricians and plumbers by state from 1992 to 2007 in Appendix 3.

Table 7: Regulation Rankings of the Top and Bottom Grouping of States in 2007 for Plumbers

Top States		Bottom States	
State	Sum of the five Requirements	State	Sum of the five Requirements
Connecticut	4	District of Columbia	0
Hawaii	4	California	1
Idaho	4	South Carolina	1
Indiana	4		
Kentucky	4		
Michigan	4		
North Carolina	4		
North Dakota	4		
Ohio	4		
Oregon	4		

Source: The authors' survey of licensing statutes for electricians and plumbers by state from 1992 to 2007 in Appendix 3.

Table 8: Basic Statist tics from the CPS MORG, 1992-2007

	Electricians			Plumbers		
Variable	Obs	Mean	S.D.	Obs	Mean	S.D.
Hourly earnings	9,439	21.30	9.89	6,978	20.69	9.57
Gender (1: Male; 0: Female)	10,781	0.98	0.13	8,357	0.99	0.10
Age (Years)	10,781	37.29	10.91	8,357	38.43	10.99
Experience	10,781	18.64	10.95	8,357	20.23	11.10
Experience squared	10,781	4.67	4.71	8,357	5.32	5.03
High school graduate	10,781	0.46	0.50	8,357	0.51	0.50
Some college experience	10,781	0.24	0.43	8,357	0.19	0.40
College diploma or more	10,781	0.23	0.42	8,357	0.15	0.36
Marriage	10,781	0.64	0.48	8,357	0.66	0.47
White	10,781	0.92	0.27	8,357	0.92	0.27
Hispanic origin	10,781	0.08	0.27	8,357	0.11	0.31
Part-time	10,781	0.02	0.14	8,357	0.03	0.17
Government	10,781	0.02	0.14	8,357	0.01	0.11
Union member	9,440	0.38	0.49	6,978	0.33	0.47

Source: The CPS MORG files from 1992 to 2007.

Table 9: The Effects of Occupational Licensing on Hourly Earnings for Electricians

	1	2	3	4	5	6	7	8	9
License	-0.017	0.006	0.026						
	(0.056)	(0.051)	(0.037)						
State license				-0.044	-0.006	0.021			
				(0.057)	(0.053)	(0.038)			
Local license				0.050	0.034	0.085†			
				(0.065)	(0.053)	(0.046)			
Apprenticeship							0.063*		
							(0.030)		
Exam Requirements								0.073**	
								(0.025)	
Continuing Education									0.057†
									(0.034)
Local license							0.061*	0.123***	0.068*
							(0.029)	(0.028)	(0.030)
Union member		0.319***	0.269***		0.314***	0.269***	0.269***	0.269***	0.269***
		(0.012)	(0.013)		(0.012)	(0.013)	(0.013)	(0.013)	(0.013)
Gender	0.039	0.080*	0.085*	0.045	0.081*	0.086*	0.085*	0.085*	0.085*
(1: Male; 0: Female)	(0.047)	(0.036)	(0.034)	(0.047)	(0.036)	(0.034)	(0.034)	(0.034)	(0.034)
Age (Years)	0.009	0.014*	0.013*	0.009	0.014*	0.013*	0.012*	0.013*	0.013*
	(0.006)	(0.005)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Experience	0.027***	0.019**	0.019**	0.028***	0.019**	0.020**	0.020**	0.019**	0.019**
	(0.007)	(0.006)	(0.006)	(0.007)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Experience squared	-0.060***	-0.057***	-0.055***	-0.060***	-0.057***	-0.055***	-0.055***	-0.055***	-0.055***
	(0.005)	(0.004)	(0.004)	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
High school graduate	0.188***	0.113**	0.100**	0.182***	0.112***	0.099**	0.099**	0.099**	0.099**
	(0.038)	(0.032)	(0.033)	(0.034)	(0.032)	(0.033)	(0.033)	(0.033)	(0.033)
Some college experience	0.228***	0.124**	0.099**	0.223***	0.123**	0.098*	0.098*	0.098**	0.098*
	(0.041)	(0.037)	(0.036)	(0.039)	(0.037)	(0.037)	(0.037)	(0.037)	(0.037)
College diploma or more	0.315***	0.178***	0.159***	0.307***	0.178***	0.160***	0.160***	0.160***	0.160***
	(0.051)	(0.040)	(0.041)	(0.044)	(0.039)	(0.041)	(0.041)	(0.041)	(0.041)
Marriage	0.085***	0.069***	0.074***	0.082***	0.068***	0.074***	0.074***	0.074***	0.074***
	(0.013)	(0.011)	(0.010)	(0.012)	(0.011)	(0.010)	(0.010)	(0.010)	(0.010)
White	0.126***	0.126***	0.127***	0.120***	0.124***	0.127***	0.128***	0.127***	0.127***
	(0.024)	(0.023)	(0.022)	(0.026)	(0.024)	(0.022)	(0.022)	(0.022)	(0.022)
Hispanic origin	-0.133**	-0.096**	-0.112***	-0.134**	-0.097**	-0.111***	-0.112***	-0.112***	-0.111***
	(0.042)	(0.032)	(0.021)	(0.048)	(0.035)	(0.021)	(0.021)	(0.021)	(0.021)
Part-time	-0.111*	-0.084*	-0.107**	-0.109*	-0.084*	-0.107**	-0.107**	-0.109**	-0.107**
	(0.044)	(0.040)	(0.039)	(0.044)	(0.041)	(0.039)	(0.040)	(0.040)	(0.039)
Government	-0.034	-0.037	-0.046	-0.038	-0.038	-0.047	-0.045	-0.046	-0.047
	(0.033)	(0.035)	(0.038)	(0.033)	(0.035)	(0.038)	(0.038)	(0.038)	(0.038)
Employment Growth			0.136			0.142	0.130	0.126	0.133
			(0.234)			(0.234)	(0.232)	(0.230)	(0.236)
Unemployment Rate			0.012†			0.012†	0.013†	0.013†	0.012†
			(0.007)			(0.007)	(0.007)	(0.007)	(0.007)
Contract Coverage in the			0.002			0.003	0.003	0.003	0.003
Construction Industry			(0.002)			(0.002)	(0.002)	(0.002)	(0.002)
Constant	2.029***	1.882***	1.713***	2.030***	1.884***	1.720***	1.676***	1.660***	1.738***
	(0.128)	(0.109)	(0.120)	(0.132)	(0.111)	(0.122)	(0.120)	(0.115)	(0.110)
Year Fixed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other State Control	No	No	Yes	No	No	Yes	Yes	Yes	Yes
State Fixed	No	No	Yes	No	No	Yes	Yes	Yes	Yes
R-squared	0.210	0.317	0.352	0.218	0.319	0.352	0.352	0.353	0.352
N	9,435	9,435	9,317	9,435	9,435	9,317	9,317	9,317	9,317

Note: † significant at the 0.10 level; * significant at the 0.05 level; ** significant at the 0.01 level; *** significant at the 0.001 level; and standard error shown in parenthesis is clustered by state.

Table 10: The Effects of Occupational Licensing on Hourly Earnings for Plumbers

	1	2	3	4	5	6	7	8	9
License	0.093†	0.083†	-0.050*						
	(0.055)	(0.044)	(0.024)						
State license				0.087	0.080†	-0.049*			
				(0.057)	(0.045)	(0.024)			
Local license				0.122*	0.096*	-0.116***			
				(0.059)	(0.046)	(0.023)			
Apprenticeship							-0.067**		
							(0.024)		
Exam Requirements								-0.087***	
								(0.019)	
Continuing Education									-0.071***
									(0.018)
Local license							-0.065**	-0.152***	-0.064**
							(0.020)	(0.028)	(0.020)
Union member		0.332***	0.290***		0.331***	0.290***	0.289***	0.289***	0.290***
		(0.018)	(0.019)		(0.018)	(0.019)	(0.019)	(0.019)	(0.019)
Gender	0.066	0.075	0.068	0.064	0.074	0.069	0.069	0.069	0.070
(1: Male; 0: Female)	(0.069)	(0.073)	(0.074)	(0.070)	(0.074)	(0.073)	(0.074)	(0.074)	(0.072)
Age (Years)	0.021***	0.019***	0.018***	0.021***	0.019***	0.018***	0.018***	0.018***	0.018***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Experience	0.012*	0.012*	0.012*	0.012*	0.012*	0.012*	0.012*	0.012*	0.013*
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Experience squared	-0.050***	-0.053***	-0.051***	-0.050***	-0.053***	-0.051***	-0.051***	-0.051***	-0.051***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
High school graduate	0.186***	0.130***	0.115***	0.184***	0.129***	0.115***	0.115***	0.115***	0.115***
	(0.019)	(0.020)	(0.022)	(0.020)	(0.021)	(0.022)	(0.022)	(0.022)	(0.022)
Some college experience	0.240***	0.161***	0.137***	0.239***	0.160***	0.137***	0.137***	0.138***	0.138***
	(0.028)	(0.026)	(0.026)	(0.029)	(0.026)	(0.026)	(0.026)	(0.026)	(0.026)
College diploma or more	0.277***	0.176***	0.152***	0.275***	0.175***	0.152***	0.152***	0.152***	0.154***
	(0.039)	(0.040)	(0.041)	(0.041)	(0.040)	(0.041)	(0.041)	(0.041)	(0.041)
Marriage	0.097***	0.083***	0.084***	0.097***	0.083***	0.084***	0.084***	0.084***	0.085***
	(0.015)	(0.013)	(0.014)	(0.015)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
White	0.140***	0.111***	0.109***	0.140***	0.111***	0.109***	0.109***	0.109***	0.108***
	(0.031)	(0.027)	(0.025)	(0.031)	(0.027)	(0.025)	(0.025)	(0.025)	(0.026)
Hispanic origin	-0.133*	-0.091*	-0.107***	-0.130*	-0.090*	-0.107***	-0.107***	-0.107***	-0.107***
	(0.050)	(0.043)	(0.030)	(0.049)	(0.043)	(0.030)	(0.030)	(0.030)	(0.030)
Part-time	-0.153†	-0.098	-0.121†	-0.152†	-0.098	-0.121†	-0.122†	-0.121†	-0.120†
	(0.082)	(0.073)	(0.068)	(0.082)	(0.074)	(0.068)	(0.068)	(0.068)	(0.068)
Government	-0.111*	-0.138***	-0.139***	-0.110*	-0.137***	-0.139***	-0.141***	-0.141***	-0.139***
	(0.043)	(0.037)	(0.039)	(0.043)	(0.038)	(0.039)	(0.039)	(0.039)	(0.039)
Employment Growth			-0.349			-0.352	-0.345	-0.336	-0.352
			(0.235)			(0.234)	(0.234)	(0.235)	(0.231)
Unemployment Rate			0.020†			0.020†	0.020†	0.019†	0.019†
			(0.010)			(0.010)	(0.010)	(0.010)	(0.010)
Contract Coverage in the			0.002			0.002	0.002	0.002	0.003
Construction Industry			(0.002)			(0.002)	(0.002)	(0.002)	(0.002)
Constant	1.689***	1.705***	1.550***	1.693***	1.707***	1.551***	1.571***	1.594***	1.508***
	(0.118)	(0.107)	(0.116)	(0.117)	(0.106)	(0.117)	(0.122)	(0.124)	(0.124)
Year Fixed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other State Control	No	No	Yes	No	No	Yes	Yes	Yes	Yes
State Fixed	No	No	Yes	No	No	Yes	Yes	Yes	Yes
R-squared	0.231	0.334	0.368	0.232	0.334	0.368	0.368	0.368	0.368
N	6978	6976	6826	6978	6976	6826	6826	6826	6826

Note: † significant at the 0.10 level; * significant at the 0.05 level; ** significant at the 0.01 level; *** significant at the 0.001 level; and standard error shown in parenthesis is clustered by state.

Table 11: The Effects of Occupational Licensing on the State Injury Rates for Electricians

Variable	1	2	3	4	5	6	7
License	0.181	-0.727					
	(0.738)	(0.916)					
State license			0.218	-0.754			
			(0.753)	(0.906)			
Local license			0.019	-0.457			
			(0.802)	(1.421)			
Apprenticeship					2.613*		
					(1.097)		
Exam requirement						-0.415	
						(0.850)	
Continuing Education							2.032***
							(0.431)
Year Fixed	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other state controls	No	Yes	No	Yes	Yes	Yes	Yes
State Fixed	No	Yes	No	Yes	Yes	Yes	Yes
Observations	589	589	589	589	502	502	502
R-squared	0.26	0.38	0.26	0.38	0.39	0.38	0.38

Note: † significant at the 0.10 level; * significant at the 0.05 level; ** significant at the 0.01 level; *** significant at the 0.001 level; standard error shown in parenthesis is clustered by state; and other state controls include the percentages of the following variables: the six age groups between 20 and 24, between 25 and 34, between 35 and 44, between 45 and 54, between 55 and 64, and 65 and greater (age group between 16 and 19 as a reference), marriage status, white and nonwhite (the portion of black as a reference), Hispanic origin, and high school diploma, some other college, college diploma and more (high school dropouts as a reference), part-time, unemployment rate, employment growth, and union coverage in the construction industry.

Table 12: The Effects of Occupational Licensing on the State Injury Rates for Plumbers

	1	2	3	4	5	6	7
License	0.073	0.481					
	(0.304)	(1.213)					
State license			0.090	0.492			
			(0.324)	(1.220)			
Local license			-0.042	-2.113			
			(0.561)	(1.386)			
Apprenticeship					0.237		
					(0.564)		
Exam requirement						0.274	
						(0.846)	
Continuing Education							0.088
							(0.645)
Year Fixed	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other state controls	No	Yes	No	Yes	Yes	Yes	Yes
State Fixed	No	Yes	No	Yes	Yes	Yes	Yes
Observations	578	578	578	578	514	514	514
R-squared	0.16	0.28	0.16	0.28	0.27	0.27	0.27

Note: † significant at the 0.10 level; * significant at the 0.05 level; ** significant at the 0.01 level; *** significant at the 0.001 level; standard error shown in parenthesis is clustered by state; and other state controls include the percentages of the following variables: the six age groups between 20 and 24, between 25 and 34, between 35 and 44, between 45 and 54, between 55 and 64, and 65 and greater (age group between 16 and 19 as a reference), marriage status, white and nonwhite (the portion of black as a reference), Hispanic origin, and high school diploma, some other college, college diploma and more (high school dropouts as a reference), part-time, unemployment rate, employment growth, and union coverage in the construction industry.

Table 13: The Effects of Occupational Licensing on the Severity of Injury for Individual Electricians

Variable	1	2	3	4	5	6	7
License	-0.143	0.290					
	(0.095)	(0.286)					
State license			-0.201*	0.303			
			(0.093)	(0.287)			
Local license			0.030	0.176			
			(0.102)	(0.295)			
Apprenticeship					-0.175		
					(0.161)		
Exam requirement						0.120	
						(0.241)	
Continuing Education							-0.361***
							(0.095)
Year Fixed	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	No	Yes	No	Yes	Yes	Yes	Yes
State Fixed	No	Yes	No	Yes	Yes	Yes	Yes
Observations	19,576	19,556	19,576	19,556	15,999	15,999	15,999
-Log Likelihood	-542,130	-540,250	-541,843	-540,238	-428,577	-428,587	-428,550

Note: † significant at the 0.10 level; * significant at the 0.05 level; ** significant at the 0.01 level; *** significant at the 0.001 level; coefficients are estimated incidence-rate ratios; standard error shown in parenthesis is clustered by state; and other controls include individual characteristics including age, age squared, gender, and four dummy variables of length of service, and dummy variables indicating white, Hispanic, black, and Asians (other races as a reference), and state level of unemployment rate, employment growth, and union coverage in the construction industry.

Table 14: The Effects of Occupational Licensing on the Severity of Injury for Individual Plumbers

	1	2	3	4	5	6	7
License	-0.118†	0.545					
	(0.064)	(0.371)					
State license			-0.109	0.545			
			(0.067)	(0.371)			
Local license			-0.171	0.559			
			(0.112)	(0.375)			
Apprenticeship					0.216†		
					(0.113)		
Exam requirement						0.325***	
						(0.093)	
Continuing Education							-0.121
							(0.121)
Year Fixed	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other state controls	No	Yes	No	Yes	Yes	Yes	Yes
State Fixed	No	Yes	No	Yes	Yes	Yes	Yes
Observations	14,681	14,485	14,485	14,454	12,495	12,495	12,495
-Log Likelihood	-491,781	-483,369	-484,705	-482,926	-423,150	-423,138	-423,159

Note: † significant at the 0.10 level; * significant at the 0.05 level; ** significant at the 0.01 level; *** significant at the 0.001 level; coefficients are estimated incidence-rate ratios; standard error shown in parenthesis is clustered by state; and other controls include individual characteristics including age, age squared, gender, and four dummy variables of length of service, and four dummy variables of race, and state level of unemployment rate, employment growth, and union coverage in the construction industry.

Table 15: The Effects of Occupational Licensing on the State Death Rates for Electricians

Variable	1	2	3	4	5	6	7
License	-0.001	-0.007					
	(0.004)	(0.004)					
State license			-0.001	-0.007			
			(0.004)	(0.004)			
Local license			-0.003	0.003			
			(0.005)	(0.009)			
Apprenticeship					0.000		
					(0.006)		
Exam requirement						0.002	
						(0.006)	
Continuing Education							-0.005
							(0.011)
Year Fixed	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other state controls	No	Yes	No	Yes	Yes	Yes	Yes
State Fixed	No	Yes	No	Yes	Yes	Yes	Yes
Observations	787	787	787	787	666	666	666
R-squared	0.11	0.21	0.11	0.21	0.24	0.24	0.24

Note: † significant at the 0.10 level; * significant at the 0.05 level; ** significant at the 0.01 level; *** significant at the 0.001 level; standard error shown in parenthesis is clustered by state; and other state controls include the percentages of the following variables: the six age groups between 20 and 24, between 25 and 34, between 35 and 44, between 45 and 54, between 55 and 64, and 65 and greater (age group between 16 and 19 as a reference), marriage status, white and nonwhite (the portion of black as a reference), Hispanic origin, and high school diploma, some other college, college diploma and more (high school dropouts as a reference), part-time, unemployment rate, employment growth, and union coverage in the construction industry.

Table 16: The Effects of Occupational Licensing on the State Death Rates for Plumbers

	1	2	3	4	5	6	7
License	-0.002	0.003					
	(0.003)	(0.009)					
State license			-0.003	0.004			
			(0.002)	(0.006)			
Local license			-0.007**	-0.016**			
			(0.002)	(0.007)			
Apprenticeship					0.005†		
					(0.003)		
Exam requirement						-0.001	
						(0.005)	
Continuing Education							-0.003
							(0.004)
Year Fixed	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other state controls	No	Yes	No	Yes	Yes	Yes	Yes
State Fixed	No	Yes	No	Yes	Yes	Yes	Yes
Observations	787	787	787	787	666	666	666
R-squared	0.11	0.21	0.11	0.21	0.24	0.24	0.24

Note: † significant at the 0.10 level; * significant at the 0.05 level; ** significant at the 0.01 level; *** significant at the 0.001 level; standard error shown in parenthesis is clustered by state; and other state controls include the percentages of the following variables: the six age groups between 20 and 24, between 25 and 34, between 35 and 44, between 45 and 54, between 55 and 64, and 65 and greater (age group between 16 and 19 as a reference), marriage status, white and nonwhite (the portion of black as a reference), Hispanic origin, and high school diploma, some other college, college diploma and more (high school dropouts as a reference), part-time, unemployment rate, employment growth, and union coverage in the construction industry.