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Kihwan Bae
Morris M. Kleiner
Conor Norris
Edward J. Timmons

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Analyzing the Effects of Occupational Licensing on Earnings Inequality in the United States
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ABSTRACT

There is a consensus that there is an earnings premium for licensed workers relative to unlicensed workers. However, little is known about how occupational licensing affects earnings inequality. In this paper, we study dynamic, heterogeneous earnings effects of occupational licensing and draw implications for earnings inequality in the United States. First, we find that the earnings gap between workers in licensed occupations and those in unlicensed occupations with similar characteristics ("licensing premium") increased slightly during the 1983–2019 period. Second, we find that the licensing premium for workers in high paying occupations significantly increased, which is not the case for workers in lower paying occupations. The finding is consistent with growing demands for skills over the past decades, given the more rigorous licensing requirements for high-skilled occupations. As a result, earnings inequality among workers in licensed occupations increased. Third, we document that the licensing premium for female workers and workers without a college education declined relative to male workers and college graduates. Taken together, our findings suggest that occupational licensing is associated with widening earnings inequality in the United States during the 1983–2019 period.

Kihwan Bae
West Virginia University
Knee Regulatory Research Center
kihwan.bae@mail.wvu.edu

Conor Norris
West Virginia University
Knee Regulatory Research Center
conor.norris@mail.wvu.edu

Morris M. Kleiner
University of Minnesota
Hubert H. Humphrey School of
Public Affairs
and NBER
kleiner@umn.edu

Edward J. Timmons
West Virginia University
Knee Regulatory Research Center
and Archbridge Institute
edward.timmons@mail.wvu.edu

I. Introduction

The preponderance of academic research has documented an increase in income inequality over the past several decades (Piketty and Saez, 2014; Autor, 2014; Ravallion, 2014).[1] Among the different sources of income, labor earnings are the key driver of rising income inequality (Hoffmann, Lee, and Lemieux, 2020). Several alternative explanations have been proposed for the observed rise in income inequality, including changes in the relative demand for skills (Katz and Murphy, 1992), the weakening of unions and the reduction in the relative size of the minimum wage (DiNardo, Fortin, and Lemieux, 1996), changes in progressive taxation (Piketty and Saez, 2003), and evolving employment arrangements like performance-based pay and independent contracting (Bidwell, Briscoe, Fernandez-Mateo, and Sterling, 2013). However, occupational licensing, which limits entry into many professions, has drawn little attention as a potential factor for rising earnings inequality.

Over the course of the twentieth century, occupational licensing emerged as one of the most important labor market institutions (Carollo, Hicks, Karch, and Kleiner, 2025). In the United States in the early 1900s, occupational licensing laws were reserved primarily for high-skilled professionals like physicians and dentists, but by the 1950s, they had expanded to lower-wage service providers like nurses, real estate agents, electricians, and cosmetologists (Law and Kim, 2005). Since the 1960s, they have come to encompass many other healthcare practitioners (Han and Kleiner, 2021). As a result, in the United States in 2022, the fraction of licensed workers among employed workers was 21.7%, which is about twice the fraction of workers belonging to a union (10.1%) and more than 15 times the fraction receiving the federal minimum wage (1.3%; BLS, 2023a, b, c).[2] Moreover, several studies documented a larger earnings premium from occupational licensing for high earners than low earners (Kleiner and Vorotnikov, 2017; Zhang and Gunderson, 2020) and a larger wage dispersion among licensed workers than unlicensed ones (Nunn, 2018; Gittleman, Klee, and Kleiner, 2018; Koumenta and Pagliero, 2019). Still,

[1] Recent research on income inequality has shown that the top 1% after-tax-and-transfer income share changed only slightly in 1960–2019 period (Auten and Splinter 2023).

[2] Occupational licensing is not a uniquely American institution. More than 20% of workers in the European Union and approximately 11% of workers in Canada are licensed (Koumenta and Pagliero, 2019; Zhang, 2019). Occupational licensing is also prevalent in developing nations like China and Russia (Chi, Kleiner, and Qjan, 2017; Kukaev, Thornton, Baryshnikov, and Timmons, 2021).

there is a paucity of literature on occupational licensing's implications for earnings inequality along various parts of the earning distribution in the past several decades.[3]

In this paper, we examine the evolution of the earnings dispersion effect of occupational licensing in the United States from 1983 to 2019. Occupational licensing may increase earnings of licensed practitioners by limiting entry into licensed occupations (Friedman, 1962; Stigler, 1971; Kleiner, 2016a), which could increase earnings inequality between licensed and unlicensed workers. Earnings inequality may increase because it effectively filters out prospective workers who do not meet minimum quality standards set by licensing requirements (Shapiro, 1986). Alternatively, occupational licensing may function as a means of job market signaling (Akerlof, 1970; Leland, 1979), which could reduce between-group earnings inequality, such as gender or racial wage gap measures (Blair and Chung, 2024). Moreover, the earnings effect of occupational licensing may not be static but dynamic. It would narrow if licensing requirements became less strict or binding over time, or it would expand if the shortage of service providers worsened in a changing environment, owing to rigid licensing regulation. Lastly, the earnings effect of occupational licensing may vary across workers or occupations with different levels of skills. Our study focuses on the potential of dynamic, heterogeneous changes in the earnings effect of occupational licensing, given growing demand for skilled workers and healthcare workers in licensed occupations over recent decades (Autor, 2022; Catlin and Cowan, 2015).

Our analysis consists of three separate parts, each of which is relevant to an aspect of earnings inequality due to occupational licensing. Using wage and salary data from the Current Population Survey's (CPS) Outgoing Rotation Group (ORG) from 1983 to 2019, we first analyze trends in the earnings effect of occupational licensing ("licensing premium") for workers in 22 licensed occupations ("licensed workers") relative to workers in all other occupations ("unlicensed workers"). Given our data sources, we focus on licensing coverage—that is, if the occupation has a licensing statute—rather than attainment, which is whether the individual had obtained an occupational license (Gittleman and Kleiner, 2016). In this study, our working

[3] By contrast, there is a series of studies on the effect of union or minimum wage on earnings inequality in the late twentieth century. For example, see DiNardo, Fortin, and Lemieux (1996) and Fortin, Lemieux, and Lloyd (2021) on both union and minimum wage, Card, Lemieux, Riddell (2020), Farber, Herbst, Kuziemko, and Naidu (2021) on unions, Lee (1999), Autor, Manning, and Smith (2016) and Blau et al. (2023) on the minimum wage.

definition of the licensing premium is the average gap in logarithmic earnings between workers in licensed occupations and those in unlicensed occupations with similar demographics, educational attainment, and union membership. Given that licensed workers on average earn more than unlicensed workers, an increase in the licensing premium would indicate growing earnings inequality between licensed and unlicensed workers due to licensing entry barriers or continuing education requirements. For a better understanding of interactions between licensing entry barriers and changing demand for licensed workers, we compare heterogeneous changes in the licensing premium across high-, middle-, and low-income occupations and between the medical and non-medical sectors. We also analyze the dynamics in the licensing premium for opticians to disentangle the effect of entry barriers from that of secular changes in the demand for licensed workers.

Next, we examine earnings inequality among licensed workers. We first track changes in interdecile ratios (the 90/50, 90/10, and 50/10 earnings ratios) and the Gini coefficients among licensed workers. Then, we examine three driving factors for the changes in earnings inequality within licensed workers. We also analyze the effect of occupational licensing on quantiles of the earnings distribution. Lastly, we assess the potential differences in changes in the licensing premium across socio-demographic subgroups. If the licensing premium for gender, racial, or ethnic minorities in the labor market declined, it could have negative implications for earnings inequality.

We find evidence that the licensing premium did not decline, instead increasing modestly between 1983 and 2019. That is, rigid licensing entry barriers have limited market pressure to mitigate extra earnings towards licensed workers for the past four decades. This finding suggests that earnings inequality between licensed and unlicensed workers grew in the sample period. We show that the driving factor behind these changes was an increasing licensing premium among workers in high paying occupations, but not among workers in middle- or low-income occupations. As a result, we find that earning inequality increased within workers in licensed occupations. Our analysis reveals that the 90/10, 90/50, and 50/10 earnings ratios and Gini coefficient increased more among licensed workers than all workers in the sample period. Similarly, during the sample period, the earnings gap between licensed and unlicensed workers increased at above median quantiles relative to below median quantiles. Regarding heterogeneity

by demographic subgroups, we find a larger licensing premium for female workers, younger workers (aged 16–24), older workers (aged 55–64), racial and ethnic minorities, and those without a college education, but the advantage for female workers and those without a college education declined over the past decades. Overall, our findings suggest that occupational licensing has increased earnings inequality in the United States between 1983 and 2019.

Our results are a natural extension of the existing literature on the earnings effects of occupational licensing. Studies have consistently found evidence of an earnings premium for licensed workers or occupations.[4] Some papers document that in the United States and the EU countries, earnings are more dispersed among licensed workers than unlicensed workers (Nunn, 2018; Gittleman, Klee, and Kleiner, 2018; Koumenta and Pagliero, 2019). Other studies showed that the quantile earnings effect of occupational licensing is relatively large at the high end of the earnings distribution. Specifically, Kleiner and Vorotnikov (2017) found that the quantile earnings effect increases from the 20^{th} to 90^{th} quantile in the United States. Our study shows that these patterns have not weakened but strengthened in the United States over the past four decades, probably because of the increasing demand for licensed services and increasing entry barriers, particularly to high-paying occupations. The finding is in line with Zhang and Gunderson (2020), which shows that the quantile earnings effect is skewed to the higher end of earnings distribution, which solidified in Canada in 1998–2018.

Our work also adds to several recent studies on occupational licensing and income inequality in the United States. Meehan, Timmons, Meehan, and Kukaev (2019) found that a growth in the number of low-income licensed occupations in 1993–2012 was associated with a higher Gini coefficient in 2012, and Dodini (2023) showed that the 90/10 earnings ratio and Gini coefficient are higher among observed earnings in 2014–2017 than they would have been among counterfactual earnings in an environment without occupational licensing. By contrast, Chen, Franko, and McGrath (2024) showed that the proportion of workers covered by licensing laws was negatively associated with the ratio of top 20% income share to the bottom 20% income

[4] See Kleiner and Krueger (2010, 2013), Gittleman and Kleiner (2016), Kleiner and Vorotnikov (2017), Gittleman, Klee, and Kleiner (2018), and Ingram (2019) for evidence in the United States, and Koumenta and Pagliero (2019) and Zhang (2019) for evidence on the EU countries and Canada, respectively. See also Kugler and Sauer (2005), Timmons and Thornton (2010), Pagliero (2010), and Law and Marks (2017) for occupation-specific analysis.

share in 2000–2016. Our study's focus on the dynamics of a licensing premium and its long-run implications for income inequality is unique. Also, our analysis of universally licensed occupations allows us to show the important role of major licensing laws. For example, physicians, dentists, and pharmacists have seen a steady growth in wages compared with comparable unlicensed professions over the recent decades. However, these major occupations were not specifically examined in previous studies based on partially licensed occupations (Dodini, 2023) or occupations licensed or delicensed with recent changes in the law (Meehan et. al., 2019; Chen, Franko, and McGrath, 2024). All these occupations have been licensed in most states at least since the 1950s (Stigler, 1971).

II. Background on Occupational Licensing and Income Inequality

1. Occupational Licensing and Income Inequality

Occupational licensing laws limit the legal ability to practice a profession to those who meet entry standards set by state legislatures, which create a licensing board to oversee the practice of active market participants. The effects of licensing laws on income inequality in a static model are theoretically ambiguous. The entry requirements of licensing laws—which include human capital development—restrict entry, barring lower-skilled professionals. The earliest work on occupational licensing focuses on the anticompetitive nature of licensing laws and their use by active market participants to limit competition from new entrants (Smith, 1776/1936; Kuznets and Friedman, 1945). Restricting the supply of professionals through entry requirements increases the earnings of professionals. There is broad evidence that licensing reduces the supply of professionals (Blair and Chung, 2019; Kleiner, 2006; Kleiner and Soltas, 2023) and creates a consistent licensing wage premium (see Kleiner and Krueger, 2010, 2013; Ingram, 2019; Gittleman and Kleiner, 2016; Gittleman, Klee, and Kleiner, 2018; Kleiner and Vorotnikov, 2017). Alternatively, because licensing requires an up-front investment in human capital and board oversight removes professionals who provide low-quality services, licensing may serve to increase earnings through higher-skilled or more productive professionals (Leland, 1979; Shapiro, 1986). Either or both mechanisms lead to increased earnings for licensed professionals, increasing income inequality.

On the other hand, occupational licensing may reduce income inequality because it serves as a minimum quality standard. Labor unions, an institution often compared to licensing, have been found to reduce within-union wage dispersion because of the politics of the constituents within the organization (Card, 1996). Licensing may achieve a similar reduction in dispersion through a different mechanism, such as minimum quality standards and eliminating the bottom part of the distribution. Licensed professionals enter with similar skills due to their similar training, which reduce variation, which should lead to similar earnings. In practice, this could decrease within-profession inequality.

Another factor that could lead to licensing laws reducing income inequality is the differences in licensing premia between groups. For instance, Blair and Chung (2024) estimate the licensing premium for Black males is 16%, higher than the premium for White males. They show that the higher earnings premium is a result of licensing serving as a signal for a lack of criminal history, since state licensing policies require good moral character and usually exclude ex-offenders. Additionally, women have a higher licensing premium relative to that of men; in this case, licensing requirements can signal continuing competency. This mechanism may cause licensing to further compress wage dispersion within professions by increasing income for workers who are typically on the low end of the income distribution within a profession.

Occupational licensing may not simply have a static effect on income inequality, but rather it may be dynamic if the effects of licensing become more pronounced over time. In practice, licensing laws do not result in a sudden reduction in the supply of professionals. Instead, they result in slower entry into the profession, as new entrants have to complete licensing requirements while active participants are "grandfathered in" (Han and Kleiner, 2021). Once licensed, states often increase education requirements to enter the profession, requiring more specific education, longer programs, and additional degrees (Cai and Kleiner, 2020). An increase in demand for a licensed profession will result in earnings increases when the licensing requirements create a barrier. An example is healthcare professions, which since the mid-twentieth century have experienced a substantial increase in both demand and education requirements (Kleiner, 2016b). It is essential to consider the long-run dynamic earning effects of occupational licensing because of the increases in education requirements and the increases in demand.

2. Technology, Labor Market Institutions, and Income Inequality

The study of long-run income inequality dates to Kuznets's (1955) work on inequality. In his model, income inequality follows a basic U-shaped trend as a nation undergoes development. It starts low, increasing when industrialization begins, then eventually lowers as more workers join the high productivity sectors. Subsequent work showed this pattern holding in the United States and in a number of other countries. However, by the 1980s, this relationship broke down in the US, and income inequality began to rise again. This result either refutes Kuznets's model or suggests that the US underwent another period of industrialization thanks to the widespread adoption of computers and the internet.

Owing to a lack of detailed income records, it was difficult to measure income inequality before 1960, until Piketty and Saez (2003) analyzed individual tax returns data. Although all 13 of the countries they studied experienced the same pattern, the US' sharper increase in income inequality stands out. Piketty and Saez also estimated a sharp decline in income inequality from 1940 to 1944 (Piketty and Saez, 2007). However, subsequent work cast doubt on their estimates, suggesting that the decline in the 1940s was gentle and more in line with other nations (Geloso, Magness, Moore, and Schlosser, 2022). More accurate estimates of pre-1960 income inequality change inferences about the role of different policies, but they did not change the trend since 1960.

What can explain the increase in income inequality since the 1970s remains an open question with several plausible contributing factors. As early as the 1970s, the skills and education necessary to accommodate technological progress emerged as a factor (Tinbergen, 1974). The wage premium for college-educated workers began increasing in the 1970s (Acemoglu and Autor, 2011). The skill bias of technological change has not been consistent over time—it increased in the 1980s and 1990s (Autor, Katz, and Krueger, 1998). Education is a complement to technology; for instance, workers whose job involves computers saw large wage gains in the 1980s and 1990s (Krueger, 1993; Autor, Katz, and Krueger, 1998). Since the 1960s, empirical models testing this relationship consistently have consistently found evidence that skill-biased technological change contributes to income inequality (Katz and Murphy, 1992; Autor, Katz, and Krueger, 1998; Autor, Katz, and Kearney, 2008). In this period, as technology was incorporated into job tasks, lower-skilled workers were pushed into low wage roles without a chance for

advancement into higher skilled positions. This caused a "fissuring of the workplace," where less educated workers did not share in the gains from the adoption of technology (Autor, 2019). Intermediately skilled jobs—ones a worker without education could move into with experience—have gradually disappeared since the 1970s (Autor, 2019). However, technological innovation does not guarantee an increase in income inequality. The 1920s were a similar period of increased productivity resulting from the adoption of technological innovation (in this case, electricity), yet the increase in high school graduates (high-skilled workers at that time) moderated its effect on income inequality (Goldin and Katz, 1996). Conversely, the supply of high-skilled workers declined in the late twentieth century, and income inequality increased as a result (Katz and Murphy, 1992).

Lower skilled workers have also experienced a decline in real wages since the 1980s due to changes in labor market institutions, which contributed to the growth in income inequality. Decreasing union membership and the declining power of labor unions contributed to this trend, as unions tend to compress wages and lower income inequality (Card, 1996; Card, 2001; Herzer, 2016). Additionally, throughout this period the real minimum wage fell, which also contributed to rising income inequality at the lower end of the income distribution (Autor, Manning, and Smith, 2016; DiNardo, Fortin, and Lemieux, 1996). Lemieux characterized the 1980s as a perfect storm with institutional and technological changes that combined to increase income inequality at multiple points on the income distribution (Lemieux, 2010). At different periods of time, varying mechanisms dominated. The decline in unionization and technological changes were important in the 1980s and 1990s, the increasing college premium was important from the 1980s through the 2000s, and the ability to offshore manufacturing was important in the 2000s (Firpo, Fortin, and Lemieux, 2011).

While skill-biased technological changes account for much of the increase in income inequality, the importance of labor market institutions should not be ignored. In addition to minimum wage laws and unionization, healthcare policy influences income inequality through payments made to physicians. Physicians face strong entry barriers, through licensing requirements and a limited number of residency positions. When combined with regulated pricing for medical services, incumbents are able to capture a greater portion of the payments (Gottlieb, Polyakova, Rinz, Shiplett, and Udalova, 2023). Physicians represent a large share of

top income earners; they are also a profession with strict occupational licensing laws restricting entry into the profession.

By changing the composition of employment and wages, licensing should have had an impact on income inequality in recent decades. Like literature on the minimum wage, much of the current literature focuses on the lower end of the income distribution. Education and training requirements pose substantial costs for workers in low-income professions, and an increase in the number of licensed professions reduces economic mobility and increases income inequality (Meehan, Timmons, Meehan, and Kukaev, 2019). Many who lack the resources to meet those requirements choose to enter unlicensed professions and earn lower wages or leave the labor force entirely, which contributes to income inequality in the lower end of the income distribution (Zhang and Gunderson, 2020). Occupational licensing requirements can also have spillover effects on unlicensed professions involving similar tasks and skills. While licensed workers earn a wage premium, workers in unlicensed, similar professions suffer a wage penalty greater than the licensing premium, while employment also declines (Dodini, 2023). This is driven by a firm's decision to locate in less regulated areas and increases in firms' monopsony power in the labor market. Others have found evidence that licensing laws slow wage growth for low-income professions (Zhang and Gunderson, 2020; Kleiner and Vorotnikov, 2017). Finally, Chambers, McLaughlin, and Stanley (2019) identify a broader set of entry restrictions, including licensing laws, which disproportionately impact low-income workers and increase income inequality. Combined with evidence that the largest licensing premia are found in high-income professions, the effect on lower income earners suggests that the growth in licensing should contribute to income inequality.

However, one recent study has opposite findings for the relationship between licensing premia and income inequality. Examining the period 2000 to 2016, Chen, Franko, and McGrath (2024) find evidence of a licensing wage premium occurring in lower- and middle-income professions, but not high-income professions. As a result, their findings suggest that during this period, occupational licensing reduced income inequality in states, and this change was driven by wage gains for lower-income professions.

Our study builds on past work on income inequality by including an important labor market institution that impacts both wages and the supply of professionals. Importantly, we consider the

dynamic effects of the licensing premium over the past four decades and the heterogeneous effects across professions of the licensing premium on income inequality. The study also complements prior research on skills-biased technological change and earnings inequality – which has not attended to supply restrictions by occupational licensing in many high-skilled professionals.

III. Data and Methodology

1. Empirical Methodology

In this study, we focus on three questions: 1) whether licensing increases earnings inequality between licensed and unlicensed workers, 2) whether licensing increases earnings inequality within licensed worker categories, and 3) whether licensing has heterogeneous earnings effects across demographic subgroups.

A crucial challenge for the empirical analysis of licensing and earnings inequality is the lack of individual licensing attainment data in public surveys until the early 2010s.[5] To overcome this challenge, we use an occupation-based measure of licensing status based on universally licensed occupations that are identifiable in public surveys from the most recent four decades. The term "universally licensed occupations" refers to occupations that are licensed by all states in the US. We obtain a list of universally licensed occupations in Census surveys from Johnson and Kleiner (2020) and Han and Kleiner (2021). With this information, we define licensed workers as individuals whose occupation is a universally licensed occupation and unlicensed workers as all other workers. The occupation-based licensing status does not exactly match individual license attainment in Census surveys since the mid-2010s, which is too restrictive to be used for our analysis. Our approach classifies individuals who do not have a license but practice in universally licensed occupations as licensed workers and those who have a license but do not practice in universally licensed occupations as unlicensed workers, which is expected to attenuate our estimate of earnings gap between licensed and unlicensed workers.

[5] There is some historical data on when licensing takes effect in select professions, but an additional difficulty is the issue of licensing attainment versus coverage (Carollo, Hicks, Karch, and Kleiner, 2025). As an example, certified public accountants are covered by occupational licensing statutes, but not all accountants attain this specific license.

To answer the first question, on earnings inequality between licensed and unlicensed workers, we begin by comparing trends in earnings of licensed and unlicensed workers, respectively. Then, we compute the gap in earnings between licensed and unlicensed workers and analyze how it evolved from 1983 to 2019. Given growing demand for skilled workers and for healthcare workers over the past decades, we also compare changes in the earnings gap for high-, intermediate, and low-skilled occupations and between medical and non-medical sector occupations.

We use two measures of earnings gap throughout the paper: one is a "simple earnings gap," defined as the difference between the mean of logarithmic earnings of licensed workers and that of unlicensed workers. The simple earnings gap between licensed and unlicensed workers is expected to be caused by licensing restrictions, but other differences between the two groups of occupations may also affect the earnings gap. To account for different changes in human capital and demographics across occupations, we estimate an "adjusted earnings gap," an earnings gap after controlling for demographics, educational attainment, and union membership.

We define the adjusted earnings gap as the licensing premium and use both terms interchangeably. Because our definitions of licensed and unlicensed workers are based on occupation, the adjusted earnings gap could be affected by compensating wage differentials that may vary across occupations. Throughout the study, we assume that compensating wage differentials do not change over time, and hence we can translate changes in the adjusted earnings gap into changes in the licensing premium.

To implement the analysis, we estimate the earnings gap between licensed and unlicensed workers in each year with the following OLS regression model:

$$Y_i = \alpha + \beta Licensed_i + \gamma X_i + \epsilon_{i,}$$

where i indexes person, Y_i is log of earnings, $Licensed_i$ is a dummy for licensed workers, X_i is a set of individual characteristics, and ϵ_i is the error term. In this model, the coefficient β measures the earnings gap between licensed and unlicensed workers. We estimate the simple earnings gap (without individual characteristics) and the adjusted earnings gap (with individual characteristics). Individual characteristics include age, age squared, a female dummy variable, three dummies for race and ethnicity (Black, Hispanic, and other race and ethnicity except

White), and four dummies for educational attainment, excluding those without a high school diploma (high school graduates, those with some college education, college graduates, and those with advanced degrees). With the estimate of the earnings gap in each year, we also present 95% confidence intervals that are robust to heteroscedasticity. We also use the regression model with an addition of year fixed effects to summarize the earning gap by decades and in the entire sample period.

To address the second question, about earnings inequality within licensed occupations, we first examine trends in interdecile ratios (the 90/50, 90/10, and 50/10 earnings ratios) and the Gini coefficient. The 90/10 earnings ratio is defined as the difference between the 90th and 10th percentile of logarithmic earnings. This measure provides a range of the entire earnings distribution, comparing those near the top of the distribution with those near the bottom, while removing the outliers. Similarly, the 90/50 and 50/10 earnings ratios compare the median earnings with either the 90th or the 10th percentile of earnings using the logarithm value. This measure compares the high or low end of the earnings distribution to the middle. The Gini coefficient quantifies how much an income distribution deviates from an equal income distribution. The 90/10 earnings ratio is good at quantifying changes at the top and bottom of income distribution, while the Gini coefficient has an advantage for summarizing overall changes in the income distribution.

Moreover, we compare trends in the earnings gap at different quantiles of the earnings distribution. To estimate the earnings gap by quantile, we use quantile regression (Firpo, 2007; Powell, 2020; Borgen, Haupt and Wiborg, 2021a, 2023). First, we track changes in annual estimates of the simple and adjusted earnings gaps at the 10th, 50th, and 90th percentiles. Then, we examine a profile of the 1st to 99th percentile adjusted earnings gap between licensed and unlicensed workers in the 1980s and 2010s. Next, to estimate the effect of occupational licensing on the earnings distribution, we use the unconditional quantile regression (Firpo, Fortin, and Lemieux, 2009).[6]

[6] With this tool, we examine changes in the distributional effect of occupational licensing in each percentile between the 1980s and 2010s. The analysis of quantile earnings gap with quantile regressions is implemented with the Stata

For the last question, about the possibility of differential changes in the licensing premium across demographic subgroups, we compare the adjusted gaps in mean earnings between age groups, female and male workers, racial and ethnic groups, and groups by educational attainment and union membership, and explore how they evolved by decades in the sample.

For robustness checks, we analyze the licensing premium with a propensity score matching method as an alternative to OLS estimates. Also, we estimate it using a broader set of licensed occupations with seven additional licensed occupations. Next, we analyze the gap in labor earnings in the Panel Study of Income Dynamics (PSID) data, as an alternative measure of earnings in an alternative dataset including self-employed workers. Moreover, we estimate the licensing premium with a sample of opticians, an occupation that is licensed in some states but not in others, as an alternative to our baseline approach with universally licensed occupations. Additionally, we examine if our baseline analysis is robust to excluding two major uniquely licensed occupations (teachers and nurses), removing weighting, and using individual license attainment data in the recent CPS survey.

2. Data

We primarily use Current Population Survey (CPS) Outgoing Rotation Group (ORG) data from 1983 to 2019. Among several different sources of the CPS ORG data, we use CPS ORG CEPR Uniform Extracts 1983–2019 (Version 2.5), obtained from the Center for Economic and Policy Research (CEPR) website (CEPR, 2020). Since the CPS survey design and instrument have changed several times, it is crucial to construct a consistent data series.[7] As a measure of earnings, we choose to use hourly wages in 2019 dollars constructed by the CEPR with an adjustment for top-coding and a trimming of extreme hourly wages, which the CEPR recommends using for an analysis of the period from 1983 to 2019.[8] We also use age, gender, race/ethnicity, and educational attainment data harmonized by the CEPR to account for

community-provided commands *rqr* and *rqrplot* (Borgen, Haupt and Wiborg, 2021b), and the analysis of the distribution effect with unconditional quantile regressions is done with *rifhdreg* (Rios-Avila 2020).

[7] For more details on the issue, see Autor, Katz, and Kearney (2008).

[8] This measure of hourly wages excludes overtime, tips, and commissions for hourly workers and includes them for non-hourly workers. Top-coded weekly earnings are imputed with an estimated mean above the top-code threshold using a log-normal approximation. Extreme wages less than 0.5 or more than 200 in 1989 dollars are trimmed.

demographics and human capital. Individuals are classified into four categories by race and ethnicity: White (non-Hispanic), Black (non-Hispanic), Hispanic, and other race/ethnicity. Individuals are also separated into five categories of educational attainment: less than high school, high school, some college, college degree, and advanced degree.

The CPS ORG provides occupation data for individuals who are employed as of the time of the survey. However, occupation codes changed several times in the sample period. To consistently identify universally licensed occupations over the years, we harmonize occupation codes by applying crosswalk files suggested by previous studies (Autor and Dorn, 2013; Hunt and Nunn, 2019). Through this process, we find 22 universally licensed occupations that are consistently identifiable in the CPS ORG (Johnson and Kleiner, 2020).

Our sample is wage and salary workers (not self-employed) aged 16 to 64 in current employment with non-extreme hourly wages.[9] We use earnings weights, the product of CPS sampling weights and hours worked in the CPS ORG, throughout the paper. Table 1 presents average characteristics of the sample in column 1 and compares them between workers in licensed occupations ("licensed workers") and those in other occupations ("unlicensed workers") in columns 2 and 3. Licensed workers on average earn more than unlicensed workers ($30.05 in 2019 dollars versus $21.73). About two-thirds of licensed workers have a college or advanced degree; by contrast, just a quarter of unlicensed workers have this level of education. Also, female workers are more than two-thirds of licensed workers, whereas they make up less than half of unlicensed workers. Licensed workers are slightly older and more likely to be White non-Hispanics than unlicensed workers. Lastly, licensed workers are more than twice as likely to be a member of labor unions (29%) than unlicensed workers (14%).

As shown in Figure 1, panel A, in the sample period, hourly wages of licensed workers on average increased more than those of unlicensed workers. The mean wages of licensed workers (red dots) continually increased from $23.93 in 1983 to $31.6 in 2002 and then to $31.54 in 2019 in real terms in 2019 dollars. By contrast, the mean wages of unlicensed workers (blue dots)

[9] We mostly follow the sample restrictions and weighting in Autor, Katz, and Kearney (2008) on trends in US wage inequality with the CPS ORG 1979–2005. An exception is their sample restriction based on potential experience, because the paper does not provide a clear description on how they define "potential experience."

stagnated around $20 in 1983–1997. Then, their mean wage took off and increased to $22.53 in 2002 and $24.83 in 2019. As a result, the mean wage gap between the two groups expanded from $4.52 to $9.07 in 1983–2002 and somewhat narrowed to $7.86 by 2019. Trends in median wages show similar patterns (Figure 1, Panel B). Also, panels C and D of the figure reveal that hourly wages became more dispersed among licensed workers than unlicensed workers: from 1983 to 2019, the 90th percentile wage of licensed workers increased much more than that of unlicensed workers (Figure 1, panel C), while the 10th percentile wage of licensed workers increased slightly less than that of unlicensed workers (Figure 1, panel D).

As a result, the share of licensed workers among the top 10% of earners in the entire sample, whose wage is above $40.87 in 2019 dollars, increased from 7% to 23% in 1983–2019, as shown in Figure 2, panel A. By comparison, the share of unlicensed workers among the top 10% of earners changed from 5% to 13% in the same period. Conversely, panel B of Figure 2 shows that the share of licensed workers among workers earning more than the median wage, $17.86, and that of unlicensed workers similarly increased by about 10 percentage points in the sample period. Moreover, as shown in panel C of Figure 2, the share of licensed workers among the bottom 10% of earners, whose wage is below $8.95, declined much more than the share of unlicensed workers at the same decile. These trends imply that occupational licensing may have gradually expanded earnings inequality at the top of earnings distribution, but it may not have narrowed at the bottom.[10]

Table 2 shows the list of 22 universally licensed occupations in the study sample. Column 1 of the table presents each occupation's composition among all 22 universally licensed occupations.[11] Teachers, including primary and secondary school teachers, and nurses, consisting of registered and licensed practical nurses, are two major occupation groups whose share among universally licensed occupations is about two-thirds. Given the large number of teachers and nurses in the sample of licensed individuals, our analysis with subgroups becomes much more important.

[10] This type of inequality is known as absolute inequality. See Blackburn (1994) for the concept of absolute inequality and an application to a cross-country comparison of poverty index.
[11] According to Johnson and Kleiner (2020), these occupations were licensed in all states from 2003 to 2017.

We now turn to columns 2 to 3 in Table 2, which show variations in average hourly wages and education across universally licensed occupations in the CPS ORG data. For example, individuals in high paying jobs—like dentists, physicians, and lawyers—attain the highest level of education, which is driven by professional degree requirements for licensing. In contrast, those in lower paying jobs, like barbers and cosmetologists, are among the least educated. Using the average hourly wage by occupation ("occupational earnings") in the first five years at the beginning of the sample period 1983–1987, we classify 22 universally licensed occupations into three terciles: high, intermediately, and low paying occupation groups.[12] For an analysis of sectoral differences in licensing premium, we distinguish medical sector occupations from non-medical sector occupations.[13] The share of workers in the medical sector is about two-fifths of licensed workers in the sample. Column 4 in Table 2 reveals that the share of female workers is relatively high among intermediately and low paying occupations such as nurses, teachers, social workers, and cosmetologists. Lastly, column 5 of the table shows that teachers, psychologists, social workers, nurses, and occupational therapists have a relatively high share of union members.

IV. Results

1. Earnings Inequality Between Licensed and Unlicensed Workers

In the first part of our analysis, we show an increase in the gap in log earnings between licensed and unlicensed workers estimated from a regression model with or without accounting for individual characteristics. As a diagnostic test before our primary analysis of dynamic changes in the earnings effect of occupational licensing, column 1 of Table 3 shows estimates of the average earnings gap in the entire sample period. The simple earnings gap between licensed and unlicensed workers is 0.346 log points, as shown in Table 3, panel A, column 1. When we

[12] The high paying occupation group includes seven occupations: dentist, optometrist, lawyer, physician, pharmacist, veterinarian, and psychologist. The intermediate paying occupation group includes eleven occupations: insurance agent, electrician, physical therapist, real estate agent, dental hygienist, secondary school teacher, registered nurse, occupational therapist, primary school teacher, social worker, and physician assistant. The low paying occupation group includes four occupations: licensed practical nurse, pest control worker, barber, and cosmetologist.
[13] Medical sector occupations include eleven occupations: physician, dentist, veterinarian, optometrist, registered nurse, pharmacist, occupational therapist, physical therapist, physicians' assistant, dental hygienist, and licensed practical nurse. Non-medical sector occupations make up the remaining eleven occupations.

account for demographics, educational attainment, and union membership, the adjusted earnings gap is 0.079 log points (Table 3, panel B, column 1).[14] The large difference between the simple and adjusted earnings gaps is mainly because licensed workers are more educated and more likely to be union members than unlicensed workers are. The estimate of the adjusted earnings gap is consistent with recent studies on a licensing premium of about 4 to 11% in the United States.[15]

Looking at the evolution of earnings gap by decades, we find both the simple and the adjusted earnings gaps increased between the 1980s and 2010s. As shown in Table 3, panel A, columns 2 to 5, the simple earnings gap increased from 0.296 log points in the 1980s to 0.373 log points in the 1990s, then slightly declined to 0.340 log points in the 2010s. Similarly, the adjusted earnings gap changed from 0.051 log points in the 1980s to 0.09 log points in the 1990s to 0.082 log points in the 2010s (Table 3, panel B, columns 2 to 5). The net change between the 1980s and 2010s is 0.044 log points in the simple earnings gap and 0.031 log points in the adjusted earnings gap, which implies that some of the increase in the earnings of licensed workers is attributable to changes in educational attainment, union membership, or demographics.

Our main analysis on annual trends in the earnings gap shows that both the simple and the adjusted earnings gap between licensed and unlicensed workers increased in 1983–2019. Figure 3, panel A shows that the simple earnings gap (blue dots with the left axis label) increased from 0.255 log points in 1983 to 0.399 log points in 1994 and then trended down to 0.307 log points in 2019. If we look at it closely, the downward trend can be broken down into three phases: a decline in the late 1990s, a bit of recovery in the 2000s, and a second decline in the 2010s. When we account for educational attainment, union membership, and demographics, the adjusted

[14] Log points are a measurement for the difference between two logarithmic numbers, and *g* log points are mathematically equivalent to 100 times $ln(1+g)$ percent (%). As a rule of thumb, if a number *g* is sufficiently small, *g* log points correspond to 100 times *g* %. For example, the wage gap of 0.079 log points between licensed occupations and other occupations means that the former group earns 7.6% more than the latter group.

[15] Earlier studies, like Kleiner and Krueger (2010, 2013), found a 15 to 18% licensing premium, but recent studies—including Gittleman and Kleiner (2016), Kleiner and Vorotnikov (2017), Gittleman, Klee, and Kleiner (2018), and Ingram (2019)—found smaller estimates ranging from 4 to 11%. The difference is in part due to the use of different databases, time periods, and estimation techniques.

earnings gap (red dots with the right axis label) increased from 0.04 log points in 1983 to 0.108 log points in 1994 but declined to 0.061 log points in 2019.

Panel B of Figure 3 shows a normalized earnings gap with 1983 as a base year. It clarifies that the simple gap (blue dots) increased by 0.051 log points in 1983–2019, and the adjusted gap (red dots) increased by 0.021 log points, both of which are statistically significant, at least at the 5% level. The figure also suggests that parts of the increase in the simple earnings gap between licensed and unlicensed workers are attributable to changes in demographics and educational attainment in the sample period. The earnings gap after accounting for demographics (green dots) changed less than the simple gap throughout the period. When we control for both demographics and education (yellow dots), the earnings gap increased by only about 0.05 log points, or 5%, up to 1994 and then slightly declined by 2019. Lastly, adding an additional control of union membership (red dots) slightly expands the increase in the earnings gap until 1994 and significantly moderates the decline in the earnings gap since 1994. These findings are consistent with an increase in college premium (Autor, Katz, and Kearney, 2008) and de-unionization (Card, Lemieux, and Riddell, 2020; Fortin, Lemieux, and Lloyd, 2021) in the recent decades, given that college graduates and unionized workers are overrepresented among licensed workers.

In the remainder of this section, we present evidence showing that the increase in earnings gap between licensed and unlicensed workers is associated with an increase in demand for licensed workers. First, we find that the earnings gap increased more among higher-skilled workers than lower-skilled ones. In the analysis, we use the average occupational wage as a proxy for skill. Figure 4 shows trends in the simple and adjusted earnings gaps of high, intermediate, and low paying licensed occupations, respectively. The high paying occupation group (red dots) gained about 0.2 log points in the simple gap (Panel A) and 0.1 log points in the adjusted gap (Panel B) until the early 1990s, and it did not lose many of the gains afterward. By contrast, the intermediate paying occupation group (blue dots) saw relatively small gains in the early period, and its gains were almost completely erased in the following period. Lastly, the low paying occupation group (green dots) gained little even in the early period and lost a bit in the later period.

These findings show that in the sample period, the increase in the earnings gap between licensed and unlicensed workers is driven by an increase in earnings of workers in high-skilled

occupations, relative to unlicensed workers. The result is in line with previous studies on increasing demand for skilled workers in the past decades (Katz and Murphy, 1992; Autor, Katz, and Kearney, 2008; Autor and Dorn, 2013). Given rigid entry barriers by occupational licensing, growing demand for skilled workers might have resulted in a dynamic increase in their licensing premium. An additional possibility is that occupational licensing barriers, which are stricter for high paying occupations than for intermediate or low paying occupations, might delay adjustments to mitigate the licensing premium in the labor market.

Next, we find a notable difference in the evolution of the earnings gap between the medical and non-medical sectors. Entry into medical sector occupations is heavily regulated by occupational licensing despite growing demand for medical services in recent decades. We would therefore predict a relative increase in earnings for licensed workers in medical sector occupations. We find that the simple earnings gap between licensed workers in medical sector occupations and unlicensed workers increased by 0.15 log points between 1983 and 2019, as shown in Figure 5, panel A. By contrast, the simple earnings gap between licensed workers in non-medical sector occupations and unlicensed occupations did not increase but instead slightly declined during the same period. When we account for an increase in education among medical sector workers relative to non-medical sector workers, the net change in the adjusted earnings gap is not statistically different from zero for both sectors (Figure 5, panel B). This is because educational attainment increased among medical sector workers in licensed occupations relative to other workers, at least partly owing to ratcheting up of licensing requirements (Han and Kleiner, 2021; Cai and Kleiner, 2020).

Looking at sub-periods, we see that medical sector occupations are the key driver of the increase in the earnings gap between licensed and unlicensed workers in 1983–1994. As shown in Figure 5, the simple earnings gap between licensed workers in medical sector occupations and unlicensed workers increased by more than 0.2 log points in 1983–1994, and the adjusted earnings gap expanded by about 0.1 log points. By contrast, the simple earnings gap between for non-medical-sector occupations increased by about 0.1 log points in the same period, and the adjusted earnings gap for these jobs grew by less than 0.05 log points. However, licensed workers in the medical sector and those not in the medical sector have experienced a similarly sized decline in simple earnings relative to unlicensed workers since 1994. Once we control for

individual characteristics, the adjusted earnings gap for medical sector workers declined significantly more than that for non-medical sector workers in the same period.

Moreover, we suspect that some of the decline in earnings gap for medical sector workers might be due to healthcare reforms, which countervails an increase in earnings gap due to occupational licensing entry barriers. Panel B of Figure 5 shows a slight decline in the adjusted earnings gap for medical sector workers in licensed occupations in 1983–1986, the period of Medicare Prospective Payment System (PPS) reform and the congressional freeze of Medicare physician fees (Catlin and Cowan, 2015; Acemoglu and Finkelstein, 2008). Also, the adjusted earnings gap for in medical sector occupations significantly declined in 1993–1998, the era of managed care, which featured government efforts to control healthcare spending (Catlin and Cowan, 2015), and in 2010–2019, the period of the Affordable Care Act, which featured a slow growth of healthcare expenditures (Weiner, Marks, and Pauly, 2017). In a counterfactual world without these healthcare reforms, we might observe an increase in the adjusted earnings gap for medical sector workers in the sample period because of increasing demand for medical services under rigid occupational licensing regulations. This important qualification is also in line with a recent study's finding that in 2005–2017, 25% of physician fee revenues from Medicare reimbursements went to physicians (Gottlieb, Polyakova, Rinz, Shiplett, and Udalova, 2023).

Additionally, we find that the earnings gap increased by the largest magnitude for the high paying occupation group in the medical sector, whose relative demand might increase the most among six groups of workers by sectors by skills. As shown in Figure 6, panels A and B, between 1983 and 2019, the high paying medical sector occupation group gained 0.25 log points in the simple earnings gap and 0.12 log points in the adjusted earnings gap. During the same period, its counterpart in the non-medical sector gained 0.15 log points in the simple earnings gap but stayed at par in the adjusted earnings gap (Figure 6, panels C and D).

Figure 6 also confirms that regardless of sector, the earnings gap tends to have increased the most for high paying licensed occupations. In the medical sector, the earnings gap for high paying occupations and that for intermediate paying occupations increased together until 1993, after which they diverged, as shown in panels A and B of the figure. The divergence seems partly attributable to an increase in the supply of registered nurses, a major intermediate paying occupation, in the 1990s. This caused a substantial increase in the number of registered nurses

who are not employed in nursing (Sprately, Johnson, Sochalski, Fritz, and Spencer, 2000). In our sample there is only one low paying occupation in the medical sector, licensed practical nurses; the gap for this occupation stayed similar at the beginning and end of the sample period. Relative to the intermediate paying occupation group, the low paying occupation group saw a decline in the simple earnings gap but an increase in the adjusted earnings gap. This result is partly because of a relative increase in the attainment of college degrees among workers in the intermediate paying occupations, including registered nurses, (U.S. Department of Health and Human Services, 2020) and doctoral degrees among advanced practitioners (Cai and Kleiner, 2020).

In the non-medical sector, we observe a notable increase in the simple earnings gap for the high paying occupation groups in the 1980s, most of which is sustained for the rest of the sample period. The simple earnings gap for the intermediate paying occupation group also increased in the early period but gradually declined (Figure 6, Panel C). This finding is consistent with a rapid increase in the supply of teachers in the 1990s to 2000s, a relative growth in alternative teaching preparation programs in the 2010s, and a stagnation of teacher salaries since the 1990s (Kraft and Lyon, 2024). When we account for education, union membership, and demographics, the earnings gap stayed similar in 1983 and 2019 for both high and intermediate paying occupations (Figure 6, Panel D). For low paying occupations, the simple earnings gap changed little throughout the sample period, and the adjusted earnings gap slightly declined.

Overall, these findings support a demand-driven increase in the licensing premium for high-skilled workers given rigid entry barriers created by occupational licensing regulations. The asymmetric increase in licensing premium by skills may increase the earnings gap between high and low earners even within licensed occupations, as well as the earnings gap between licensed and unlicensed workers.[16]

2. Earnings Inequality Among Licensed Workers

Expanding our comparison of licensed and unlicensed occupations, we find that occupational licensing increased earnings inequality among licensed workers from 1983 to 2019. As shown in

[16] Appendix Figures A1 and A2 present trends in the adjusted earnings gap for major licensed occupations in the sample.

Figure 7, panel A, the 90/10 earnings ratio among licensed workers (red dots) trended up from 1.1 in 1983 to 1.52 in 2019. Moreover, it increased more steeply than the same measure for all workers (blue dots).[17] At the same time, the 90/50 and 50/10 earnings ratios expanded among licensed workers (Figure 6, panels B and C). In other words, among licensed workers, the top and bottom 10th percentile of earnings moved away from median earnings in the sample period. By contrast, the 50/10 earnings ratio declined among all workers. Overall, panel D of Figure 7 shows that the Gini coefficient increased more among licensed workers (0.26 in 1983 to 0.32 in 2019) than it did among all workers (0.32 to 0.36). These findings show that the earnings distribution of workers in licensed occupations has become more dispersed over the sample period. The findings also suggest that earnings inequality became wider among licensed workers than it did among all workers.

We find three major factors behind the increase in earnings inequality within licensed workers in the sample period. First, the average earnings of high paying licensed occupations increased more than those of intermediate or low paying licensed occupations in the period. It is a corollary of our analysis of the simple earnings gap between each group of licensed workers and a common set of unlicensed workers (Figure 3, panel A). As we discussed in the previous section, it is probably because the relative demand of high paying licensed occupations increased more than that for lower paying occupations, owing to increasing demands for skills and relatively strict licensing entry barriers for high skilled licensed occupations.

Next, we find that throughout the sample period, the number of workers in high paying licensed occupations increased more than that in lower paying occupations. As shown in Figure 8, the share of workers in high paying occupations among all licensed workers in the sample (blue dots) increased by about 4 percentage points, while that in intermediate or low paying occupations declined. The increase is probably a response to increasing demand for skilled workers. But we also observe two discontinuous changes in the sample composition of the three groups of workers that coincide with major changes in the CPS survey. As shown with vertical dotted lines in Figure 8, the re-engineering of the CPS seems to have caused a sharp increase in

[17] Autor, Katz, and Kearney (2008) documented with the CPS ORG 1979–2005 that the 90/10 and 90/50 earnings ratios among male workers increased in the US.

the share of licensed workers in high paying occupations between 1993 and 1994, and a change in the Census occupation coding system seems to have driven it down between 2002 and 2003.[18] Moreover, the re-engineering of the CPS seems to have caused a sharp uptick in inequality measures in 1994 (Figure 7), while the change in the occupation coding system does not. Despite these limitations, the share of highly paid licensed workers increased in all three subperiods without the two events (1983–1992, 1994–2002, 2004–2019), and so did the 90/10 and 90/50 earnings ratios and the Gini coefficient among licensed workers.

Third, we find increasing trends in earnings inequality even within each of the skill groups of licensed workers, except highly paid workers. As shown in Figure 9, the 90/10 and 90/50 earnings ratios and the Gini coefficient gradually increased among workers in low and intermediate paying licensed occupations in the sample period. Conversely, we find little change in the same measures of earnings inequality among workers in high paying licensed occupations, which implies that variations in their earnings changed little despite a large increase in their average earnings.

Our findings suggest that the 10th percentile of earnings (a measure of lowest earnings except the bottom decile) has grown as fast as the 90th percentile of earnings (a measure of highest earnings except the top decile) among workers in the high paying licensed occupations for the past four decades. This seemingly surprising fact may be attributable to occupational licensing regulations. High paying licensed occupations tend to require more strict, standardized education and training for licensure than other occupations, which effectively sets a solid wage floor for those who pass the bar. Moreover, strict entry barriers might have been protecting workers in high paying licensed occupations from competitive pressure from other workers or occupations that could expand variations in earnings. Ratcheting up licensing standards might have added both types of momentum and restrained variations in earnings among licensed workers in high paying occupations.

[18] To be clear, we use harmonized occupation codes based on Autor and Dorn (2013) for the analysis, as described in the methodology section. Still, we find the discontinuous change in the sample share of the three skill groups of licensed workers between 2002 and 2003. See Hunt and Nunn (2019) for another example showing the imperfectness of Census occupation code harmonization.

For a better understanding of the dynamic effects of occupational licensing on earnings distribution, we now compare trends in the earnings gap between licensed and unlicensed workers at 90th, 50th, and 10th percentiles. Figure 10, panel A, shows that the 10th percentile simple earnings gap between licensed and unlicensed workers (green dots) slightly increased in the 1980s and gradually declined for the rest of the sample, ending up with a net decline of more than 0.1 log points. Conversely, both the 50th and 90th percentile earnings gaps (blue and red dots) steadily increased, peaked in the mid-1990s, and moderately declined in the following period. As a result, in the sample period, the 50th percentile earnings gap increased by more than a half log point, and the 90th percentile earnings gap increased by more than 1.5 log points. These findings imply that the 90/10 and 90/50 earnings ratios increased among licensed workers relative to unlicensed workers because of a relative increase in the 90th percentile earnings gap between licensed and unlicensed workers.

Also, panel B of Figure 10 shows that only the 90th percentile earnings gap increased in 1983–2019, after accounting for individual characteristics. By contrast, we observe little net change in both the 50th and 10th percentile earnings gaps in the same panel. These findings imply that 90/10 and 90/50 earnings inequality increased among licensed workers relative to unlicensed workers even after accounting for education, union membership, and demographics. From the perspective of earnings as a proxy for skills, the analysis of quantile earnings gap focuses on individual earnings, complementing our previous analysis with average occupational earnings. Both analyses suggest an increase in licensing premium for highly skilled workers over the past decades, probably because of an increase in the relative demand for high skilled licensed workers arising from technological changes and occupational licensing entry barriers.

To clarify implications of the relative increase in the earnings gap at the top quantile, we also compare the earnings gap at the 1st to 99th percentiles between 1983 and 1989 and 2010 and 2019. Figure 11 panel A clarifies that between the 1980s and 2010s, the quantile earnings gap between licensed and unlicensed workers increased above the 40th percentile but declined below it. Moreover, the earnings gap declined the most around the 10th to 20th percentile, while it had its largest increase above the 90th percentile.

Next, Figure 11 panel B shows unconditional quantile partial effect estimates, which summarize the influence of occupational licensing on the earnings distribution. The distributional

effect of occupational licensing is influenced by the share and earnings distribution of licensed workers as well as the size of the quantile earnings gap. Like quantile earnings gap estimates, unconditional quantile partial effect estimates increased at the high end of earnings distribution between the 1980s and 2010s. But the distributional effect estimates (Figure 11, panel B) are less left-skewed than the quantile earnings gap estimates (Figure 11, panel A) because intermediately paid workers are overrepresented in the group of licensed workers in the sample. As a result, our estimate of the effect on the distribution increased at quantiles above the median and declined at quantiles below. In sum, in our analysis of the effect of occupational licensing on earning quantiles, we consistently find larger effects for higher earners relative to lower earners, implying that earnings inequality within licensed workers increased in 1983–2019.

3. Earnings Inequality Between Groups

Now we turn to the analysis of licensing and earnings inequality between socio-demographic subgroups. Table 4 presents how the adjusted earnings gap between licensed and unlicensed workers varies across socio-demographic subgroups by decades in the sample.

First, we find that the earnings gap between licensed and unlicensed workers is U-shaped by age: it is relatively larger among younger workers aged 16–24 (0.13 log points) and older workers at aged 55–64 (0.108 log points) than workers aged 25–54 (0.068 log points), as shown in Table 4, panel B, column 1. Columns 2 to 5 of the panel also show that this relationship did not change from the 1980s to 2010s. This finding suggests that the earnings effect of occupational licensing is larger for those with little working experience or those at or near retirement age, who may benefit more from job market signaling with occupational credentials under asymmetric information on the productivity of service providers (Blair and Chung, 2024; Cassidy and Dacass, 2021; Koumenta, Pagliero, and Rostam-Afschar, 2022). Our finding is also consistent with Oh and Kleiner (2025), which shows that licensed workers are less likely than unlicensed workers to change their jobs when moving toward retirement.

Next, for the entire period, the earnings gap between licensed and unlicensed workers is much larger among female workers (0.122 log points) than male workers (0.012 log points), as shown in Table 4, panel C, column 1. That is, working with an occupational license rewards female workers more than male workers. Given the prevalence of gender wage gap (Blau and Kahn,

2017), this finding implies that the gender gap is smaller among licensed workers than unlicensed workers, as documented by Blair and Chung (2024).

However, we also find that the female licensing premium declined relative to the male licensing premium during the sample period. Columns 2 through 5 in panel C of Table 4 show that the earnings gap between licensed and unlicensed female workers increased between the 1980s and 1990s but declined back to its original level in the following decades. This finding is consistent with similar changes in licensing premiums for female-dominant occupations, like registered nurses. By contrast, the earnings gap between licensed and unlicensed male workers increased by 0.055 log points as a result of a steady increase until the 2000s and a slight setback in the 2010s. This outcome is in line with a significant increase in licensing premiums for high paying occupations in which male workers are overrepresented, such as physicians. From a broader perspective, the decline in the licensing premium among female workers relative to male workers is likely to be associated with two important changes in the labor market over the past decades: the growth in women's education (Bureau of Labor Statistics, 2024) and the narrowing gender wage gap (Blau and Kahn, 2017), both of which might have reduced the benefits of careers with an occupational license among female workers.

Third, the earnings gap between licensed and unlicensed workers is consistently larger among racial and ethnic minorities in the labor market. Column 1 of panel D in Table 4 shows that the earnings gap is 0.098 log points among Black workers and 0.122 log points for Hispanic workers, both of which are larger than that among White workers (0.077 log points). Between the 1980s and 2010s, the earnings gap increased among all three groups of workers (Table 4, panel D, columns 2 to 5). Also, these findings are consistent with Blair and Chung's (2024) findings of a smaller racial wage gap among licensed workers than that among unlicensed peers.

Fourth, the earnings gap between licensed and unlicensed workers by education is inverse U-shaped. The first column in panel E of Table 4 shows that the earnings gap is 0.105 log points for workers with at most high school education, 0.195 log points for those with some college education, and 0.053 log points for college graduates. This finding suggests that educational credentials (like college education) and non-educational credentials (like an occupational license) are imperfect substitutes and imperfect complements. They are unlikely to be perfect complements because occupational licensure typically requires a certain level of education; also,

they are unlikely to be perfect substitutes because education programs for occupational licensure focus on building up occupation-specific human capital.

We also observe a shift of the inverse-U shape in favor of workers with college education, especially college graduates, over the past decades (Table 4, panel E, columns 2 to 5). The earnings gap between licensed and unlicensed workers among college graduates surged from 0.008 log points in the 1980s to 0.051 log points in the 1990s and steadily increased up to 0.064 log points in the 2010s. By contrast, the earnings gap among workers with at most high school education continuously declined from 0.125 log points in the 1980s to 0.079 log points in the 2010s, and that among workers with some college education just slightly increased in the same period. These changes imply that college education and occupational licenses have become more complementary, which is probably because of the ratcheting up of education requirements for occupational licensure (Cai and Kleiner, 2020; Han and Kleiner, 2021). These findings are also consistent with our previous finding of a relative increase in the licensing premium for high paying occupations, which typically require an advanced degree for licensure.

Lastly, the earnings gap between licensed and unlicensed workers is similar between workers who are in unions and those who are not. As shown in the first column of panel F in Table 4, the earnings gap is about 0.1 log points among both groups of workers. However, we also find a steady increase in the earnings gap between licensed and unlicensed workers among union members, from 0.047 log points in the 1980s to 0.116 log points in the 2010s. By contrast, there is little change in the earnings gap among those who are not in unions (Table 4, panel F, columns 2 to 5). As a result, the earnings gap is smaller among unionized workers in the 1980s, but larger in the 2010s. The finding implies that unions' influence on earnings declined more among unlicensed workers over the past decades than it did among licensed workers, possibly because of the decline of industrial unions in the manufacturing sector. From a broader perspective, our findings also suggest that unions and occupational licensure have become more complementary labor market institutions.

The bottom line is that working in licensed occupations provides relatively large earnings premiums to minorities in the labor market, who may need to signal their skills or ability with an occupational license, but licensing premiums for female workers and workers without a college education significantly declined over the past decades.

4. Robustness Checks

(1) Alternative Method: Propensity Score Matching

We first check if our key findings on the earnings gap between licensed and unlicensed workers are robust to an alternative estimation method using propensity score matching. The alternative method compares the earnings between licensed workers and unlicensed workers who have similar characteristics according to a matching procedure. This systematic matching could improve the precision of the estimates but is computationally more intensive than our baseline methods with OLS regressions. We use the same set of individual characteristics for both methods.

We find that trends in the average earnings gap between licensed workers and matched unlicensed workers ("matched earnings gap") are quite similar to trends in the adjusted earnings gap from our baseline analysis. Figure 12 panel A shows that the matched earnings gap is larger than the adjusted earnings gap, meaning that our baseline estimates are more conservative estimates of licensing premium than the matching estimates. The figure also shows that the two sets of estimates move together throughout the sample period. Moreover, Figure 12 panel B shows that in 1983–2019, the matched earnings gap significantly increased for licensed workers in high paying occupations but not for licensed workers in lower paying occupations.

(2) Alternative Set of Licensed Occupations

Next, we examine robustness of our baseline results to an alternative definition of licensed workers based on a broader set of licensed occupations. In this robustness analysis, we use 29 universally licensed occupations analyzed in Johnson and Kleiner (2020) and Han and Kleiner (2021) that are consistently identifiable in the sample period. The alternative set of licensed occupations includes the 22 occupations used for our baseline analysis and 7 additional

occupations: architect, civil engineer, funeral director, plumber, speech language therapist, respiratory therapist, and dental assistant.[19]

Figure 13, panel A, shows that the average earnings gap between workers in the 29 licensed occupations and those in other occupations (red dots) is higher than our baseline estimates (blue dots), but both series move in tandem throughout the sample period. The net increase in the earnings gap between 1983 and 2019 is 0.021 log points in our baseline analysis and 0.013 log points in the robustness analysis, which is probably because of a relatively low licensing attainment rate in five of the seven additional occupations (Han and Kleiner, 2021). Also, panel B of the figure shows that with the addition of architects and civil engineers, the earnings gap increased for workers in the high paying occupation group, while that for workers in lower paying occupations did not. These results show that our key findings on rising inequality due to occupational licensing are not sensitive to the choice of licensed occupations.

(3) Alternative Earnings Data: PSID Labor Earnings

Now, we analyze trends in the gap in labor earnings between licensed and unlicensed workers in the Panel Study of Income Dynamics (PSID). PSID labor earnings data include wages and salaries, bonuses, overtime, tips, and commissions, earnings from professional practice or trade, and several other categories of income. Occupation codes are harmonized as described for our baseline analysis. The sample is a pooled cross section of 163,553 individuals who are the head/reference person of household or their spouse and have labor earnings in the PSID 1983–2019. In comparison to the CPS ORG sample used in our baseline analysis, the PSID sample is small but homogeneous across years because the survey tracks the same households over time. Also, the PSID sample includes self-employed workers, especially those engaging in professional practice or trade, while the CPS sample does not. In the analysis, we account for the

[19] Civil engineer and speech language therapist are modifications of engineer and audiologist, both listed in Han and Kleiner (2021). We use civil engineer instead of the entire engineer category because the rate of license attainment is too low for entire engineers, according to the CPS 201 –2019. Also, we use speech language therapist instead of audiologist because workers in the two categories conduct similar tasks and are typically licensed by the same licensing board, and because speech language therapist is consistently identifiable in the sample, but audiologist is not.

same set of individual characteristics, except the Hispanic category, which is not identifiable in the PSID.

We find that the gap in labor earnings between licensed and unlicensed workers in the PSID increased in the sample period, which is consistent with our findings on the CPS wage gap. Table 5, column 1, shows that the simple and adjusted earnings gaps are 0.330 and 0.131 log points, respectively. As shown in Table 5, panel A, columns 2 to 5, the simple earnings gap increased by 0.024 log points between the 1980s and 2010s. Also, Panel B of the table shows that the adjusted earnings gap increased by 0.038 log points between the same periods. The smaller change in the simple earnings gap is primarily because the sample is highly homogeneous across the decades. The analysis of PSID suggests that the licensing premium increased over the past decades in an alternative sample of homogeneous individuals, including self-employed workers, based on an alternative measure of earnings including those from professional practice or trade.

(4) Partially Licensed Occupation: The Case of Opticians

Next, we examine if our key finding of an increase in the licensing premium for universally licensed occupations holds for partially licensed occupations, which are licensed in some states but not in other states. In the analysis, we focus on opticians because this occupation is relatively large and its licensing status substantially varies across states (Kleiner and Soltas, 2023). According to Timmons and Mills (2018) and Norris and Timmons (2020), 20 states consistently licensed opticians throughout the sample period, while 29 states (including the District of Columbia) did not. We exclude opticians in California and Texas, which did not license opticians for some years in the sample period. With the sample of opticians in 49 states in the CPS ORG 1983–2019, we compare the average earnings of opticians between states with optician licensure and those without by decades.

We find that the earnings gap between opticians with licensure and those without increased over the past decades. As shown in Table 6 column 1, the simple and adjusted earnings gaps are 0.167 and 0.126 log points, respectively, for the entire sample period. The estimate of adjusted earnings gap is comparable to Timmons and Mills's (2018) estimate of the earnings effect of optician licensing with the 1940–2000 Census and 2001–2012 American Community Survey. Moreover, columns 2 through 5 in panel A of Table 6 show that the simple earnings gap increased from 0.124 log points in the 1980s to 0.253 log points in the 2010s. Similarly, columns

2 through 5 in panel B of Table 6 confirm that the adjusted earnings gap increased from 0.098 log points to 0.168 log points in the same period. These findings imply that optician licensure may limit the supply of opticians despite growing demand for eyeglasses and lenses in the recent decades. Also, the analysis using variations in licensure across states, which is unavailable for the analysis with universally licensed occupations, makes a concrete case that the dynamic increase in the licensing premium is associated with entry barriers even after accounting for secular increases in the demand for licensed workers.

(5) Alternative Data on Licensing Status: Individual License Attainment

Our baseline analysis with a measure of occupation-based licensing status is also robust to an analysis with a measure of individual license attainment available in the recent CPS. In the analysis, we use a subsample of 667,072 workers in the CPS ORG 2015–2019 whose license attainment data is available in the CPS Basic Monthly Survey (BMS) 2015–2019. For the purposes of this robustness analysis, a license is defined as a professional credential issued by the government. In the sample, 72% of workers in universally licensed occupations have a license, while 16% of workers in other occupations have attained an occupational license. That is, the occupation-based licensing status is an imperfect but reasonable proxy for individual license attainment. Also, the 22 universally licensed occupations in the sample represent 37% of workers with a license.

As shown in Table 7, column 1, the simple and adjusted earnings gaps between workers in universally licensed occupations and those in other occupations ("occupation-based earnings gap") are 0.292 and 0.067 log points, respectively. Column 2 of the table shows the earnings gap between workers with a license and those without ("attainment-based earnings gap") is somewhat smaller than the occupation-based gap in column 1. Column 3 in panel B, with the interaction between the two measures of licensing status, reveals that after we account for individual characteristics, the earnings effect of working in universally licensed occupations is larger among those who have a license (0.063=0.018+0.045) than it is among those who do not (0.018). That is, our baseline analysis with the occupation-based measure underestimates the level of the licensing premium for workers in universally licensed occupations who have a license. Furthermore, the same column shows that the earnings effect of working with a license

in partially licensed occupations is also positive (0.035), which is consistent with our previous analysis of opticians.

(6) Additional Robustness Results

Lastly, we present additional robustness results. Table 8, panel B, shows that our key findings are robust to the exclusion of two major licensed occupations, teachers and nurses, from the analysis. This robustness check is informative because their share among licensed workers is about two-thirds, and we observe an abnormal increase in teachers' earnings after the changing of codes in the CPS between 1993 and 1994 (Appendix Figure A2). As shown in panel B of Table 8, the adjusted earnings gap increased by 0.019 (=0.096 – 0.077) log points between the 1980s and 2010s in the sample without teachers and nurses, which is smaller than the corresponding one from our baseline analysis (0.031 = 0.082 – 0.051; Table 8, panel A). Also, both teachers and nurses are intermediately paying occupations, and our finding of an increase in the adjusted earnings gap for high paying occupations does not change in the sample without these two occupations.

Table 8, panel C, shows that our key findings are not driven by weighting of regression. As shown in the panel, the adjusted earnings gap based on unweighted regressions increased by 0.035 (=0.089 – 0.054) log points between the 1980s and 2010s. The change in unweighted estimates is slightly larger than that in our baseline, weighted estimates (0.031).

V. Conclusions

Overall, we find that occupational licensing has raised earnings inequality in the United States during the period 1983–2019. Also, we observe a large increase in the licensing premium for high-skilled workers, especially in the healthcare sector, which is likely a result of the growing demand for high-skilled workers in professions with rigid licensing entry barriers. As a result, the Gini coefficient and interdecile ratios (the 90/10, 90/50, and 50/10 earnings ratios) increased among licensed workers. By demographic subgroups, the licensing premium for female workers and those without a college education declined relative to males and college graduates, which is partly because these workers are overrepresented in intermediate and low-skilled licensed occupations. As these findings are based on 22 universally licensed occupations identifiable in the Census surveys, whose share in the sample is only 8.5% of workers in 1983 and 11.1% in

2019, the actual distributional effect of occupational licensing could be different from our estimates.

These findings have several implications for the study of occupational licensing and earnings inequality. First, it is useful to account for heterogeneity across occupations over time when studying the effects of occupational licensing. Licensing premiums change over time in favor of occupations with growing demand and strict licensing requirements. Next, our findings raise the possibility that the labor supply restrictions created by occupational licensing may be conflated with technological progress as labor demand shocks increase the demand for these workers. Even though skill-biased technological change has emerged as one of the key explanations for increases in earnings inequality (Autor, Katz, and Kearney, 2008; Acemoglu and Restrepo, 2022), existing literature does not account for supply restrictions created by occupational licensing on many high-skilled occupations. Third, our findings suggest that some of the return to college or post-graduate education could be attributable to licensing premiums resulting from entry barriers, given complementarity between education and occupational licenses. For example, a recent study of returns to post-graduate education found the highest returns to programs for physicians and lawyers (Altonji and Zhong, 2021), but it does not mention issues about strict licensing barriers limiting entry into those occupations. Lastly, our findings indicate that the earnings effect of occupational licensing has become complementary to that of labor unions as manufacturing sector unions have declined. These potential interactions of occupational licensing with technology, education, and labor unions and their contribution to earnings inequality warrant additional study.

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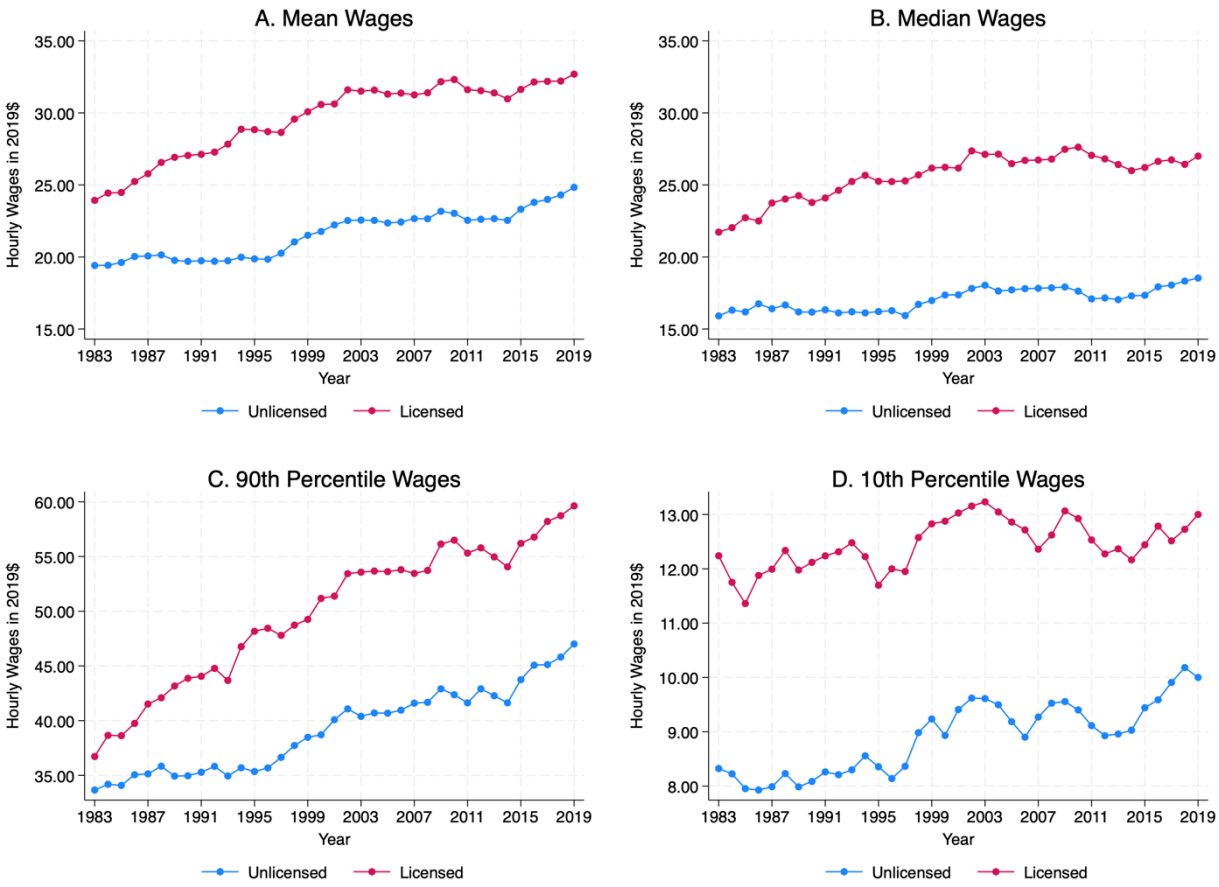
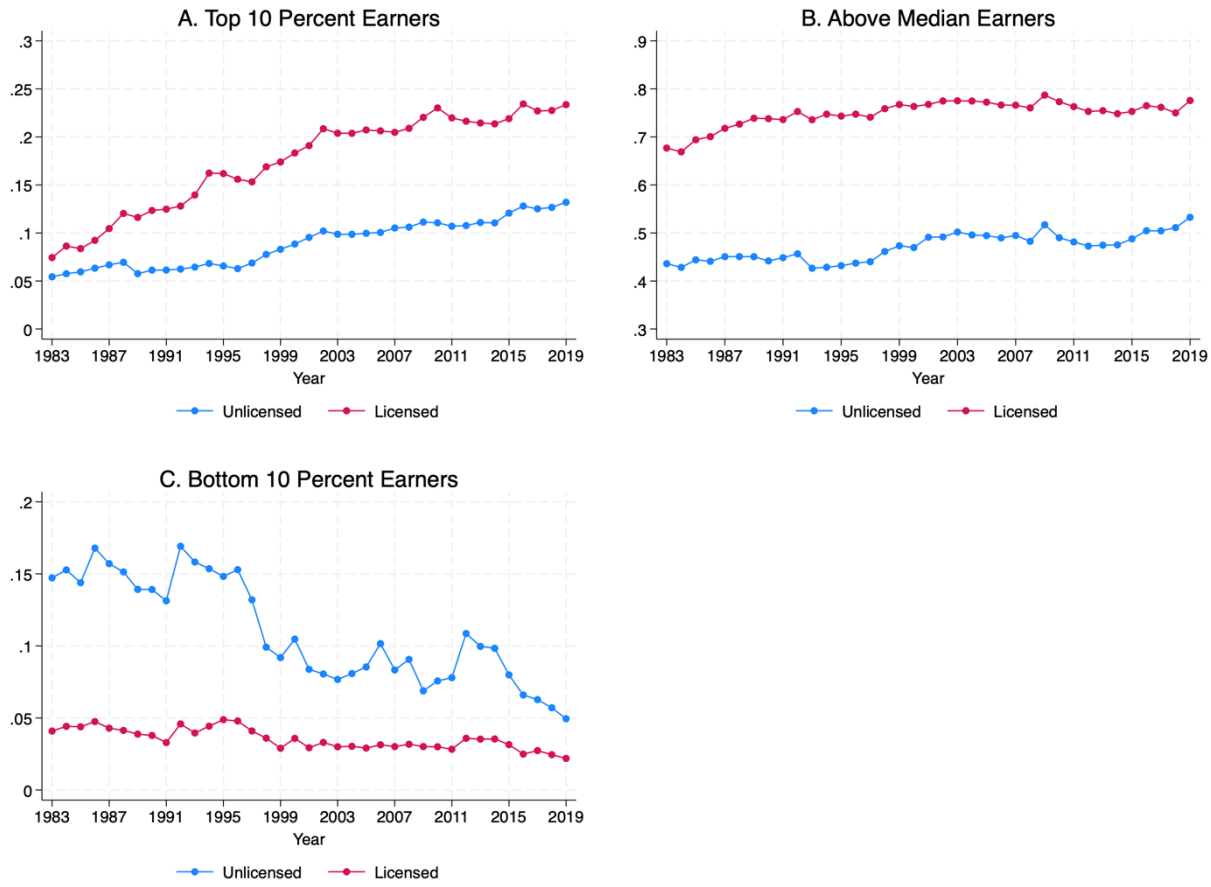
Figure 1. Trends in Earnings by Licensing Status



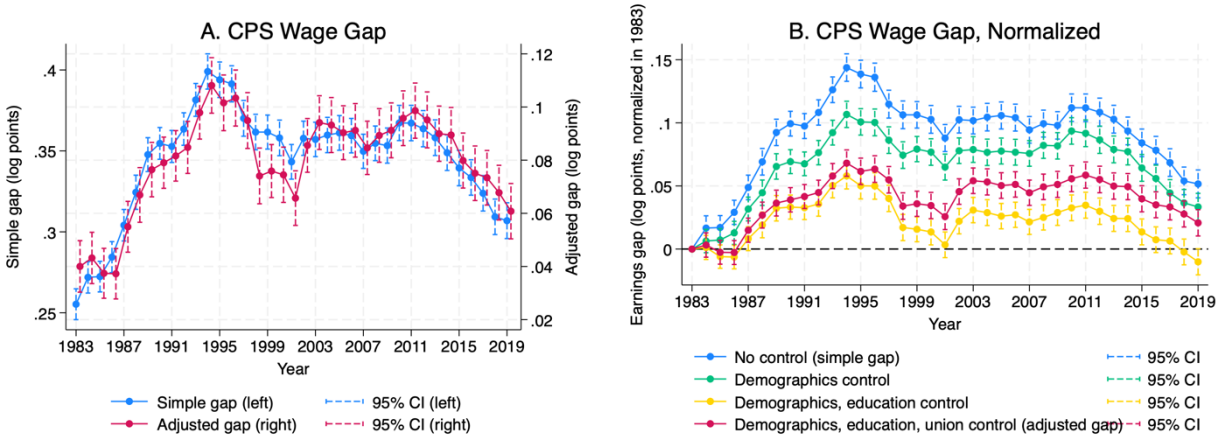
Notes: Estimates are weighted by earnings weight. Panels A to D show the mean, median, 90th percentile, and 10th percentile wage each year by licensing status. The sample includes wage/salary workers (not self-employed) aged 16 to 64 in current employment with non-extreme hourly wages in the CPS ORG 1983 –2019. Licensed workers are individuals whose occupation is one of the 22 universally licensed occupations listed in Table 2, and unlicensed workers are those in all other occupations.

Figure 2. Trends in Absolute Inequality by Licensing Status



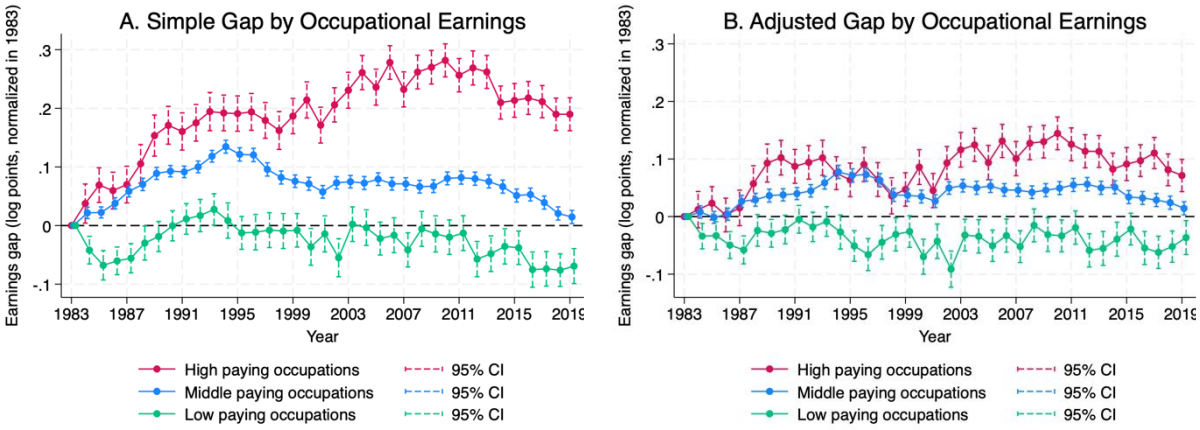
Notes: Estimates are weighted by earnings weight. Panel A shows the share of workers whose wage is above the 90th percentile wage of entire sample ($40.87 in 2019$) each year by licensing status, panel B shows the share of workers whose wage is above the median wage of entire sample ($17.86 in 2019$), and panel C shows the share of workers whose wage is below the 10th percentile wage of entire sample ($8.96 in 2019$). The sample includes wage/salary workers (not self-employed) aged 16 to 64 in current employment with non-extreme hourly wages in the CPS ORG 1983–2019. Licensed workers are individuals whose occupation is one of the 22 universally licensed occupations listed in Table 2, and unlicensed workers are those in all other occupations.

Figure 3. Trends in the Earnings Gap between Licensed and Unlicensed Workers



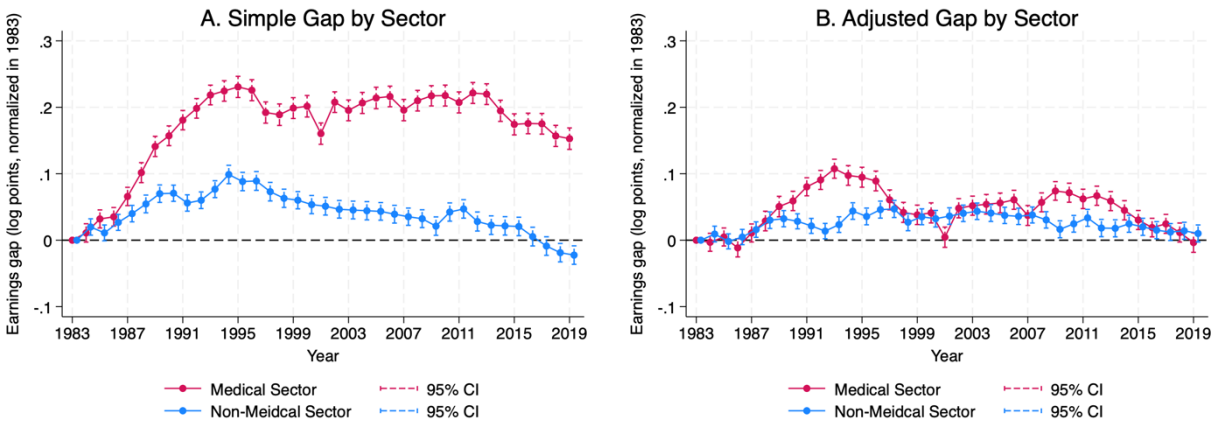
Notes: Panel A shows point estimates of the simple and adjusted earnings gaps and their 95% confidence intervals from OLS regressions with each year's sample. Panel B presents the difference in each earnings gap between 1983 and each subsequent year. The simple earnings gap is the difference between the mean log hourly wages of licensed workers and that of unlicensed workers. The adjusted earnings gap is an earnings gap after accounting for differences in educational attainment, union membership, and demographics between the two groups of workers. Estimates are weighted by earnings weight. The sample include wage/salary workers (not self-employed) aged 16 to 64 in current employment with non-extreme hourly wages in the CPS ORG 1983–2019. Licensed workers are individuals whose occupation is one of the 22 universally licensed occupation listed in Table 2, and unlicensed workers are those in all other occupations.

Figure 4. Trends in Earnings Gap Between Licensed and Unlicensed Workers by Skills



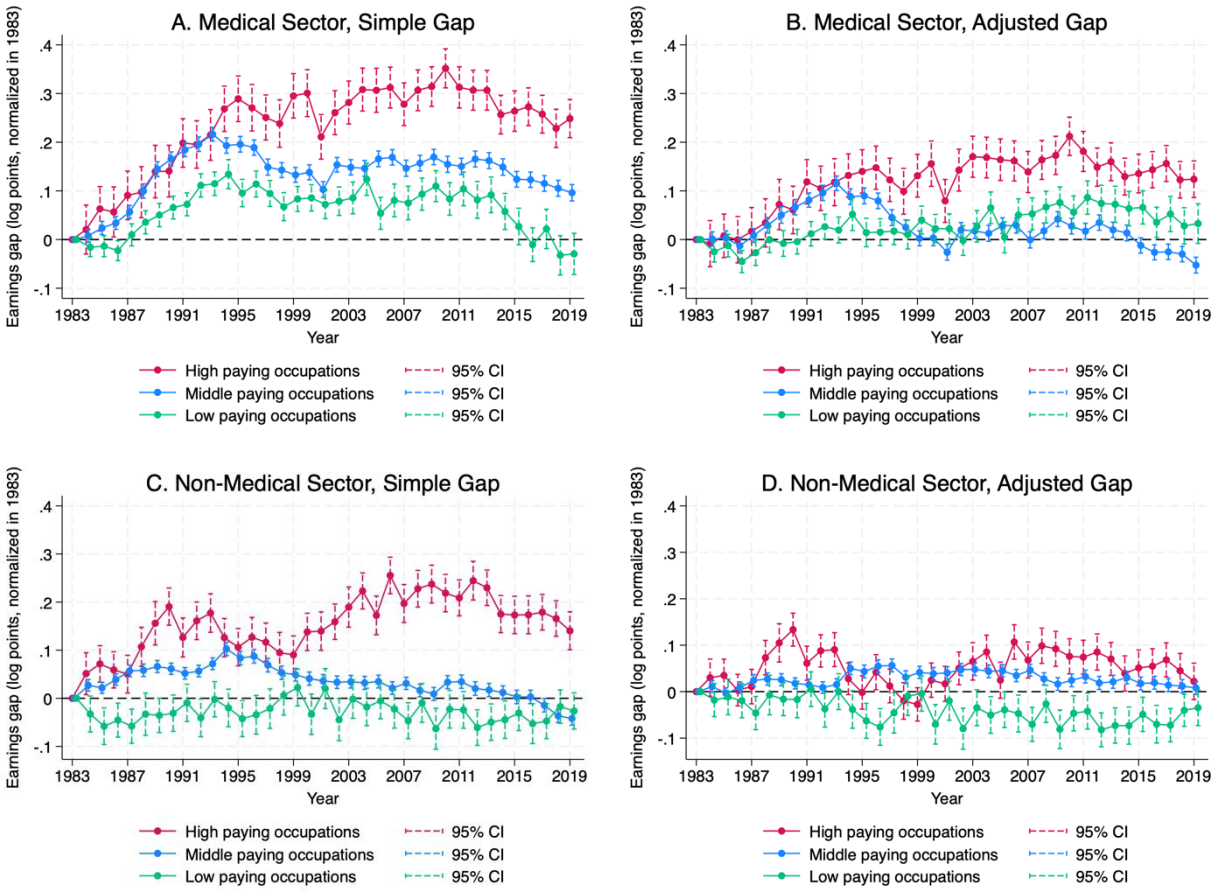
Notes: The high paying occupation group includes seven occupations (dentist, optometrist, lawyer, physician, pharmacist, veterinarian, psychologist) whose average occupational earnings are in the third tercile of wages in the first five years at the beginning of the sample period 1983–1987; the middle paying occupation group consists of eleven occupations (insurance agent, electrician, physical therapist, real estate agent, dental hygienist, secondary school teacher, registered nurse, occupational therapist, primary school teacher, social worker, physician assistant) whose average occupational earnings are in the second tercile; the low paying occupation group is four occupations (licensed practical nurse, pest control worker, cosmetologist, and barber) whose average occupational earnings are in the first tercile. The simple earnings gap is the difference in the mean log hourly wages of workers in each subgroup and that of unlicensed workers. The adjusted earnings gap is an earnings gap after accounting for differences in education and demographics between the two groups of workers. Estimates are weighted by earnings weight. The sample include wage/salary workers (not self-employed) aged 16 to 64 in current employment with non-extreme hourly wages in the CPS ORG 1983–2019.

Figure 5. Trends in Earnings Gap Between Licensed and Unlicensed Workers by Sectors



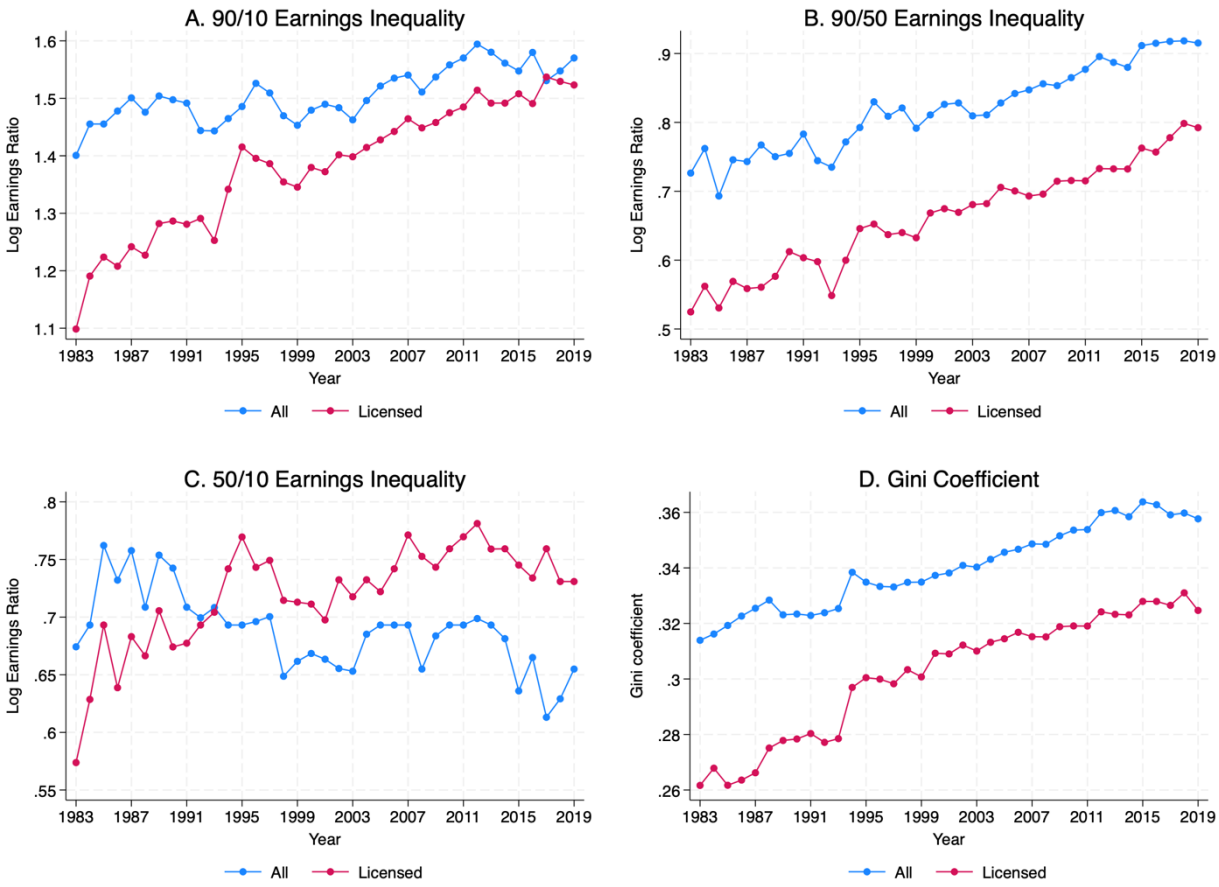
Notes: Medical sector occupations include eleven occupations: physician, dentist, veterinarian, optometrist, registered nurse, pharmacist, occupational therapist, physical therapist, physicians' assistant, dental hygienist, and licensed practical nurse. Non-medical sector professionals include the other eleven occupations: lawyer and judge, psychologist, social worker, primary school teacher, secondary school teacher, insurance agent, real estate sales agent, pest control worker, cosmetologist, barber, and electrician. The simple earnings gap is the difference in the mean log hourly wages of licensed workers and unlicensed workers. The adjusted earnings gap is an earnings gap after accounting for differences in education and demographics between the two groups of workers. Estimates are weighted by earnings weight. The sample include wage/salary workers (not self-employed) aged 16 to 64 in current employment with non-extreme hourly wages in the CPS ORG 1983–2019.

Figure 6. Trends in Earnings Gap Between Licensed and Unlicensed Workers by Sectors and Skills



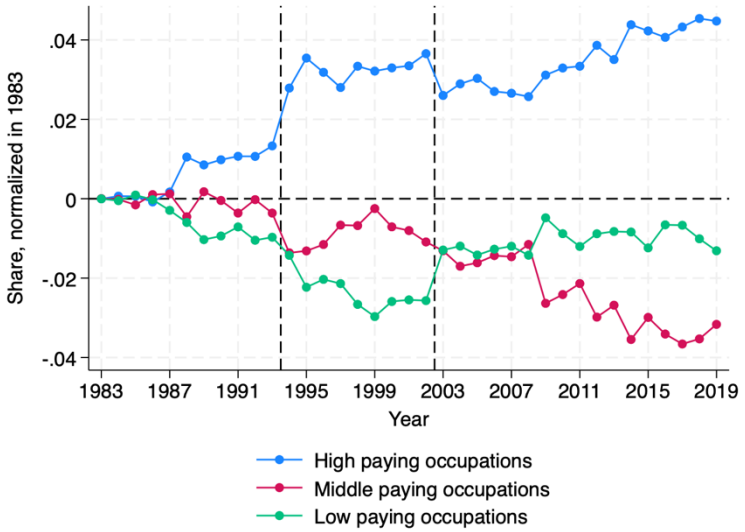
Notes: Medical sector occupations include eleven occupations: physician, dentist, veterinarian, optometrist, registered nurse, pharmacist, occupational therapist, physical therapist, physicians' assistant, dental hygienist, and licensed practical nurse. Non-medical sector professionals include the other eleven occupations: lawyer and judge, psychologist, social worker, primary school teacher, secondary school teacher, insurance agent, real estate sales agent, pest control worker, cosmetologist, barber, and electrician. The high paying occupation group includes seven occupations (dentist, optometrist, lawyer, physician, pharmacist, veterinarian, psychologist) whose average occupational earnings are in the third tercile of wages in the five years at the beginning of the sample period, 1983–1987; the middle paying occupation group consists of eleven occupations (insurance agent, electrician, physical therapist, real estate agent, dental hygienist, secondary school teacher, registered nurse, occupational therapist, primary school teacher, social worker, physician assistant) whose average occupational earnings are in the second tercile; the low paying occupation group is four occupations (licensed practical nurse, pest control worker, cosmetologist, and barber) whose average occupational earnings are in the first tercile. The simple earnings gap is the difference in the mean log hourly wages of workers in each subgroup and that of unlicensed workers. The adjusted earnings gap is an earnings gap after accounting for differences in education and demographics between the two groups of workers. Estimates are weighted by earnings weight. The sample include wage/salary workers (not self-employed) aged 16 to 64 in current employment with non-extreme hourly wages in the CPS ORG 1983–2019.

Figure 7. Trends in Inequality Measures



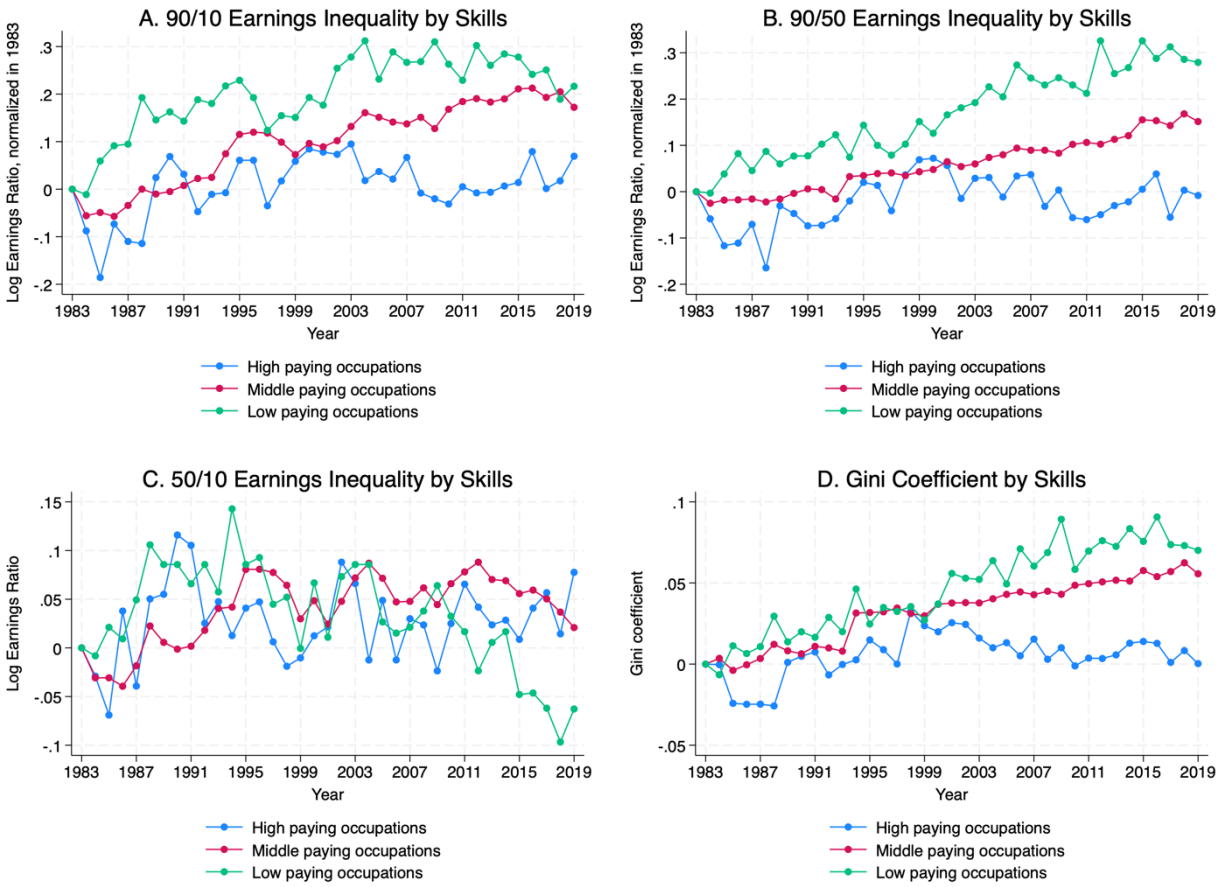
Notes: Estimates are weighted by earnings weight. The sample includes wage/salary workers (not self-employed) aged 16 to 64 in current employment with non-extreme hourly wages in the CPS ORG 1983–2019. Licensed workers are individuals whose occupation is one of the 22 universally licensed occupation listed in Table 2, and unlicensed workers are those in all other occupations.

Figure 8. Trends in the Share of Licensed Workers by Skills



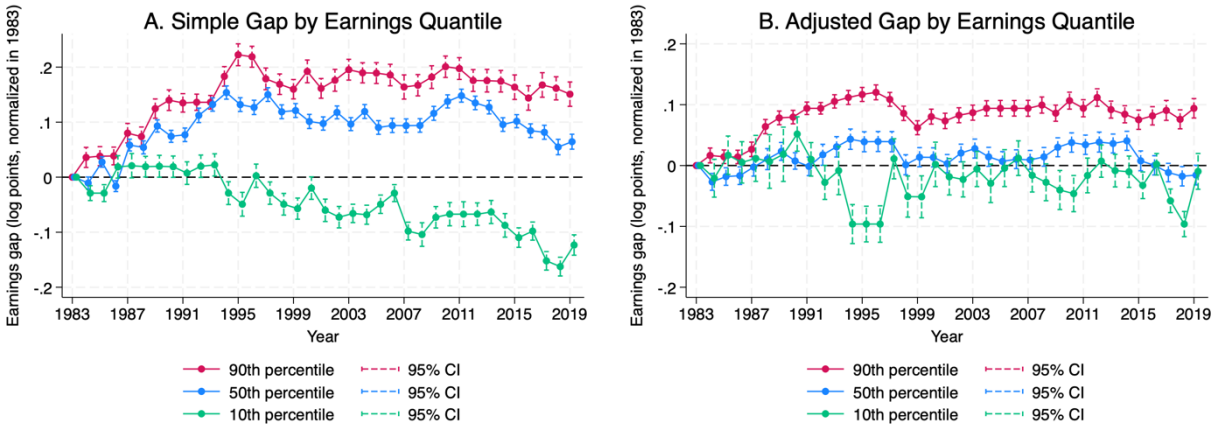
Notes: Estimates are weighted by earnings weight. The sample include wage/salary workers (not self-employed) who are in licensed occupations and aged 16 to 64 in current employment with non-extreme hourly wages in the CPS ORG 1983–2019. The vertical dashed lines correspond to a change in the CPS survey or occupation codes that might have changed the composition of licensed occupations in the sample and subsequently 90/10 and 90/50 earnings inequality. The high paying occupation group includes seven occupations (dentist, optometrist, lawyer, physician, pharmacist, veterinarian, psychologist) whose average occupational earnings are in the third tercile of wages in the five years at the beginning of the sample period, 1983–1987; the middle paying occupation group consists of eleven occupations (insurance agent, electrician, physical therapist, real estate agent, dental hygienist, secondary school teacher, registered nurse, occupational therapist, primary school teacher, social worker, physician assistant) whose average occupational earnings are in the second tercile; the low paying occupation group is four occupations (licensed practical nurse, pest control worker, cosmetologist, and barber) whose average occupational earnings are in the first tercile.

Figure 9. Trends in Inequality Measures by Skills



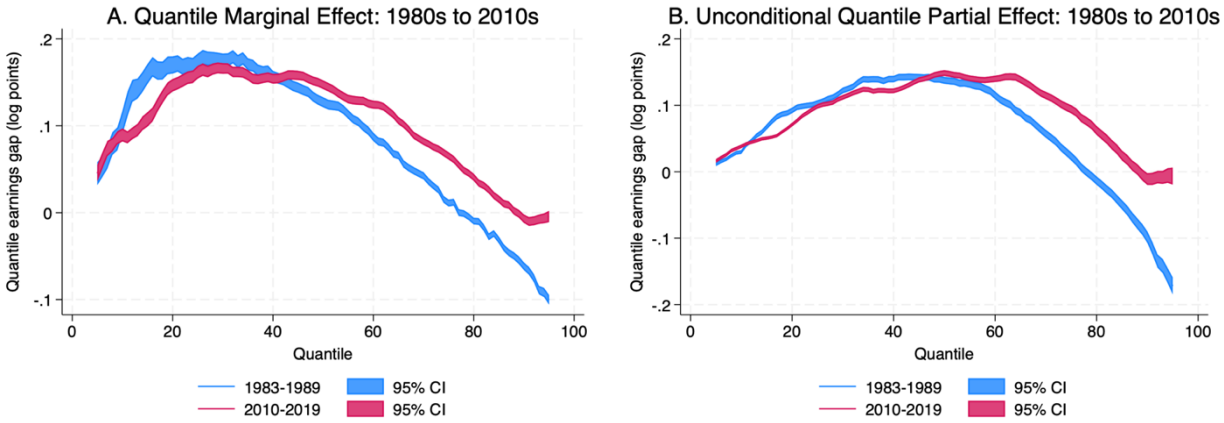
Notes: Estimates are weighted by earnings weight. The sample includes wage/salary workers (not self-employed) aged 16 to 64 in current employment with non-extreme hourly wages in the CPS ORG 1983–2019. The high paying occupation group includes seven occupations (dentist, optometrist, lawyer, physician, pharmacist, veterinarian, psychologist) whose average occupational earnings are in the third tercile of wages in the five years at the beginning of the sample period, 1983–1987; the middle paying occupation group consists of eleven occupations (insurance agent, electrician, physical therapist, real estate agent, dental hygienist, secondary school teacher, registered nurse, occupational therapist, primary school teacher, social worker, physician assistant) whose average occupational earnings are in the second tercile; the low paying occupation group is four occupations (licensed practical nurse, pest control worker, cosmetologist, and barber) whose average occupational earnings are in the first tercile.

Figure 10. Trends in Quantile Earnings Gap Between Licensed and Unlicensed Workers



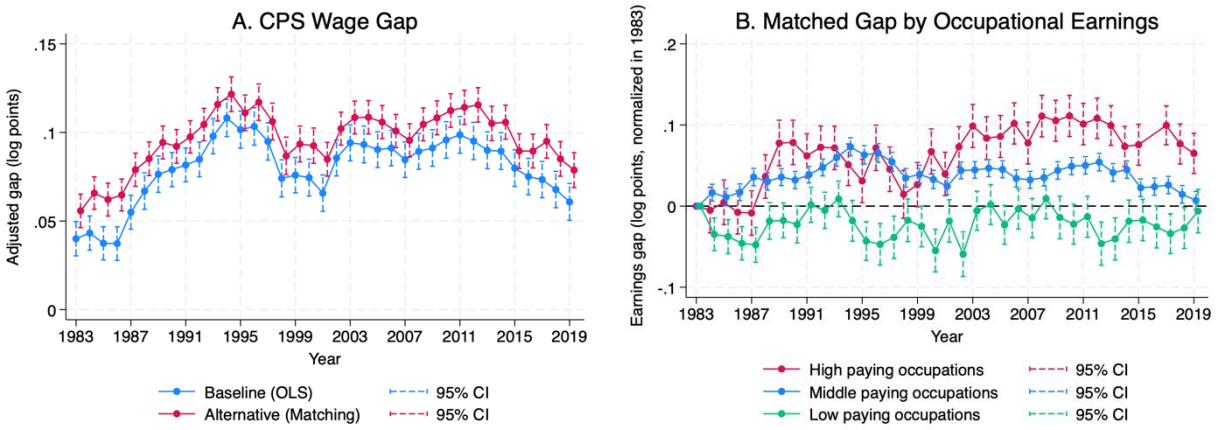
Notes: The simple earnings gap for each quantile is the difference in the quantile of log hourly wages of licensed workers and that of unlicensed workers. The adjusted earnings gap is the quantile earnings gap after accounting for differences in education, union membership, and demographics between the two groups of workers. Estimates are weighted by earnings weight. The sample include wage/salary workers (not self-employed) aged 16 to 64 in current employment with non-extreme hourly wages in the CPS ORG 1983–2019.

Figure 11. Quantile Earnings Gap Between Licensed and Unlicensed Workers in the 1980s and 2010s



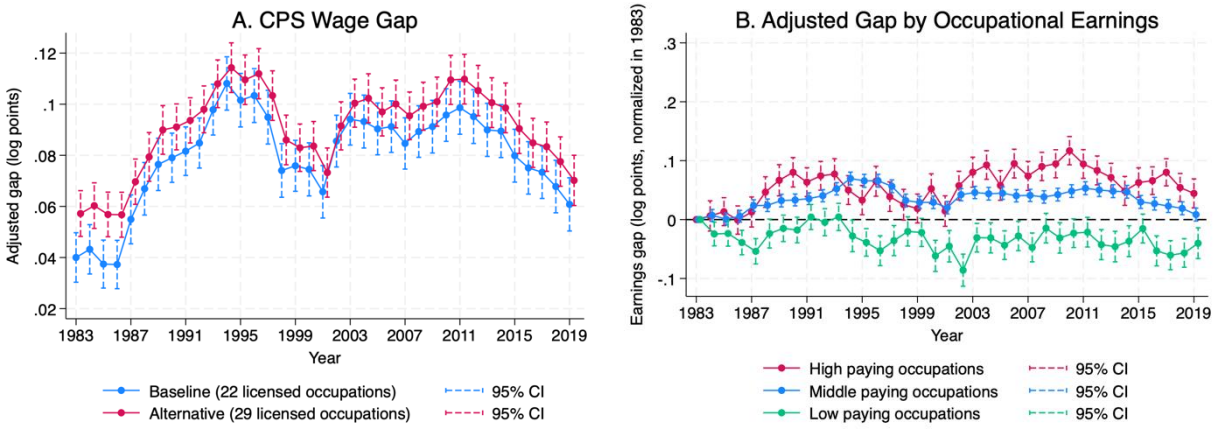
Notes: Panel A shows the adjusted earnings gap for each percentile from the 5th to 95th percentile obtained from quantile regressions. Noisy estimates on percentiles below the 5th and above the 95th percentiles are not presented. Panel B shows the estimate of the unconditional quantile partial effect on the earnings distribution from unconditional quantile regressions. All estimates account for differences in education, union membership, and demographics between licensed and unlicensed workers. The sample include wage/salary workers (not self-employed) aged 16 to 64 in current employment with non-extreme hourly wages in the CPS ORG 1983–2019.

Figure 12. Robustness to Matching Method



Notes: In panel A, blue dots show our baseline estimates of the adjusted earnings gap, as previously shown in Figure 3, and red dots show alternative estimates based on propensity score matching ("matched earnings gap"). The sample include wage/salary workers (not self-employed) aged 16 to 64 in current employment with non-extreme hourly wages in the CPS ORG 1983–2019. The baseline estimate is weighted by earnings weights, but the matched earnings gap is not. Panel B shows the matched earnings gap for three groups of workers by occupational earnings (as a proxy for skills). The matched earnings gap for the high paying occupation group is missing because it is not estimable in 2016 because of a perfect prediction issue. The high paying occupation group includes seven occupations (dentist, optometrist, lawyer, physician, pharmacist, veterinarian, psychologist) whose average occupational earnings are in the third tercile of wages in the five years at the beginning of the sample period, 1983–1987; the middle paying occupation group consists of eleven occupations (insurance agent, electrician, physical therapist, real estate agent, dental hygienist, secondary school teacher, registered nurse, occupational therapist, primary school teacher, social worker, physician assistant) whose average occupational earnings are in the second tercile; the low paying occupation group is four occupations (licensed practical nurse, pest control worker, cosmetologist, and barber) whose average occupational earnings are in the first tercile.

Figure 13. Robustness to Alternative Set of Licensed Occupations



Notes: In panel A, blue dots show our baseline estimates of the adjusted earnings gap, as previously shown in Figure 3, and red dots show alternative estimates when we define licensed workers according to 29 occupations analyzed in Johnson and Kleiner (2020) and Han and Kleiner (2021) that are consistently identifiable in the CPS ORG 1983–2019. The 7 additional occupations are architect, civil engineer (high paying occupations), plumber, funeral director, speech language therapist, respiratory therapist (middle paying occupations), and dental assistant (low paying occupations). The sample include wage/salary workers (not self-employed) aged 16 to 64 in current employment with non-extreme hourly wages in the CPS ORG 1983–2019. Panel B shows the adjusted earnings gap between licensed and unlicensed workers by three skill groups of workers in the 29 licensed occupations. All estimates are weighted by earnings weight.

Table 1. Descriptive Statistics

Variable	(1) All	(2) Licensed workers	(3) Unlicensed workers
Hourly earnings (2019$)	22.52	30.05	21.73
	(16.46)	(19.11)	(15.95)
Age	38.17	40.61	37.91
	(12.42)	(11.09)	(12.52)
Female	0.48	0.68	0.46
White non-Hispanic	0.71	0.78	0.70
Black non-Hispanic	0.12	0.10	0.12
Hispanic	0.12	0.07	0.13
Other race/ethnicity	0.05	0.06	0.05
Less than high school	0.11	0.01	0.12
High school	0.32	0.11	0.34
Some college	0.28	0.22	0.29
College degree	0.19	0.34	0.18
Advanced degree	0.09	0.32	0.07
Licensed	0.10	1.00	0.00
Union member	0.15	0.29	0.14
Observations	6,089,795	586,872	5,502,923

Notes: Weighted means using earnings weights. Standard errors are in parentheses. The sample is wage/salary workers (not self-employed) aged 16 to 64 in current employment with non-extreme hourly wages in the CPS ORG 1983–2019. Licensed workers are individuals whose occupation is one of the 22 universally licensed occupation listed in Table 2, and unlicensed workers are those in all other occupations.

Table 2. Licensed Occupations: Composition and Characteristics

Occupation	(1) Composition (%)	(2) Hourly wages (2019$)	(3) College degree	(4) Female	(5) Union member
Dentists	0.4	54.51	0.95	0.41	0.06
Physicians	4.6	48.71	0.97	0.36	0.09
Lawyers and judges	6.7	48.15	0.97	0.36	0.07
Optometrists	0.2	44.68	0.88	0.55	0.05
Pharmacists	2.2	42.59	0.94	0.52	0.09
Veterinarians	0.4	37.81	0.95	0.60	0.03
Physical therapists	1.5	34.71	0.86	0.70	0.08
Occupational therapists	0.7	34.26	0.87	0.89	0.17
Physicians' assistants	0.8	33.00	0.65	0.60	0.12
Psychologists	1.5	32.38	0.91	0.65	0.27
Dental hygienists	1.3	31.84	0.39	0.98	0.03
Registered nurses	24.6	31.35	0.58	0.92	0.19
Real estate sales occupations	5.0	29.67	0.45	0.58	0.05
Secondary school teachers	12.7	28.99	0.95	0.56	0.63
Insurance sales occupations	4.4	28.14	0.43	0.49	0.03
Primary school teachers	24.4	27.45	0.93	0.82	0.58
Electricians	7.6	25.25	0.06	0.02	0.39
Social workers	7.2	25.00	0.75	0.75	0.25
Licensed practical nurses	5.2	20.58	0.07	0.93	0.14
Pest control occupations	0.6	16.99	0.09	0.04	0.05
Barbers	0.4	14.79	0.04	0.25	0.05
Cosmetologists	5.9	13.97	0.06	0.91	0.02
Total	100.0	30.05	0.66	0.68	0.29

Notes: Composition is the weighted share of each occupation among 22 universally licensed occupations in the CPS ORG 1983–2019 using earnings weights. Four occupational characteristics (hourly wages, college degree attainment, female, and union membership) are weighted means of individual characteristics among workers in each occupation. The sample includes wage/salary workers (not self-employed) aged 16 to 64 in current employment with non-extreme hourly wages in the CPS ORG 1983–2019.

Table 3. Earnings Gap Between Licensed and Unlicensed Workers

	(1)	(2)	(3)	(4)	(5)
	Entire period	1983–1989	1990–1999	2000–2009	2010–2019
A. Simple earnings gap					
Licensed	0.346***	0.296***	0.373***	0.355***	0.340***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Observations	6,089,795	1,208,640	1,635,455	1,693,303	1,552,397
R-squared	0.04	0.02	0.03	0.03	0.03
B. Adjusted earnings gap					
Licensed	0.079***	0.051***	0.090***	0.086***	0.082***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Observations	6,089,795	1,208,640	1,635,455	1,693,303	1,552,397
R-squared	0.38	0.39	0.39	0.38	0.37

Note: Outcome is the log of hourly wages. The sample include wage/salary workers (not self-employed) aged 16 to 64 in current employment with non-extreme hourly wages in the CPS ORG 1983–2019. Column 1 estimation uses the entire sample, and columns 2 to 5 use a decadal subsample stated in the column heading. All regression models include year fixed effects, whose coefficient estimates are not shown in the table. Regressions for adjusted earnings gap also include age, age squared, female, race and ethnicity (Black, Hispanic, and all others), educational attainment (high school graduate, some college, college degree, advanced degree), and union membership dummies. Standard errors are robust to heteroscedasticity and presented in parentheses, and *, **, *** represent statistical significance at the 10%, 5%, and 1% level, respectively.

Table 4. Earnings Gap Between Licensed and Unlicensed Workers by Socio-Demographics

	(1)	(2)	(3)	(4)	(5)
	Entire period	1983–1989	1990–1999	2000–2009	2010–2019
A. All	0.079***	0.051***	0.090***	0.086***	0.082***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
B. By age					
16–24	0.130***	0.120***	0.134***	0.131***	0.138***
	(0.003)	(0.006)	(0.006)	(0.006)	(0.006)
25–54	0.068***	0.042***	0.080***	0.076***	0.072***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
55–64	0.108***	0.076***	0.135***	0.115***	0.101***
	(0.003)	(0.007)	(0.006)	(0.005)	(0.004)
C. By gender					
Female	0.122***	0.118***	0.143***	0.121***	0.119***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Male	0.012***	-0.033***	0.012***	0.033***	0.022***
	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
D. By race/ethnicity					
White	0.077***	0.047***	0.089***	0.085***	0.082***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Black	0.098***	0.089***	0.094***	0.096***	0.112***
	(0.003)	(0.007)	(0.006)	(0.005)	(0.005)
Hispanic	0.122***	0.085***	0.124***	0.136***	0.124***
	(0.003)	(0.010)	(0.008)	(0.006)	(0.005)
E. By education					
High school	0.105***	0.125***	0.116***	0.106***	0.079***
or below	(0.002)	(0.004)	(0.004)	(0.004)	(0.005)
Some college	0.195***	0.171***	0.210***	0.192***	0.195***
education	(0.002)	(0.004)	(0.003)	(0.003)	(0.003)
College degree	0.053***	0.008***	0.051***	0.060***	0.064***
or above	(0.001)	(0.003)	(0.002)	(0.002)	(0.002)
Panel F. By union					
Member	0.094***	0.047***	0.092***	0.107***	0.116***
	(0.002)	(0.003)	(0.003)	(0.003)	(0.004)
Non-member	0.102***	0.094***	0.118***	0.102***	0.092***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)

Note: Outcome is the log of hourly wages. The sample is wage/salary workers (not self-employed) aged 16–64 in current employment with non-extreme hourly wages in the CPS ORG 1983–2019. An estimate in each cell is based on a subsample specified by the row and column

heading. All regression models include year fixed effects, whose coefficient estimates are shown in the table. Regressions also include age, age squared, female, race and ethnicity (Black, Hispanic, and others except White), and educational attainment (high school graduate, some college, college degree, advanced degree), and union membership dummies. Standard errors are robust to heteroscedasticity and presented in parentheses, and *, **, *** represent statistical significance at the 10%, 5%, and 1% level, respectively.

Table 5. Robustness to Alternative Data: Labor Earnings in PSID 1983–2019

	(1)	(2)	(3)	(4)	(5)
	Entire period	1983–1989	1990–1999	2000–2009	2010–2019
A. Simple earnings gap					
Licensed	0.330***	0.309***	0.298***	0.339***	0.333***
	(0.019)	(0.029)	(0.036)	(0.024)	(0.023)
Observations	163,553	34,360	42,913	40,932	45,348
R-squared	0.02	0.02	0.01	0.02	0.02
B. Adjusted earnings gap					
Licensed	0.131***	0.104***	0.082**	0.145***	0.142***
	(0.018)	(0.027)	(0.038)	(0.022)	(0.022)
Observations	163,553	34,360	42,913	40,932	45,348
R-squared	0.23	0.28	0.17	0.23	0.25

Notes: Outcome variable is the log of hourly labor earnings. The sample include workers (including self-employed) aged 16 to 64 who are the head/reference person of household or their spouse and have labor earnings in the PSID 1983–2019. The column 1 estimation uses the entire sample, and columns 2 to 5 use a decadal subsample stated in the column heading. Regressions for adjusted earnings gap also include year fixed effects, age, age squared, female, race and ethnicity (Black and all others), educational attainment (high school graduate, some college, college degree, advanced degree), and union membership dummies, whose coefficient estimates are not shown in the table. Standard errors are clustered by persons and presented in parentheses, and *, **, *** represent statistical significance at the 10%, 5%, and 1% level, respectively.

Table 6. Robustness to Partially Licensed Occupations: A Case Study of Opticians

	(1)	(2)	(3)	(4)	(5)
	Entire period	1983–1989	1990–1999	2000–2009	2010–2019
A. Simple earnings gap					
Licensed	0.167***	0.124**	0.112*	0.188***	0.253***
	(0.036)	(0.054)	(0.058)	(0.039)	(0.042)
Observations	2,609	545	850	660	554
R-squared	0.12	0.04	0.03	0.07	0.12
B. Adjusted earnings gap					
Licensed	0.126***	0.098*	0.087*	0.149***	0.168***
	(0.024)	(0.049)	(0.049)	(0.028)	(0.054)
Observations	2,609	545	850	660	554
R-squared	0.31	0.27	0.30	0.22	0.32

Notes: Outcome variable is the log of hourly wages. The sample include opticians who are not self-employed, and who are aged 16 to 64 in current employment with non-extreme hourly wages in the CPS ORG 1983–2019. "Licensed" is an indicator for opticians in states that regulate opticians with occupational licensing throughout the sample period. Opticians in California and Texas are excluded from the sample because they were not required to have an occupational license for a part of sample period. The column 1 estimation uses the entire sample, and columns 2 to 5 use a decadal subsample stated in the column heading. Regressions for adjusted earnings gap also include year fixed effects, age, age squared, female, race and ethnicity (Black, Hispanic, and all others), educational attainment (high school graduate, some college, college degree, post college education), and union membership dummies, whose coefficient estimates are not shown in the table. Standard errors are clustered by states and presented in parentheses, and *, **, *** represent statistical significance at the 10%, 5%, and 1% level, respectively.

Table 7. Robustness to Individual License Attainment Data in CPS 2015–2019

	(1)	(2)	(3)
A. Simple earnings gap			
Licensed occupation (L1)	0.292***		0.149***
	(0.003)		(0.005)
License attainment (L2)		0.238***	0.163***
		(0.002)	(0.002)
L1*L2			0.072***
			(0.006)
Observations	667,072	667,071	667,071
R-squared	0.02	0.03	0.03
B. Adjusted earnings gap			
Licensed occupation (L1)	0.067***		0.018***
	(0.002)		(0.004)
License attainment (L2)		0.055***	0.035***
		(0.002)	(0.002)
L1*L2			0.045***
			(0.005)
Observations	667,072	667,071	667,071
R-squared	0.34	0.34	0.34

Note: Outcome is the log of hourly wages. The sample include wage/salary workers (not self-employed) at age 16 to 64 in current employment with non-extreme hourly wages in the CPS ORG 1983–2019. All regression models include year fixed effects, whose coefficient estimates are not shown in the table. Regressions for adjusted earnings gap also include age, age squared, female, race and ethnicity (Black, Hispanic, and all others), educational attainment (high school graduate, some college, college degree, post college education), and union membership dummies. Standard errors are robust to heteroscedasticity and presented in parentheses, and *, **, *** represent statistical significance at the 10%, 5%, and 1% level, respectively.

Table 8. Robustness to Analysis Without Major Occupations or Weighting

	(1)	(2)	(3)	(4)	(5)
	Entire period	1983–1989	1990–1999	2000–2009	2010–2019
A. Baseline					
Licensed	0.079***	0.051***	0.090***	0.086***	0.082***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Observations	6,089,795	1,208,640	1,635,455	1,693,303	1,552,397
R-squared	0.38	0.39	0.39	0.38	0.37
B. Except teachers/nurses					
Licensed	0.101***	0.077***	0.104***	0.112***	0.096***
	(0.001)	(0.003)	(0.002)	(0.002)	(0.002)
Observations	5,755,660	1,149,389	1,551,913	1,598,439	1,455,919
R-squared	0.39	0.40	0.39	0.38	0.38
C. Unweighted					
Licensed	0.083***	0.054***	0.095***	0.092***	0.089***
	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
Observations	6,089,795	1,208,640	1,635,455	1,693,303	1,552,397
R-squared	0.38	0.39	0.38	0.37	0.36

Note: Outcome is the log of hourly wages. The sample include wage/salary workers (not self-employed) aged 16 to 64 in current employment with non-extreme hourly wages in the CPS ORG 1983–2019. An estimate in each cell is based on a subsample or a method specified by the row and column heading. All regression models include year fixed effects, whose coefficient estimates are not shown in the table. Regressions for adjusted earnings gap also include age, age squared, female, race and ethnicity (Black, Hispanic, and all others), educational attainment (high school graduate, some college, college degree, advanced degree), and union membership dummies. Standard errors are robust to heteroscedasticity and presented in parentheses, and *, **, *** represent statistical significance at the 10%, 5%, and 1% level, respectively.

Appendix

Table A1. Descriptive Statistics: PSID 1983–2019

Variable	(1) All	(2) Licensed workers	(3) Unlicensed workers
Hourly labor earnings	30.57	40.17	29.36
(2019$)	(45.73)	(48.91)	(45.17)
Age	42.52	43.25	42.43
	(11.39)	(10.99)	(11.43)
Female	0.48	0.67	0.45
White non-Hispanic	0.81	0.86	0.80
Black non-Hispanic	0.11	0.08	0.11
Other race/ethnicity	0.08	0.06	0.09
Less than high school	0.11	0.02	0.12
High school	0.28	0.11	0.30
Some college	0.25	0.20	0.26
College degree	0.21	0.29	0.20
Advanced degree	0.15	0.39	0.12
Union membership	0.12	0.21	0.11
Observations (person-year)	201,223	19,368	181,855

Notes: Weighted means using individual cross-sectional weights of PSID. Standard errors are in parentheses. The sample is workers (including self-employed workers) aged 16 to 64 who are the head/reference person of household or their spouse and have labor earnings in the PSID 1983–2019. Licensed workers are individuals whose occupation is one of the 22 universally licensed occupation listed in Table 2, and unlicensed workers are all others. Regarding variables on race and ethnicity, the PSID does not identify Hispanic as a separate category.

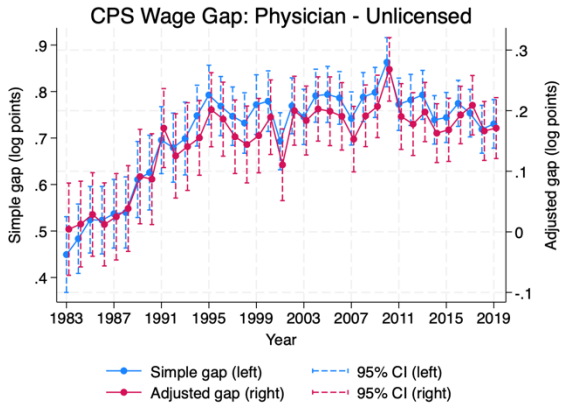
Table A2. Descriptive Statistics: Opticians in the CPS ORG 1983–2019

Variable	(1) All	(2) Licensed opticians	(3) Unlicensed opticians
Hourly earnings (2019$)	19.36	20.90	17.74
	(10.55)	(10.46)	(10.39)
Age	38.27	38.78	37.74
	(11.83)	(11.73)	(11.90)
Female	0.63	0.58	0.69
White non-Hispanic	0.85	0.81	0.89
Black non-Hispanic	0.07	0.08	0.06
Hispanic	0.05	0.07	0.03
Other race/ethnicity	0.03	0.04	0.02
Less than high school	0.04	0.04	0.04
High school	0.37	0.33	0.42
Some college	0.44	0.47	0.40
College degree	0.12	0.13	0.11
Advanced degree	0.03	0.03	0.03
Licensed	0.45	1.00	0.00
Union member	0.04	0.04	0.05
Observations	2,609	1,162	1,447

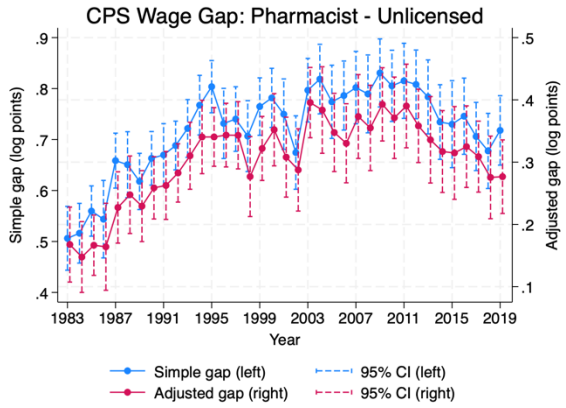
Notes: Estimates are weighted means using earnings weights. Standard errors are in parentheses. The sample is opticians with wages and salaries (not self-employed) who are aged 16 to 64 in current employment with non-extreme hourly wages in the CPS ORG 1983–2019. Licensed opticians are those who reside in states with optician licensure, and unlicensed opticians are those who reside in states without. Opticians in California and Texas are excluded from the sample because they did not license opticians for some years in the sample period.

Figure A1. Licensed-Unlicensed Earnings Gap by Major Occupations, Medical Sector

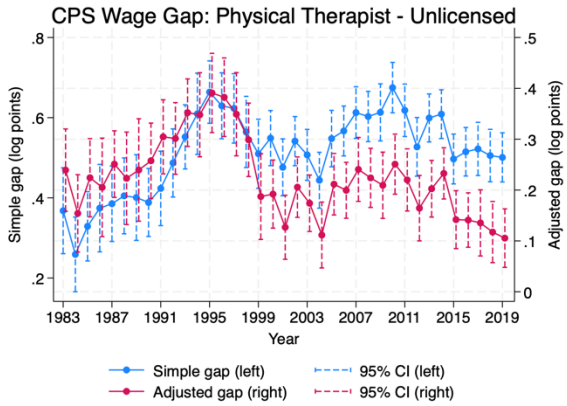
A. Physician



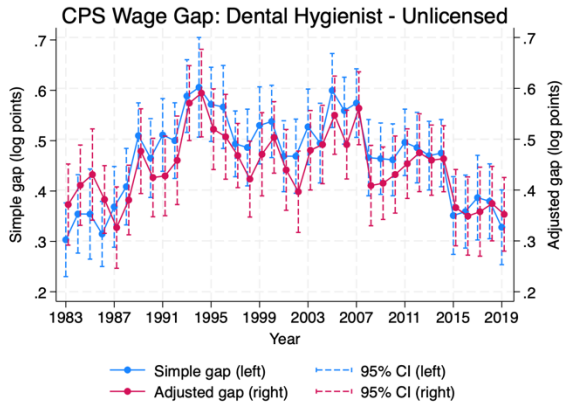
B. Pharmacist



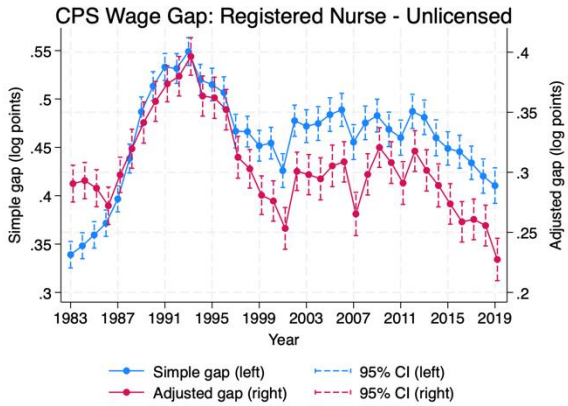
C. Physical Therapist



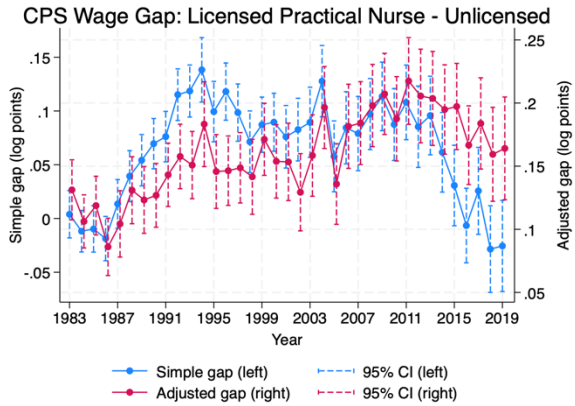
D. Dental Hygienist



E. Registered Nurse



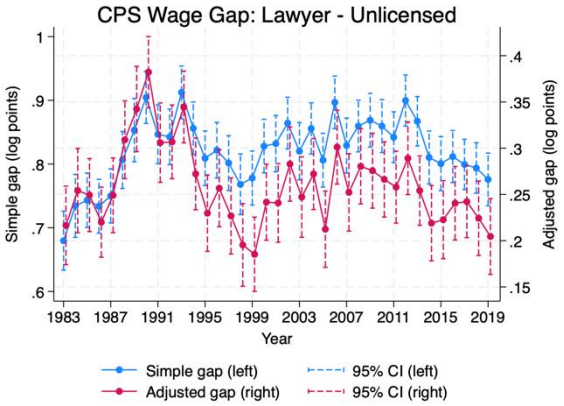
F. Licensed Practical Nurse



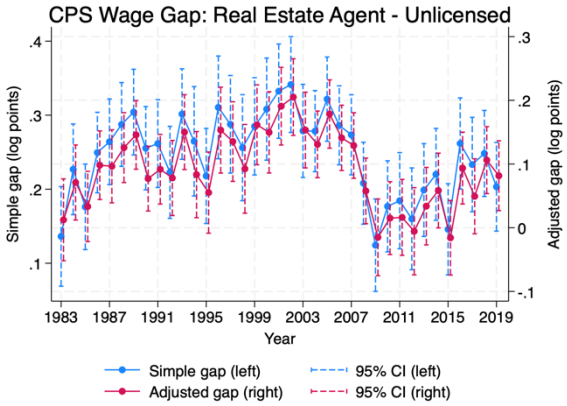
Notes: The simple earnings gap is the difference in the mean log hourly wages of workers in the specified occupation and that of unlicensed workers. The adjusted earnings gap is an earnings gap after accounting for differences in education, union membership, and demographics between the two groups of workers. Estimates are weighted by earnings weight. The sample include wage/salary workers (not self-employed) ages 16 to 64 in current employment with non-extreme hourly wages in the CPS ORG 1983-2019.

Figure A2. Licensed-Unlicensed Earnings Gap by Major Occupations, Non-Medical Sector

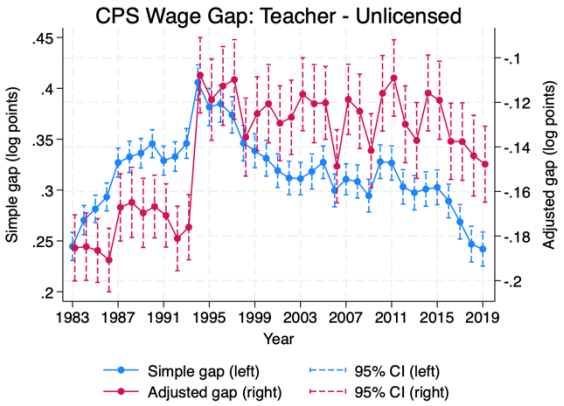
A. Lawyer



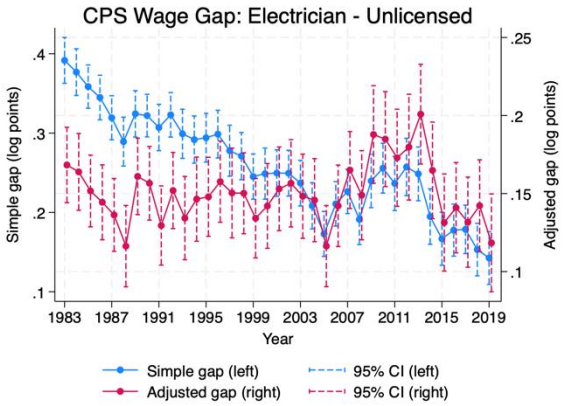
B. Real Estate Agent



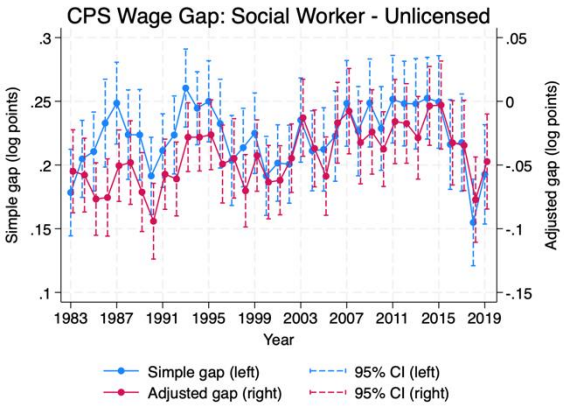
C. Teacher



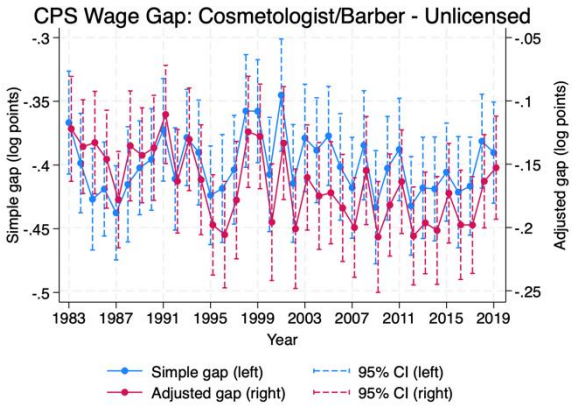
D. Electrician



E. Social Worker



F. Cosmetologist/Barber



Notes: The simple earnings gap is the difference in the mean log hourly wages of workers in the specified occupation and that of unlicensed workers. The adjusted earnings gap is an earnings gap after accounting for differences in education, union membership, and demographics between the two groups of workers. Estimates are weighted by earnings weight. The sample include wage/salary workers (not self-employed) aged 16 to 64 in current employment with non-extreme hourly wages in the CPS ORG 1983–2019.