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ABSTRACT

This study shows the influence of occupational licensing on two occupations that provide similar services: occupational therapists and physical therapists. Most of the tasks for these two occupations differ, but several jobs overlap, and individuals in both occupations could have legal jurisdiction over these tasks. We empirically examine how these two occupations interact with one another in the labor market on wage determination and employment. Unlike previous studies, our study examines two occupations that are female dominated both within the professions and among its leadership. Our results show that occupational licensing can raise the wages of members of both occupations, but the duration of state occupational licensing statutes is the dominant influence on wage determination. Occupational licensing is also associated with a reduction in annual hours worked and in the relative numbers of members in each of the professions. Moreover, the ability of physical therapists to have direct access to patients is associated with a reduction in hourly earnings for occupational therapists, suggesting some substitution for certain service tasks across the two occupations. The ability of these two occupations to be both complements to and substitutes for one another provides new evidence on how the growing number of regulated occupations that are similar interact and influence one another.

JEL Classification Codes: J44, J31, J38, J88

Key Words: Occupational licensing, wage determination, interaction of occupations

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In models of competitive labor markets, workers with overlapping skills are assumed to compete for work. With the introduction of occupational licensing, these regulations may function as a barrier to entry that drives up wages in the licensed occupation and increases the prices of products and services that are produced by licensed workers (Friedman and Kuznets 1945; Friedman 1962; Kleiner and Krueger 2013). In addition, there can be further allocative inefficiencies through deadweight losses introduced by these regulations (Schmidt 2012).

The governmental regulation of occupations has been among the fastest-growing labor market institutions in the U.S. economy. Kleiner and Krueger (2013) estimate that the proportion of all American workers covered by occupational regulations increased from about 5 percent in the 1970s to almost 29 percent in 2008 (Kleiner and Krueger 2013). For example, during the 2012–2013 legislative sessions, at least seven new occupations were licensed in at least one state—occupations ranging from scrap metal recyclers in Louisiana to body artists in the District of Columbia.[1]

The health sector is especially subject to occupational regulations. The core health occupations—physicians, nurses, and dentists—are universally licensed. Over 76 percent of nonphysician health workers also are employed in licensed occupations (Kleiner and Park 2010). By definition, the purpose of a licensing regulation is to deny the legal right to perform a particular type of work to anyone who does not hold the appropriate credential for pay, and to impose conditions that restrict access for permission to do certain tasks. Licensing regulations are usually modeled as a barrier to entry in a particular type of market setting (Kleiner and Vorotnikov 2012).

Early research considered the effects of licensing in health care markets (Friedman and Kuznets 1945; Friedman 1962). Subsequent analysis is concerned with the role of licenses in

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

markets that would otherwise produce suboptimal outcomes because of adverse selection of low-quality workers (Leland 1979) or because members of an occupation may underinvest in job-specific skills that may change over time (Shapiro 1986). Three types of models provide different insights into the welfare consequences of licensing regulations in different situations, but all three approaches imply that regulations can have important effects on the wages of different occupations. Conventional licensing arrangements are common in the health sector. But other occupational regulations, which do not fit the microeconomic model as well, are also quite prevalent. For example, states commonly impose regulations that limit the scope of practice of particular occupational groups, require supervisory relationships between members of two occupational groups, and limit the ability of health insurance companies to directly reimburse members of some occupational groups. These constraints may alter the production function that is used to combine the services of heterogeneous workers to efficiently provide health services. As a result, the wages and employment levels of these regulated occupations may be affected by these regulatory provisions.

Understanding the effects of occupational regulation in the health sector is important. In 2013, the health sector accounted for almost 18 percent of U.S. gross domestic product, and expenditures on provider services represented about 21 percent of total expenditures on health services (Centers for Medicare and Medicaid Services 2014. If occupational regulations have even small effects on wages and employment, then the aggregate costs of regulation could be large. In principle, the regulations could also affect population health outcomes by making it harder for people to obtain health services.[2]

[2] For example, allowing nurse practitioners to perform certain medical procedures is associated with a reduction in almost 10 percent for well-child checkups which could result in a reduction of $600 million dollars ($10 × 60 million visits per year) (Kleiner et al. 2014).

In this study, we analyze the effects of occupational regulations in the health sector by focusing on the practice restrictions faced by two occupations: physical therapists (PT) and occupational therapists (OT). Across different situations, the services of a PT may function as either a substitute for or a complement to the services of other medical professionals such as an OT. It is possible, for example, that PTs provide a set of services that are very similar to the services offered by OTs but that are offered with a greater emphasis on factors such as convenience, personal attention, or specialization, which are important to some patients in some situations. In short, PTs are an ideal example of an occupation with training and productive capacities that in some cases overlap with other occupations such as OTs. This overlap means that the content and context of the work provided by PTs depend on a variety of occupational regulations that have varied across states and over time.

Using data from the American Community Survey (ACS), we analyze the effects of state-level PT and OT regulations on wages and employment. To examine how PT and OT regulations affect wages, we use state statutory data over the period 2000–2011.

The broad goal of our study is to develop a more detailed understanding of the way in which occupational regulations affect labor market outcomes in the United States. To examine this issue, we analyze how regulations affect the relative wages of two key health care occupations that are female dominated and are similar with respect to patient care. In addition, unlike earlier work that focused on occupations that were clearly dominant and subordinate, our study examines occupations that are largely equivalent in terms of their incomes, prices charged, education, and tasks (Kleiner and Park 2010; Kleiner et al. 2014). In our analysis we review some previous studies that show how some occupational groups can be both complements and substitutes in the delivery of certain medical services. We also show and give example of how

these two occupations have some overlap where regulations would matter for their labor market outcomes. Next, we explain the sources of our data on OT and PT regulations and labor market outcomes. We describe our econometric strategies and consider issues of internal validity and the sensitivity of the estimates to alternative specifications.

To preview our empirical work, our estimates show that occupational licensing regulations for OT vary but are associated with a 0–6 percent wage increase based on the model specification, and that the length of time that licensing statutes have been in place are associated with higher wages in most of our models. Licensing and the length of time that it has been passed and implemented are associated with a reduction in the hours worked by both PTs and OTs, as well as with a reduction in the number of individuals who enter both occupations. These estimates suggest that regulation raises wages and reduces the supply of effort measured by hours of work and the relative number of workers in an occupation. Moreover, the licensed occupation that was initially licensed (PT) seemed to set the agenda for the regulation of the following occupation (OT). The remainder of the paper details how we developed these results.

OVERVIEW OF OCCUPATIONAL REGULATIONS IN THE HEALTH SECTOR

A large empirical literature is devoted to estimating the wage and employment effects of licensing regulations; it includes work related to a variety of health occupations.[3] The literature concerned with overlapping occupations in which substitution and complementarity may be important is much smaller and more recent. Persico (2015) presents a theoretical model suggesting that when occupations are complementary, members of an incumbent occupation may have incentives to allow more individuals into the competing occupation. Occupational therapy

[3] See Kleiner (2006) for a review of the empirical literature on the wage determination effects of licensing.

and physical therapy are plausibly complementary because patients who visit an OT for basic health services may also be referred to a PT for more complex or different but related care. More generally, the use of an OT for low complexity home care may free up time for PTs to specialize in more complex care, such as muscular/skeletal development. Hand care therapies are generally the specialty of occupational therapists, but physical therapists also claim this as a specialty. This type of care, which is essential to mobility, could be more lucrative in terms of billable hours. Some of these regulatory preferences may depend on the industrial organization of the medical sector. One conjecture is that health workers whose compensation depends in part on the economic performance of a particular health care firm might be less supportive of regulations that force the firm to adopt production processes that are not efficient.

Some empirical work can be found on the regulation of overlapping occupations. Kleiner and Park (2010) provide evidence that occupational regulations that alter the boundaries between the work tasks of dentists and dental hygienists appear to affect the earnings of both occupational groups. In a similar manner, Wing and Marier (2014) study regulations that define whether a hygienist may independently perform particular dental procedures, allowing hygienists to perform the service leads to lower prices for that service. Stange (2014) examines the impact of changes in the supply of nurse practitioners and physician assistants, as well as the utilization and costs of health services. He finds that increases in the supply of nurse practitioners and physician assistants at the county level do not directly increase utilization, but nurse practitioner supply increases do lead to small gains in utilization in geographical areas that offer more independence to them, as measured by an index of regulations and by prescription drug authority. Our study focuses on the conceptual and empirical implications of the work task restrictions that are used to regulate OTs and PTs in many states. This approach is somewhat

distinct from the supply-side entry barrier framework that is standard in the licensing literature and which is implicit in Stange's approach. Finally, we examine outcomes in these two labor markets that are closely connected to the importance of direct access by each of the occupations to patients or clients. This approach allows us to trace the effects of the regulations across different domains. In particular, we study how the regulations affect the wages and employment of PTs and OTs.

INSTITUTIONAL BACKGROUND ON TWO SIMILAR LICENSED HEALTH CARE OCCUPATIONS

> The impact of different state licensure laws for the two professions in terms of the need for physician referral would certainly have workforce implications[;] whether this supports collaboration or points to growing differences between the two professions is still to be determined. In addition to concerns over the efforts to achieve unrestricted access directed by physical therapists, some occupational therapists are protesting what they believe to be added language in physical therapy practice acts in the area of "functional training in self-care and in home, community or work reintegration." Although this terminology has been in physical therapist education program accreditation criteria and practice acts for many years, the AOTA [American Occupational Therapy Association] has taken the position that this terminology is evidence of PTs encroachment into the scope of practice of OT. (Fisher and Keehn 2007, p. 26)

The general work of occupational therapists and physical therapists each has a distinct focus. Occupational therapists train or retrain individuals to do general work that allows patients to work independently, whereas physical therapy focuses on physical rehabilitation and muscular and skeletal improvements. The two occupations overlap, however, in several areas: modality or method of treatment, wound care, and orthopedics, and foot care. A key issue for both occupations is to get insurers to pay for direct access rather than be billed through a medical facility or through a physician's office. Another key element for both occupations is how they bill through Medicare or how they are reimbursed for care.

What Tasks Do Occupational Therapists Do?

As defined by the occupation, occupational therapists define their work as follows:

> The therapeutic use of everyday life activities (occupations) with individuals or groups for the purpose of participation in roles and situations in home, school, workplace, community, and other settings. Occupational therapy services are provided for the purpose of promoting health and wellness and to those who have or are at risk for developing an illness, injury, disease, disorder, condition, impairment, disability, activity limitation, or participation restriction. Occupational therapy addresses the physical, cognitive, psychosocial, sensory, and other aspects of performance in a variety of contexts to support engagement in everyday life activities that affect health, well-being, and quality of life. (American Occupational Therapy Association 2004, p. 694)

According to the Bureau of Labor Statistics (2014), the entry-level requirements for an OT degree include a master's degree. Many in the occupation, however, including those in the occupational association, see the entry qualifications as evolving to a doctoral degree.

In contrast, PT tasks are noted as follows: "Physical therapists help people who have injuries or illnesses improve their movement and manage their pain. They are often an important part of rehabilitation and treatment of patients with chronic conditions or injuries" (Bureau of Labor Statistics 2014).

As of 2015, the current entry point into the occupation of physical therapist is a professional doctoral degree that requires three years of classroom work and internships beyond a bachelor's degree. A key element for both occupations is direct access to the patient and billing procedures for Medicare and health insurance.

INSTITUTIONAL BACKGROUND FOR REGULATING PTS AND OTS

Physical therapy as an occupation gained much greater public attention as a medical intervention and was used more extensively following the U.S. participation in World Wars I and II. During and following these conflicts, wounded soldiers benefited from a combination of

surgery and nonevasive procedures such as physical therapy. The number of physical therapists grew, and their procedures generally involved similar processes and standard patient care. The physical therapists then formed organizations that were the initial movers to obtain occupational licensing across states. Pennsylvania was the first state to license physical therapists in 1913, followed by New York in 1926 and Kansas in 2003; Kansas is used as a case study in our analysis.

In a similar manner, occupational therapists were regulated much later than physical therapists. The first state to license occupational therapists was Florida in 1975. In 2013 Colorado licensed occupational therapists, but Hawaii did not pass a law to fully license occupational therapists until 2014. The passage of laws and how long they have been in effect influenced OT and were likely influenced by the passage of PT laws many decades earlier, but not the other way around. Consequently, we suspect that the wages of OTs and PTs would be determined independently. Therefore, we suspect that the duration of the passage of licensing laws for PTs would influence the wages of OTs and may serve as a reasonable instrumental variable in our subsequent analysis.

THEORETICAL FRAMEWORK FOR ANALYZING PT AND OT INTERACTIONS

Classical models of occupational licensing are concerned with explicit barriers to entering a profession (requirements involving exams, moral standing, and the availability of accredited schools) and with how the barriers affect wages and employment quality under different market settings (i.e., perfect competition, adverse selection, moral hazard). The scope of practice regulations is conceptually distinct from entry barriers, although in many situations they may lead to similar economic outcomes. A scope of practice regulation does not directly make it

harder for a person to enter the OT or PT profession. Instead, the regulations define work tasks that members of the occupation are not allowed to perform, and they may impose procedures and supervision requirements that must be followed by each occupation that performs certain tasks. Occupation-specific work tasks and work procedure regulations could affect the production of health services in a variety of ways. Limits on work tasks could restrict the effective productivity of OTs relative to PTs, and the limits and procedural requirements could make it more difficult to substitute OT labor for PT labor in production.

Our empirical strategy in this paper is based on quasi-experimental variation in state regulations, but we do not attempt to build a structural model of the market for basic health services. The theoretical approach is there, however, to guide our analysis and interpretation; we worked with a very simple model that clarifies some mechanisms through which scope of practice regulations may lead to different economic outcomes. The model highlights the way in which occupational regulations can act as a constraint on production functions that combine heterogeneous labor inputs such as OT and PT.

Analyzing Similar Occupations

Many of the tasks of OTs and PTs are similar. Both occupations engage in generally nonevasive procedures to allow clients or patients to increase their strength and become more mobile within their environments. Each occupation establishes tasks that are different from one another. However, some tasks overlap and are common to both occupations. Figure 1 is a Venn diagram that conceptually shows both the differences and similarities between OTs and PTs. As the diagram illustrates, most of the tasks and some of the objectives of PTs and OTs differ, but a number of jobs and tasks overlap. For these tasks, individuals in both occupations can perform them, and OTs and PTs can serve as substitutes for one another. Occupational licensing laws can

allocate these tasks to either OTs or PTs, with a resulting increase in earnings and more work for the occupation that has tasks that are capable of being allocated to the job. We attempt to empirically examine how these occupations interact with one another in the labor market regarding their wage determination and employment and how occupational licensing may influence their labor market behavior.

DATA AND SAMPLE DESCRIPTION

Measures of Licensing and Regulation

We collected information on statutes and the statutory changes regulating occupational therapists from the state-by-state law database from the American Occupational Therapy Association. The data show in which year each state passed a licensing or registration law as well as the current licensing (registration) requirements set by each state board. We collected the corresponding information on statutes regulating physical therapists from the board of physical therapy in each state. All 50 states license PTs, and each state had passed a licensure law at least by 2003 in addition virtually all PTs and OTs are both covered and have attained a license (Gittleman and Kleiner 2016). We contacted the board of physical therapy in a state if we were not able to get the precise year of the legislation. This approach allowed us to obtain information for all fifty states for the period 1995–2013.

In Figures 2A and 2B we show how the numbers of states that license OTs and PTs have grown over time and Figure 3 shows the number of OTs and PTs in the various data sets that we use. Figure 2 shows that 40 states passed a licensure law for OTs by 1995, and this number increased to 49 in 2011 (including Washington, DC). Only Hawaii has a less restrictive registration law regulating OTs. Colorado did not regulate any OTs until the state passed a

registration law in 2008 and a licensing law in 2013. For the growth of PT licensing, we plot the numbers over 1950–1975, a period during which most states started to license PTs. The first mover states that passed licensure laws before the 1950s were Pennsylvania, New York, and Connecticut. We calculate the durations of licensure for each state based on the year in which the states passed their first licensure law for OTs and PTs.

Figure 3, Panel A, shows a comparison of national total employment of OTs over time from the three data sources. Since 2002, the numbers of OTs from the American Occupational Therapy Association (AOTA) survey have been larger than the numbers from the other sources.[4] The board survey numbers may include those not active in the labor force but still holding an unexpired license; therefore, we think that the simulated totals based on the OES is closer to the actual OT workforce population.[5] The OT population calculated from the weighted ACS sample is likely an underestimate of the actual total OT employment compared with the other two data series. In contrast, for PTs we estimate the national total employment from two sources: the ACS and Occupational Employment Statistics (OES). The values from the PT sample in the ACS are similar to the PT statistics in OES, which suggests that the PT sample in the ACS is more representative of the actual PT workforce population.

The March Current Population Survey (CPS) also collects wage and income information from individuals and households, and the data are available for longer time series than the ACS. It also has additional covariates such as unionization and the ability to examine outgoing rotation groups. Because of the limit on the sample size, we use the 1995–2011 sample from the CPS file as a robustness test in addition to the wage and employment model using ACS data.

[4] According to the published OT Licensees Totals from the AOTA survey of state regulatory boards and rosters of licensees, no information is available before 2002 for California and Michigan—two of the states that have the largest OT population. This could largely account for the underestimation of the national total.

[5] Refer to the notes in Figure 3 for the calculation of simulated totals of the OT workforce.

For the legal requirements we track any substantial changes on licensing requirements from 2000 to 2010 through the LexisNexis legal research database. The criteria and policies we used are shown in Table A.6. We also collected information on the state legislative and register archives as alternative sources for the information on updates and amendments to statutes as well as administrative rules.

We focus on the legal authority for an OT or a PT to practice with or without a referral from a physician or other medical professionals, which is usually part of the operation standards set by a state board through its licensure statute. This is also understood as the direct access to OT and PT services by patients. Figure 4 shows the growth in direct access to therapy services during the period 1995–2011. Although OT licensure has a much shorter history than PT licensure in the United States, in the early 2000s the practice of OT was not restricted by physician referral in more than 35 states (including those states that were not licensing OTs at the time)—a number much greater than the number of states with unlimited access to PT services. Starting in 2000, many more states started to reduce barriers of access to PT services. These states have mostly allowed PT treatment without physician referral under some restrictions, which led to a dramatic growth of direct access to PT service. By 2011, only five states restricted access for direct treatment by PTs or OTs.

Age, education, and examinations are common criteria when OTs or PTs first apply for a license. Figure 5 plots the distribution of the licensing requirement index, which we calculate from a set of components that are considered barriers to entry to becoming a licensed OT or PT. The figure shows that OT regulations became more restrictive during the past decade, with an increase in the mean and a slight decrease in the variance. This reflects not only the movement of regulation from a less restrictive law to a licensure law by a few states, but also the increase in

regulation intensity by those states who began to license OTs before the period of analysis. For example, some states began to establish or increase hours of continuing education a few years after a licensure law was passed. Table 1 displays the descriptive values of the regulation requirement index, and Table 2 lists the states with the most and least restrictive details on licensing requirements. In Table 3 we show the years in which a state enacted a statute regulating OTs or PTs during the period for which we have labor market data.

Measures of Wages and Labor Supply

We use ACS data from 2000 to 2010 to extract our basic sample of OTs and PTs. Using the Standard Occupational Classification (SOC) System, we find that 21,394 are identified PTs in the ACS survey sample, and 10,134 are identified as OTs. The ACS data are based on census interviews with individuals and allow for wage and employment analysis by state with various covariates such as demographic background and human capital variables.

The wage estimates are constructed by applying several restrictions to exclude unpaid family workers, individuals with invalid educational attainment (those with below some college education), or inappropriate years of experience. We also eliminate individuals in the sample over age 65 or with more than 60 working hours a week. In addition to all these restrictions, the original sample is trimmed down by excluding individuals whose wages are below the federal minimum wage level or with an hourly wage in the top 1 percent of the sample.[6] The final sample size that we used in our analysis is reduced by 5 percent for OTs (9,668) and 7 percent for PTs (19,788) compared with the original sample.

We calculated the measure of hourly wages based on individuals' income from salaries as well as their returns from business income. Our sample from the ACS data shows that 7 percent

[6] See Table A.2 for details regarding sample construction.

of OTs and 10 percent of PTs are self-employed. We also calculated individuals' annual number of hours worked using the information from the weekly working hours and the number of weeks per year in the ACS. Figure 6 shows the kernel distribution of hourly rates for OT and PT from the 2010 sample. The PT sample has a pattern similar to that of the wage distribution in the OT sample, but with a slightly higher level of mean value. Table 4 includes the weighted mean on wages and annual hours of labor supply for the pooled sample for the period 2000–2010. PTs earn $30 per hour on average, whereas the hourly earnings average for OTs is about $28.

Other Data Sources Used to Test for Robustness

The ACS is our main data source and provides measures of wages, labor supply, and other covariates. We also obtained data on wages and total employment by state and year from three other data sources. First, the OES provides annual wage and employment information for each occupational category. It is collected from a Department of Labor employer survey but does not cover the self-employed, unincorporated firms, or unpaid family workers. The data in the OES allow for wage and employment estimates for OTs and PTs at the state level but without covariates at the individual level. Second, the AOTA also conducts annual surveys of state regulatory boards and rosters of licensees, but it does not collect the type of data that are in either the ACS or OES.

Descriptive Statistics

Table 4 shows the means and standard deviations of wage and employment variables and the covariates for the OT and PT samples. The individual average annual hours of work derived from the OT sample is 1,661. Similarly, the annual hours worked based on the PT sample was 1,789. The OTs have 16.4 years of professional experience—slightly higher than that of PTs. The OT sample has a higher percentage with a bachelor's degree, whereas the PT sample has a

relatively higher percentage—around 46 percent—with a degree beyond an undergraduate education. These results are consistent with the evolution of education requirements for both occupations.[7] Females are the dominant gender in both occupations.—more than 90 percent of the OTs and about 70 percent of the PTs in our sample are women. In addition, about 13 percent of OTs and 11 percent of PTs are part-time workers, and 7 percent of OTs and almost 10 percent of PTs are self-employed. Moreover, about 19 percent of OTs work for government agencies, whereas less than 8 percent of PTs work do. Generally, the differences in ACS data for OTs and PTs lie in gender distribution, educational group distribution, and type of work.

EMPIRICAL RESULTS

Our Basic Model

From the theoretical background, the assumption is an optimal combination of labor inputs from OTs and PTs, but they are affected by the changes in the regulations in both occupations. We examine the regulation effect on the hourly wages for both occupations, because we assume that the change in regulations shifts the market supply curves of these two occupations. The basic wage model is

(1) $\ln(E_{ist}^{ot/pt}) = \alpha + \beta R_{st} + \gamma X_{ist} + \delta_s + \theta_t + \varepsilon_{ist}$,

where $\ln(E_{ist}^{ot/pt})$ is the logged hourly earnings of OTs or PTs from person *i* in state *s* at time period *t*. R_{st} is the vector of regulation measures for OTs and PTs in state *s* in time period *t*; the vector X_{ist} includes covariates measuring the characteristics of each person; δ_s and θ_t are state and year fixed effects; and ε_{ist} is the error term.

[7] Physical therapists will require a Doctor of Physical Therapy degree for full licensure in most states by 2016; occupational therapists are considering increasing requirements to a similar level.

Next we examine the regulation effect on the labor supply for these two occupations. The basic employment model can be written as follows:

(2) $L_{ist}^{ot/pt} = \alpha + \beta R_{st} + \gamma X_{ist} + \delta_s + \theta_t + \varepsilon_{ist}$,

where $L_{ist}^{ot/pt}$ is the measure of person *i's* labor participation as an OT/PT in state *s* at time period *t*, so it equals one if person *i* is an OT/PT and zero if person *i* works in a different occupational category. R_{st} is the vector of regulation measures for OTs and PTs in state *s* in time period *t*; the vector X_{ist} includes covariates measuring the characteristics of each person; δ_s and θ_t are state and year fixed effects; and ε_{ist} is the error term. Both the linear and nonlinear probability models are applied to test Equation (2).

We further examine the influence of regulation labor inputs using measures of working hours by OTs and PTs. The model is described as follows:

(3) $H_{ist}^{ot/pt} = \alpha + \beta R_{st} + \gamma X_{ist} + \delta_s + \theta_t + \varepsilon_{ist}$.

In this model, $H_{ist}^{ot/pt}$ equals the annual hours of labor supply as an OT/PT from person *i* in state *s* at time period *t*. R_{st} is the vector of regulation measures for OTs and PTs in state *s* in time period *t*; the vector X_{ist} includes covariates measuring the characteristics of each person; δ_s and θ_t are state and year fixed effects; and ε_{ist} is the error term.

The model we implement is applied to occupation-specific log wages and is a fixed effects version of the standard cross-sectional human capital wage equation, which leads to a few subtleties concerning how to construct the market-level regulatory effect estimates. We estimated the earnings equations using two different approaches. In the first approach, we estimated the model using the full micro-level data set and estimated standard errors that are robust to heteroskedasticity and clustering at the state level. In the second approach, we aggregated the data to the level of state *x* year cells using the two-stage procedure described in the work of

Hanushek (1974), Amemiya (1978), and Conley and Taber (2011). In the first stage, individual-level outcomes are regressed on individual covariates and a full set of state × time fixed effects. The coefficients on the state × time fixed effects represent state × time cell means that have been purged of the variation associated with the within-cell variation in the covariates. In the second stage, the covariate-adjusted cell means are regressed on the policy variables, state fixed effects, and year fixed effects as described above. Standard errors are again constructed to allow for heteroskedasticity and clustering at the state level.

Use of Instrumental Variables

Though our model assumes that the causal effect of regulations has an impact on market outcomes, we do not ignore the potential issue that licensing variables are endogenous in Equation (2), since other observed and unobserved factors may affect both wages and regulations, or market factors may affect regulations. Moreover, occupations in a state that have low earnings may seek additional regulations in order to raise earnings or gain further control over labor supply factors. Since PT was regulated 20–30 years earlier than OT, the duration of the regulations by PT would likely influence when a state would license OT, but not necessarily the wages of practitioners of OT, which are determined by market factors and price setting by government and insurance agencies. Consequently, the duration of PT would serve as a potentially good instrumental variable to deal with the endogeneity of the regulations and wage determination of the occupations.[8]

Influence of Licensure and Duration on Wage Determination

Our wage model in Equation (1) estimates a basic two-state two-period difference-in-difference model for the treatment effect of regulation. We use two measures of regulation for

[8] These estimates are presented in Table A.8.

licensing: the basic dummy variable, which indicates that a state licenses OTs in year *t*, and a partially continuous variable, which indicates the number of years since the initial licensure took place or what we call a duration variable. In Table 5, the main results for the regulation effect are presented in columns 3, 6, and 8. Estimates using a model with only year fixed effects and additional controls with year fixed effects are presented. The first three columns show that when a licensing law is passed, the wage of OTs increases by 7 percent in the model with year fixed effects but has no impact on wages in the model with both state and year fixed effects. On the other hand, when we estimate logged hourly wages on the duration since licensing, one more year after licensing contributes to approximately a 1.2 percent wage increase in the main model. In the IV model, the duration of an OT licensing law is associated with a 7 percent wage effect. The test of endogeneity shows a statistically significant result, which implies that the duration of OT licensing should be treated as endogenous.[9]

Using the numbers in the OES annual report, Figure 7 shows a plot of the average hourly wage from 2000 through 2010 for PTs in Kansas. Kansas is the only state that started licensing PTs in 2003, and it was the last state to license these workers in the occupation. When the Kansas PT Practice Act was implemented in 2004, PT wages in the state substantially increased. The figure shows that the wage gap between Kansas and the national average for PTs narrowed from more than 10 percent in 2004 to about 3 percent in 2010. These data provide a case study of licensing reducing the wage gap for physical therapists.[10]

Panel B of Table 5 shows the estimates of the influence of licensing PTs on their hourly wages. Only one state changer switched from a certification law to a licensing law in 2003 using

[9] For a test of endogeneity, Wooldridge's (2005) robust score test and a robust regression-based test are performed in our two-stage least-squares IV estimation with clustered standard errors at the state level.

[10] Additional tests of changes in other states prior to the passage of a law in Kansas showed no clear effects of adoption of licensing on wage determination.

both state and year fixed effects. With a licensure dummy variable, we find positive but not significant effects in the OLS model. Moreover, the duration of licensing PTs is associated with an approximately 3 percent wage increase per year according to columns (6) and (7) as well as columns (9) and (10), but the magnitudes of the coefficients vary by model specification.

Wage Effects of Access to Services

As shown in Figure 4, patients' direct access to therapy services has been one of the most prominent issues for PTs during the past decade, when most states that had given no direct access to PT services began to allow limited access under certain conditions. At the same time, OTs can have direct access change in different directions. For example, the level of access is assumed to have declined if a state passed a licensing statute for OTs and subsequently restricted access via statute.

We assume that two occupations with a potentially overlapping scope of practice may substitute for or complement each other when one of the occupations experienced a substantial change based on their level of access. Therefore, we examine the wage effect of one occupation changing its level of direct access on both occupations. In Table 6, indicators for OT and PT access are each included in the OT wage models separately and then together in the same equation. In columns (1)–(3), OT access levels are interacted with licensure status, so those states with unlimited access to OT services before they license OTs are grouped separately from those states with licensing laws but unrestricted access, and the omitted group is state by year groups with no access. In columns (4)–(6), the partial OT sample with state-years having licensing laws are used in estimation, so the net effect from an increase in direct access is tested conditionally on no variation on licensing status. The PT access level is represented by a dummy variable grouping limited or unlimited access relative to no access, since no state changed to

unlimited access from a different level during the period. All models use controls for state and year fixed effects. We find that a state-year gaining direct access to PT services bid down the wages for OT by approximately 5 percent. At the same time, changing from no access to having access to OT services has a positive but not significant relationship with OT wages. The results for PT wage models are presented in columns (7)–(9). We did not find any significant results of direct access with respect to PT wages. Overall, direct access to OT and PT services was likely affecting the wages of the two occupations in opposite directions, which implied substitution between OTs and PTs. However, only the increase of PT direct access significantly causes a change in wage outcomes from this type of competition.[11]

Employment Effects of Licensure and Its Duration

We initially estimate an employment model with a dummy variable for labor force participation as an OT/PT with employment relative to other occupations. Since the total employment within an occupation is determined by a large variety of factors, we also include estimates from aggregate and alternative employment estimates using data from the OES data in the appendices.

Results for OTs are presented in Table 7. Licensing OTs is associated with a negative relationship on the probability of being an OT in the labor force, and this change is consistent in all specifications. These estimates are also consistent with the results in the wage equations, since a downward shift in supply is associated with an increase in market wages. In the PT models, the results presented in Table 8 do not show estimates from a fixed effect model with a licensure dummy, because the only state that changed its licensing status (Kansas) does not have

[11] In Table A.7 we show the influence of each occupation in a combined sample of the two occupations. The results show that OT wages are lower than those for PTs and that their hours worked per year are lower than that for PTs.

a large enough sample for stable employed PTs to estimate the full fixed effects model. Instead, we only report estimates from the duration estimates. The general trends indicate a decline in the probability of being employed (or self-employed) as a PT when the duration of licensing is longer, and this is reflected when both state and year fixed effects are controlled for.

For each specification, we apply both the linear probability model and the nonlinear probit model to test for the robustness of our estimates. The first halves of Tables 7 and 8 present the linear regressions results, and the second parts report the marginal effects from a probit model. The nonlinear models generate estimates in the same direction as linear models do, and the magnitude of parameters is smaller.

Estimates of Annual Hours of Labor Supply

Licensing an occupation not only increases the entry barriers that restrict the employment of that occupation, but also clarifies the practice standard of that occupation so that professionals are not allowed to do tasks beyond their scope of practice. Table 9 shows that passing a licensing law in a state negatively affects the annual hours of labor supply by OTs and PTs. OTs worked 47 hours less per year after getting licensed, and PTs worked 43 hours less. A second set of estimates shown in the table provides evidence that the decline in labor supply mostly occurred during a shorter period of time after licensing began. In the long run, we do not observe a significant downward shift in working hours. In contrast, the duration since licensing began is positively associated with the annual hours of labor supply, but the influence is small. This could be explained by the expanding of scope of practice, increasing coverage under national medical programs, and the potential increase in demand for services, all of which accompany the more complete and mature licensing system over time.

CONCLUSIONS

Our analysis shows the influence of occupational licensing for two occupations that provide similar services: occupational therapists and physical therapists. Unlike previous examinations of occupations that provide overlapping services, where one occupation dominates the other in its ability to provide higher value-added tasks, our examination reveals that these two occupations are similar in the areas of education, age, and income. In addition, unlike previous research on occupational licensing, our study examines two occupations that are female dominated both within the professions and among its leadership. The ability to examine the labor market consequences of the level and changes of occupational licensing and its duration adds to the field's knowledge of how occupational licensing works in the United States.

Our results show that occupational licensing raises the wages of OTs and PTs and that the dominant influence on wage determination is the length of time that an occupation has been licensed in a state. Moreover, the ability of PTs to have direct access to patients is associated with a reduction in hourly earnings for OTs, suggesting some substitution for certain services across the two occupations. The introduction of a licensing statute reduces the relative number of both OTs and PTs. A licensing statute also negatively influences hours worked in the short run. For PTs, the duration of licensing is associated with a reduction in the relative number of practitioners. The ability of these two occupations to be both complements to and substitutes for one another provides new evidence on how regulated occupations influence one another. Further examination of how regulation influences patient care and costs would add a great deal to understanding the role that occupational regulation has in the labor market and the economy.

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Table 1 Growth of Regulation Intensity over Time

Panel A: Occupational Therapist

Year	Number of states	Mean	St. dev.	Min.	Max.
2000	51	3.05	1.57	0	5.88
2001	51	3.14	1.53	0	5.88
2002	51	3.26	1.47	0	5.88
2003	51	3.40	1.40	0	5.88
2004	51	3.44	1.39	0	5.88
2005	51	3.49	1.37	0	5.88
2006	51	3.57	1.38	0	5.88
2007	51	3.57	1.37	0	6.01
2008	51	3.64	1.31	1	5.90
2009	51	3.71	1.24	1	5.90
2010	51	3.75	1.23	1	5.90
2011	51	3.77	1.24	1	5.90

Panel B: Physical Therapist

Year	Number of states	Mean	St. dev.	Min.	Max.
2000	51	3.99	1.42	1.55	7.75
2001	51	4.05	1.41	1.55	7.75
2002	51	4.11	1.40	1.55	7.75
2003	51	4.25	1.37	1.55	7.75
2004	51	4.29	1.37	1.55	7.75
2005	51	4.35	1.42	1.55	7.75
2006	51	4.50	1.48	1.55	7.75
2007	51	4.56	1.52	1.55	7.75
2008	51	4.74	1.48	1.55	7.75
2009	51	4.88	1.46	1.55	7.75
2010	51	4.92	1.49	1.55	7.75
2011	51	4.96	1.46	1.55	7.75

Table 2 State Regulation Rankings of the Top and Bottom States for the Restrictiveness of Their Licensing (or Registration) on Therapist, 2010

Panel A: Occupational Therapist

Top states		Bottom states	
	Index		Index
New Hampshire	5.9	Colorado	1
Maryland	5.88	Hawaii	1
Washington	5.73	Pennsylvania	1.21
Arkansas	5.65	Utah	1.79
Maine	5.5	Massachusetts	2.04
Nevada	5.38	Illinois	2.36

Panel B: Physical Therapist

Top states		Bottom states	
	Index		Index
Nevada	7.75	South Dakota	1.55
Washington DC	7.61	Colorado	1.88
Louisiana	7.58	Indiana	2
Idaho	6.95	Vermont	2.5
New Hampshire	6.9	Massachusetts	2.95
New Jersey	6.86	Delaware	3.29

Table 3 States that Enacted a Licensure Law for Regulating Occupational Therapists or Physical Therapists, 2000–2010

State	Occupation	Year of licensure law
California	OT	2000
Indiana	OT	2007
Kansas	OT	2002
Michigan	OT	2009
Minnesota	OT	2000
Vermont	OT	2002
Wisconsin	OT	2000
Kansas	PT	2003

Table 4 Descriptive Statistics for Occupational Therapists and Occupational Therapists using ACS, 2000–2010

	Occupational therapists		Occupational therapists	
	Mean	Std. dev.	Mean	Std. dev.
Individual variables				
Hourly earnings	28.203	12.657	30.116	15.455
Annual hours	1,661	628.5	1,789	647.2
Experience	16.420	10.147	16.132	9.963
Bachelor	0.575	0.494	0.448	0.497
Master	0.325	0.468	0.414	0.493
Doctor	0.005	0.069	0.044	0.205
Male	0.098	0.298	0.293	0.455
Married	0.678	0.467	0.700	0.458
White	0.883	0.322	0.854	0.353
Black	0.043	0.202	0.035	0.183
Citizenship	0.966	0.180	0.939	0.239
Part-time	0.127	0.333	0.111	0.314
Self-employed	0.072	0.259	0.098	0.297
Work for profit	0.486	0.500	0.570	0.495
Work for nonprofit	0.248	0.432	0.254	0.436
Work for gov't	0.194	0.396	0.077	0.267
Observations	9,668		19,788	

Table 5 Effects of Regulations on Log Wage for Occupational Therapists and Physical Therapists, ACS 2000–2010

Panel A: Occupational Therapist

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	One-Stage Model							Two-Stage Model		
OT licensure	0.0611**	0.0775**	−0.0288					−0.0284		
	(3.27)	(4.46)	(-0.86)					(−0.83)		
OT duration				0.00084	0.0015**	0.0122*	0.0103		0.0122*	0.0103
				(1.51)	(2.89)	(2.56)	(1.59)		(2.31)	(1.48)
OT duration squared							0.0044			0.004
							(0.43)			(0.41)
Covariates	N	Y	Y	N	Y	Y	Y	Y	Y	Y
State FE	N	N	Y	N	N	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
R-squared	0.09	0.19	0.23	0.09	0.18	0.23	0.23	0.57	0.57	0.57
1st stage N	9,668	9,668	9,668	9,668	9,668	9,668	9,668	9,668	9,668	9,668
2nd stage N	n/a	n/a	n/a	n/a	n/a	n/a	n/a	546	546	546

NOTE: *t*-statistics are reported in parentheses. + p<0.1, * p<0.05, ** p<0.01, *** p<0.005.
OT licensure is 1 if OT is licensed in the current year in the state of residence, and is 0 otherwise. Ot duration is the number of years since licensed if OT is licensed in the current year in the state of residence, and 0 otherwise.

Panel B: Physical Therapist

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	One-Stage Model							Two-Stage Model		
PT licensure	0.219**	0.0758	0.0187					0.0177+		
	(2.70)	(1.41)	(1.58)					(1.79)		
PT duration				0.00087**	0.00055*	0.027***	0.038***		0.027***	0.039***
				(2.98)	(2.18)	(3.06)	(2.81)		(7.38)	(5.55)
PT duration squared							−0.005*			−0.005*
							(−2.16)			(−2.06)
Covariates	N	Y	Y	N	Y	Y	Y	Y	Y	Y
State FE	N	N	Y	N	N	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
R-squared	0.05	0.19	0.21	0.05	0.19	0.21	0.21	0.57	0.57	0.57
1st stage N	19,788	19,788	19,788	19,788	19,788	19,788	19,788	19,788	19,788	19,788
2nd stage N	n/a	n/a	n/a	n/a	n/a	n/a	n/a	548	548	548

NOTE: *t*-statistics are reported in parentheses. +p<0.1, * p<0.05, ** p<0.01, *** p<0.005.
PT licensure is 1 if PT is licensed in the current year in the state of residence, and is 0 otherwise. PT duration is the number of years since licensed if PT is licensed in the current year in the state of residence, and 0 otherwise.

Table 6 Effects of Direct Access on Log Wage for Occupational Therapists and Physical Therapists, ACS 2000–2010

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	---------OT sample---------			-------OT: Licensure=1-------			----------PT sample---------		
OT licensure=0	0.104		0.0879					-0.0474	-0.0467
	(1.30)		(1.07)					(-0.91)	(-0.87)
OT licensure=1	0.0884		0.0726	0.0942		0.0748		-0.0315	-0.0306
& limited access	(1.14)		(0.90)	(1.31)		(0.97)		(-0.64)	(-0.60)
OT licensure=1	0.0935		0.0830	0.0863		0.0763		-0.0610	-0.0603
& unlimited access	(1.25)		(1.08)	(1.27)		(1.07)		(-1.39)	(-1.34)
(omitted group: OT licensure=1 & no access)									
PT limited/unlimited		-0.0537*	-0.0531*		-0.0568*	-0.0550*	0.00394		0.00465
access		(-2.30)	(-2.21)		(-2.55)	(-2.36)	(0.25)		(0.30)
(omitted group: PT no access)									
Covariates	Y	Y	Y	Y	Y	Y	Y	Y	Y
State FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
N	9,668	9,668	9,668	8351	8265	8265	19645	19645	19645
R-squared	0.226	0.227	0.228	0.228	0.229	0.229	0.206	0.208	0.206

NOTE: *t*-statistics are reported in parentheses. + p<0.1, * p<0.05, ** p<0.01, *** p<0.005.

Table 7 Effects of Licensure on Labor Participation of Occupational Therapists, ACS 2000–2010

Linear Probability Model

	(1)	(2)	(3)	(4)	(5)	(6)
OT licensure	-0.186***	-0.207***	-0.108*			
	(−5.10)	(−5.08)	(−2.11)			
OT duration				4.64e-4	0.000142	0.0212
				(0.57)	(0.16)	(1.51)
Covariates	No	Yes	Yes	No	Yes	Yes
State FE	No	No	Yes	No	No	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	12,017,882	10,802,891	10,802,891	12,017,882	10,802,891	10,802,891
R-squared	0	0.002	0.002	0	0.002	0.002

Probit Model (marginal effects)

	(1)	(2)	(3)	(4)	(5)	(6)
OT licensure	−0.188***	−0.0494***	−0.0265**			
	(−5.73)	−5.52)	(−2.38)			
OT duration				4.59e-04	6.63e-05	0.00469
				0.57	0.31	1.67
Covariates	No	Yes	Yes	No	Yes	Yes
State FE	No	No	Yes	No	No	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	12,017,882	10,802,891	10,802,891	12,017,882	10,802,891	10,802,891
R-squared	0.001	0.148	0.151	0.000	0.147	0.151

NOTE: The coefficients are reported in units of 1/1000.The coefficient of OT licensure in model (3) is -0.108 in linear probability model, which means the probability of one OT in one thousand persons decreased by 10.8% by changing status to licensure for OT.

t-statistics are reported in parentheses. + p<0.1, * p<0.05, ** p<0.01, *** p<0.005.

Table 8 Effects of PT Licensure on Labor Participation of Physical Therapists, ACS 2000–2010

Linear Probability Model

	(1)	(2)	(3)
PT duration	0.00536***	0.00171+	−0.191***
	(6.41)	(1.84)	(−6.88)
Covariates	No	Yes	Yes
State FE	No	No	Yes
Year FE	Yes	Yes	Yes
N	11,950,613	10,739,185	10,739,185
R-squared	0.000	0.003	0.003

Probit Model (marginal effects)

	(1)	(2)	(3)
PT duration	0.00516***	3.07e-04	−0.100***
	6.62	0.89	−8.27
Covariates	No	Yes	Yes
State FE	No	No	Yes
Year FE	Yes	Yes	Yes
N	11,950,613	10,739,185	10,739,185
R-squared	0.001	0.126	0.127

NOTE: The coefficients are reported in units of 1/1000.The coefficient of OT licensure in model (3) is -0.191 in linear probability model, which means the probability of one OT in one thousand persons decreased by 19.1% by one year of increase in the duration of licensure for PT.
t-statistics are reported in parentheses. + p<0.1, * p<0.05, ** p<0.01, *** p<0.005.

Table 9 Effects of OT Licensure on Annual Hours of Labor Supplied by Occupational Therapists and Physical Therapists

Panel A: OT

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
OT licensure	40.61	−16.39	−47.07**									
	(1.20)	(−0.69)	(−2.99)									
OT duration<=2				−52.43	−52.61	−54.26*						
				(−0.76)	(−1.03)	(−2.15)						
OT duration>2				45.68	−14.31	−38.41						
				(1.35)	(−0.60)	(−1.46)						
OT duration							2.916**	0.878	11.05**	2.558	-2.853	3.512
							(3.22)	(1.34)	(3.08)	(0.81)	(−1.10)	(0.77)
OT duration sq										1.141	11.95+	17.52*
										(0.13)	(1.81)	(2.23)
Covariates	N	Y	Y	N	Y	Y	N	Y	Y	N	Y	Y
State FE	N	N	Y	N	N	Y	N	N	Y	N	N	Y
Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
R-squared	0.003	0.43	0.44	0.004	0.43	0.44	0.003	0.43	0.44	0.003	0.43	0.44
1st stage N	9,668	9,668	9,668	9,668	9,668	9,668	9,668	9,668	9,668	9,668	9,668	9,668
2nd stage N	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Panel B: PT

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
PT licensure	−90.17	−31.16	−43.20**									
	(−0.87)	(−0.37)	(−3.26)									
PT duration<=2				−204.5	−164.1	-164.1***						
				(−0.91)	(−0.88)	(−10.35)						
PT duration>2				−90.17	−31.11	−4.191						
				(−0.87)	(−0.37)	(−0.29)						
PT duration							−0.210	−0.316	12.82**	−5.385*	−2.909	7.534
							(−0.51)	(−1.03)	(3.44)	(−2.16)	(−1.22)	(0.74)
PT duration sq											2.201	2.256
											(1.17)	(0.60)
Covariates	N	Y	Y	N	Y	Y	N	Y	Y	N	Y	Y
State FE	N	N	Y	N	N	Y	N	N	Y	N	N	Y
Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
R-squared	0.001	0.46	0.47	0.001	0.46	0.47	0.001	0.46	0.47	0.001	0.46	0.47
1st stage N	19,737	19,737	19,737	19,737	19,737	19,737	19,737	19,737	19,737	19,737	19,737	19,737
2nd stage N	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

NOTE: *t*-statistics are reported in parentheses. + p<0.1, * p<0.05, ** p<0.01, *** p<0.005.

Figure 1 Overlapping on Scope of Practice, Occupational Therapist vs. Physical Therapist

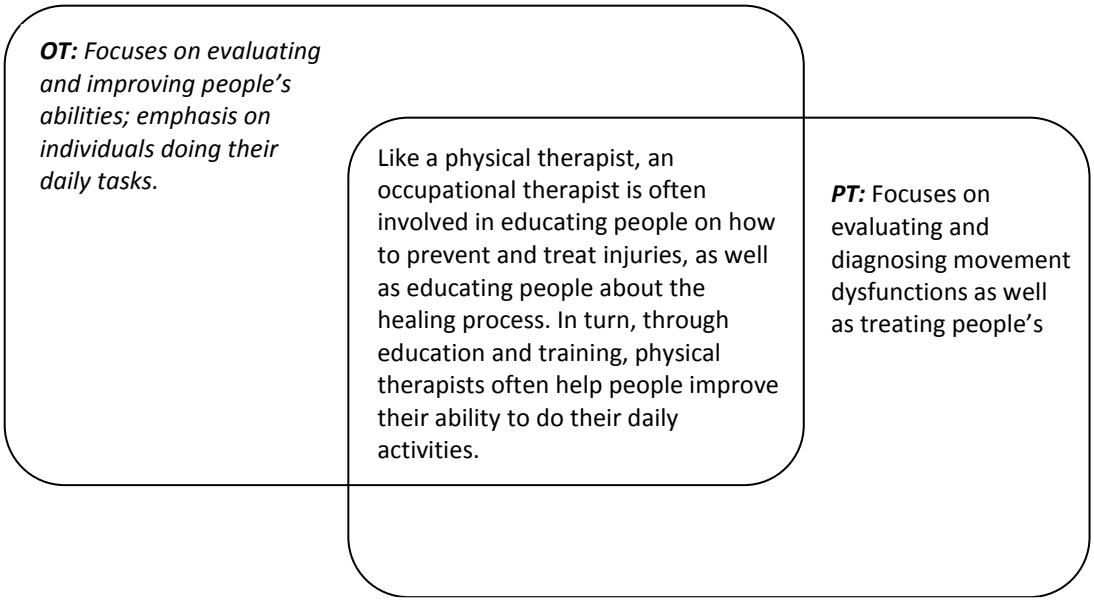
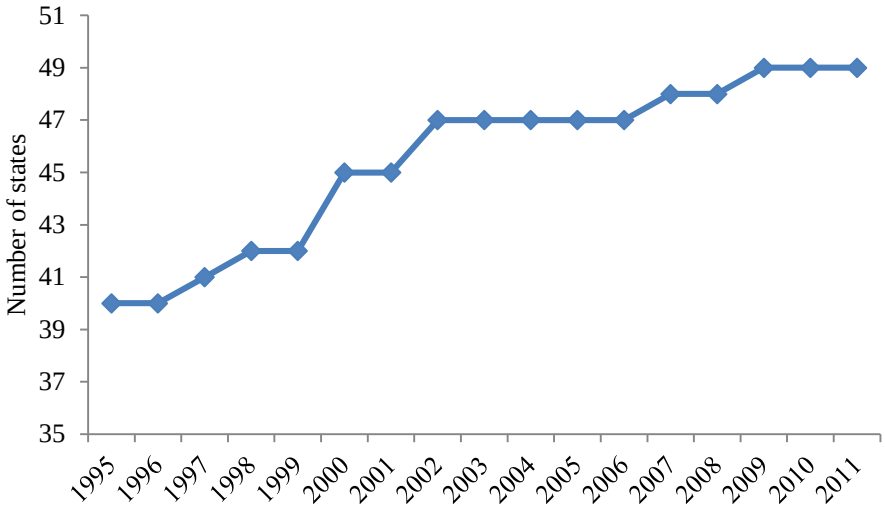


Figure 2 Growth in the Licensing of Occupational and Physical Therapists

Panel A: Occupational Therapist, 1995–2011



Panel B: Physical Therapist, 1950–1975

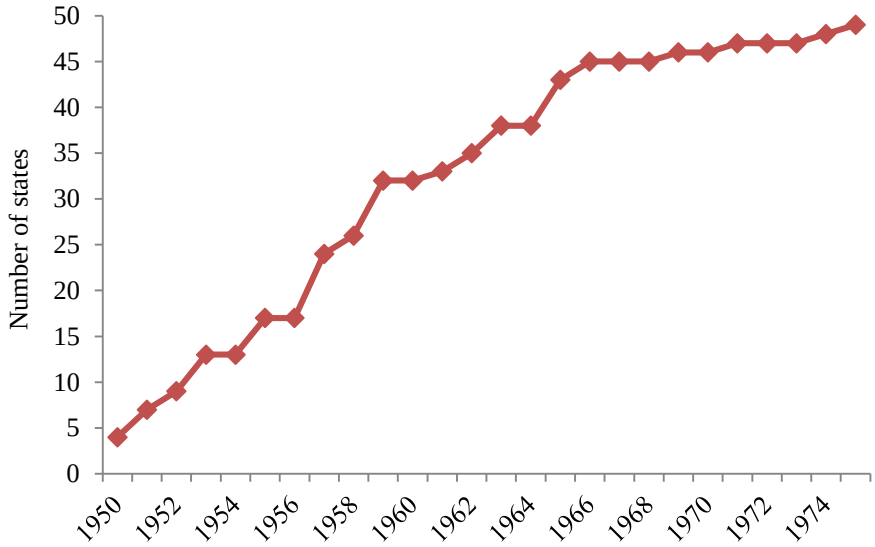
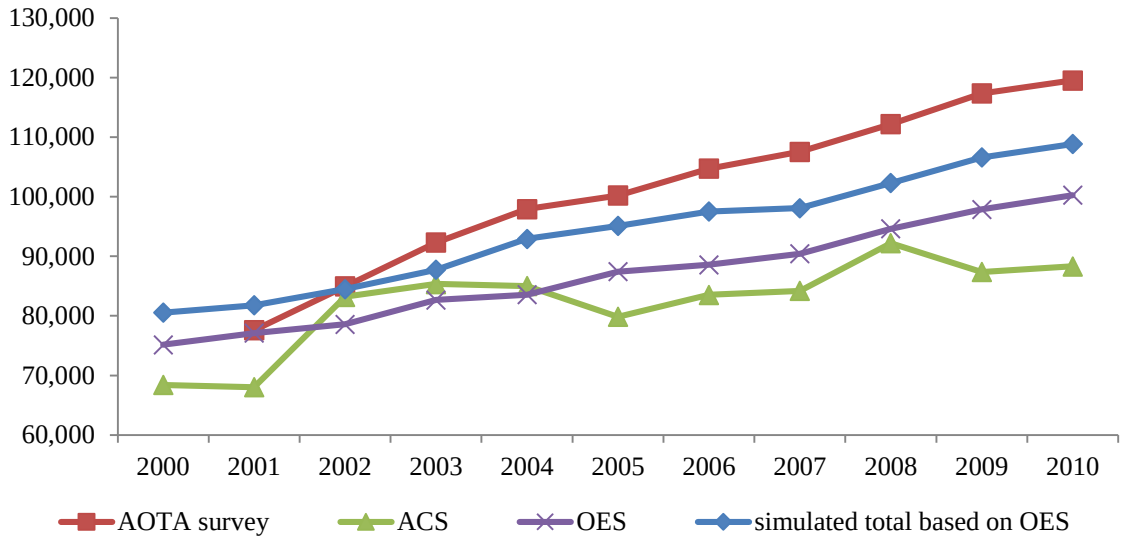


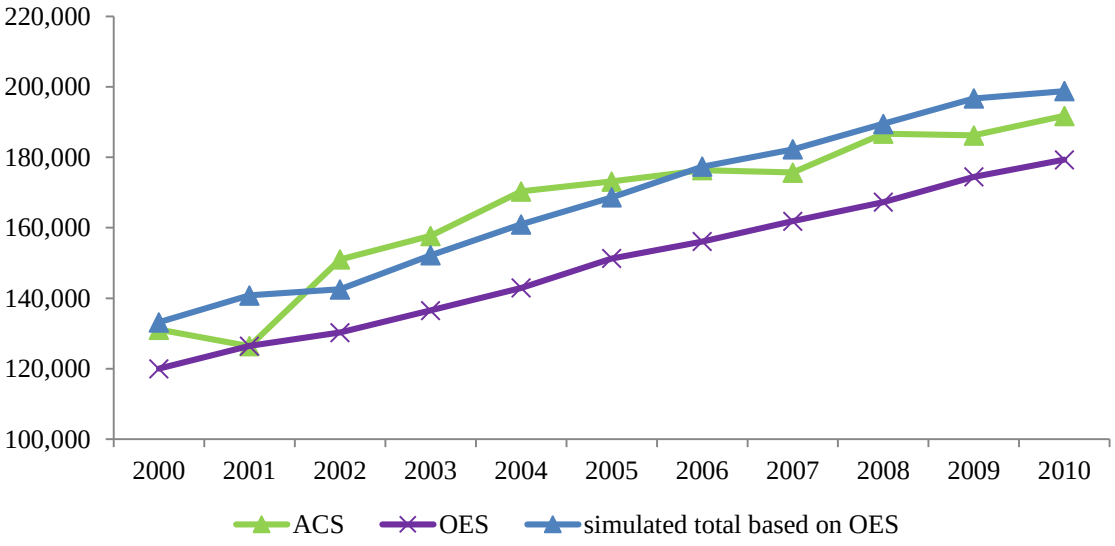
Figure 3 Estimates of Total Occupational Therapists and Physical Therapists, 2000–2010

Panel A: Occupational Therapist



NOTE: The first series is the estimates of total licensed OTs from AOTA survey of state regulatory boards and rosters of licensees; the second series is the calculated labor force population of OTs from American Community Survey 2000–2010; the third series is the estimates from Occupational Employment Statistics from Bureau of Labor Statistics, which does not include self-employed persons; in the fourth series, the simulated total number of OTs is calculated by author using OES total divided by the percentage of OT employees in ACS samples.

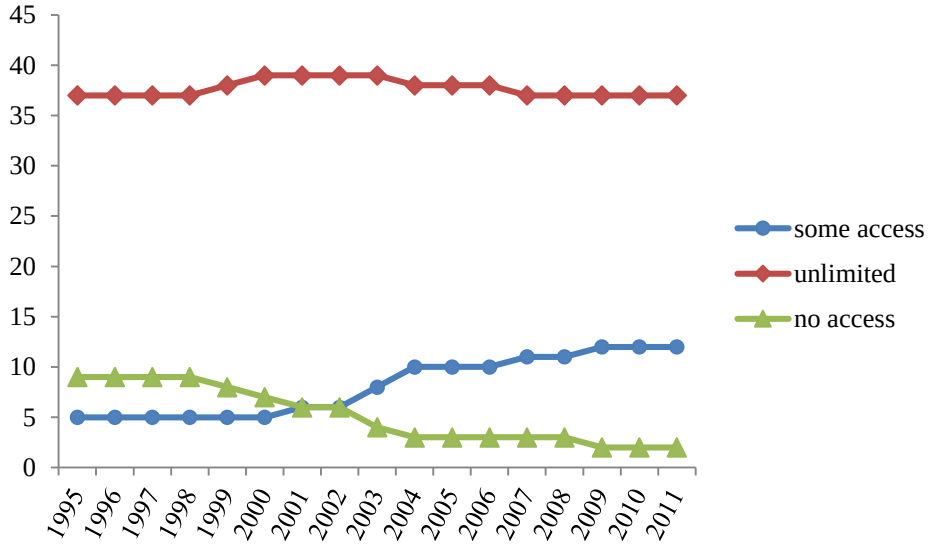
Panel B: Physical Therapist



NOTE: The first series is the calculated labor force population of PTs from American Community Survey 2000–2010; the second series is the estimates from Occupational Employment Statistics from Bureau of Labor Statistics, which does not include self-employed persons; in the third series, the simulated total number of PTs is calculated by author using OES total divided by the percentage of PT employees in ACS samples.

Figure 4 Growth in Direct Access to Therapy Services, 1995–2011

Panel A: Occupational Therapy Services



Panel B: Physical Therapy Services

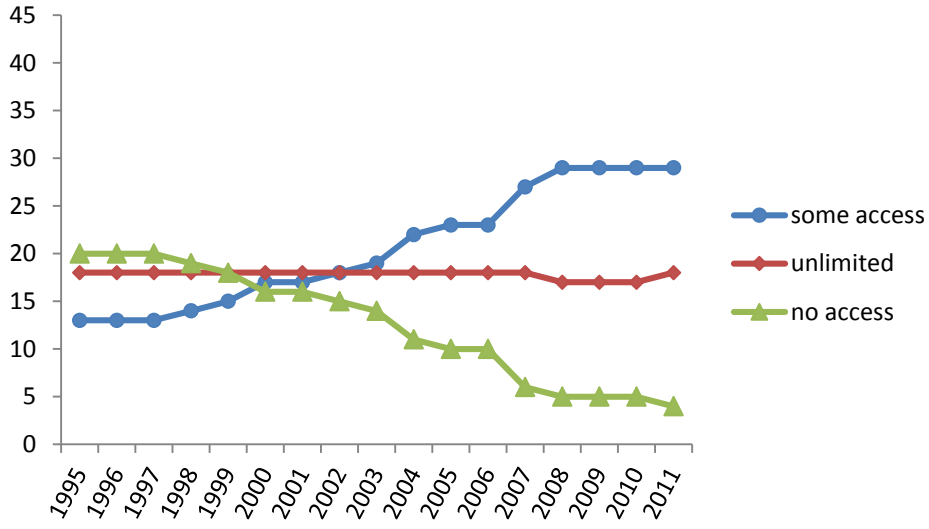
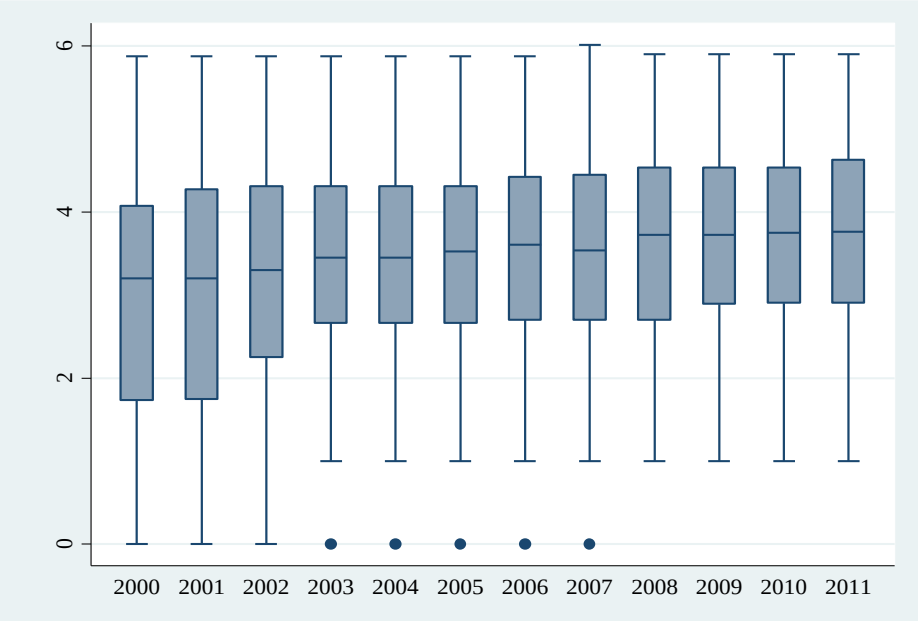
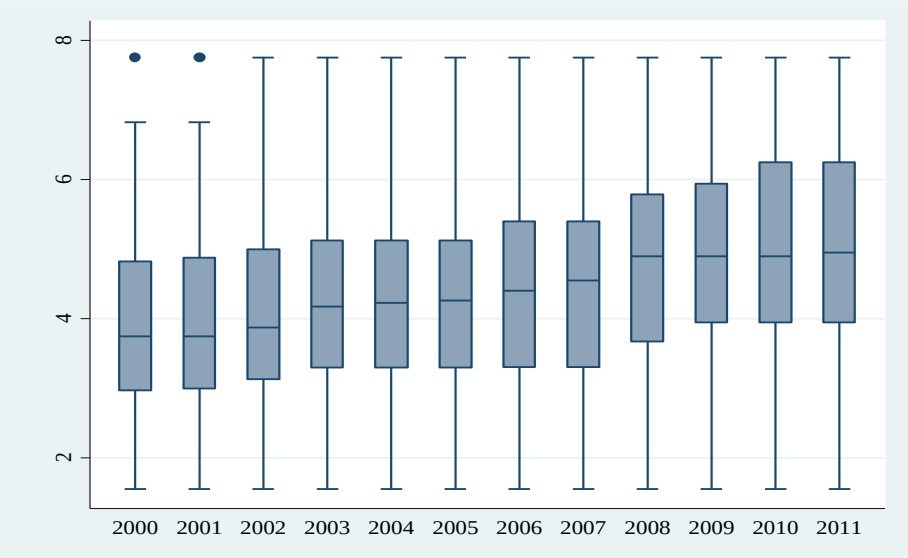


Figure 5 Box and Whisker Plot of the Growth of Licensing Provision for Therapist, 2000–2011

Panel A: Occupational Therapist

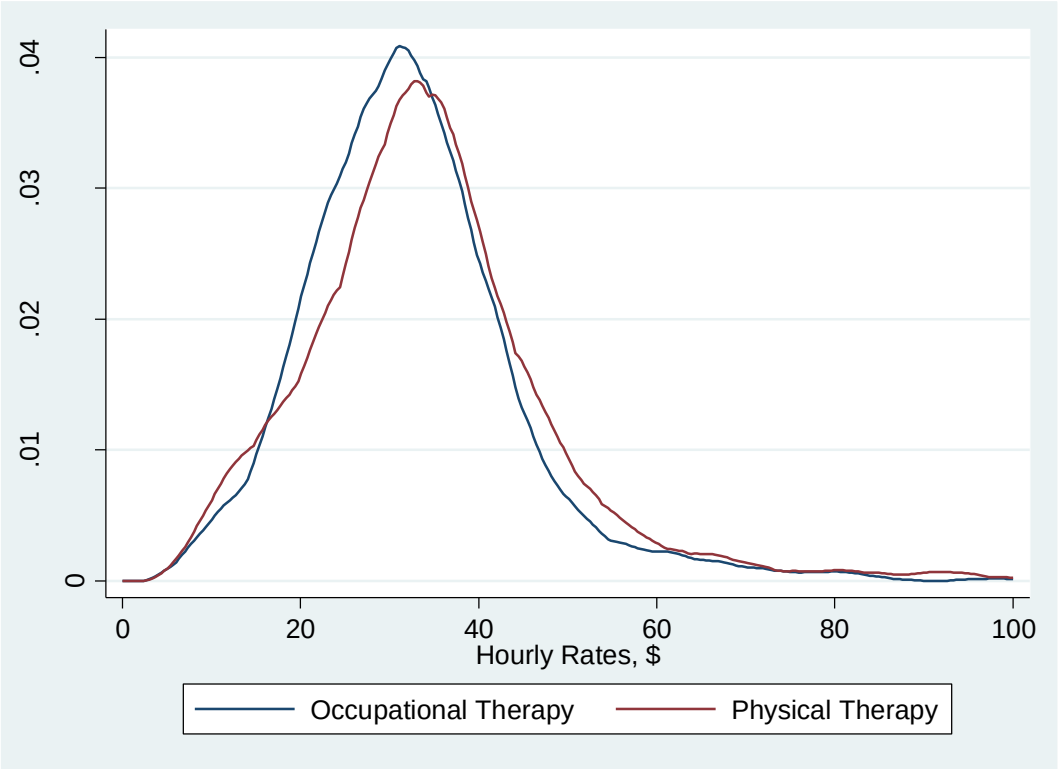


Panel B: Physical Therapist



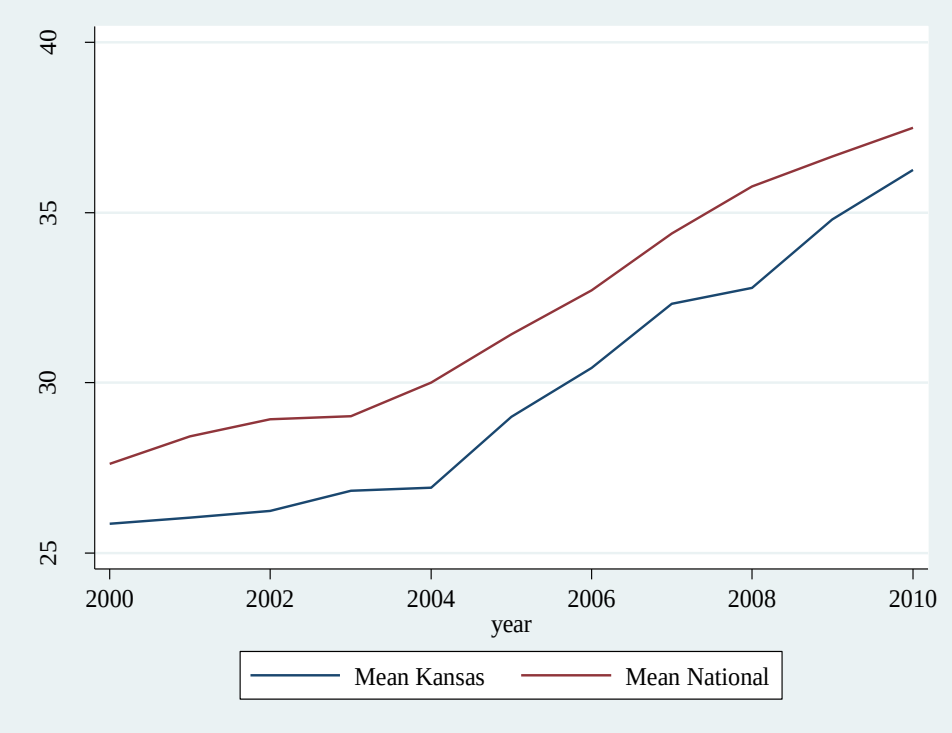
NOTE: The results presented in this figure show the growth of the mean and the variance for the regulation requirements index of occupational therapist and physical therapist from 2000 to 2011. The requirements index for each state, which measures the restriction level of regulation, is produced based on series of requirements to obtain a license, including age, education, and background requirements, examination requirements, cost of license application and renewal, and continuing competence requirements.

Figure 6 Kernel Distribution of Hourly Earnings for Occupational Therapy and Physical Therapy, 2010



NOTE: The distributions are calculated using an Epanechnikov kernel from the ACS 2010 sample constructed by rules in Table A.2. Epanechnikov kernel is in a functional form of k(u)= ¾(1-u^2)1(|u|<=1).

Figure 7 Growth of Hourly Wage for Physical Therapists in Kansas



NOTE: In 2000 the hourly wage for PTs in Kansas is around 6% below the national average. This gap is enlarged to 10% by 2004, when the hourly wage for a PT is $26.92 on average in Kansas. In 2010 the hourly wage in Kansas increases to $36.25, only 3% lower than the national mean in that year.
SOURCE: The Occupational Employment Statistics database, which does not include self-employed workers.

APPENDIX TABLES AND FIGURES

Table A.1 Jurisdictions Regulating Occupational Therapists and Physical Therapists

Panel A: Occupational therapist

State	Type of statute	Year passed
Alabama	Licensure	1990
Alaska	Licensure	1987
Arizona	Licensure	1989
Arkansas	Licensure	1977
California	Licensure	2000
Colorado	Registration	2008
Connecticut	Licensure	1978
Delaware	Licensure	1985
District of Columbia	Licensure	1978
Florida	Licensure	1975
Georgia	Licensure	1976
Hawaii	Registration	1998
Idaho	Licensure	1982
Illinois	Licensure	1983
Indiana	Licensure	2007
Iowa	Licensure	1980
Kansas	Licensure	2002
Kentucky	Licensure	1986
Louisiana	Licensure	1979
Maine	Licensure	1984
Maryland	Licensure	1977
Massachusetts	Licensure	1983
Michigan	Licensure	2009
Minnesota	Licensure	2000
Mississippi	Licensure	1988
Missouri	Licensure	1997
Montana	Licensure	1985
Nebraska	Licensure	1984
Nevada	Licensure	1991
New Hampshire	Licensure	1977
New Jersey	Licensure	1993
New Mexico	Licensure	1983
New York	Licensure	1975
North Carolina	Licensure	1984
North Dakota	Licensure	1983
Ohio	Licensure	1976
Oklahoma	Licensure	1984
Oregon	Licensure	1977
Pennsylvania	Licensure	1982
Rhode Island	Licensure	1984
South Carolina	Licensure	1977
South Dakota	Licensure	1986
Tennessee	Licensure	1983
Texas	Licensure	1983
Utah	Licensure	1977
Vermont	Licensure	2002
Virginia	Licensure	1998
Washington	Licensure	1984
West Virginia	Licensure	1978
Wisconsin	Licensure	2000
Wyoming	Licensure	1991

Panel B: Physical therapist

State	Type of statute	Year passed
Alabama	Licensure	1965
Alaska	Licensure	1957
Arizona	Licensure	1952
Arkansas	Licensure	1959
California	Licensure	1953
Colorado	Licensure	1959
Connecticut	Licensure	1942
Delaware	Licensure	1953
District of Columbia	Licensure	
Florida	Licensure	1957
Georgia	Licensure	1951
Hawaii	Licensure	1957
Idaho	Licensure	1963
Illinois	Licensure	1965
Indiana	Licensure	1957
Iowa	Licensure	1965
Kansas	Licensure	2003
Kentucky	Licensure	1958
Louisiana	Licensure	1966
Maine	Licensure	1955
Maryland	Licensure	1957
Massachusetts	Licensure	1951
Michigan	Licensure	1965
Minnesota	Licensure	1951
Mississippi	Licensure	1966
Missouri	Licensure	1969
Montana	Licensure	1961
Nebraska	Licensure	1957
Nevada	Licensure	1955
New Hampshire	Licensure	1974
New Jersey	Licensure	1963
New Mexico	Licensure	1953
New York	Licensure	1926
North Carolina	Licensure	1959
North Dakota	Licensure	1959
Ohio	Licensure	1959
Oklahoma	Licensure	1965
Oregon	Licensure	1959
Pennsylvania	Licensure	1913
Rhode Island	Licensure	1962
South Carolina	Licensure	1952
South Dakota	Licensure	1955
Tennessee	Licensure	1955
Texas	Licensure	1971
Utah	Licensure	1953
Vermont	Licensure	1957
Virginia	Licensure	1958
Washington	Licensure	1949
West Virginia	Licensure	1963
Wisconsin	Licensure	1975
Wyoming	Licensure	1962

Table A.2 Sample Construction from the ACS, 2000–2010

Selection rule	Occupational therapists	Physical therapists
Initial observations	10,134	21,394
1. Unpaid family worker	–6	–12
2. Educational attainment (some college for OT and PT)	–94	–528
3. Age over 65	–85	–242
4. Experience(=Age-Years of schooling-6) less than 0	–18	–127
5. Work more than 60 hours weekly	–66	–264
6. Hourly wage less than the federal minimum during 2000–2010	–98	–242
7. Trim down the top 1% of the sample by wage	–99	–191
Total observations	9,668	19,788

Table A.3 CPS Estimates of the Effects of Regulations on Log Wage for Occupational Therapist, 1995–2011

Panel A: Licensure and duration

	(1)	(2)	(3)	(4)	(5)	(6)
licensure	0.0354	0.0358	0.0282			
	0.0457	0.0440	0.0816			
otduration				-0.000410	0.000239	-0.00983
				0.00138	0.00136	0.0124
experience		0.0111**	0.0113**		0.0108**	0.0113**
		0.00499	0.00515		0.00499	0.00514
exper_sq		−0.262**	−0.293**		−0.256**	−0.293**
		0.129	0.133		0.129	0.133
bachelor		0.374***	0.348***		0.374***	0.348***
		0.0438	0.0453		0.0439	0.0453
master		0.432***	0.392***		0.434***	0.394***
		0.0485	0.0503		0.0485	0.0503
phd		0.619***	0.472***		0.623***	0.473***
		0.161	0.169		0.161	0.169
male		0.0310	0.0221		0.0316	0.0231
		0.0441	0.0449		0.0441	0.0449
married		0.0224	0.0413		0.0234	0.0417
		0.0310	0.0322		0.0310	0.0322
white		−0.0631	−0.0441		-0.0587	-0.0500
		0.0587	0.0668		0.0598	0.0667
black		−0.126	−0.123		−0.122	−0.128
		0.0936	0.102		0.0949	0.102
citizenship		-0.0105	0.0486		-0.0115	0.0531
		0.0582	0.0616		0.0583	0.0619
parttime		0.0655**	0.0651**		0.0657**	0.0656**
		0.0291	0.0296		0.0291	0.0296
selfemp		0.0344	−0.00444		0.0326	−0.00253
		0.0591	0.0607		0.0590	0.0607
private		0.0459	0.0366		0.0454	0.0365
		0.0323	0.0337		0.0323	0.0336
State FE	No	No	Yes	No	No	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	886	886	886	886	886	886
R-squared	0.086	0.196	0.264	0.086	0.196	0.265

Table A.3 (Continued)

Panel B: Direct access to occupational and physical therapy services

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ot_access	−0.00393	−0.0174	−0.0180				−0.0135	−0.0271
	0.0199	0.0191	0.0727				0.0193	0.0733
pt_access				−0.0348*	−0.0304	−0.0511	−0.0286	−0.0541
				0.0199	0.0190	0.0582	0.0192	0.0588
experience		0.0105**	0.0112**		0.0106**	0.0115**	0.0105**	0.0115**
		0.00498	0.00515		0.00497	0.00515	0.00497	0.00516
exper_sq		−0.249*	−0.290**		−0.251*	−0.294**	−0.246*	−0.294**
		0.129	0.133		0.129	0.133	0.129	0.133
bachelor		0.377***	0.348***		0.371***	0.346***	0.373***	0.347***
		0.0439	0.0454		0.0438	0.0453	0.0440	0.0454
master		0.435***	0.392***		0.431***	0.392***	0.433***	0.392***
		0.0485	0.0503		0.0485	0.0503	0.0485	0.0503
phd		0.620***	0.480***		0.623***	0.472***	0.621***	0.478***
		0.161	0.170		0.161	0.169	0.161	0.170
male		0.0305	0.0228		0.0352	0.0244	0.0340	0.0254
		0.0441	0.0449		0.0441	0.0449	0.0442	0.0450
married		0.0263	0.0418		0.0233	0.0412	0.0255	0.0410
		0.0312	0.0322		0.0310	0.0322	0.0311	0.0322
white		−0.0562	−0.0477		−0.0622	−0.0477	−0.0617	−0.0501
		0.0581	0.0669		0.0582	0.0666	0.0582	0.0669
black		−0.125	−0.129		−0.135	−0.130	−0.139	−0.133
		0.0935	0.102		0.0937	0.102	0.0939	0.102
citizenship		−0.0143	0.0476		−0.0139	0.0457	−0.0154	0.0449
		0.0582	0.0616		0.0581	0.0616	0.0582	0.0617
parttime		0.0652**	0.0649**		0.0664**	0.0636**	0.0660**	0.0635**
		0.0291	0.0296		0.0291	0.0296	0.0291	0.0296
selfemp		0.0296	−0.00377		0.0253	−0.00538	0.0234	−0.00556
		0.0591	0.0607		0.0591	0.0607	0.0592	0.0607
private		0.0463	0.0364		0.0437	0.0366	0.0446	0.0363
		0.0323	0.0337		0.0323	0.0336	0.0323	0.0337
State FE	No	No	Yes	No	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	886	886	886	886	886	886	886	886
R-squared	0.086	0.196	0.264	0.089	0.198	0.265	0.198	0.265

Table A.4 Effects of Licensure on Log Wage of Occupational Therapists using the OES, 2000–2010

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
licensure	0.0217***	0.0277***	−0.00565					
	(2.71)	(3.23)	(−0.59)					
otduration				0.000728*	0.000880*	0.00119	0.00384***	0.0252+
				(1.99)	(2.46)	(0.55)	(3.68)	(1.80)
lnpcinc		0.173***	−0.0694		0.172***	−0.0733		
		0.0262	0.0925		0.0264	0.0954		
ttempgr		−0.00675	−0.00217		−0.00658	−0.00221		
		0.00432	0.00357		0.00433	0.00357		
State FE	No	No	Yes	No	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	557	557	557	557	557	557	0.88	0.88
R-squared	0.609	0.638	0.890	0.609	0.638	0.890	0.57	0.57

Table A.5 Effects of Licensure on Total Employment of Occupational Therapists using the OES and the AOTA survey data

	OES, 2000–2010					
	(1)	(2)	(3)	(4)	(5)	(6)
licensure	−0.114	−0.0291	0.00330			
	0.170	0.168	0.0417			
otduration				−0.0009	0.00133	0.00609
				0.00511	0.00506	0.00683
lnpcinc		1.286***	−0.407		1.292***	−0.446
		0.340	0.327		0.343	0.334
ttempgr		−0.135***	−0.00501		−0.137***	−0.00511
		0.0406	0.0102		0.0406	0.0102
State FE	no	no	yes	no	no	yes
Year FE	yes	yes	yes	yes	yes	yes
N	558	558	558	558	558	558
R-squared	0.008	0.058	0.981	0.007	0.058	0.981

	AOTA survey of state regulatory boards and licensee rosters, 2001–2010					
	(9)	(10)	(11)	(12)	(13)	(14)
licensure	−0.0885	−0.00403	−0.0747***			
	0.167	0.162	0.0226			
otduration				0.000960	0.00341	0.00577
				0.00504	0.00485	0.00861
lnpcinc		1.678***	−0.167		1.682***	−0.145
		0.313	0.173		0.318	0.169
ttempgr		−0.167***	−0.00237		−0.171***	−0.00284
		0.0400	0.00426		0.0400	0.00434
State FE	no	no	yes	no	no	yes
Year FE	yes	yes	yes	yes	yes	yes
N	497	497	497	497	497	497
R-squared	0.013	0.099	0.991	0.013	0.100	0.991

Table A.6 Key Variable in the Development of the Licensing Index for OTs and PTs

Major components	Definition
Examination requirement	1 if jurisprudence exam required in addition to the standard professional examination; otherwise 0
Age requirement	2 if minimum age above 21 is required; 1 if an age requirement clarified but under 21; 0 if no requirement
Continuing education requirement	1 for each ten hours of continuing education annually; 0 if no continuing education required
Background check	1 if a criminal background checked is required for application or renewal; otherwise 0
Cost of license	1 for each one hundred dollars of average cost for license annually
Additional documents	1 if at least two additional documents required for supporting education achievement, reputation or moral character; 0.5 if one additional document required; otherwise 0

Table A.7 Differences between Occupational Therapists and Physical Therapists, Wage and Annual Hours of Labor Supply

	(1)	(2)	(3)	(4)	(5)	(6)
	Wage	Wage	Wage	Hours	Hours	Hours
OT dummy	−0.047***	−0.019*	−0.019+	−126.4***	−52.88***	−53.32***
variable	(−6.06)	(2.51)	(−1.85)	(−11.13)	(−5.82)	(−5.91)
experience		0.026***	0.026***		11.61***	12.01***
		(17.88)	(20.72)		(6.46)	(6.72)
exper_sq		−0.504***	−0.503***		−248.4***	−248***
		(−13.66)	(−15.88)		(−5.68)	(−5.72)
bachelor		0.343***	0.338***		21.97	26.32+
		(25.40)	(20.26)		(1.59)	(1.94)
master		0.413***	0.406***		50.84***	59.55***
		(29.76)	(23.75)		(3.52)	(4.13)
phd		0.463***	0.449***		92.99***	107.4***
		(21.78)	(17.53)		(3.36)	(3.80)
male		0.060***	0.061***		258.5***	258.8***
		(6.90)	(6.37)		(24.81)	(24.89)
married		0.060***	0.065***		−82.14***	−87.24***
		(7.52)	(7.70)		(−8.75)	(−9.28)
white		−0.049***	−0.027+		19.08	10.19
		(−3.94)	(−1.81)		(1.43)	(0.74)
black		−0.047+	−0.042*		82.01**	62.23*
		(−1.83)	(−2.10)		(3.28)	(2.47)
citizenship		−0.023	−0.015		29.4	28.58
		(−1.22)	(−1.34)		(1.43)	(1.40)
parttime		0.062***	0.061***		−1226***	−1222***
		(4.60)	(5.00)		(−125.95)	(−124.8)
selfemp		0.109***	0.099***		72.09***	75.21***
		(6.44)	(4.40)		(4.74)	(4.86)
private		0.004	0.001		7.737	6.349
		(0.63)	(0.20)		(0.90)	(0.74)
State FE	No	No	Yes	No	No	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	29,456	29,456	29,456	29,456	29,456	29,456
R-squared	0.06	0.19	0.20	0.01	0.46	0.46

Table A.8 Effects of Regulations on Log Wage for Occupational Therapists Using Instrumental Variables, ACS 2000–2010

	(1)	(2)
otduration	0.0059***	0.0792*
	(2.60)	(2.16)
Covariates	Yes	Yes
State FE	No	Yes
Year FE	Yes	Yes
R-squared	0.18	0.21
1st stage N	9,602	9,602
2nd stage N	9,602	9,602

Figure A.1 Wage Estimates from OES