LICENSING AND SERVICE QUALITY: EVIDENCE USING YELP CONSUMER REVIEWS

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Abstract: A common justification for licensing is consumer protection, that is, quality and safety. We employ a unique dataset of individual Yelp business ratings to estimate the relationship between licensing and quality for four occupations. We test whether licensing impacts competition for these occupations using a negative binominal model and find a negative relationship between more licensing and the number of firms. We design a difference-in-differences model with state fixed effects, using business location near state borders as a treatment group and state requirements for licensing as the treatment. Yelp ratings are used as the measure of service quality. We find that having any licensing for an occupation or requiring any licensing exams significantly lowers quality within a state. We also find evidence for diminishing returns from licensing for education and training, licensing exams, and minimum school grade requirements. The results are robust to several specification tests.

JEL Keywords: occupational licensing, quality, regulation

JEL Codes: L51, L84

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1. Introduction

In the United States, occupational licensing varies widely from state to state. As of 2013, one-third of the workforce was licensed, compared with 5 percent of the workforce in 1950 (Kleiner and Krueger 2013). In July 2015, the White House issued a report on the rise of occupational licensing in recent decades and the potential for licensing to have a negative impact on consumers and the labor force (The White House 2015). Although conventional wisdom argues that occupational licensing protects the public health and safety, empirical research on the impact of licensing on quality remains an important field of study.

Research has consistently found that occupational licensing creates market power and monopoly effects, including increased prices, a fall in the labor supply, and increased profits for licensed providers (Dorsey 1983; Hogan 1983; Klein 1998; Kleiner 2000). Suppliers face less competition in the marketplace with licensing, and as licensing often represents sunk costs in the form of entry fees and education or training, it may represent significant barriers to entry, as defined in Baumol & Willig (1981). Licensing has been found to increase massage therapists earnings by over 16 percent and barber earnings between 11 and 22 percent, while midwife licensing has been found to increase prices by as much as 44 percent (Adams, III, Ekelund, Jr., and Jackson 2003; Timmons and Thornton 2010; Thornton and Timmons 2013). In addition to reducing the number of suppliers and increasing both prices and profits, licensing may also result in lower quality as suppliers face less competition, especially if consumers face asymmetric information or if reputational effects are weak (Shapiro 1982; Shapiro 1983; Shapiro 1986).

Legislatures and courts often cite product quality and consumer safety rationales when passing and upholding occupational licensing (*Thomas v.* Collins (323 U.S. 516) [1945]; *Meadows v. Odom* (03-960-B-2) [2003]; *Vong v. Sansom* (037208) [2009]; Theiss 2011). In the

1889 case of *Dent v. West Virginia* (129 U.S. 114 [1889]), the first Supreme Court decision to address occupational licensing, Justice Stephen Field held that "The power of the state to provide for the general welfare of its people authorizes it to prescribe all such regulations as, in its judgment, will secure or tend to secure them against the consequences of ignorance and incapacity as well as of deception and fraud." If occupational licensing increases quality, the net effect of licensing may be positive. However, the growth of licensing laws has been linked political competition, higher demographic stability, greater labor heterogeneity, and government demand (Smith 1982; Faith and Tollison 1983). None of these factors illustrate a clear link between licensing and protecting quality. Therefore, it is possible that the argument that licensing increases quality is an *ex post* rationale for existing regulation.

Current research suggests that licensing may not increase quality. As a medical profession, dentistry is a commonly licensed or certified profession, but more stringent licensing has not been found to improve dental outcomes (Kleiner and Kudrle 2000). Licensing may also not affect quality in the same way for all income-groups. Child care licensing reduced the number of providers in low-income neighborhoods while increasing the quality of providers in high-income neighborhoods (Hotz and Xiao 2011). Licensing may also change the distribution of quality without changing the average level of quality, either by shifting the distribution of quality or by changing the tails of the quality distribution. Teacher certification tests, for example, widen the distribution of quality as measured by student test scores, and the gains from licensing primarily accrue to high-income areas (Larsen 2015).

Although the impact of licensing on quality has been studied for professional occupations such as dentistry and teaching, research on the impact of licensing on quality for occupations, such as barbers and manicurists, is more limited (Carpenter II 2011; Hotz and Xiao 2011;

Carpenter, II 2012). There is also no theoretical reason to expect licensing to affect quality in the same way for all skill groups. Further, there is significant variance in which occupations are licensed and by how much (Carpenter II et al. 2012). The variance in the extent and stringency of occupational licensing allows us to study the intensive effects of licensing on quality using Yelp ratings for individual businesses.

Yelp ratings have been found to work well as a substitute for other reputational effects and to accurately reflect quality as measured by other sources (Bardach et al. 2013; Luca 2016; Ranard et al. 2016). There is also evidence that businesses change their behavior in response to public ratings databases, suggesting consumers believe ratings accurately measure quality (Bardach et al. 2013; Gergaud, Storchmann, and Verardi 2015; Luca 2016; Ranard et al. 2016). Yelp ratings have even been used to improve hospital care as a supplement to traditional patient surveys, with Yelp ratings reporting on quality for more hospitals and subjects than traditional surveys (Ranard et al. 2016). Yelp is also partnering with local health departments to improve visibility and information about safety ratings for food trucks (Booth 2014). The Yelp data therefore allow us to address questions about the impact of state occupational licensing on quality. Further, if Yelp ratings represent perceived quality, both consumers and suppliers would have the same imperfect information from Yelp. The ratings may also represent expected quality, such that consumers respond to the Yelp ratings as if they represented true quality and suppliers respond as if the ratings represented the true quality of their competitors (Luca 2016). We also formally tested for whether the Yelp sample reflects the true distribution of businesses within states to determine if the Yelp sample is representative.

In this study, we focus on the impact of licensing on quality for four occupations: barbers, cosmetologists, manicurists, and massage therapists. These occupations were selected due to the

competitive features of the markets, aside from the barriers to entry created by licensing. The four occupations are labor-intensive and are common in informal markets in the developing world, suggesting very low capital constraints for start-ups (Tshuma and Jari 2013). There is also frequent overlap across the occupations, as manicure parlors may also offer massage therapy services, and so on. However, we formally test if licensing affects competitiveness in these occupations before proceeding to the quality and licensing analysis. We then employ a difference-in-differences analysis with state fixed effects to estimate the relationship between licensing and quality. We identify businesses near state borders as the treatment group and states which require any licensing for given types of licensing or states which requiring any licensing overall as the treatment in their respective models. We then used the Yelp ratings and a database of state licensing requirements to estimate the effect of licensing on quality.

We have three main findings of statistical significance. First, there is less competition in states with more licensing exams, and the effect of licensing on quality is more significant when using the quadratic term for licensing requirements. States with higher minimum age requirements have more competition, though the significance of the effect disappears when accounting for diminishing returns.

Secondly, increasing education and training requirements is associated with increases in quality, but we also find diminishing returns from licensing. Adding more licensing exams or increasing the minimum school grade lowers quality, and we again find diminishing returns. We find that requiring any licensing exams lower quality. Finally, requiring any licensing for an occupation also significantly lowers quality in the identifying variation.

2. Data and Background

2.1. Yelp Data

Summary statistics for the variables in our study, including the mean, median, and standard deviation, are included in Table 1. Definitions for each variable in our study are included in Table 2. Our panel data comes from individual Yelp ratings from businesses located in the 50 states and the District of Columbia for barbers, cosmetologists, manicurists, and massage therapists. We collected the data from Yelp in May 2015 using a web scraper that pulled the information for individual businesses in a given city and state using the Yelp Application Programming Interface (API). The original sample consisted of ratings from 189,624 businesses. The individual business rating is used as the measure of quality. We used the number of reviewers to restrict the sample to business ratings with at least 10 reviewers, accounting for the possibility of business owners leaving themselves ratings that positively bias the sample of ratings although this risk is expected to be small (Luca 2016).

The Yelp data includes the individual business' Yelp rating, the number of Yelp reviewers, and the address, city and state of the business. The business rating is the average of all individual ratings left for the business and is measured on a half-point scale from 1 to 5 (Table 3). Average business ratings are built from individual reviews, potentially dating from Yelp's launch in October 2004 to the data collection in May 2015. It is not possible to disaggregate the average business ratings over time, precluding time series analysis. The final sample includes 54,602 businesses in the four occupations outlined above. North Dakota and South Dakota are not included in our final sample due to the minimum number of 10 reviews restriction.

2.2. Licensing Requirements

This study uses individual Yelp business ratings for barbers, cosmetologists, manicurists and massage therapists to measure the impact of licensing on quality. We consider the effect of

licensing fees, the days of education and training, the number of total state licensing exams (both practical and written), the minimum school grade, and the minimum age requirement.

Barbers cut and shave hair and beards. Cosmetologists shampoo, cut, color, and style hair, as well as provide other hair styling services. Manicurists clean, shape and decorate nails. Massage therapists massage customers for medical or cosmetic purposes (Carpenter II et al. 2012). At the time of the licensing study, barber licensing applied in 49 states and the District of Columbia (Carpenter II et al. 2012). On average barbers are required to pay $130 in fees; complete 416 days of education and training; and pass two exams. Cosmetology licensing applied in all 50 states and the District of Columbia. On average cosmetologists are required to pay $142 in fees; complete 372 days of education and training; and pass two exams. Manicurist licensing applied in 49 states and the District of Columbia. On average manicurists are required to pay $91 in fees; complete 87 days of education and training; and pass two exams. Massage therapist licensing applied in 38 states and the District of Columbia. On average, massage therapists are required to pay $181 in fees; complete 139 days of education; and training; and pass one exam.

Occupational licensing types vary by state, and firms in our sample potentially face different five types of licensing requirements. Operators must pay an entry fee; they must complete a certain number of education or other training days; they must pass a given number of practical and/or written licensing exams; they must complete a minimum school grade; and/or they must be a certain age before they can work in the market[3]. The License to Work Report details occupational licensing requirements for 102 occupations which require some skill but have not traditionally been licensed (Carpenter II et al. 2012). These requirements can vary broadly across states and occupations. For example, California required barbers to pay $125 in licensing fees,

[3] The days of education and training may include on-the-job training, internships, apprenticeships, or other forms of non-traditional education (Carpenter II et al. 2012).

complete 350 days of education and training, and pass two exams. New York required barbers to pay $60 in licensing fees, complete 884 days of education and training, and pass three exams. In comparison, California did not license massage therapists at all, while New York required massage therapists to pay $115 in licensing fees, complete 233 days of education and training, and pass one exam. Given the extent and variance of licensing requirements across the United States, we focus here on the *intensive* effect of licensing levels, as well as the impact of requiring a type of licensing.

2.3. Joining the Data

We joined the Yelp ratings data with the licensing database for the four occupations in our study. The Yelp rating for individual businesses is used as the dependent variable for our primary models of interest. We use four types of licensing requirement variables as our independent variables. We first use the value associated with licensing requirements, for example, fees for massage therapists in Arizona are $189. Licensing fees and the days of education and training are logged. We then created a vector of licensing variables by type equal to the squared value of the actual licensing requirement to account for the diminishing returns from licensing. Next, we created an "any licensing type" binary indicator variables associated with each type of licensing by state and occupation, for example, where any licensing fees = 1 if a state requires any licensing fees. Finally, we created a "licensed" binary indicator variable for each state and occupation, where if a state requires any one of the five licensing types, licensed = 1. The Pearson correlations between licensing types and the Yelp ratings are listed in Table 4. Requiring licensing fees is highly correlated with requiring education and training and licensing exams. Requiring any education or training is also highly correlated with requiring licensing exams.

The number of businesses by industry and state from the 2012 SBO is included as the dependent variable when considering the effect of licensing on competition, to address the possibility that the higher occupational earnings associated with licensing reflect higher quality, increased demand, or a reduction in the lemons problem (Akerlof 1970). It is also possible that markets are monopolistic due to reasons other than licensing. The number of firms therefore includes a measure of relative market competition as used in Bloom, Propper, Seiler, & Van Reenen (2015). We also include the SBO number of firms to control for how competition may influence quality.

We identified businesses which are on state borders using the Yelp city which will allow us to identify the effect licensing has on businesses in border cities and non-border cities. Usefully, firms in border cities face a similar mix of consumers and quality expectations but different licensing requirements. Using a binary indicator variable, we identify and set equal to 1 those businesses in cities within one hour drive of a state border. All other businesses are identified as non-border and are set equal to 0, including those in cities on international borders.

We then created the difference-in-differences treatment and treatment group interaction variables, where the interaction variable = 1 if the "any licensed by type" or the "licensed" variable = 1 and border = 0. We also include a vector of state demographic variables to control for factors other than licensing that may influence quality (Smith 1982; Faith and Tollison 1983). Data from 2012 was used to match the 2012 License to Work study data. Logged median wages from the 2012 American Community Survey (ACS) were used to control for the possibility that areas with higher incomes may attract higher quality, or that individuals with higher income may expect higher quality and therefore leave lower ratings relative to the true quality. Although we do not have any price information for the businesses in the sample, but the selection effect test

suggests that omitted prices are not driving our results. The state population from the 2012 ACS was included to control for the possibility that areas with higher populations or higher population density may differ significantly from low population or low population density areas for produced and expected quality. These factors may indirectly capture some of the directional effect from business prices, which are unobservable. Finally, we created an indicator variable for each of the four occupations, to control for occupation-specific variation in the ratings.

We compare the mean values, standard deviation, and frequency of ratings for firms in our study for each of the licensing variables in Table 5, broken down between firms which are not on state borders and firms which are on state borders. Importantly, there appear to be small differences in unlicensed non-border and border firms and larger differences between licensed non-border and border firms. Firms licensed and on the border appear to have lower ratings than firms which are unlicensed and on the border. We find this result for overall licensing, for education and training, for licensing exams, and for minimum school grade requirements, although the difference for the last category is not significant. The standard deviation appears similar across categories.

3. Empirical Model

If occupational licensing creates monopoly power and allows suppliers to increase prices in order to generate monopoly profits, suppliers may also increase profits by lowering or not investing in quality, especially for markets with lower consumer willingness to pay or weak reputational effects. Although licensing requirements are expected to remove the bottom tail of the provider distribution and thus increase quality, the monopoly effects from licensing on quality may instead lower average quality (Shapiro 1982). Although fixed costs will not create monopoly effects, licensing requirements are often sunk costs which may lower quality:

practitioners pay a licensing fee which they cannot recover; they complete days of education or training; they pass a number of exams; and/or they meet a minimum grade or age requirement (Baumol and Willig 1981)[4]. The direction of the effect may only be determined empirically.

New research also suggests that the impact of licensing on quality may be ambiguous, or that licensing may change the distribution of quality, especially if the requirements deter skilled workers (Besanko, Donnenfeld, and White 1987; Larsen 2015). The potential for low quality products is increased in the case of asymmetric information, and in the case of weak reputational effects. As low quality from monopoly effects may occur without licensing, we focus on occupations which appear competitive aside from the barriers to entry created by licensing, and we include a measure of competition in the model using the number of firms for each occupation and state. We then employ a difference-in-differences analysis to compare the quality of licensed firms against unlicensed firms and identify firms which face more competition using a binary indicator for a firm's location near the state border.

3.1. Identification Strategy

Our difference-in-differences analysis departs from the traditional method of time and place. The treatment in our analysis comes from a state requiring licensing for an occupation. We analyze the presence of state licensing requirements by type of licensing and by the presence of any state licensing, by occupation. The treatment is exogenous to a single firm, which cannot influence whether a state requires licensing, or which types of licensing a state requires. The choice of quality by a firm, therefore, is a response to the presence of licensing (Shapiro 1986). The treatment and control groups in our analysis are determined by a firm's location near the state border. If the city in which a firm is located is within an hour's drive of the state border, the

[4] Licensing requirements for the days of education or training may not represent sunk costs if suppliers can amortize the cost of their education or training and pass the cost on to consumers.

firm is on a state border and falls into our control group[5]. Otherwise, the firm is not on the state border, and falls into our treatment group.

Firms on the state border are our control group for licensing as customers have the option to drive across the state border for services and therefore competition may be stronger in these markets. Firms in the treatment group are far enough away from the state border that the impact of licensing should dominate the effect of any cross-border competition. Therefore, our interaction variable compares the licensing coefficient for firms which are unlicensed and operate on a state border with firms which are licensed and operate on a state border, firms which are unlicensed and do not operate on a state border, and firms which are licensed and do not operate on a state border. The coefficient for our treatment group should therefore measure the impact of licensing on quality relative to competitive, unlicensed markets. We also separately test the effect of licensing on quality for border and non-border businesses in order to test the parallel trends assumption of the difference-in-differences model.

Although we are concerned about how the quality for a given occupation in a state may influence licensing regulation, we do not think that quality in a given state will influence the licensing requirements in a state which it borders. Therefore, the use of the border variable should effectively identify the direction of causality from licensing on quality. We also include a robustness test to address licensing changes within a state.

3.2. Model Design

We first developed a negative binominal regression model to estimate the impact of licensing on competition, by each type of licensing. The model uses the level of licensing as the independent variable of interest, and is estimated at the state level. Fees and the days of education and training are logged.

[5] A city's border status was determined using Google Maps.

(1) $FIRMS_{os} = \alpha + \beta_1 LICLEV_{os} + \beta_2 Z_s + \beta_3 OCC_o + \varepsilon_i$,

where $FIRMS_{os}$ is the number of firms by occupation and state using the 2012 U.S. Census Survey of Business Owners (SBO). *LICLEV* is a vector of the five licensing types by occupation and state. Z is a vector of local demographic characteristics for each state: logged median wages and population, in millions, for 2012. OCC is an indicator variable for each occupation. We estimate this model first using the level of each licensing type and then using the squared value for the level of each licensing type to account for potential diminishing returns from licensing.

We then employ an OLS state fixed effects model measuring differences in quality from licensing. The model uses the level of licensing as the independent variable of interest and estimates rating differences within states and across occupations. Coefficients are the weighted average across occupations and states. We then exploit variation in the level and type of licensing. Fees and the days of education and training are logged.

(2) $YELP_{ios} = \alpha + \beta_1 LICLEV_{os} + \beta_2 BORDER_s + \beta_3 Z_s + \beta_4 FIRMS_{os} + \beta_5 OCC_o + \varepsilon_i$,

where $YELP_{ios}$ is the individual Yelp rating for an individual business in an occupation and state. *LICLEV* is a vector of the five licensing types by occupation and state. Z is a vector of local demographic characteristics for each state: logged median wages and population, in millions, for 2012. FIRMS is the number of firms by occupation and state using the 2012 SBO. We estimate this model first using the level of each licensing type and then using the squared value for the level of each licensing type to account for potential diminishing returns from licensing.

The last two models employ the OLS difference-in-differences state fixed effects model. The first model uses a binary indicator for whether a state has any licensing, by type of licensing

and occupation; a binary indicator which identifies whether a business is located near a state border; and the interaction between each licensing type indicator variable and the border variable. As cities on state borders include businesses with various mixes of licensing by occupation and type, and consumers which are not bound by state lines when making purchases, the interaction variable captures how licensing affects the quality of businesses which face more licensing and less competition than businesses which face less licensing and more competition. The coefficients estimate the impact of licensing within states and across occupations. We then exploit variation in ratings across the type of licensing and the border city indicator to estimate the impact of licensing on quality.

(3) $YELP_{ios} = \alpha + \beta_1 ANYLIC_{os} + \beta_2 BORDER_s + \beta_3 D*LIC + \beta_4 Z_s + \beta_5 FIRMS_{os} + \beta_5 OCC_o + \varepsilon_i$,

where *ANYLIC* is the vector of licensing types and *ANYLIC* = 1 for a state, occupation, and type of licensing; *ANYLIC* = 0 otherwise. *ANYLIC* measures the treatment group in the analysis. For example, Massachusetts requires 733 days of education and training for barbers, and so ANYLIC for education and training (ANYEDU) = 1 for barber businesses in that state. However, Massachusetts does not require a minimum grade for barbers, so ANYLIC for the minimum grade (ANYGRADE) = 0 for barber businesses in that state. If a business is located within an hour's drive of the state border, BORDER = 1, and = 0 otherwise. BORDER is the treatment group in the analysis. *D*LIC* is the vector of interaction variables by licensing types, where *D*LIC* = 1 for a business if *ANYLIC* = 1 and BORDER = 0. Z is a vector of local demographic characteristics for each state: logged median wages and population, in millions, for 2012. FIRMS is the number of firms by occupation and state using the 2012 SBO.

The second difference-in-differences state fixed effects model uses a binary indicator for whether a state has any licensing for an occupation, across licensing types, a binary indicator

which identifies whether a business is located near a state border, and the interaction between each licensing indicator variable and the border variable. The coefficients are estimated at the individual business level by state and licensing type and reflect the weighted average across occupations and states. We then exploit variation in ratings across the licensing indicator variable and the border city indicator to estimate the impact of overall licensing on quality.

(4) $YELP_{ios} = \alpha + \beta_1 LIC_{os} + \beta_2 BORDER_s + \beta_3 D^*LIC + \beta_4 Z_s + \beta_5 FIRMS_{os} + \beta_5 OCC_o + \varepsilon_i$,

where LIC = 1 for a state, occupation, and type of licensing if a state requires any licensing for an occupation, and LIC = 0 otherwise. LIC measures the treatment group in the analysis. For example, LIC = 1 for a state which requires licensing fees, but no other licensing, and for a state which requires fees, days of education and training, exams, a minimum school grade, and a minimum age. If a business is located within an hour's drive of the state border, BORDER = 1, and = 0 otherwise. BORDER is the treatment group in the analysis. D*LIC is the interaction variable, where D*LIC = 1 for a business if LIC = 1 and BORDER = 0. Z is a vector of local demographic characteristics for each state: logged median wages and population, in millions, for 2012. FIRMS is the number of firms by occupation and state using the 2012 SBO. All standard errors are robust.

3.3. Robustness Tests

The distribution of Yelp ratings is clustered around the top of the scale, which runs contrary to conventional wisdom about people being more likely to leave negative reviews on Yelp. We first assume the Yelp rating ($YELP_{ios}$) follows a cardinal scale, where the distances between each rating along the distribution are equal. Specifically, reviewers may believe that the difference between a rating of 1 star and 2 stars is equal to the difference between 3 and 4 stars. Given this assumption, we approach the data using an OLS model. Given this possibility, we also

employed an ordered logistic model. The marginal effects for the ordered logistic model are evaluated at the likelihood of occupational licensing leading to a 5 star rating compared with all other ratings. We run these regressions on the full sample of all occupations pooled together. In a sensitivity test, we also run all the regressions on separate samples for each individual occupation.

We considered several potential issues with the Yelp data, especially as this is the only study using this unique dataset. First, it is possible that selection bias exists in the Yelp data and that the distribution of businesses by states in our sample does not match the true distribution of businesses by states. To address this possibility, we compared the distribution of Yelp businesses by occupation and state with the distribution of their corresponding North American Industry Classification System (NAICS) industries in the 2012 SBO, also by state. Barbers in our sample were matched to NAICS industry code 812111 (barber shops); cosmetologists were matched to NAICS industry code 812112 (beauty salons); manicurists were matched to NAICS industry code 812113 (nail salons); and massage therapists were matched to NAICS industry code 621340 (offices of physical, occupational and speech therapists, and audiologists), based on the NAICS industry descriptions. We tested for selection bias in each occupation by comparing the Yelp distributions with the SBO distributions. We used the Aspin-Welch two-sample t-test with unequal variance, as well as a two-sample Kolmogorov-Smirnov test for equality of distributions in the number of businesses by state and occupation. We used the full sample of all Yelp ratings for this analysis as we are interested in the overall distribution of businesses and not the value of the ratings.

Yelp was launched in October 2004, and the Yelp ratings potentially include reviews left over the entire time period from October 2004 to May 2015, when we collected the data.

Fourteen states changed their licensing requirements during this period, as determined from news articles and WestLaw, an online legal research service. We also considered how states may change their licensing in response to quality and therefore how states which changed their licensing requirements may differ from states which did not. We therefore ran a robustness test for whether states which changed their licensing requirements during the study period have significantly different Yelp ratings than states which did not change their licensing requirements. These changes were primarily to the level of the licensing requirements, for example, increasing licensing fees or the days of education and training. We tested for significant differences in ratings for states which changed their licensing requirements and those which did not using two-sample t-tests for each occupation, after first testing for whether the variances were equal for these two groups in each occupation. We used the sample of Yelp ratings with 10 or more reviews for this analysis as we ae interested in differences in ratings between states which did and did not change their licensing requirements.

It is also possible that unobservable variables may be driving our results. We therefore conduct the selection on unobservable variables test used by Altonji, Elder, and Taber (2005), Bellows and Miguel (2009), and Nunn and Wantchekon (2011) for each of the regression models discussed above, using a restricted model that does not include the variable for the number of firms from the 2012 SBO.

4. The Effect of Licensing on Quality

We find that licensing occupations impacts quality across occupations within states significantly, although the effect and direction varies by type of licensing. We also find that licensing lowers competition, as measured by the number of firms by occupation from the 2012 SBO. Licensing fees and licensing for days of education and training increase quality while

licensing exams lower quality. Sensitivity tests were run for each occupation and the results are included in the Appendix. A positive sign in our results means more licensing increases quality, as measured by Yelp ratings. A negative sign means licensing lowers quality. The OLS results are discussed here and the ordered logistic robustness test results are discussed in the table notes.

4.1. Measuring The Effect of Licensing on Competition

The marginal effect of licensing on competition for the four occupations in the study is statistically significant for the days of education and training, the number of licensing exams, and the minimum age (Table 6). Increasing the days of education and training is associated with more competition. Increasing the number of licensing exams and increasing increases are associated with less competition in both models. Increasing the minimum age is associated with less competition in both models. Higher median wages are associated with less competition and higher population is associated with more competition, supporting previous research on licensing and competition (Smith 1982; Faith and Tollison 1983). This suggests that the higher earnings from licensing found in other studies are due to monopoly effects and that licensing does lower competition for the occupations in our study.

4.2. Quality Comparisons Between Border and Non-Border Firms

We separately test the sample of border businesses and the sample of non-border businesses using Model 2 to examine whether the results are significantly different (Table 7). We find that the results for the licensing variables of interest are similar between the two samples, although there are some small differences in magnitude and significance. The results reflect that state licensing requirements within a state will be the same for both border and non-border firms, and that the variation in licensing comes from the mix of businesses on state borders and the level and type of licensing by state.

4.3. The Effect of Licensing by Type of Licensing

The marginal effect of licensing on quality, as measured by the level of licensing, is statistically significant for all five licensing types (Table 8). Requiring any licensing fees does increase quality, so that requiring licensing fees increases quality about a quarter of a Yelp rating star in Model 3. It is possible that requiring licensing fees does work as theorized; that is, the bottom of the distribution is cut out by requiring a monetary commitment from the potential supplier. However, the level of licensing fees are not associated with differences in quality in Models 2a and 2b, suggesting licensing fees at the top of the distribution do not work better than licensing fees at the bottom of the distribution.

Increasing the days of education or training is associated with higher quality in Model 2a; however, there is no effect from increasing increases in the requirement or for simply requiring any days of education or training or from the identifying variation in Model 3. Notably, firms have an incentive to invest in education and training, as firms which invest in human capital outperform firms which do not (Bosma et al. 2004; Dimov and Shepherd 2005). Firms may invest in education and training and internalize the gains from education and training without a licensing requirement. There may also be occupation-specific gains from education and training, as the identifying variation for requiring any education and training among massage therapists is positive and significant (0.199 points), while the identifying variation for requiring any education and training among manicurists is negative and significant (0.145 points). Given the diminishing returns analysis in Model 2b, it is also possible that the positive effect of requiring any kind of education and training licensing may be mitigated by monopoly effects (Adams, III, Jackson, and Ekelund, Jr. 2002). We find support for this finding in testimony which shows what is actually included in some schools' curriculum (U.S. District Court Eastern District of Missouri 2015). In

this case, an owner of a barber and cosmetology academy stated the curriculum at the academy included 245 hours of required fitness education, including an indeterminate number of hours on how to stand properly.

Increasing and requiring licensing exams significantly lowers quality in Models 2a, 2b, and 3. Increasing the number of licensing exams and increasing increases have an economically small effect on quality, but requiring any licensing exams significantly lowers quality about a quarter of a Yelp rating star. It may be that exams influence quality due to the fact that in states which require both practical and written exams, potential suppliers must pass both exams to become licensed. The disparity between the pass rates in these exams can be high. For example, from FY2013 – FY2015, the pass rates for barber exam rates in Texas averaged 65 percent for all exams; 53 percent for the written exams; and 92 percent for the practical exams (Texas Department of Licensing and Regulation). From 2011-2012, the pass rates for nail technicians in Virginia averaged 63 percent for all exams; 49 percent for the theory/written exams; and 77 percent for the practical exams (Virginia Department of Professional and Occupational Regulation). If potential suppliers are passing practical exams, which actually measure the practices of their expected trade, failure on the written exams may indicate that licensing exams are not actually measuring quality. State exams would therefore restriction competition and potentially lower quality. Further, exams are often administered by state licensing boards staffed by existing industry professionals with an incentive to keep out new entrants (Meehan and Benson 2015).

Increasing and requiring a minimum school grade significantly lowers quality in Models 2a, 2b, and 3. The effect from increasing the minimum school grade, as well as increasing increases, is economically small, but requiring any minimum grade lowers quality about a quarter of a

Yelp star, and the effect from the identifying variation is about half that. Minimum school grade requirements usually reflect a high school graduation or its equivalency. Importantly, individuals who have not met a minimum school grade, such as high school graduation, will often be unable to meet licensing requirements for days of education due to trade school enrollment prerequisites. It is therefore possible that the minimum school grade requirement is linked to the licensing requirement for the days of education and that removing the minimum school grade requirement would increase quality which is currently attributed to the days of education and training requirement.

Finally, increasing and requiring a minimum age significantly increases quality in Models 2a, 2b, and 3. The effect from increasing the age, as well as increasing increases, is economically small, but requiring any minimum age increases quality about a quarter of a Yelp star, and the effect from the identifying variation is about half that size. Licensing may increase quality by preventing teenagers from providing these services.

4.4. The Effect of Having Any Licensing on Quality

Figure 1 illustrates the 95 percent confidence interval for ratings and licensing, defined as a state requiring any licensing for a given occupation. There is a clear negative relationship between more licensing and ratings, such that having more licensing produces lower ratings. The rating scale is restricted to the 4 stars and higher in this figure for purposes of scale. The box plot in Figure 2 also illustrates the range of Yelp ratings by firm border and licensed status. As illustrated in Table 3, the median value of Yelp ratings is about 4 stars, but the box plot illustrates there is still a wide range in the distribution of ratings between firms and their border and licensed status.

Licensing as measured by states having any licensing for an occupation is statistically significant and negative (Table 9). The treatment variable of licensing and the identifying variation are significant and negative. Despite quality increases from some types of licensing, the overall effect of licensing across occupations within states is negative when comparing businesses near state borders with those away from state borders.

4.5. Robustness Tests for Potential Bias in the Yelp Ratings

We conducted several robustness and specification tests on our results. We considered whether there are significant differences between licensed and unlicensed firms (Table 10). We employed the Aspin-Welch two-sided t-test with unequal variance to compare the mean values of quality and other outcome variables for licensed and unlicensed firms, as determined by whether a firm is in a state which requires licensing for that occupation. The test reveals there are significant differences between the two groups for all variables, but most importantly for Yelp ratings.

We also tested for the possibility of selection bias in the Yelp data such that the distribution of businesses by states in our sample did not match the true distribution of businesses by states. We first used the Aspin-Welch two-sample t-test for whether the Yelp distributions were significantly different from the SBO distributions, assuming unequal variances, and found no significant differences for any of the four occupations (Table 11). To check the results, we also used a two-sample Kolmogorov-Smirnov test for equality of distributions, for each occupation. We found no significant difference between the business distributions for any of the occupations.

Fourteen states changed their licensing requirements since the Carpenter II et al. study in 2012 (Table 12). We therefore identified states which changed their licensing requirements, by occupation, and tested whether states which changed their licensing requirements had

significantly different ratings from states which did not. We first used a Satterthwaite test for equality of variance for ratings between states which did and states which did not change their requirements. Ratings for barbers, cosmetologists, and massage therapists did not have significantly unequal variance between these two state groups, while manicurist ratings did exhibit unequal variance. We then used a two-sample t-test to determine whether ratings between states which did and did not change their licensing requirements were significantly different, by occupation (Table 13). The t-test assumed equal variance except for manicurist ratings, which uses the Aspin-Welch two-sample t-test assuming unequal variance. We found no significant differences for ratings between the state groups over the study period, suggesting that states are not changing their licensing in response to changes in quality in our sample study period.

We also addressed the possibility that unobservable variables may be driving our results using the selection on unobservable variables test used by Altonji, Elder, and Taber (2005), Bellows and Miguel (2009), and Nunn and Wantchekon (2011) for each of the regression models, using a restricted model that does not include the variable for the number of firms from the 2012 SBO. We do not find evidence that unobservable variables are driving our results, except in the case of education and training with a comparison ratio of 1.1 in the non-difference-in-differences diminishing returns model (Table 14). The models which use the difference-in-differences design do not have a comparison ratio less than 7, meaning that the selection on unobservable variables would have to be 7 times greater than the selection on observed variables to attribute the entire effect from the full model to selection effects.

5. Conclusion

We find that requiring any licensing lowers quality. We find small increases in quality from licensing fees, the days of education and training, and minimum age requirements and large

decreases in quality from licensing exams and minimum grade requirements. This suggests that licensing does not increase product quality as measured by consumer reviews (Adams, III, Jackson, and Ekelund, Jr. 2002; Federman, Harrington, and Krynski 2006; Kleiner 2006).

Our study cannot control for unobservable changes over time. The ratings for individual businesses are an average of all ratings, which could have potentially been left any time between October 2004 and May 2015. We also cannot determine whether there are unlicensed producers on Yelp, although there are strong incentives for producers outside the legal market to avoid publicity, or whether businesses choose to operate in a licensed or an unlicensed state based on the quality they expect to produce (Balko 2014; Sibilla 2016). However, we know of no evidence that suggests sellers strategically choose quality first and then choose whether or not to operate in a licensed or unlicensed state. In fact, as a single business cannot directly influence the choice of licensing, it is more likely the relationship works the other way and that businesses choose quality after facing a set of exogenous constraints such as licensing requirements.

It is also worth noting that ratings of 4 stars and above represent a large proportion of our sample (Figure 3). Ratings of 4 stars and above represent 62.8 percent of the sample for barbers; 81.1 percent of the sample for cosmetologists; 49.9 percent of the sample for manicurists; 70.7 percent of the sample for massage therapists; and 69.9 percent overall (Table 3). It is possible that people do not like to give negative reviews, or even that Yelp removes reviews (Handy 2012). The proportion of high ratings suggests that if our results are biased, it is from an overestimation of the benefits of licensing requirements. The high ratings for businesses may also illustrate how licensing removes the bottom of the distribution. Self-service by consumers can also lead to a fall in real quality which is not captured in the Yelp ratings (Carroll and Gaston 1983). Similarly, the only costs we can capture in these models are the upfront costs of licensing.

Significant other costs exist from licensing, such as reduced availability or longer wait time, which cannot be captured in our analysis.

On the other hand, the costs of compliance with licensing are also large compared to the magnitude of the impact of licensing. For example, in our sample, a total of $2 million was hypothetically paid to state licensing authorities by barbers; $7.9 million by cosmetologists; $2.8 million by manicurists; and $2.5 million by massage therapists[6]. It is also possible that reputational effects are weaker with more licensing. If licensing signals quality without increasing it, we would expect a negative impact on quality as consumers rely on licensing instead of alternative reputational signals.

Despite conventional wisdom that occupational licensing ensures product quality and protects the public interest, there has been little research on the impact of licensing on quality for occupations like the ones in our study. Our analysis suggests that licensing can actually significantly lower quality for these occupations, especially when states require licensing exams.

[6] These costs were calculated by multiplying the number of businesses in the full sample collected from Yelp by state with the licensing fees in those states.

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TABLE 1 – Summary Statistics

Variable	Mean	S.D.	Min	Max	States Which Licensed in 2012			
					Barbers	Cosmetology	Manicurists	Massage
Yelp.com Rating	4.06	1.09	1	5				
Fees	$125	$76.11	$0	$775	50	51	50	39
Education/Training	338	150	0	884	49	50	48	38
Exams	2	0.64	0	4	50	51	50	39
School Grade	10	5.18	0	12	50	51	50	38
Age	17	7.31	0	23	33	40	29	15
Licensed	0.91	0.29	0	1	50	51	50	39
Border	0	0.34	0	1				
Logged Median Wages	8.16	0.56	5	9.47				
Population (Millions)	19	14	1	37				
SBO Firm Count	38,700	35,925	82	91,665				

Note: Licensing variables from the IJ License to Work report (Carpenter II et al. 2012). A median age less than 16 indicates that more states do not have any minimum age licensing.

TABLE 2 – Variable Definitions

Variable	Description
Yelp.com Rating	Individual business ratings, measured on a ½ point scale from 1 to 5
Fees	Logged fees paid in $, including application fees, processing fees, and licensing fees, for the initial license only
Education/Training	Total days of education or training required, where hours were converted to days, years were multiplied by 365. Educational degrees were converted to the number of days it took to complete the degree.
Exams	The number of written and practical licensing exams
School Grade	The minimum school grade, e.g. 10 = 10^{th} grade, 12= high school completion
Age	The minimum age required
Licensed	Binary indicator for whether a state requires any licensing, where if a state requires fees, education or training, exams, or minimum school grade or ages, Licensed = 1
Border	Binary indicator for whether a city is within one hour of another state (=1 if yes, =0 if no)
D*	The difference-in-differences variables associated with each licensing type, where Border = 0 and Any Licensing by type = 1 (Model 3) or where Border = 0 and Licensing = 1 (Model 4)
Logged Median Wages	Logged median wages from the 2012 Census Public Use Microdata Statistical Areas
Population	State population from the 2010 Census Urban and Rural Classification and Urban Area Criteria (in millions)
SBO Firm Count	The number of businesses by occupation by state according to the 2012 Survey of Business Owners

Note: Licensing variables from the IJ License to Work report (Carpenter II et al. 2012). A median age less than 16 indicates that more states do not have any minimum age licensing.

TABLE 3 – Percent Distribution of Ratings by Industry

Yelp Rating	All	Barbers	Hair	Nails	Massage
1	0.05	0.06	0.02	0.1	0.07
1.5	0.45	0.32	0.15	1.01	0.39
2	1.55	1.1	0.67	3.23	1.33
2.5	4.33	3.54	2.24	8.5	3.49
3	8.44	9.74	5.23	14.57	7.69
3.5	15.28	22.53	10.63	22.72	16.29
4	21.93	39.38	19.4	25.4	21.65
4.5	28.79	23.33	35.07	18.46	26.25
5	19.18	0.06	26.59	6.01	22.84

Note: Calculated from study sample of ratings with at least 10 reviewers. Hair is the cosmetology occupation, and Nails is the manicurist occupation.

TABLE 4 – Pearson Correlation Matrix of Any Licensing and All Yelp Ratings

	Fees	Education/ Training	Exams	School Grade	Age	Rating
Fees	1.00					
Education/ Training	0.85	1.00				
Exams	0.82	0.88	1.00			
School Grade	0.57	0.49	0.46	1.00		
Age	0.38	0.34	0.32	0.36	1.00	
Rating	0.02	-0.03	-0.04	0.05	0.30	1.00

Note: No states require a minimum age for manicurists. All Pearson correlations are significant at the 99 percent confidence level.

TABLE 5 – Mean, Standard Deviation, and Frequencies for Ratings by Treatment and Control Groups and State Border Location

		Non-Border	Border
Licensed	No	4.16	4.12
		(0.72)	(0.78)
		4,893	275
	Yes	4.07	3.95
		(0.76)	(0.76)
		42,379	7055
Fees	No	4.06	3.83
		(0.75)	(0.83)
		6,489	869
	Yes	4.09	3.97
		(0.76)	(0.75)
		40,783	6,461
Education/Training	No	4.13	4.11
		(0.73)	(0.79)
		5,458	295
	Yes	4.08	3.95
		(0.76)	(0.76)
		41,814	7,035
Exams	No	4.16	4.09
		(0.72)	(0.81)
		5,190	604
	Yes	4.07	3.94
		(0.76)	(0.76)
		42,082	6,726
School Grade	No	4.03	3.96
		(0.75)	(0.76)
		13,008	4,747
	Yes	4.10	3.95
		(0.75)	(0.76)
		34,264	2,583
Age	No	3.83	3.83
		(0.79)	(0.78)
		21,775	4,341
	Yes	4.30	4.13
		(0.65)	(0.70)
		25,497	2,989

Note: Licensing variables represent the "Any Licensing" variable definition. Standard deviations are listed below means, and frequencies listed below standard deviation, for Yelp ratings with 10 reviews or more.

TABLE 6 – OLS Results – Licensing and Competition

SBO Firm Count	**(1a)**	**(1b)**
Fees	-0.007	-0.009
	(0.024)	(0.012)
Education/Training	0.105***	0.050***
	(0.032)	(0.015)
Exams	-0.216***	-0.062***
	(0.057)	(0.016)
School Grade	-0.019***	-0.002***
	(0.006)	(0.001)
Age	0.001	-0.000
	(0.005)	-0.009
Observations	319	319
R-Squared	0.10	0.10

Note: Model 1a reports the results for the negative binomial model using the level of licensing. Model 1b reports the results for the same model using the squared level of licensing. Logged median wages is negative and significant in both Models 1a and 1b. Population is positive and significant in both Models 1a and 1b. Robust standard errors are in parentheses.
* $P < .10$; ** $P < .05$; *** $P < .01$

TABLE 7 – OLS Fixed Effects Border and Non-Border Sample Results – Licensing Type

	(2a)		(2b)	
Yelp Rating	**Border**	**Non-Border**	**Border**	**Non-Border**
Fees	0.002	0.019	-0.001	0.009
	(0.019)	(0.016)	(0.015)	(0.009)
Education/Training	0.100***	0.023	0.042***	0.001
	(0.023)	(0.017)	(0.015)	(0.009)
Exams	-0.155***	-0.206***	-0.037***	-0.065***
	(0.031)	(0.038)	(0.011)	(0.016)
School Grade	-0.015*	-0.018***	-0.001**	-0.002***
	(0.008)	(0.005)	(0.001)	(0.001)
Age	0.015***	0.026***	0.001***	0.0016***
	(0.003)	(0.005)	(0.000)	(0.000)
Border	0.002	0.019	-0.001	0.009
	(0.019)	(0.016)	(0.015)	(0.009)
Observations	7,330	47,272	7,330	47,272
Groups	43	44	43	44
R-Squared Within	0.07	0.12	0.06	0.12
R-Squared Between	0.11	0.24	0.08	0.21
R-Squared Overall	0.06	0.13	0.05	0.12

Note: Model 2a reports the results for the model using the level of licensing. Model 2b reports the results for the model using the squared level of licensing. Robust standard errors are in parentheses. * $P < .10$; ** $P < .05$; *** $P < .01$

TABLE 8 – OLS State Fixed Effects Overall Results – Licensing Type

Yelp Rating	**(2a)**	**(2b)**	**(3)**
Fees	0.007	0.001	0.211+
	(0.018)	(0.011)	(0.112)
Education/Training	0.041**	0.009	-0.221
	(0.018)	(0.009)	(0.138)
Exams	-0.200***	-0.056**	-0.226**
	(0.039)	(0.016)	(0.082)
School Grade	-0.020***	-0.002**	-0.143*
	(0.006)	(0.001)	(0.071)
Age	0.024***	0.002**	0.304**
	(0.005)	(0.000)	(0.049)
Border	0.018	0.031	-0.027
	(0.035)	(0.040)	(0.093)
D*Fees			-0.075
			(0.094)
D*Edu			0.125
			(0.122)
D*Exams			-0.172*
			(0.087)
D*Grade			0.024
			(0.065)
D*Age			0.184+
			(0.107)
Observations	54,602	54,602	54,602
Groups	49	49	49
R-Squared Within	0.11	0.11	0.11
R-Squared Between	0.07	0.05	0.04
R-Squared Overall	0.12	0.11	0.12

Note: Model 2a reports the results for the model using the level of licensing. Model 2b reports the results for the model using the squared level of licensing. Model 3 reports the results for the model using the binary indicators for any licensing by type of licensing using the difference-in-differences estimators. D* variables report the point estimates for the difference-in-differences estimator for each type of licensing. Fees and education and training are logged in Models 2a and 2b. The SBO firm count was positive and significant in Model 2a, 2b, and 3. Population was positive and significant in Model 3. The ordered logistic marginal effects were consistent with Models 2a, 2b, and 3. In Model 2a, the point estimate on Exams increased to the 99 percent confidence level, and in Model 2b it increased to the 95 percent confidence level. The confidence of the Border variable in Model 3 did not appear in the ordered logit results. Robust standard errors are in parentheses.
* $P < .10$; ** $P < .05$; *** $P < .01$

FIGURE 1 – Confidence Interval for Ratings and Licensing

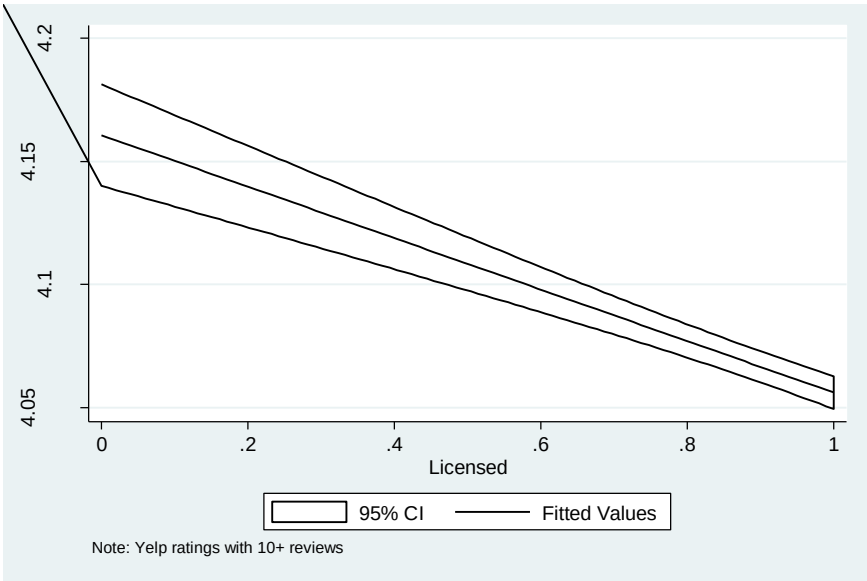


FIGURE 2 – Box Plot of Licensing and Ratings, by Border Status

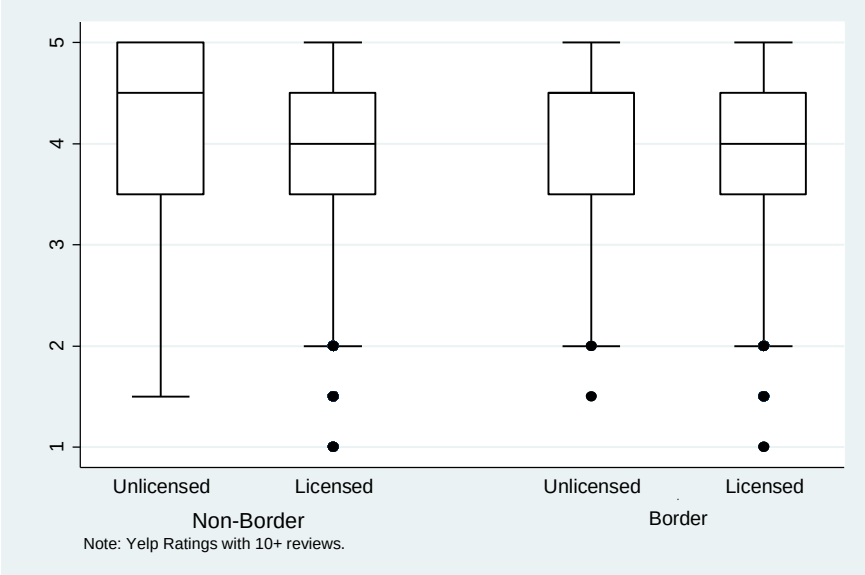


TABLE 9 – OLS State Fixed Effects Results – Any Licensing

Yelp Rating	**(4)**
Licensed	-0.197**
	(0.082)
Border	-0.238***
	(0.084)
D*Licensed	-0.235***
	(0.080)
Observations	54,602
Groups	49
R-Squared Within	0.06
R-Squared Between	0.00
R-Squared Overall	0.07

Note: Model 4 reports the results for the model using the binary indicator for a state having any licensing using the difference-in-differences estimators. D*Licensed reports the point estimate for the difference-in-differences estimator. Population and the SBO firm count were both positive and significant. The ordered logit marginal effects were consistent only with the Licensed variable. Robust standard errors are in parentheses.
* $P < .10$; ** $P < .05$; *** $P < .01$

TABLE 10 – Mean, Standard Deviation, and Two-Sided T-Test for All Variables Comparing Unlicensed and Licensed Observations

	Mean	Unlicensed	Licensed	[t-test]
Ratings	4.07 (0.76)	4.16	4.06	9.86
Border	0.13 (0.34)	0.05	0.14	-25.60
Logged Median Wage	8.32 (0.45)	8.18	8.34	-50.70
Population (Millions)	26.44 (14.02)	34.84	25.56	68.79
SBO Firm Count	38,700 (35,926)	8,221	41,887	-200.00
N	54,602	5,168	49,434	

Note: Mean, standard deviation, and confidence t-test for all variables by state border location. Results for the two-tailed t-test allow for unequal variance between the samples.

TABLE 11 – Equality of Distribution Tests Between Yelp Sample and Census Survey of Business Owners (2012)

	Two-Sample T-Test	Two Sample Kolmogorov-Smirnov	Unique Values (KS)
Barbers	0.990	0.728	45/102
Cosmetology	1.000	0.187	39/102
Manicurists	0.989	0.877	39/102
Massage	0.998	0.408	38/102

Note: P-values are reported for the two sample t-test and the Kolmogorov-Smirnov test for equality of distribution. The t-tests were calculated allowing for unequal variances between the two samples, and the Kolmogorov-Smirnov tests were calculated using exact p-values. The Yelp sample is for all Yelp results, not just those with 10+ reviews. Ties existed in all four of the occupations for the Kolmogorov-Smirnov test and the ratio of unique values for each industry is reported, with a total of 102 observations from one observation from each of the 50 states and the District of Columbia.

TABLE 12 – States Which Changed Licensing Regulation During the Study Period

Barbers	Cosmetology	Manicurists	Massage
AL	AR	DE	CT
DE	DE	GA	KY
GA	GA	IL	NM
IL	IL	NH	ND
NH	MI	OK	UT
OK	NH		
WI	ND		
	OK		
	WI		

Note: Collected from WestLaw and online news reports for 2004-May 2015. If a state changed any one of the five licensing types, it is classified as having changed its licensing regulation.

TABLE 13 – Tests for Significant Differences in Ratings Between States Which Did and Did Not Change Licensing Requirements

	Satterthwaite Test	Two-Sample T-Test
Barbers	0.239	0.184
Cosmetologists	0.812	0.254
Manicurists	0.003	0.817
Massage Therapists	0.393	0.331

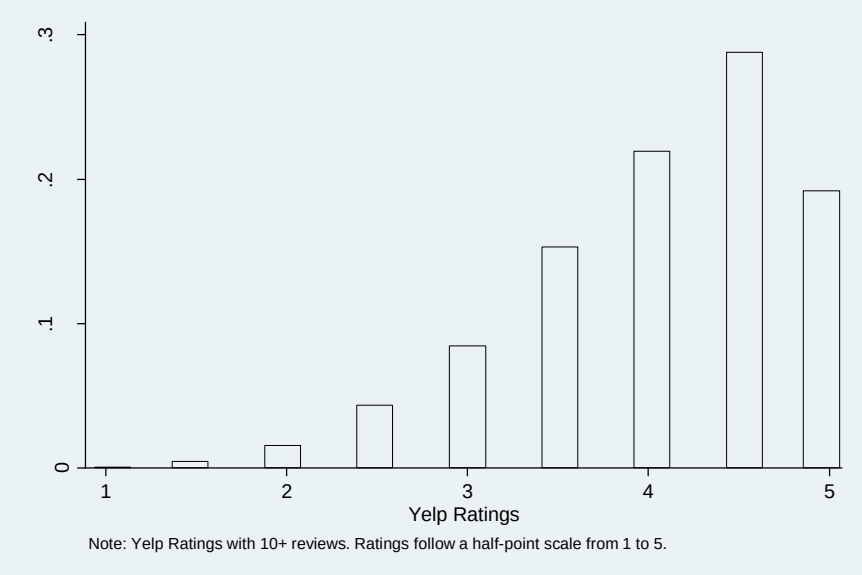
Note: P-values are reported for the Satterthwaite equality of variance and the two-sample t-test. The two-sample t-test assumes equal variance between states which did and states which did not change their licensing requirements except for manicurists. The test for manicurists uses the Aspin-Welch two-sample t-test assuming unequal variance. The sample uses Yelp ratings with 10+ reviews.

TABLE 14 – Selection Effect Test for Unobservable Variables

	Table 8 – No Diff-in-Diff						Table 8 – Diff-in-Diff			Table 9 – Diff-in-Diff		
Yelp Rating	**(2a)**			**(2b)**			**(3)**			**(4)**		
	β^F	B^R	*Ratio*	β^F	B^R	*Ratio*	β^F	B^R	*Ratio*	β^F	B^R	*Ratio*
Fees	0.007	0.006	-8.0	0.001	0.001	-17.5	0.211*	0.209*	28.0			
	(-0.018)	(-0.018)		(-0.011)	(-0.011)		(-0.112)	(-0.116)				
Education/Training	0.041**	0.054**	3.1	0.009	0.017*	1.1	-0.221	-0.229	27.6			
	(-0.018)	(-0.021)		(-0.009)	(-0.010)		(-0.138)	(-0.143)				
Exams	-0.200***	-0.202***	100.0	-0.056***	-0.060***	14.4	-0.226***	-0.212**	21.6			
	(-0.039)	(-0.049)		(-0.016)	(-0.018)		(-0.082)	(-0.086)				
School Grade	-0.020***	-0.019***	-28.6	(-0.002)***	-0.002***	-50.0	-0.143**	-0.129*	-177.5			
	(-0.006)	(-0.007)		(-0.001)	(-0.001)		(-0.071)	(-0.071)				
Age	0.024***	0.027***	9.6	0.002***	0.002***	-4.9	0.304***	0.307***	30.6			
	(-0.005)	(-0.005)		(0.000)	(0.000)		(-0.049)	(-0.051)				
D*Fees							-0.075	-0.100	24.1			
							(-0.094)	(-0.098)				
D*Edu							0.125	0.155	-20.3			
							(-0.122)	(-0.116)				
D*Exams							-0.172	-0.138*	-16.4			
							(-0.087)	(-0.082)				
D*Grade							0.024	0.031	7.0			
							(-0.065)	(-0.074)				
D*Age							0.184	0.259***	-8.7			
							(-0.107)	(-0.095)				
Licensed										-0.197**	-0.168**	-11.9
										(-0.082)	(-0.075)	
D*Licensed										-0.235***	0.117	-14.3
										(-0.080)	(-0.074)	

Note: Selection on observables test (Altonji, Elder, and Taber 2005; Bellows and Miguel 2009; Nunn and Wantchekon 2011). Comparisons are between the results from the full model from Tables 7 and 8 (β^F) and the results from the restricted model which does not include SBO firm count (β^R). Models follow the same format as in Tables 7 and 8. Only the variables of interest are listed. A ratio of 7 means that that selection on unobservable variables would have to be 7 times greater than selection on observables to attribute the entire β^F estimate to selection effects. Robust standard errors are in parentheses. * $P < .10$; ** $P < .05$; *** $P < .01$

FIGURE 3 – Percent Distribution of Yelp Ratings



Note: Yelp Ratings with 10+ reviews. Ratings follow a half-point scale from 1 to 5.

APPENDIX

TABLE A1 – OLS State Fixed Effects Results – Barbers

Yelp Rating	**(2a)**	**(2b)**	**(3)**
Fees	-0.015	-0.007	-0.234***
	(0.009)	(0.005)	(0.063)
Education/Training	0.029***	0.015***	0.156***
	(0.007)	(0.004)	(0.036)
Exams	0.067*	0.013*	0.348***
	(0.034)	(0.007)	(0.123)
School Grade	0.009**	0.001**	0.081
	(0.004)	(0.000)	(0.052)
Age	0.001	0.000	0.179**
	(0.003)	(0.000)	(0.078)
Border	-0.055	-0.055	-0.063
	(0.039)	(0.039)	(0.084)
D*Fees			0.206***
			(0.033)
D*Edu			0.000
			(0.000)
D*Exams			0.000
			(0.000)
D*Grade			-0.010
			(0.055)
D*Age			-0.291***
			(0.084)
Observations	4,723	4,723	4,723
Groups	44	44	44
R-Squared Within	0.00	0.00	0.00
R-Squared Between	0.07	0.04	0.04
R-Squared Overall	0.02	0.02	0.02

Note: Model 2a reports the results for the model using the level of licensing. Model 2b reports the results for the model using the squared level of licensing. Model 3 reports the results for the model using the binary indicators for any licensing by type of licensing using the difference-in-differences estimators. D* variables report the point estimates for the difference-in-differences estimator for each type of licensing. Fees and education and training are logged in Models 2a and 2b. Logged median wages were negative and significant above the 95 percent significance level in Models 2a, 2b, and 3. The ordered logistic marginal effects were consistent with Models 2a, 2b, and 3. Robust standard errors are in parentheses. * $P < .10$; ** $P < .05$; *** $P < .01$.

TABLE A2 – OLS State Fixed Effects Results – Barbers

Yelp Rating	**(4)**
Licensed	0.416***
	(0.066)
Border	-0.034
	(0.039)
D*Licensed	0.000
	(0.000)
Observations	4,723
Groups	44
R-Squared Within	0.00
R-Squared Between	0.01
R-Squared Overall	0.01

Note: Model 4 reports the results for the model using the binary indicator for a state having any licensing using the difference-in-differences estimators. D*Licensed reports the point estimate for the difference-in-differences estimator. Logged median wages were negative and significant above the 95 percent significance level. The ordered logit marginal effects were consistent with the OLS model. Robust standard errors are in parentheses. * $P < .10$; ** $P < .05$; *** $P < .01$.

TABLE A3 – OLS State Fixed Effects Results – Cosmetologists

Yelp Rating	**(2a)**	**(2b)**	**(3)**
Fees	-0.010	-0.007	0.000
	(0.033)	(0.017)	(0.000)
Education/Training	0.305***	0.156***	0.000
	(0.100)	(0.048)	(0.000)
Exams	-0.047	-0.012	0.000
	(0.054)	(0.015)	(0.000)
School Grade	-0.007*	-0.001*	-0.096
	(0.004)	(0.000)	(0.062)
Age	0.000	0.000	0.075
	(0.004)	(0.000)	(0.069)
Border	0.016	0.011	-0.016
	(0.027)	(0.028)	(0.046)
D*Fees			0.000
			(0.000)
D*Edu			0.000
			(0.000)
D*Exams			0.000
			(0.000)
D*Grade			0.035
			(0.061)
D*Age			-0.057
			(0.062)
Observations	24,013	24,013	24,013
Groups	48	48	48
R-Squared Within	0.00	0.00	0.00
R-Squared Between	0.03	0.03	0.05
R-Squared Overall	0.03	0.03	0.03

Note: Model 2a reports the results for the model using the level of licensing. Model 2b reports the results for the model using the squared level of licensing. Model 3 reports the results for the model using the binary indicators for any licensing by type of licensing using the difference-in-differences estimators. D* variables report the point estimates for the difference-in-differences estimator for each type of licensing. Fees and education and training are logged in Models 2a and 2b. Logged median wages were negative and significant above the 95 percent significance level in Models 2a, 2b, and 3. Population was positive and significant above the 95 percent significance level in Models 2a, 2b, and 3. The SBO firm count was negative and significant above the 95 percent significance level in Models 2a, 2b, and 3. The ordered logistic marginal effects were consistent with Models 2a and 2b. The results for Model 3 were omitted except for the Border variable. Robust standard errors are in parentheses. * $P < .10$; ** $P < .05$; *** $P < .01$.

TABLE A4 – OLS State Fixed Effects Results – Cosmetologists

Yelp Rating	**(4)**
Licensed	0.000
	(0.000)
Border	-0.007
	(0.032)
D*Licensed	0.000
	(0.000)
Observations	24,013
Groups	48
R-Squared Within	0.00
R-Squared Between	0.04
R-Squared Overall	0.03

Note: Model 4 reports the results for the model using the binary indicator for a state having any licensing using the difference-in-differences estimators. D*Licensed reports the point estimate for the difference-in-differences estimator. Logged median wages were negative and significant above the 95 percent significance level. Population was positive and significant above the 95 percent significance level. The SBO firm count was negative and significant above the 95 percent significance level. The ordered logistic results were omitted except for the Border variable. Robust standard errors are in parentheses. * $P < .10$; ** $P < .05$; *** $P < .01$.

TABLE A5 – OLS State Fixed Effects Results – Manicurists

Yelp Rating	**(2a)**	**(2b)**	**(3)**
Fees	0.015**	0.006*	0.088
	(0.007)	(0.004)	(0.070)
Education/Training	-0.008	-0.006	0.028
	(0.010)	(0.005)	(0.049)
Exams	-0.109***	-0.043***	-0.263***
	(0.026)	(0.014)	(0.010)
School Grade	0.001	0.000	-0.049
	(0.004)	(0.000)	(0.065)
Age	-0.007	0.006*	-0.086
	(0.032)	(0.004)	.
Border	0.015**	-0.006	0.049
	(0.007)	(0.032)	(0.072)
D*Fees			-0.145***
			(0.034)
D*Edu			0.088
			(0.070)
D*Exams			0.000
			(0.000)
D*Grade			0.060
			(0.074)
D*Age			0.000
			(0.000)
Observations	17,382	17,382	17,382
Groups	47	47	47
R-Squared Within	0.00	0.00	0.00
R-Squared Between	0.04	0.04	0.04
R-Squared Overall	0.00	0.00	0.00

Note: Model 2a reports the results for the model using the level of licensing. Model 2b reports the results for the model using the squared level of licensing. Model 3 reports the results for the model using the binary indicators for any licensing by type of licensing using the difference-in-differences estimators. D* variables report the point estimates for the difference-in-differences estimator for each type of licensing. Fees and education and training are logged in Models 2a and 2b. Logged median wages were negative and significant above the 95 percent significance level in Models 2a and 2b. The SBO firm count was negative and significant above the 95 percent significance level in Models 2a and 2b. The ordered logistic marginal effects were consistent with Models 2a, 2b, and 3. In Model 2a, the point estimate on Fees increased to the 99 percent significance level, and in Model 2b it increased to the 95 percent significance level. The Border variable became significant in Model 3. D*Fees was no longer significant and D*Edu became significant at the 99 percent significance level. Robust standard errors are in parentheses. * $P < .10$; ** $P < .05$; *** $P < .01$.

TABLE A6 – OLS State Fixed Effects Results – Manicurists

Yelp Rating	**(4)**
Licensed	-0.192***
	(0.029)
Border	-0.086***
	(0.000)
D*Licensed	-0.079**
	(0.032)
Observations	17,382
Groups	47
R-Squared Within	0.00
R-Squared Between	0.03
R-Squared Overall	0.00

Note: Model 4 reports the results for the model using the binary indicator for a state having any licensing using the difference-in-differences estimators. D*Licensed reports the point estimate for the difference-in-differences estimator. Logged median wages and the SBO firm count were negative and significant above the 95 percent significance level. The ordered logit marginal effects were consistent with the OLS model. Robust standard errors are in parentheses. * $P < .10$; ** $P < .05$; *** $P < .01$.

TABLE A7 – OLS State Fixed Effects Results – Massage Therapists

Yelp Rating	**(2a)**	**(2b)**	**(3)**
Fees	-0.002	-0.005	-0.356**
	(0.015)	(0.007)	(0.166)
Education/Training	0.001	-0.001	-0.208**
	(0.016)	(0.009)	(0.093)
Exams	-0.090*	-0.024*	0.076
	(0.046)	(0.014)	(0.135)
School Grade	-0.005	-0.000	0.180
	(0.007)	(0.001)	(0.140)
Age	0.009*	0.001*	0.362***
	(0.005)	(0.000)	(0.090)
Border	-0.034	-0.032	0.162**
	(0.037)	(0.037)	(0.077)
D*Fees			0.452***
			(0.171)
D*Edu			0.199***
			(0.073)
D*Exams			-0.219*
			(0.124)
D*Grade			-0.304**
			(0.129)
D*Age			-0.181*
			(0.101)
Observations	8,484	8,484	8,484
Groups	46	46	46
R-Squared Within	0.00	0.00	0.00
R-Squared Between	0.24	0.23	0.18
R-Squared Overall	0.01	0.01	0.00

Note: Model 2a reports the results for the model using the level of licensing. Model 2b reports the results for the model using the squared level of licensing. Model 3 reports the results for the model using the binary indicators for any licensing by type of licensing using the difference-in-differences estimators. D* variables report the point estimates for the difference-in-differences estimator for each type of licensing. Fees and education and training are logged in Models 2a and 2b. None of the control variables were significant above the 95 percent significance level. The ordered logistic marginal effects were consistent with Model 2a. In Model 2a, the point estimate on Exams increased to the 99 percent significance level, and in Model 2b it was no longer significant. The point estimates for Model 3 were not consistent with the OLS results. Robust standard errors are in parentheses. * $P < .10$; ** $P < .05$; *** $P < .01$.

TABLE A8 – OLS State Fixed Effects Results – Massage Therapists

Yelp Rating	**(4)**
Licensed	-0.139*
	(0.081)
Border	0.173**
	(0.083)
D*Licensed	0.223**
	(0.090)
Observations	8,484
Groups	46
R-Squared Within	0.00
R-Squared Between	0.09
R-Squared Overall	0.00

Note: Model 4 reports the results for the model using the binary indicator for a state having any licensing using the difference-in-differences estimators. D*Licensed reports the point estimate for the difference-in-differences estimator. None of the control variables were significant above the 95 percent significance level. The ordered logit marginal effects were consistent only with the Licensed variable, which increased in significance to the 99 percent significance level. Robust standard errors are in parentheses. * $P < .10$; ** $P < .05$; *** $P < .01$.