OECD Economics Department Working Papers No. 1585

Occupational licensing and job mobility in the United States

Mikkel Hermansen

https://dx.doi.org/10.1787/4cc19056-en

OECD

Organisation for Economic Co-operation and Development

ECO/WKP(2019)55

Unclassified English - Or. English

12 December 2019

ECONOMICS DEPARTMENT

OCCUPATIONAL LICENSING AND JOB MOBILITY IN THE UNITED STATES

ECONOMICS DEPARTMENT WORKING PAPERS No. 1585

By Mikkel Hermansen

JT03456039

On 25 May 2018, the OECD Council invited Colombia to become a Member. At the time of preparation the deposit of Colombia's instrument of accession to the OECD Convention was pending and therefore Colombia does not appear in the list of OECD Members and is not included in the OECD zone aggregates.

This document and any map included herein are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

ABSTRACT / RESUMÉ

Occupational licensing and job mobility in the United States

This paper studies the association between occupational licensing and job hire and job separation rates along with earnings of job stayers and job-to-job movers. In contrast to previous studies, it attempts to provide macro-level estimates by relying on a novel Job-to-Job Flows database from the U.S. Census Bureau, covering the near universe of job transitions. The empirical analysis exploits variation in licensing regulation across states and industries and constructs indicators for both the share of employment subject to licensing (the extensive margin) and the strictness of regulation (the intensive margin). Results show that more extensive and stricter licensing are both associated with lower job mobility. This holds for job-to-job mobility as well as for transitions in and out of nonemployment. The strictness indicator points to lower job-to-job mobility from entry restrictions and renewal requirements to licensing, while education and training requirements may increase job-to-job mobility. The analysis also finds a negative association between licensing restrictions for people with a criminal record and job hire from nonemployment. Further analysis shows that interstate job-to-job mobility tends to be lower towards states with more extensive and stricter licensing regulation. The results from the analysis of earnings are generally mixed and mostly insignificant. However, there is some evidence of lower earnings gains from job-to-job moves to states with more licensing within the same industry, which may reflect lower productivity growth because of weaker reallocation of labour resources and reduced competition.

JEL codes: E24, J30, J44, J61, J62, K20, L51

Keywords: Occupational licensing, regulation, entry restrictions, job mobility, earnings.

****

Autorisations professionnelles et mobilité professionnelle aux États-Unis

Dans ce document, on analyse le lien entre l'attribution d'autorisations professionnelles et les taux d'embauche et de cessation d'emploi, ainsi que les rémunération des travailleurs qui restent dans leur emploi et ceux qui en changent. Contrairement aux études précédentes, on s'efforce ici de fournir des estimations macroéconomiques en s'appuyant sur une nouvelle base de données (J2J) du Bureau du recensement des États-Unis, qui répertorie les flux inter-emplois et couvre quasiment l'intégralité des changements de situation au regard de l'emploi. À partir des différences de réglementation des autorisations professionnelles entre les États et les secteurs d'activité, l'analyse empirique permet de construire des indicateurs à la fois pour la proportion d'emplois relevant d'une autorisation (marge extensive) et pour la restrictivité de la réglementation (marge intensive). Les résultats montrent que des autorisations professionnelles plus nombreuses et plus restrictives vont de pair, dans l'un et l'autre cas, avec une moindre mobilité professionnelle. Le constat vaut pour la mobilité d'un emploi vers un autre ainsi que pour les transitions à l'entrée / en sortie du non-emploi. Si l'indicateur de restrictivité montre une moindre mobilité de l'emploi vers l'emploi résultant de restrictions d'accès et d'obligations à remplir pour le renouvellement des autorisations, les obligations en matière d'éducation et de formation peuvent, quant à elles, accroître la mobilité professionnelle. On constate également une corrélation négative entre les restrictions d'autorisations applicables aux personnes ayant des antécédents judiciaires et le recrutement à partir d'une situation de non-emploi. Une analyse plus approfondie montre que la mobilité professionnelle d'un État à l'autre tend à être plus faible dans les États où la proportion d'emplois soumis à autorisation est plus forte (marge extensive) et où les réglementations sont plus restrictives. Quant aux résultats de l'analyse des rémunérations, ils sont généralement mitigés et pour la plupart non significatifs. Toutefois, certains signes montrent que les transitions de l'emploi vers l'emploi en direction d'États où les autorisations professionnelles sont plus nombreuses au sein du même secteur vont de pair avec de plus faibles gains de rémunérations, ce qui peut s'expliquer par le fait que la productivité y est inférieure en raison d'un moindre redéploiement des ressources en main-d'œuvre et d'une concurrence réduite.

Classification JEL : E24, J30, J44, J61, J62, K20, L51

Mots-clés : Autorisations professionnelles, réglementation, restrictions d’accès, mobilité professionnelle, rémunérations.

Table of contents

Tables

Figures

Boxes

Occupational licensing and job mobility in the United States

By Mikkel Hermansen[1]

1. Introduction

1. Occupational licensing places restrictions on who is allowed to perform certain types of services, typically with the aim to protect safety and health of consumers. More than 20% of workers in the United States now hold an occupational licence to practice legally (BLS), rising steadily over several decades from just 5% in the 1950s (White House, 2015). The European Union (EU) and Japan have similar proportions of licensed workers (Koumenta and Pagliero, 2017; Morikawa, 2018), but with notable differences to the United States across occupations and industries.

2. The state level governs most of the occupational regulation in the United States with substantial variation in coverage and strictness. Licensing is the most frequent and stringent type of occupational regulation, while (voluntary) certification and registration are more lenient alternatives that are less used. This paper focuses on occupational licensing only and does not include certified or registered workers in the measures of regulation coverage.

3. Occupational licensing serves a number of public policy objectives, including consumer protection from poor service and incentives for firms and workers to invest in education and training (Shapiro, 1986). Licensing can mitigate problems of asymmetric information by providing consumers a mechanism to verify that service providers satisfy a set of minimum requirements. The few available studies of the initial adoption of licensing laws have indeed found positive effects, for instance on maternal and infant mortality when midwives became licensed in the early 20th century (Anderson et al., 2016) and on quality of physicians when they became licensed around year 1900 (Law and Kim, 2005). However, studies of more recent changes in licensing restrictions have generally not been able to find significant effects of licensing on quality of services (Kleiner, 2017). The information advantage of having a government verified licence

[1] This paper has been prepared as background work for the forthcoming 2020 OECD Economic Survey of the United States. The author is economist in the OECD Economics Department. He is grateful to Iris Hentze, Suzanne Hultin and colleagues from the National Conference of State Legislatures for discussions and help to access the National Occupational Licensing Database. He would like to thank Damien Azzopardi for invaluable help with the large Job-to-Job Flows data and Douglas Sutherland and Patrick Lenain for their guidance and many useful discussions (all OECD Economics Department). The author also thanks Christina von Rueden (Economics Department), Fozan Fareed (consultant to the OECD), Luca Marcolin (Directorate for Employment, Labour and Social Affairs), Christopher Smith (Board of Governors of the Federal Reserve System), Maria Koumenta (Queen Mary University of London), Morris Kleiner (University of Minnesota), meeting participants at the Council of Economic Advisers, the Board of Governors of the Federal Reserve System, U.S. Department of Labor, U.S. Department of the Treasury and Virginia Department of Professional and Occupational Licensing for their comments and suggestions.

has also devalued as consumers increasingly rely on digital access to online reviews when making choices (Farronato et al., 2018).

4. The benefits of licensing for some consumers may come at costs to others who face higher prices, reduced employment opportunities and are disadvantaged by weaker aggregate productivity growth. By restricting entry to professions, occupational licensing policies can reduce competitive pressures, allowing incumbents to raise prices and wages (Friedman, 1962). Entry barriers from licensing can be particularly large for foreign firms and foreign workers (e.g. from local exam and language requirements) and thus effectively imposes a non-trade tariff barrier. In addition to reduced competition, licensing can weigh on productivity growth through reduced reallocation of workers from low to high productivity firms (von Rueden et al., 2019). Reduced job mobility is not only a concern for productivity, but is also particularly important for groups with low labour market experience, such as young and low-skilled workers, to climb the job ladder (Haltiwanger et al., 2018).

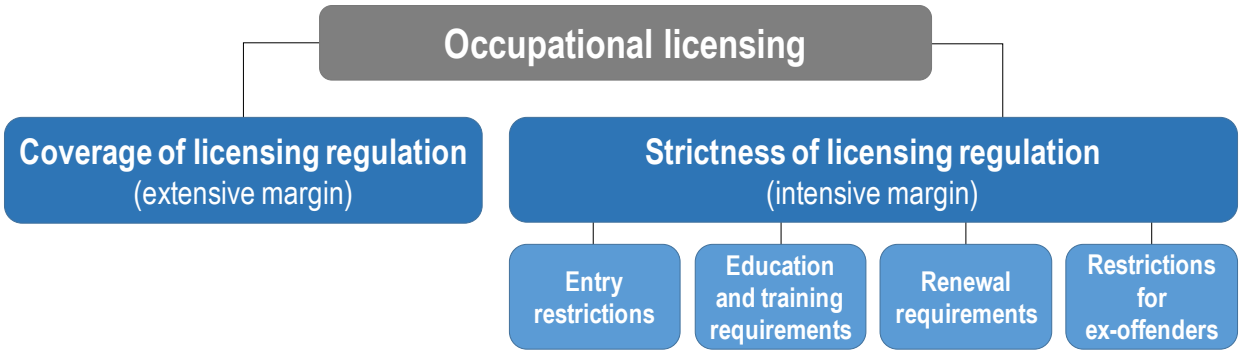
5. Policymakers have become increasingly concerned with the potential costs of occupational licensing. This is not least due to the secular decline in business dynamics, lower job and interstate mobility and sluggish growth of productivity and worker earnings in the United States (OECD, 2016). While empirical evidence is growing, more work is needed to isolate the potential effect of licensing policies on these trends. This also includes a better understanding of political economy dynamics as initiatives to reform licensing often fails due to stiff opposition from representatives of licensed professions (Kilmer, 2018).

6. This paper provides novel evidence on the association between occupational licensing and job mobility and earnings. In contrast to the majority of existing studies, it attempts to provide macro-level estimates by relying on a novel Job-to-Job Flows database (J2J Data) from the U.S. Census Bureau, covering the near-universe of job transitions quarterly since 2000. The paper constructs a number of indicators to quantify the share of employment subject to occupational licensing (the extensive margin) as well as the strictness of regulation (the intensive margin) for a subset of occupations (Figure 1, Panel A). The strictness indicator composes four subcomponents (entry restrictions; education and training requirements; renewal requirements; and restrictions for people with a criminal record), allowing for disentangling the influence of different types of requirements to hold a licence.

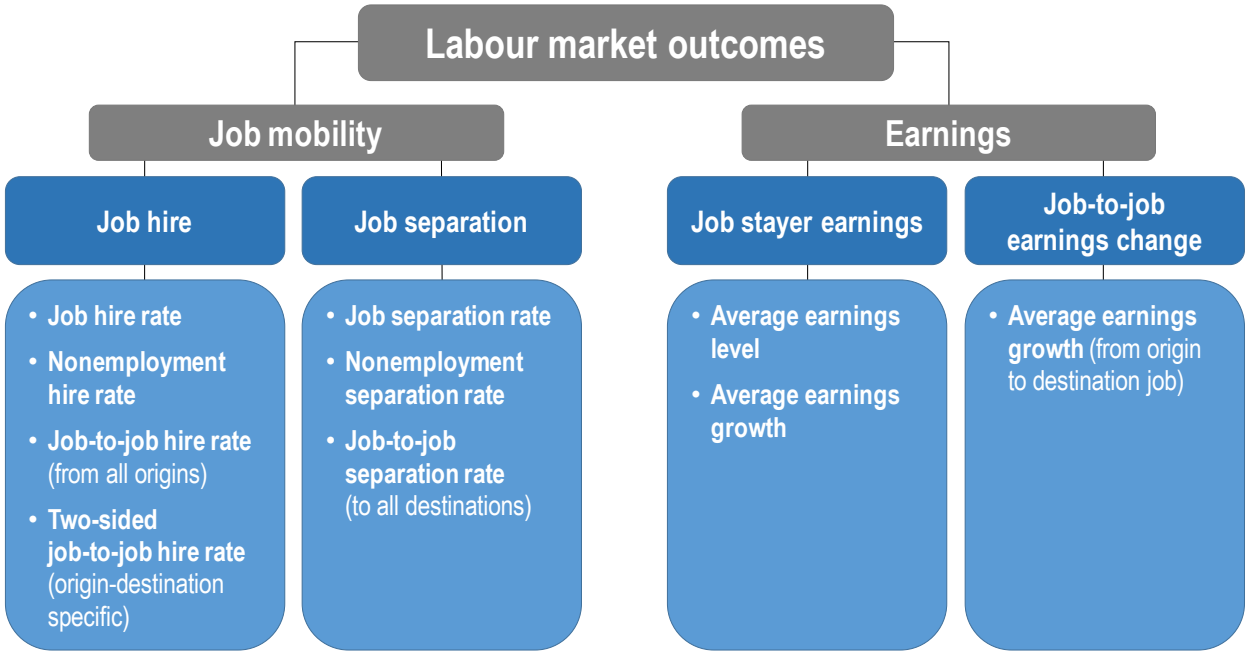
7. A range of measures quantifies labour market outcomes in terms of job mobility and earnings (Figure 1, Panel B). The J2J Data provide detailed tabulations of the number of job transitions by e.g. state, industry, age and sex. This allows for computing job hire and job separation rates (number of hires and separations relative to employment for workers with certain characteristics) at a very disaggregated level and for distinguishing between job-to-job transitions and movements in and out of nonemployment. Average earnings are provided at the same tabulation level, allowing for analysis of the association with licensing for both the level and quarterly growth rate for job stayers. The main part of the analysis controls for firm and geographic characteristics of either the destination (hires) or origin (separations) job. This is complemented by additional (two-sided) analysis for job-to-job hire and earnings growth from job-to-job moves, controlling for characteristics of both the origin and destination jobs.

Figure 1. Framework for analysis: Licensing indicators and outcome measures

A. Policy indicators of occupational licensing



B. Outcome measures of labour market performance



8. The empirical analysis relies on cross-sectional variation in licensing regulation across states and industries. The reason is that consistent state-level data on licensing, covering a large set of occupations, is currently only available at a single point in time, ruling out identification from time-variation in regulation. The analysis is done at the industry-level since the J2J Data do not provide information directly at the occupational level. To circumvent this limitation, the paper proposes a method to map licensing regulation by occupations to a measure of licensing regulation at the industry level by utilising industry-by-occupation employment statistics. The occupational licensing indicator for the extensive margin thus becomes a simple measure of the share of licensed employment by state-industry.

9. The cross-sectional analysis is complemented by panel data analysis, exploiting time-variation in the licensing indicators arising from compositional changes during 2012-2017. For instance, insurance sales agents are licensed in all states and their share of employment in the finance and insurance industry increased from 5.4% to 7.2% in California during 2012-2017. Such changes in licensed employment can be correlated with the associated change in job mobility for the industry during the same time period. In the absence of proper time variation from legislative changes, this approach provides a useful robustness analysis to the cross-sectional inference. Nevertheless, both empirical strategies are likely to be subject to

endogeneity problems. For instance from reverse causality since changes in hires and separations will affect employment and thus the constructed licensing indicators.

10. The estimated associations between licensing and job mobility can therefore not be given a causal interpretation with the available data. The results are interpreted as controlled correlations, providing suggestive evidence of the quantitative and qualitative importance of occupational licensing for job mobility and earnings. With these cautions, the main findings of the paper are (Table 1):

- Licensed employment is estimated to vary from around 15% of workers in Hawaii and Mississippi to more than 27% in Illinois and New Jersey. The variation across states is comparable to licensing variation across countries in the European Union.
- The constructed licensing strictness indicator (0-6 scale), with four subcomponents (entry restrictions; education and training requirements; renewal requirements; and restrictions for ex-offenders), ranks the states from Kansas (1.8) to Washington (2.9) as the most strictly regulated.
- Coverage and strictness of occupational licensing are both associated with lower job mobility (Table 1, Panel A). This holds for job-to-job mobility as well as for transitions in and out of nonemployment.
- Interstate job-to-job mobility within industries tends to be lower towards states with more extensive and stricter licensing (Panel B).

Strictness of licensing results

- Entry restrictions from initial fees, minimum ages, “good moral character” clauses and states not recognising licences obtained in other states have the strongest negative association with job mobility measures (Panel A).
- Renewal fees and continuing education requirements to maintain a licence is also found to have a negative association with job-to-job mobility (Panel A).
- Education and training requirements to obtain a licence is found to be positively associated with job-to-job mobility when conditioning on other licensing requirements (Panel A). This may reflect investment in human capital improving job opportunities.
- Restrictions for individuals with criminal records to obtain a licence has a significant, but smaller negative association with job mobility, notably with nonemployment hire (Panel A). A sizeable group of Americans, especially among Black and African Americans, are affected by such regulation. The indicator used captures permanent exclusions from obtaining a licence and lack of standards for background checks and relevance of previous convictions.

Earnings results

- Results for the association between earnings and occupational licensing are generally mixed and mostly insignificant (Panel A and B). This likely reflects an imprecise quarterly earnings measure with no information on hours worked or changes between part and full-time work. Furthermore, licensing is likely to have two counteracting effects on earnings growth. Entry barriers will tend to reduce supply and increase earnings, but on the contrary reduced competition and reallocation of workers can weigh on productivity growth and reduce the scope for earnings increases in the longer term.
- There is some evidence of lower earnings gains from job-to-job moves to a state with more licensed employment within the same industry (Panel B). This may reflect lower productivity growth because of licensing, but is clearly sensitive to the particular motives among observed job movers (self-selection).

Table 1. Association between occupational licensing and job mobility and average earnings

A. Main results

	Job mobility						Average earnings for stable job stayers	
Occupational licensing	Job hire rate	Job-to-job hire rate	Non-employment hire rate	Job separation rate	Job-to-job separation rate	Non-employment separation rate	Average earnings level	Average earnings growth
Extensive margin								
Licensed employment share	–	–	–	–	–	–	0	0
Intensive margin								
Strictness of regulation	–	–	–	–	–	–	0	0
Subcomponents								
Entry restrictions	–	–	0	–	–	0	0	+
Education and training	0	+	0	+	+	0	0	–
Renewal requirements	–	–	0	–	–	0	0	0
Restrictions for ex-offenders	–	0	–	–	–	0	+	0

B. Additional results for job-to-job moves

	Job-to-job hire (origin-destination)				Earnings growth from job-to-job move			
	Within state		Between states		Within states		Between states	
Occupational licensing	Within industry level	Between industries difference	Within industry difference	Between industries difference	Within industry level	Between industries difference	Within industry difference	Between industries difference
Extensive margin								
Licensed employment share	–	0	–	–	0	0	–	+
Intensive margin								
Strictness of regulation	–	0	–	–	0	0	–	+
Subcomponents								
Entry restrictions	0	+	–	–	0	0	0	–
Education and training	0	0	0	0	0	0	0	0
Renewal requirements	–	+	–	–	0	+	+	0
Restrictions for ex-offenders	0	–	0	0	0	0	–	+

Note: The reported results refer to cross-sectional estimations with sex/age and sex/education as controls. "–" refers to a negative association; "+" refers to a positive association; and "0" refers to no statistical significant association at the 5% level.
Source: See Annex B and C for detailed results.

2. Data

2.1. Occupational licensing regulation

11. The analysis in this paper applies measures of occupational licensing regulation at the state level from three different databases (Table 2). They all provide information at a single point in time with no information on when occupations became licensed or changes to legislation. Each source is applied separately in the analysis.

Table 2. Databases used to construct indicators of occupational licensing

Source	Available information	Time of recording	States covered[1]	Licences included	Occupations covered in analysis (SOC)	Estimated employment covered by licences
National Conference of State Legislatures (NCSL)	State licences. 15 indicators of licensing restrictions and requirements	2017	51	31	29	6.4%
CareerOneStop (COS) by Department of Labor	State licences	2019	51	6193	408	22.2%
Reason Foundation (RF)	State licences	2007	50	393	353	16.2%

Note: Licences included refers to the number of unique licences in each database (licence or job titles). Occupations covered in analysis refers to the number of unique occupational codes (SOC 2010) to which at least one state licence can be linked. Employment covered by licences refers to the estimated national share of licensed employment, averaged across 2012-2018 (cf. Section 2.3).
1. Coverage of 50 states plus District of Colombia.
Source: National Council of State Legislatures (2018); Summers (2007); careeronestop.org.

12. First, for 31 occupations the National Conference of State Legislatures (NCSL) collected detailed information on state licensing policies in 2017, including requirements to obtain and maintain the licences. The NCSL selected the list among occupations licensed in at least 30 states, having a substantial employment level and projected employment growth above average (NCSL, 2017). The NCSL dataset is of high quality and used to construct indicators of the share of licensed employment (extensive margin) and for the strictness of licensing (intensive margin, see Section 4.2).

13. Second, an online licensing database to assist job seekers, CareerOneStop.org (COS), contains more than 6000 licences (unique titles). In principle, this dataset covers the universe of licensed occupations since states are required to submit information and update it regularly by the U.S. Department of Labor, sponsoring the database. In practice, the database is incomplete as not all states provide full and accurate information. Nevertheless, the COS dataset is the most comprehensive source available and is ideal for analysing macro-level implications of occupational licensing at the extensive margin.

14. Third, an earlier collection of state licensing regulation in 2007 by the Reason Foundation (RF) covers 393 job titles (Summers, 2007). The RF dataset records the extensive margin only and is mainly applied since it was collected a decade before the two other sources and thus provides a partial robustness check in the absence of time-varying information.

2.2. Job mobility and average earnings

15. The outcome measures in this paper are sourced from the novel and very comprehensive Job-to-Job Flows database from the U.S. Census Bureau (Box 1), covering almost all job transitions and movements in and out of employment (see Hermansen (2020) for a detailed review). The database provides quarterly measures for job hire and job separations as well as average earnings for job stayers and before and after a job-to-job move.

Box 1. The Job-to-Job (J2J) Flows Data from the U.S. Census Bureau

The U.S. Census Bureau provides detailed statistics on job mobility and transitions in and out of employment (freely available at https://lehd.ces.census.gov/data/j2j_beta.html). The J2J statistics are quarterly and available from 2000 Q2 onwards, currently until 2018 Q1. The data is constructed from a linked employer-employee database (Longitudinal Employer Household Dynamics, LEHD data), which is collected by state unemployment insurance programs. The coverage of private sector employment is almost complete and most public sector employees are included (missing employment compose self-employed, contract workers, federal government jobs and others not covered by state UI). For example, the data counts an employment stock of 131 million workers and almost 15 million job hires in 2018 Q1, of which half are job-to-job hires with available information on the previous job. In addition, statistics are available on average earnings for (stable) job stayers each quarter and for job movers by the quarter before and after a job-to-job move.

Measures from the J2J Data applied in this paper

- *Job hire*: A worker is employed in a firm by the end of the quarter (i.e. has the largest combined earnings from this employer) and did not receive earnings from the same firm in the previous quarter.
- *Job-to-job hire*: A job hire following a separation from another firm with no or only a brief nonemployment spell, i.e. change of employer within the same quarter or with the new employer in the subsequent quarter.
- *Nonemployment hire*: A job hire after no main job for at least a quarter, i.e. no earnings from the same employer in both the beginning and end of a quarter (referred to as persistent nonemployment in the J2J Data).
- *Earnings*: Average earnings are calculated by dividing the sum of earnings received in a quarter by the count of workers for selected job histories. Information on hours worked or e.g. bonuses included are not available.

Structure of the data and level of aggregation

The J2J Data is released by semi-aggregate tabulations. This means that the number of hires and separations is reported in cells by state, industry, worker and firm characteristics (sex, age group, race/ethnicity, education, firm age and firm size). Specifically, the data is made available in two different forms:

- *J2J Counts*: Includes counts of individuals with a specified job history in each quarter and details about either the destination job (hires) or the origin job (separations). For example, 1356 job-to-job hires is counted for women aged 25-34 in the management industry in New York in 2017 Q2. Average earnings of USD 16,511 is reported for job stayers in the same cell.
- *J2J Origin-Destination*: Includes counts of job-to-job changes only and provides details about both the origin and destination job. For example, three men aged 35-44 made a job-to-job move from the manufacturing industry in Michigan to wholesale trade in California in 2017 Q2. Their average earnings increased from USD 43,714 in the quarter prior to the move to USD 44,442 in the quarter after the move.

Confidentiality of the data is protected by the use of noise infusion, whereby all the released data receive a multiplicative fuzz factor (Hyatt et al., 2017). This prevents identification at the very detailed tabulations, while leaving the more aggregate measures unbiased.

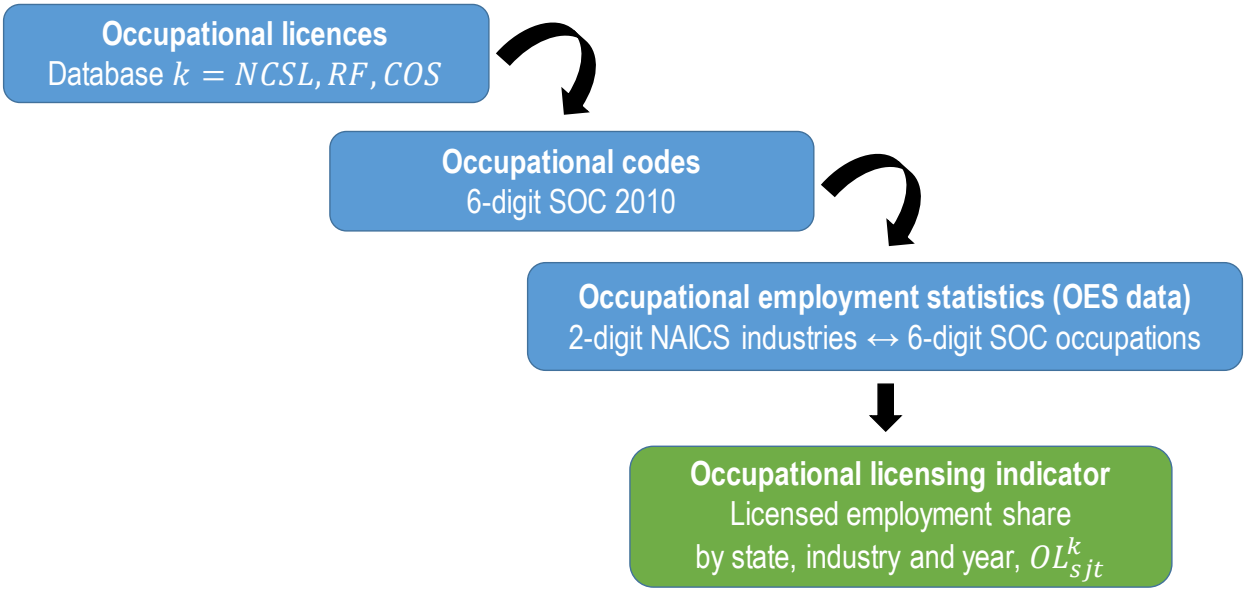
16. The Census Bureau provides the data by semi-aggregate tabulations on basic worker and firm characteristics (Box 1). Ideally, the empirical analysis would be performed on individual-level data, comparing workers in licensed and unlicensed occupations across states. While this is not possible, the J2J Data allows for a similar empirical analysis based on comparing mobility and earnings measures across state and industries with different coverage of licensed employment. In this way, the advantage of administrative-based data with almost universal coverage can be utilised. By contrast, individual-level studies usually have to rely on survey data and much smaller samples (e.g. Gittleman et al., 2018; Blair and Chung, 2018a), typically restricting the analysis to a few occupations and ruling out macro-level assessment. Nevertheless, the industry-approach has limitations since it cannot isolate the impact of licensing per se, but only make inference based on compositional shares.

17. The main limitation of the J2J Data is an imperfect coverage of self-employed (Box 1), which accounts for around 6% of U.S. employment in 2018. Occupations with a high share of self-employed are typically also more likely to be licensed (e.g. barbers and plumbers). The BLS estimates that 26.1% of self-employed are licensed and 19% of wage and salary workers are licensed in 2018. The omission of self-employed is primarily a concern for the analysis based on the NCSL dataset as the share of self-employed is high among some of the 31 selected occupations. This could bias the results if for instance earnings of self-employed in a licensed occupation rises faster than earnings of wage and salary workers in the same occupation. The empirical analysis attempts to address the issue by exploiting both cross-sectional variation and within state-industry variation.

2.3. Mapping occupational licensing to employment by state and industry

18. Utilising the J2J Data to analyse occupational licensing requires indicators of licensing at the state and industry level. Such measures are obtained by mapping information on licensing regulation for each occupation to employment composition by state and industry in two steps (Figure 2).

Figure 2. Mapping licensing regulation to obtain an indicator at the state-industry level



19. First, each occupational licence is linked to a 6-digit occupational code in the Standard Occupational Classification (SOC) System. The CareerOneStop dataset already provides such a link. For the NCSL and RF datasets, each licence is manually linked to a SOC 2010 code based on the job title (Gittleman and Kleiner (2016) follow a similar approach). In most cases, this is straightforward since e.g.

"School Bus Driver" in the NCSL data is matched with SOC code "53-3022 Bus Drivers, School or Special Client". However, a limited number of job titles in the RF dataset had to be dropped since they could not be linked to a SOC code.

20. Second, Occupational Employment Statistics (OES) from the BLS provides a detailed industry-by-occupation employment distribution at the state level. The licensed occupations at the 6-digit level is merged onto the OES data and the share of licensed employment at the 2-digit NAICS industry level is computed for each state. The occupational licensing indicator for the extensive margin is thus a share between zero and one, measuring the coverage of licensing for each state-industry. The OES data excludes the self-employed like in the J2J Data, which should ensure a close correspondence between employment populations in the two data sources.

21. The applied mapping is nevertheless indirect and noisy as occupational categories even at the 6-digit level are broad and not all employees will be subject to licensing, even if a licence can be linked to the occupational code. As such, the COS indicator encompassing all licensed occupations provides an upper bound on licensed employment. Still, since the COS database also suffers from underreporting for some states, this will bias the measure downwards. Annex A provides an assessment of the fit with available survey-based licensing measures across industries at the national level and across states.

22. The constructed licensing measures are available annually for 2012-2018 since detailed OES data are not provided prior to 2012. The measures vary over time, but only due to changes in state-industry-occupation employment composition (e.g. if the share of security guards in the administrative and support industry changes). Licensing regulation is taken to be unchanged during 2012-2018 since time series information is not available (Table 2). This is a simplification, though unlikely to be critical given the macro-level perspective. Available sources report only minor regulatory changes during this period (NCSL, 2017; Carpenter et al., 2018; Kilmer, 2018) and cases of de-licensing have historically been very rare (Thornton and Timmons, 2015). Between 2012 and 2017, Carpenter et al. (2018) find a slight increase in the average burden of regulation based on 102 low and middle-income occupations, mainly reflecting increases in fees.

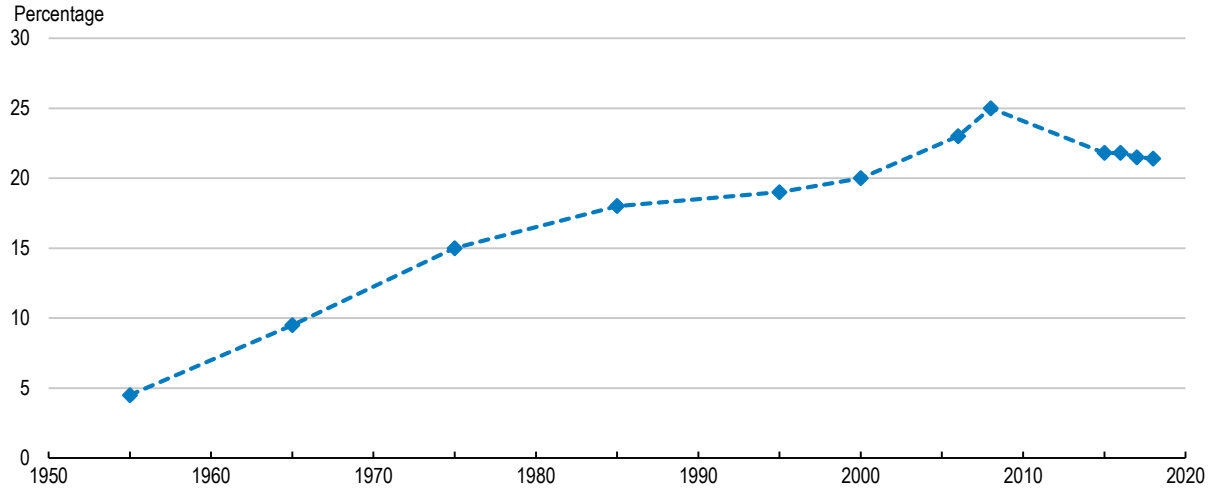
3. Occupational licensing across countries, states and industries

3.1. Licensing in the United States, the European Union and Japan

23. The right of states to regulate certain professions dates back to a Supreme Court decision in 1889 (Dent v. West Virginia). Since then, most states have adopted occupational licensing for an increasing number of professions. Available estimates suggest that licensing has increased from around 5% of the workforce in the 1950s to more than 20% since 2000 (Figure 3). Part of the increase reflects the rise of services, notably in health and education fields. Nevertheless, calculations suggest that changing composition of the workforce only accounts for around one third of the increase from the 1960s to 2008 (White House, 2015). The vast majority thus reflects an increase in the number of licensed professions.

Figure 3. Occupational licensing now covers more than 20% of workers

Percentage of workers holding an occupational licence



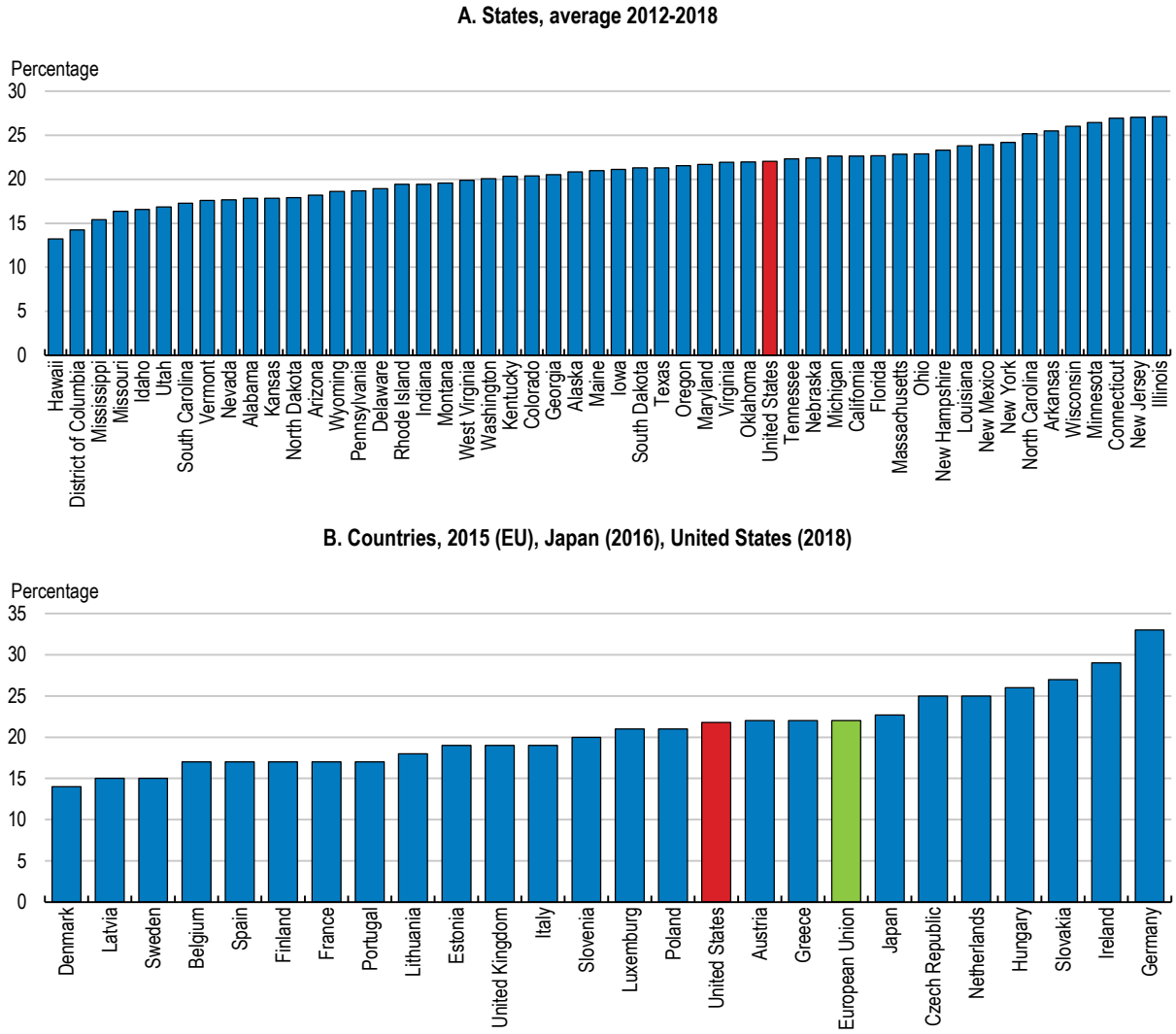
Source: White House (2015); BLS.

24. The share of licensed employment varies substantially across states from around 15% in Hawaii and Mississippi to more than 27% in Illinois and New Jersey (Figure 4, Panel A). The licensing figures at the state level are rough estimates based on the COS indicator constructed above and only cover state licences. Accordingly, states that tend to regulate occupations at the county or city level (e.g. Texas and Wyoming) are likely to be downward biased. Part of the state differences also derive from variation in industrial structure. However, calculations suggest that compositional effects only have a minor influence on the state differences in licensed employment (White House, 2015).

25. The coverage of licensing is strikingly similar in the United States, the EU and Japan, with around 22% of all workers holding a licence (Figure 4, Panel B). The cross-country comparison is based on BLS figures from the Current Population Survey, which applies similar survey questions used to compile the figures for the EU and Japan (e.g. including all levels of government and excluding certificates in all countries). A tentative comparison with the state level estimates from this paper, suggests that the variation across states is similar to the cross-country variation in the EU, ranging from 14% in Denmark to 33% in Germany. The European Commission only recently started to examine the prevalence of occupational regulation and gather evidence on the economic costs and benefits (Koumenta and Pagliero, 2017). In this context, the Commission has launched the “Regulated Professions Database”, providing information on 600 regulated professions across countries and with contact points to facilitate labour mobility.

Figure 4. The coverage of licensing and variation across states are similar to the EU

Percentage of workers with an occupational licence

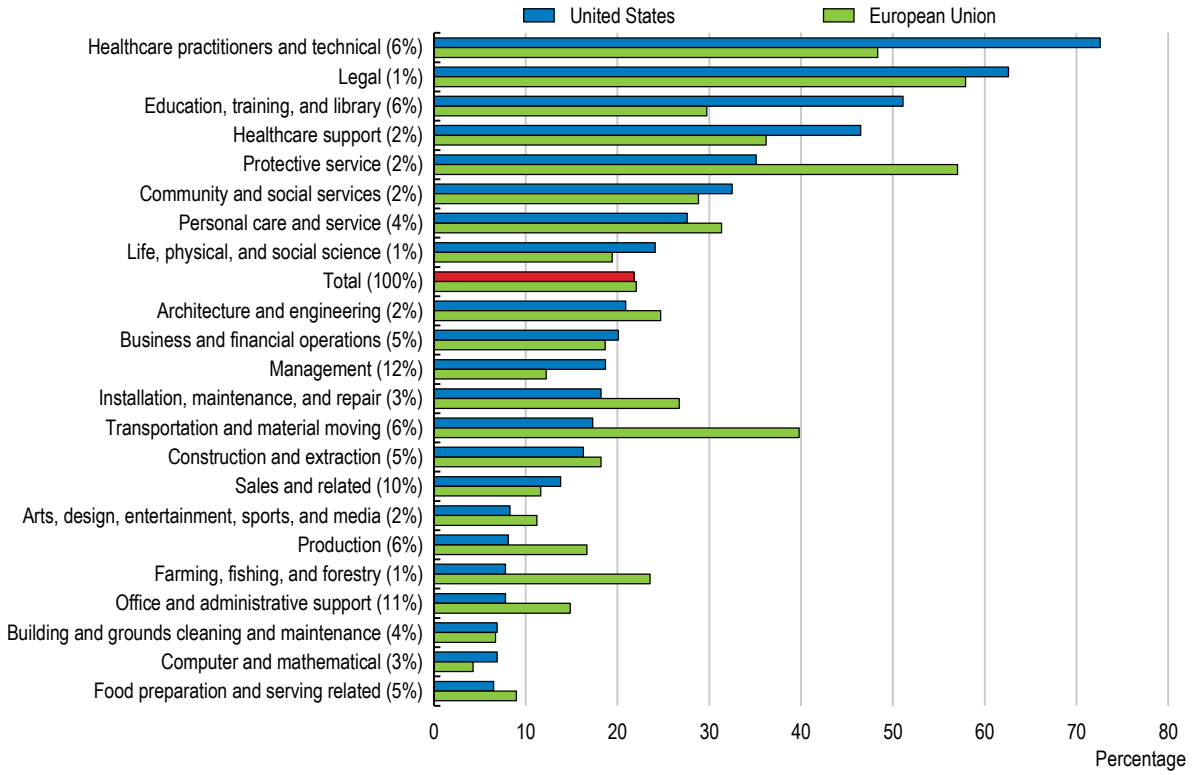


Note: In Panel A, the share of licensed employment is based on the COS indicator constructed in Section 2.3. In Panel B, the United States total is based on the Current Population Survey.
Source: OECD calculations based on careeronestop.org and Occupational Employment Statistics from BLS; Current Population Survey, BLS; Koumenta and Pagliero (2017) based on the EU Survey of Regulated Occupations; Morikawa (2018).

26. In the United States, the most licensed occupations are in healthcare, education and legal with more than half of workers holding a licence (Figure 5). More recently, licensing has expanded in management, sales and construction occupations, approaching 20% of employment. The pattern for the EU tends to be similar, but with substantially less licensing in health and education occupations and more licensing in transportation, production and protective services compared to the United States.

Figure 5. The United States licenses health and education occupations more than in the EU

Percentage of workers with an occupational licence by occupation, 2015 (EU) and 2018 (USA)

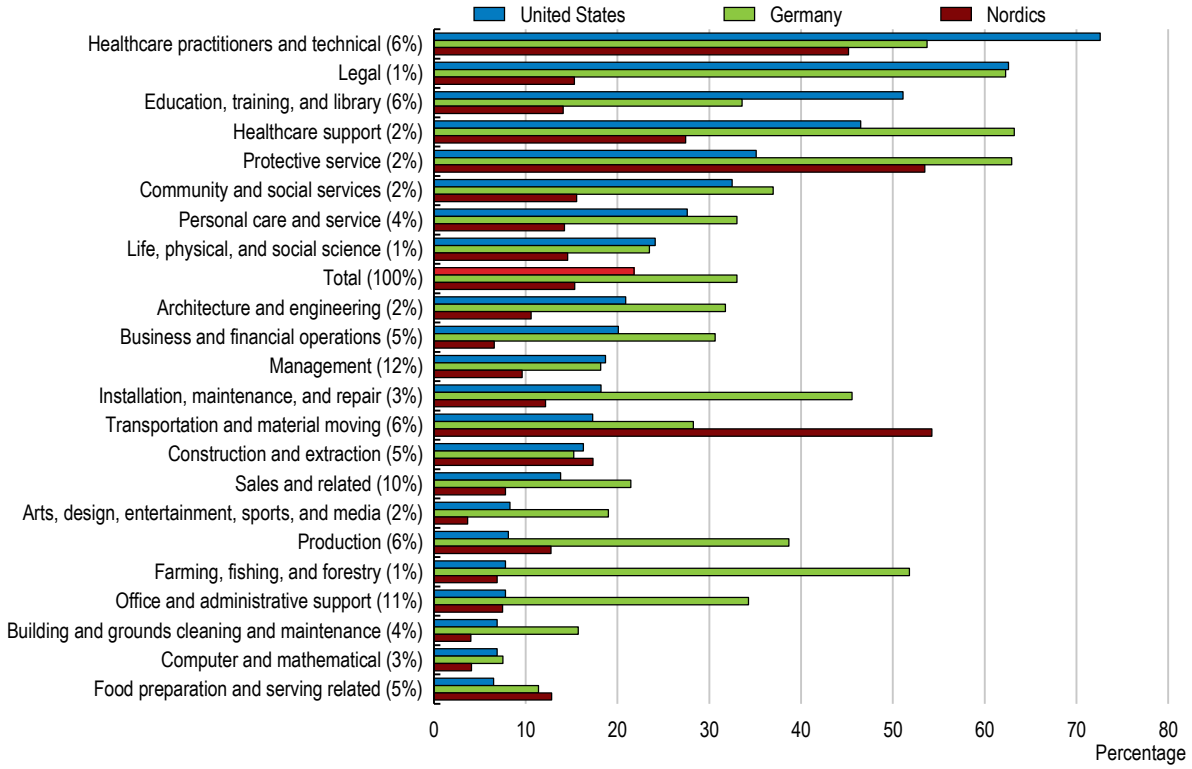


Note: The proportion of total employment in each occupation is reported in parentheses for the United States. For comparison, occupational classification codes used in the EU (ISCO-08) have been converted to occupational codes used in the United States (SOC 2010). In cases when the ISCO-08 code links to more than one main SOC group, the group with the highest employment share is used.
Source: Current Population Survey, BLS; Calculations produced by Maria Koumenta (Queen Mary University of London) based on the EU Survey of Regulated Occupations.

27. The coverage of licensing varies much more across occupations when comparing the United States to the most licensed (Germany) and some of the least licensed (the Nordics, average of Denmark, Finland and Sweden) EU countries (Figure 6). Production, agriculture, and office and administrative support occupations are much more licensed in Germany, while education and legal occupations are much less licensed in the Nordics compared to the United States.

Figure 6. Differences by occupation to the most and least licensed EU countries are large

Percentage of workers with an occupational licence by occupation, 2015 (EU) and 2018 (USA)

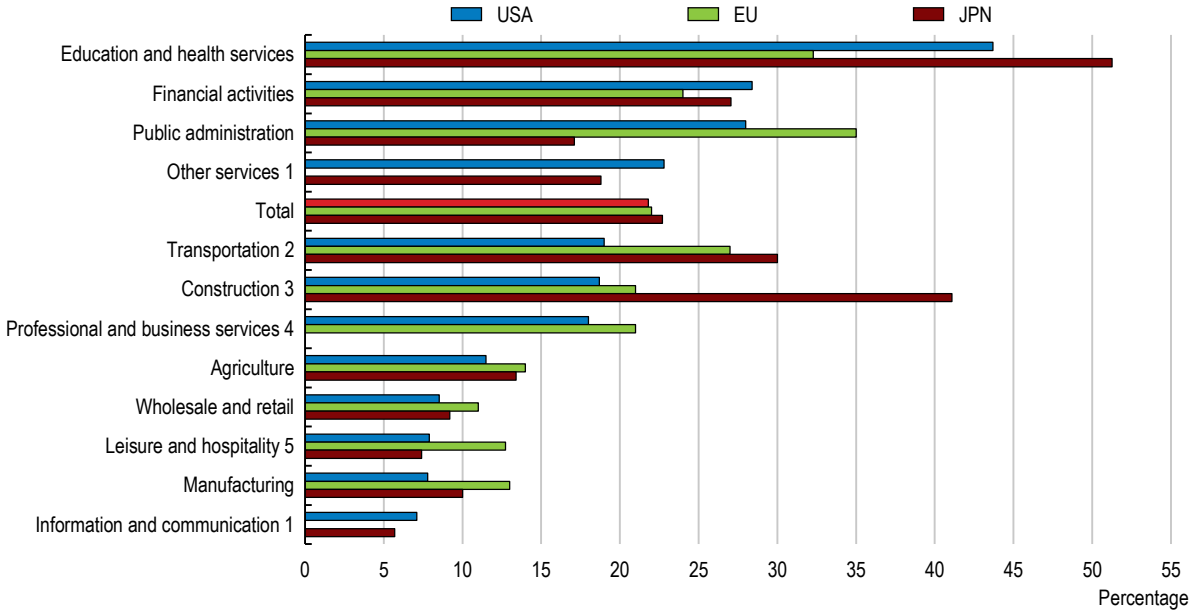


Note: Nordics is a simple average of Denmark, Finland and Sweden, all among the countries with the lowest share of licensed workers (Figure 4). Germany has the highest share of licensed workers in the EU. The proportion of total employment in each occupation is reported in parentheses for the United States.
Source: Current Population Survey, BLS; Calculations produced by Maria Koumenta (Queen Mary University of London) based on the EU Survey of Regulated Occupations.

28. Across industries, which is the focus of this paper, education and health stands out with almost 45% licensed employment in the United States (Figure 7). By contrast, less than 8% are licensed in manufacturing and information and communication industries. Differences in industry classification makes comparison with the EU and Japan difficult. Nevertheless, a tentative harmonisation shows an overall similar pattern with some notable differences. Education and health services have a lower (higher) proportion of licensed workers in the EU (Japan). Transportation and manufacturing are both more licensed in Japan and the EU, while construction in Japan has a much higher share of licensed workers.

Figure 7. Almost half of employees in education and health services hold a licence

Percentage of workers with an occupational licence by industry, 2015 (EU) 2016 (JPN) 2018 (USA)



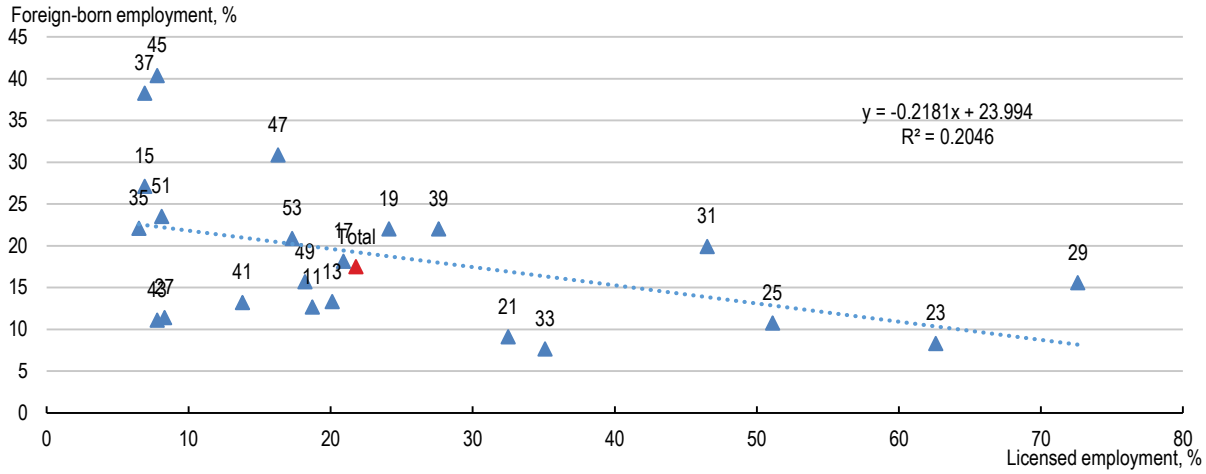
Note: Based on country-specific industry classifications. The comparison is suggestive only since groupings are not fully comparable.
1. Not available for the EU.
2. Includes utilities for the United States and communication for the EU.
3. Includes energy for the EU.
4. Not available for Japan.
5. Accommodation and restaurants only for Japan.
Source: Current Population Survey, BLS; Koumenta and Pagliero (2017) based on the EU Survey of Regulated Occupations; Morikawa (2018).

29. The licensing variation across occupations and industries gives rise to notable gender and educational differences. In the United States, the high shares in health and education fields implies that women are more likely to hold a licence (BLS). In the EU and Japan, the wider coverage in manufacturing, transportation and construction results in men having the highest licensing share (Koumenta and Pagliero, 2017; Morikawa, 2018). Likewise, the coverage of licensing tends to increase with educational attainment in the United States, licensing is particularly high for vocational education in Japan and there are no major differences across educational categories in the EU.

30. Occupational licensing also affects migrants and foreign workers, as it tends to work as an additional entry restriction to the labour market and effectively becomes a non-tariff trade barrier. While many factors influence the share of foreign-born workers across occupations, a simple scatter reveals a clear negative association with the share of licensed employment in the United States (Figure 8). Evidence for the EU shows that the share of foreign-born workers is 2 percentage points lower among licensed workers after controlling for observable characteristics (Koumenta and Pagliero, 2017). However, a lower share of foreign-born is not found for licensed workers with automatic recognition across countries and for certified workers in the EU.

Figure 8. Occupations with higher licensing coverage tend to have fewer foreign-born workers

Foreign-born and licensed employment by occupation (age 16+), 2018



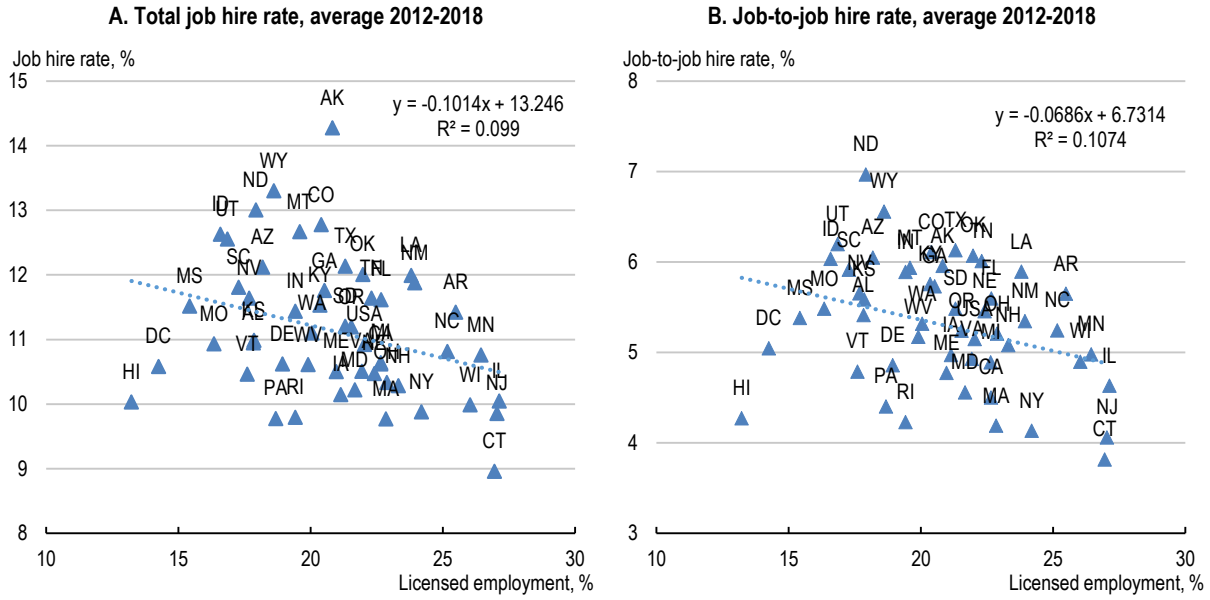
Note: Labels refer to occupational codes: 11 Management; 13 Business and financial operations; 15 Computer and mathematical; 17 Architecture and engineering; 19 Life, physical, and social science; 21 Community and social service; 23 Legal; 25 Education, training and library; 27 Arts, design, entertainment, sports, and media; 29 Healthcare practitioners and technical; 31 Healthcare support; 33 Protective service; 35 Food preparation and serving related; 37 Building and grounds cleaning and maintenance; 39 Personal care and service; 41 Sales and related; 43 Office and administrative support; 45 Farming, fishing, and forestry; 47 Construction and extraction; 49 Installation, maintenance, and repair; 51 Production; 53 Transportation and material moving
Source: Current Population Survey, BLS.

31. A case study of Vietnamese manicurists in the United States show that a requirement of English proficiency reduces the likelihood of Vietnamese to enter the occupation and to move to counties with no initial Vietnamese population (Federman et al., 2006). Since Vietnamese compose almost half of all manicurists, such regulation has significant implications for the overall number of manicurists, competition and prices.

3.2. Descriptive evidence: coverage of licensing and job mobility and earnings

32. States with a high share of licensed employment tend to have lower job hire rates (Figure 9, Panel A), with a slightly stronger correlation for the job-to-job hire rate only (Figure 9, Panel B). While this does not control for differences in industrial structure, worker demographics etc., it supports the hypothesis that occupational licensing reduces job mobility and reallocation of workers.

Figure 9. Labour market fluidity tends to be lower in states with more licensed employment



Note: Licensed employment by state is computed by mapping licensing information to occupational employment statistics and aggregating across states, cf. Section 2.3.
Source: OECD calculations based on data from careeronestop.org and Occupational Employment Statistics, BLS; Job-to-Job Flows database, Census Bureau.

33. Interstate job mobility is also negatively correlated with licensed employment across states. Workers have a lower tendency to make job-to-job moves to states with more licensed employment compared to states with less licensing (Table 3). Here this is quantified by dividing states in "high" and "low" licensing groups based on the share of licensed employment (Figure 4, Panel A). A job-to-job move in a given quarter takes place either within a state or between the four possible combinations of high and low licensed states. Table 3 sums the respective job-to-job moves and divides by job destination employment to obtain the job-to-job hire rate. An unweighted average across states shows a 5.6% job-to-job hire rate in low licensing states compared to 5.1% in high licensing states. The gap derives from higher within state mobility (4.3% vs 4.2%) and higher mobility into the low licensed states (0.5% vs 0.3% from other low licensed states and 0.8% vs 0.6% from high licensed states). Weighted averages using state employment shows a similar picture (right column of Table 3). See Table A.1 in Annex A for a parallel decomposition at the state-industry level.

34. In sum, the descriptive evidence indicates that occupational licensing not only reduces labour market mobility within states, but also hampers interstate job mobility. This is consistent with the White House (2015) that found workers in the most licensed occupations had a 14% lower interstate migration rate than workers in less licensed occupations.

Table 3. More licensed states receive fewer interstate job-to-job moves

Job-to-job hire rate for low and high licensed states, percentage of employment, average 2012 Q2-2018 Q1

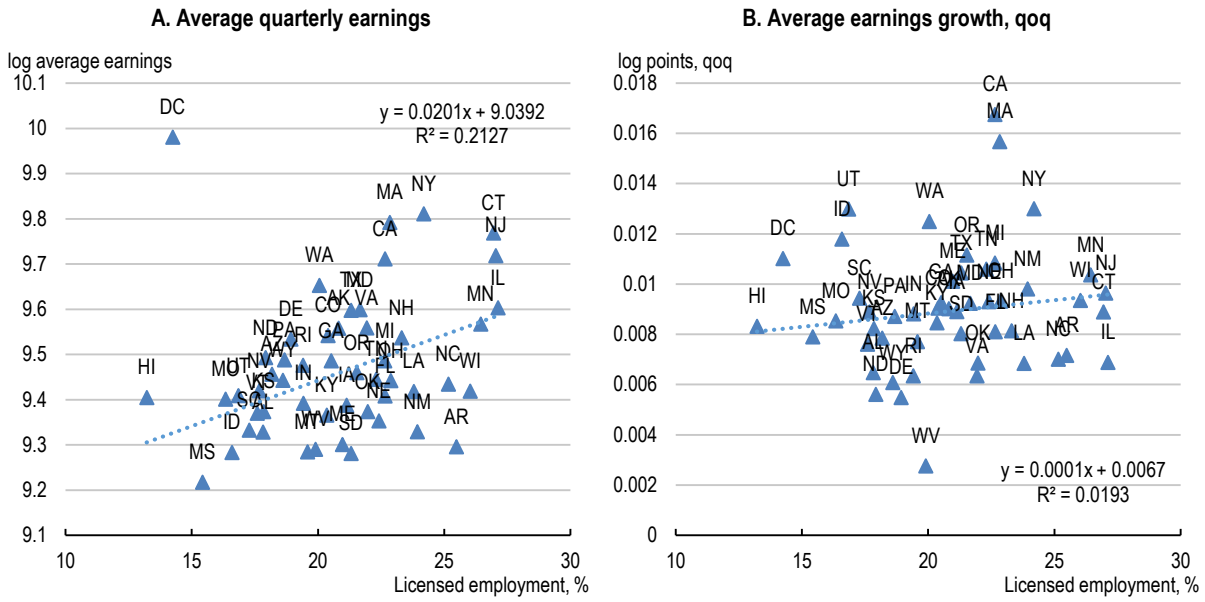
Average across high and low licensing states (unweighted average)			Aggregation of high and low licensing states (weighted average)		
	Destination state			*Destination state*	
Origin state	Low licensing	High licensing	*Origin state*	Low licensing	High licensing
Within state	4.3	4.2	Within state	4.6	4.1
Low licensing state	0.5	0.3	Low licensing state	0.6	0.4
High licensing state	0.8	0.6	High licensing state	0.4	0.3
Job-to-job hire rate	**5.6**	**5.1**	**Job-to-job hire rate**	**5.6**	**4.8**

Note: States are classified as "high" and "low" licensed according to the share of licensed employment in Figure 4. The threshold is set to approximate 50% of states and 50% of national employment in the high and low category for the unweighted and weighted average, respectively.
Source: OECD calculations based on data from careeronestop.org and Occupational Employment Statistics, BLS; and Job-to-Job Flows database, Census Bureau.

35. Much of the literature on occupational licensing have focused on wage effects, generally finding a licensing premium of 5-10% (Kleiner and Krueger, 2013; Gittleman et al., 2018; Blair and Chung, 2018b). A simple scatter of licensed employment and average earnings among stable job stayers indeed shows a positive correlation across states (Figure 10, Panel A), although this is not evidence of causality and ignores other factors.

Figure 10. Average earnings tend to be higher in more licensed states

Stable job stayers, 2012 USD, average 2012-2018



Note: Based on stable job stayers (observed for four consecutive quarters). Earnings are deflated by the PCE index. District of Columbia is excluded from the regression lines.
Source: OECD calculations based on data from careeronestop.org and Occupational Employment Statistics, BLS; Job-to-Job Flows database, Census Bureau.

36. A licensing earnings premium is likely to arise from two effects. First, the entry barrier and requirements on job takers reduce employment in licensed occupations and hence competition, driving up prices of goods and services for consumers. Licensed employees benefit from this through higher earnings, unless the profit flows to e.g. licensing authorities through fees. Second, workers excluded from licensed occupations experience reduced earnings as they may be forced to work in less well-paid occupations and since supply of workers in unlicensed occupations increases and drives down wages.

37. Earnings growth is also likely to be affected by licensing, although no clear correlation is detected across states for the selected group of stable job stayers (Figure 10, Panel B). In the short term when an occupation becomes licensed, earnings may rise stronger as employees benefit from the new entry barrier that can drive up prices and wages. In the longer term, reduced competition and labour mobility will tend to reduce productivity growth, reducing the scope for earnings growth relative to unlicensed occupations. Since the share of licensed employment has only increased slightly over the last two decades (Figure 3), the latter effect may be expected to dominate in the empirical analysis.

4. Strictness of occupational licensing across states

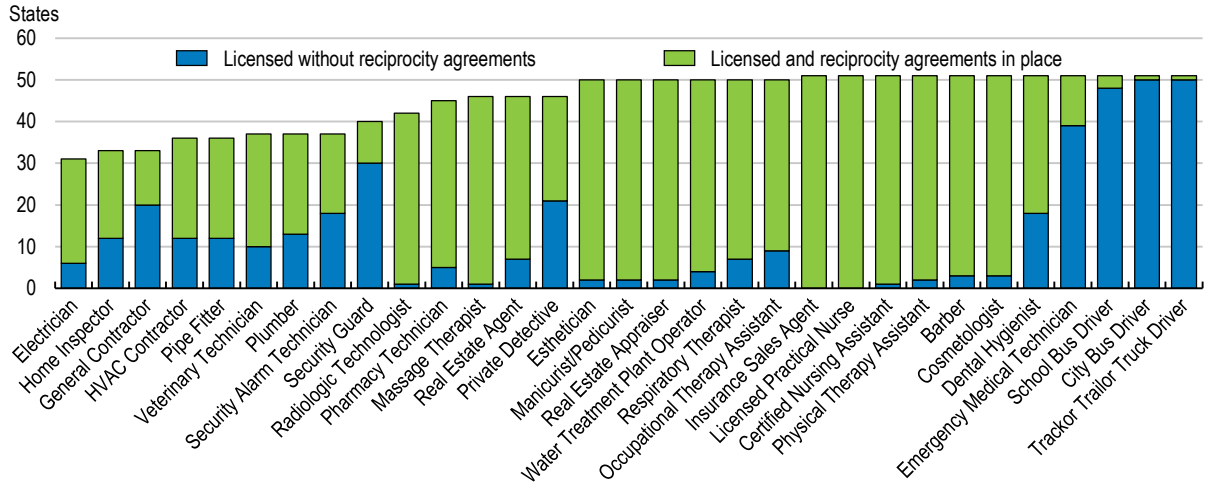
38. Applicants for an occupational licence must meet a number of entry qualifications and holding a valid licence can require regular compliance with renewal requirements. The next subsection reviews the requirements across states for the 31 occupations from the NCSL database, all licensed in at least 30 states (Figure 11). The subsequent subsection summarises the information in an indicator for the strictness of state licensing regulation.

4.1. Requirements to obtain and maintain an occupational licence

39. A licensure obtained in one state is not automatically recognised in other states. This can be an important barrier for interstate mobility if workers have to repeat the process of applying for a licence and redo education and training. To facilitate portability of licensures, states have made reciprocity agreements, covering more than half of the state licences studied here (Figure 11). Reciprocity can be made easier through interstate compacts, a formal binding contract between two or more states, or by the use of model laws and model rules to harmonise regulation (FTC, 2018; CSG, 2019). So far, mainly health professions have adopted interstate compacts (nurses, physicians, physical therapists, emergency medical technicians and psychologists). The Nurse Licensure Compact was the first (implemented in 1999) and has been shown to increase job movements of nurses from one compact state to another (Abdul Ghani, 2018). The other health profession compacts were activated in recent years or are still awaiting a minimum number of states to adopt legislation to go into effect.

Figure 11. Some occupations are licensed in almost all states

Number of states with occupational licensing among 31 selected occupations, 2017



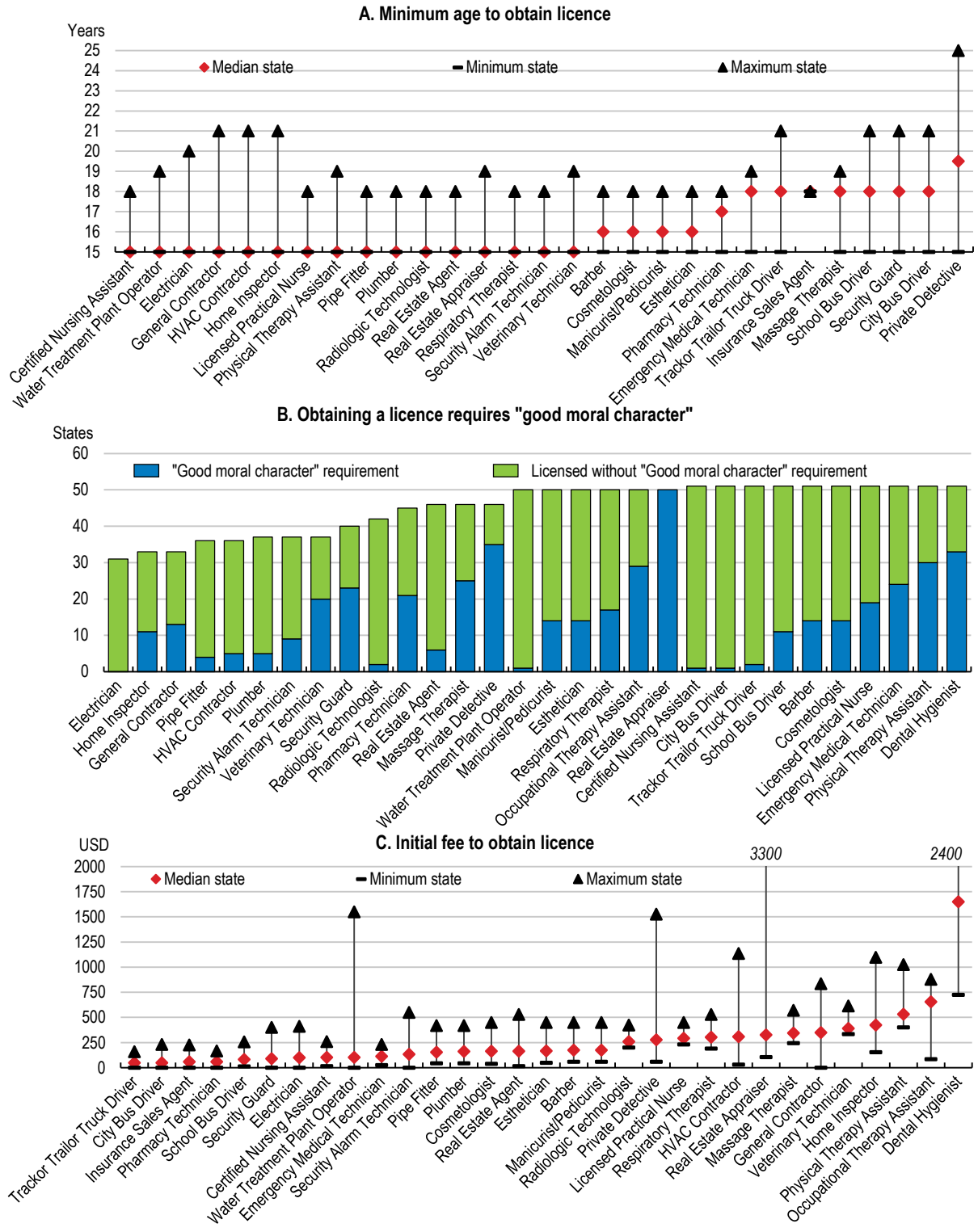
Note: States with reciprocity agreements have statutory language allowing reciprocity or endorsement agreements to recognise licences or credentials obtained in other states.
Source: Occupational Licensing Database from the National Conference of State Legislatures.

40. Nonetheless, nothing prevents a state from recognising licences obtained in other states. Recently Arizona became the first state to automatically grant occupational licences to anyone who moves there with a licence from another state (House Bill 2596). This extends a practice applied in many states for military spouses that typically must move multiple times during their careers (NCSL, 2019a). The automatic recognition does not eliminate all reciprocity barriers though, since it only applies to residents and does not allow commuters to work with an out-of-state licence.

41. Lack of portability is only one among a number of entry barriers to licensed professions (Figure 12). Some states also set a minimum age of 21 for certain occupations and even as high as 25 to become a private detective in Pennsylvania (Figure 12, Panel A). In addition, licensing regulation often requires the applicant to maintain a “good moral character” (Figure 12, Panel B), which has usually been interpreted as a ban on individuals with any criminal record (Craddock, 2008; Rhode, 2018). Indiana and Kentucky recently passed legislation to disallow the use of vague terms like “good moral character”, which provide licensing boards with substantial discretion in licensing decisions.

42. Lastly, applicants can face barriers from sizeable fees to acquire a licence. Fees are often the main revenue source for licensing authorities to finance the administrative work, but some states also rely on fees to finance other activities (NCSL, 2019b). The median state charge around USD 250 for a licence across most of the occupations studied here (Figure 12, Panel C), but going as high as USD 3300 for a real estate appraiser licence in Texas or USD 2400 for a dental hygienist licence in Arizona. Other states apply much lower fees and Florida recently implemented a licensing fee waiver for low-income households and military families.

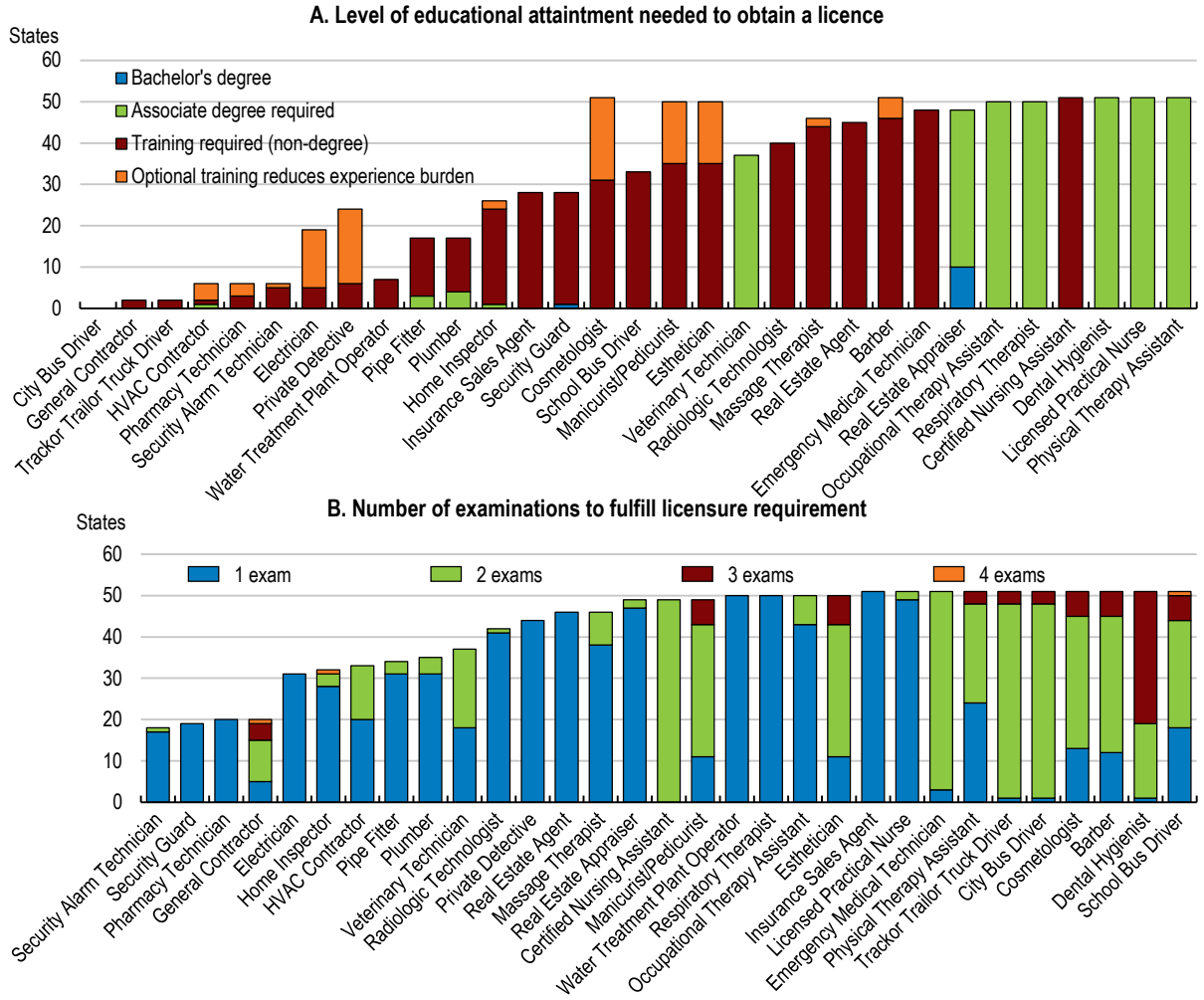
Figure 12. Barriers to enter occupations take many forms and vary across states



Note: The minimum age is set to 15 for states with no restriction. "Good moral character" means that the licensing authority determines the moral turpitude of the applicant, often with broad statutory discretion.
Source: Occupational Licensing Database from the National Conference of State Legislatures.

43. Qualifying for a licence can require a certain level of educational attainment and passing a number of exams (Figure 13). Completing a number of training hours and documenting hours of experience are also required for many occupations (Figure 14). These requirements vary substantially across states. For instance, a real estate appraiser licence requires a bachelor's degree in 10 states, an associate degree in 38 states and no degree in three states. A home inspector licence requires passing four exams in Alaska, while only one exam is required in 28 states and 19 states do not license.

Figure 13. Educational requirements can be sizeable



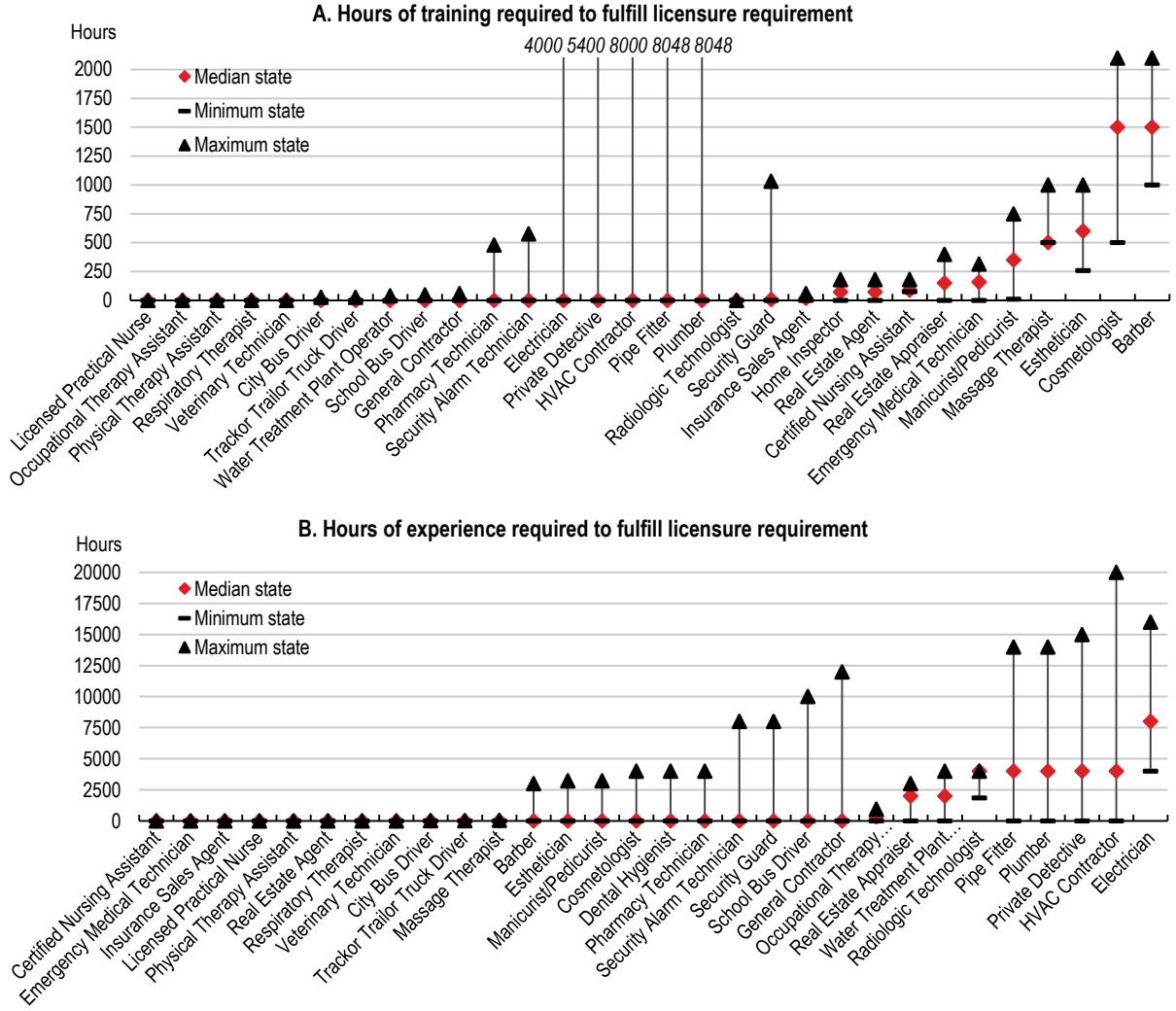
Note: For some occupations, a few states with missing information are not recorded.
Source: Occupational Licensing Database from the National Conference of State Legislatures.

44. Cosmetologists and barbers have the longest training requirements across the reviewed occupations with a median of 1500 hours across states (Figure 14, Panel A). Yet, South Carolina only requires 500 hours for cosmetologists, while 2100 hours is required in Iowa, Nebraska and South Dakota. The need for training is usually justified as a means to ensure public health and safety. Nonetheless, training requirements are much lower for e.g. emergency medical technicians (median of 160 hours) directly tasked to save lives.

45. Experience requirements and their variation across states can be even larger (Figure 14, Panel B). Electricians are only licensed in 31 states, but among those, the median experience requirement is four

years. Virginia requires ten years of experience to acquire an HVAC (heating, ventilation and air conditioning) contractor licensure, while six states license without any training and experience requirements and 15 states do not license.

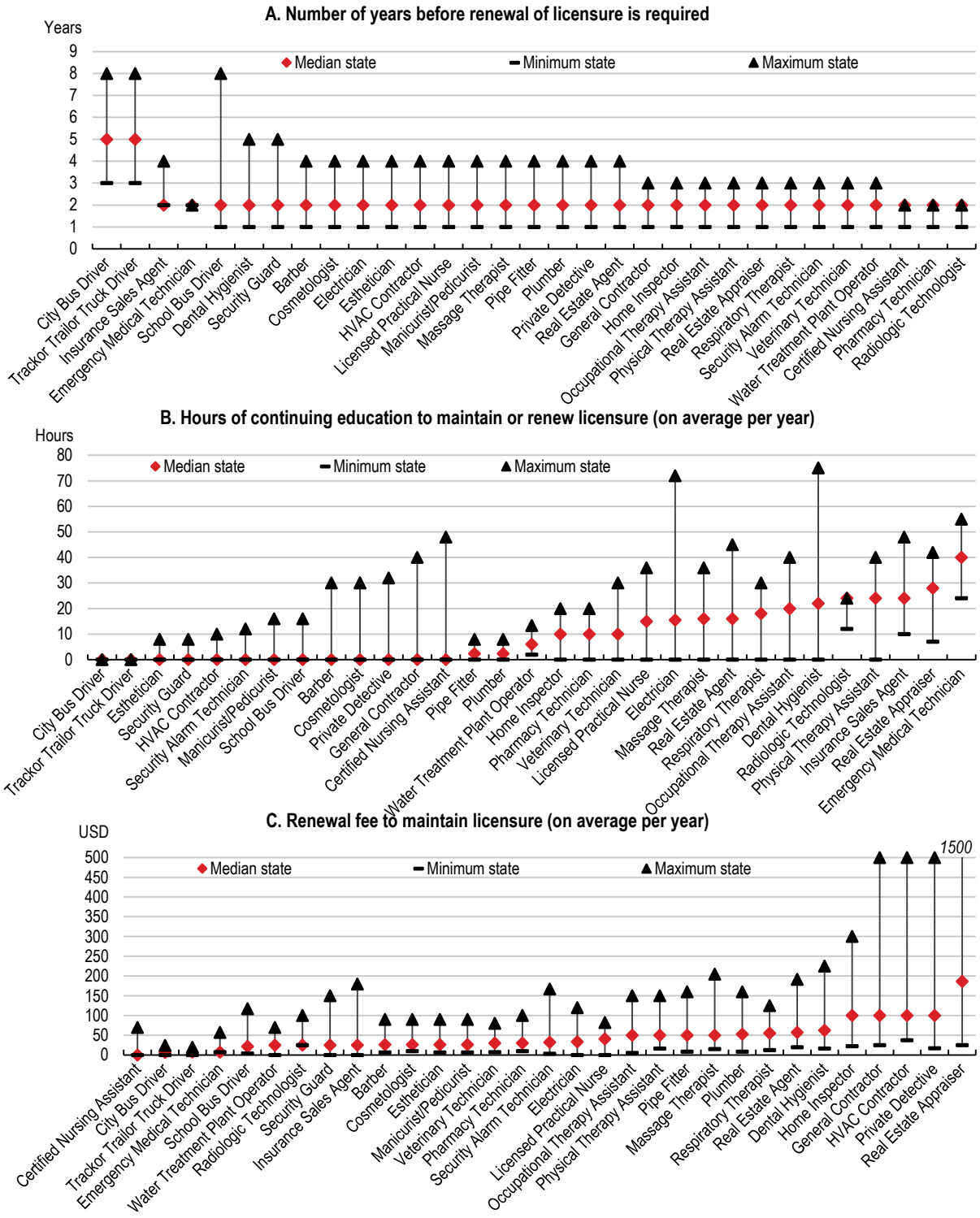
Figure 14. Training and experience requirements vary substantially across states



Note: All training and experience requirements are converted to hours (1 week = 40 hours, 1 month = 2000/12 hours; 1 year = 2000 hours). For some occupations, a few states with missing information are not recorded
Source: Occupational Licensing Database from the National Conference of State Legislatures.

46. Most states require renewal of the majority of occupational licences studied here every two years (Figure 15, Panel A). This usually involves continuing education of 10-30 hours on average per year and paying a renewal fee of USD 25-50. Again, standards are much higher in some cases and absent in others.

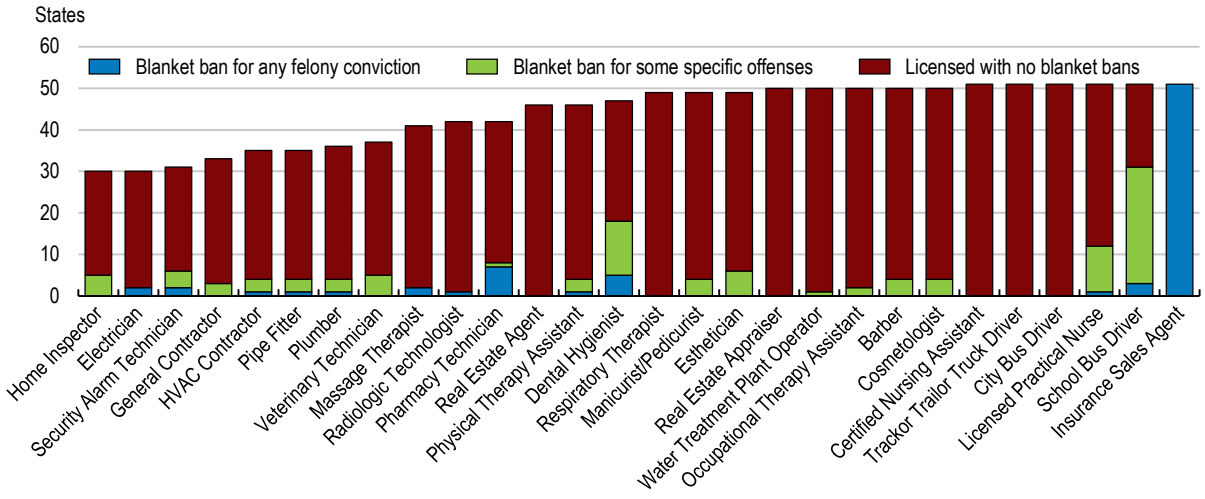
Figure 15. Renewal requirements to maintain a licensure can be substantial



Note: States with no renewal requirements are not included. Continuing education is converted to hours (1 week = 40 hours, 1 month = 2000/12 hours; 1 year = 2000 hours). For some occupations, a few states with missing information are not recorded.
Source: Occupational Licensing Database from the National Conference of State Legislatures.

47. Some licensed occupations have specific standards for individuals with a criminal record. Background checks can result in automatic disqualification if the applicant has committed serious crime (felony convictions). However, also less serious offenses (misdemeanours) and arrests that did not lead to a conviction can result in denial of a licensure (NCSL, 2019c). Outright blanket bans are rare across the reviewed occupations (Figure 16), but a handful of states deny individuals with specific offenses a licensure across most of the 31 occupations.

Figure 16. Some states deny individuals with a criminal record an occupational licence

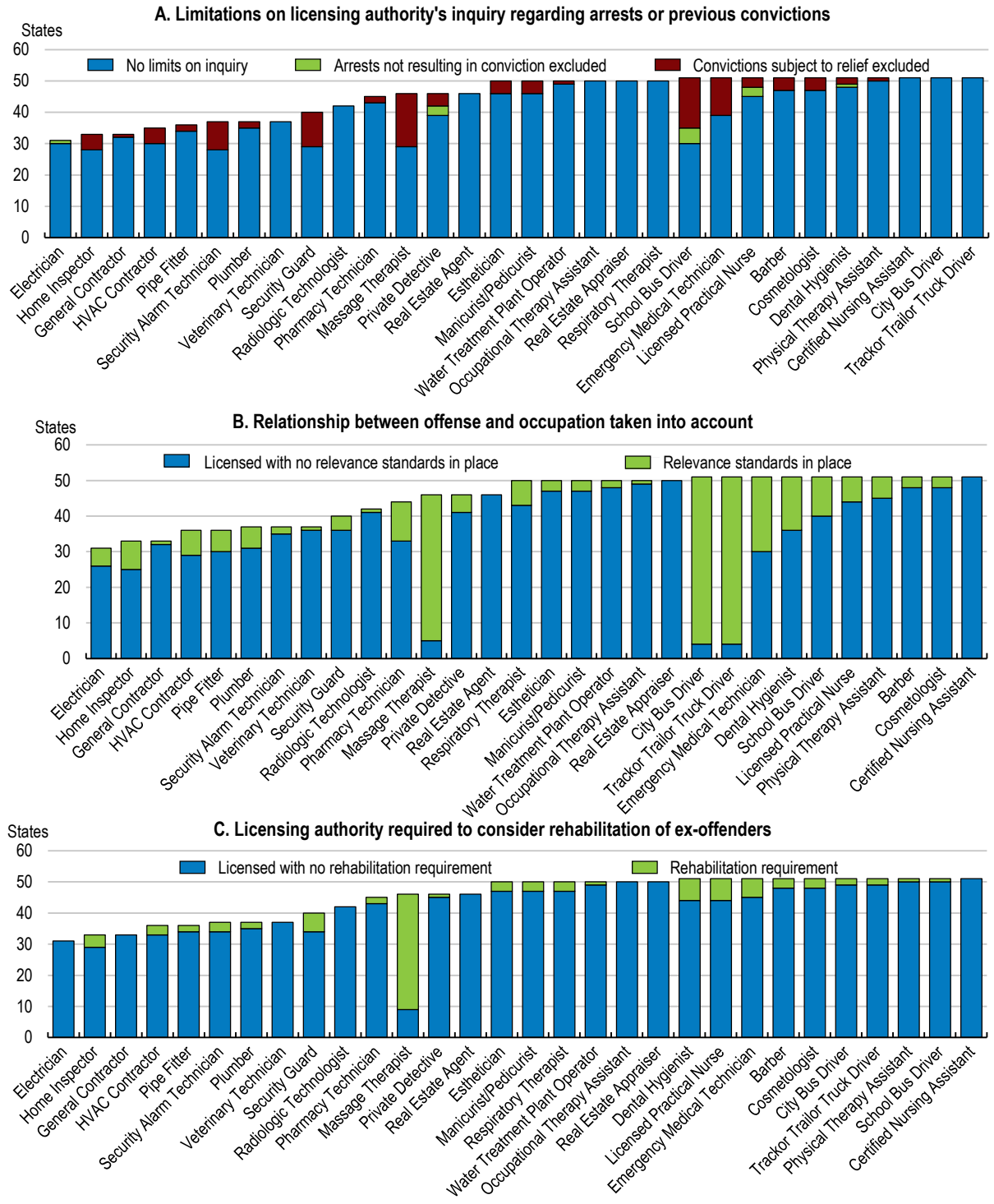


Note: A felony conviction refers to a serious crime typically punishable with one or more years in prison. Some specific type(s) of previous offenses may include both convictions and arrests. Federal law imposes a blanket bank for insurance sales agents in all states.
Source: Occupational Licensing Database from the National Conference of State Legislatures.

48. Such restrictions can exclude a large group of people from many jobs and generate mismatch problems. Estimates suggest that 3% of the adult population has ever been in prison and 8% has a felony conviction (Shannon et al., 2017). Among African Americans, the corresponding numbers are as high as 15% and 33%. Moreover, arrests with no conviction may also show up in background checks and some sources suggest that as much as one third of all Americans have criminal history records on file (Vallas and Dietrich, 2014).

49. States can set standards for licensing boards' background checks as a way to reduce barriers for individuals with a criminal record (Figure 17). In many states, licensing boards are allowed to ask and consider arrests that never led to a conviction when making their decision. Licensing boards may also deny granting a licence, regardless of whether the conviction is relevant to the occupation sought or how recent it was. Yet, inquiry restrictions and relevance standards are only implemented in a limited number of states across the reviewed occupations (Figure 17, Panel A and B). Certificates of rehabilitation is another means to improve employment options for ex-offenders (NCSL, 2019c). However, except for massage therapists, only a few states require licensing authorities to consider rehabilitation when deciding on licensures for ex-offenders (Figure 17, Panel C).

Figure 17. Standards for background checks vary across occupations and states



Note: Subject to relief in Panel A refers to convictions that have been expunged, sealed or pardoned as well as time elapsed since conviction or some other equivalent relief. Relevance standards in Panel B refer to restrictions on licensing authorities to only consider convictions that are related to the occupation for which licensure is sought.
Source: Occupational Licensing Database from the National Conference of State Legislatures.

4.2. An indicator for strictness of licensing regulation across states

50. Based on the reviewed information in the previous section a composite indicator is constructed to quantify the strictness of licensing regulation across states. The proposed indicator relies on a typical OECD approach for regulatory burdens and takes a 0-6 scale, with 0 being no regulation at all and 6 being the maximum observed regulation in any state in all dimensions. Table 4 lists the 15 variables used to construct the indicator and the weights applied. The variables are grouped in four sub-indicators for i) entry restrictions, ii) education and training requirements, iii) renewal requirements and iv) restrictions for ex-offenders. For simplicity and transparency, equal weights are applied to each sub-indicator as well as to the variables used to construct the sub-indicator.

Table 4. A composite indicator for strictness of occupational licensing

Dimensions and weights used to construct a composite indicator for the strictness of occupational licensing

Entry restrictions		Education and training requirements		Renewal requirements		Restrictions for ex-offenders	
25%		25%		25%		25%	
No recognition of out-of-state licensures	25%	Education level requirement	25%	Renewal years	33%	Blanket ban on licensure for some offenses	25%
Minimum age	25%	Number of exams	25%	Hours of continued education	33%	No limitations on the scope of inquiry on previous convictions	25%
"Good moral character" clause	25%	Training hours	25%	Renewal fee	33%	No requirements to only consider convictions related to the occupation	25%
Initial fee	25%	Experience hours	25%			Board not required to consider rehabilitation when issuing licence	25%

Note: The 15 variables applied are rescaled to the interval 0-6, with 0 being no licensing or no restrictions applied and 6 being the highest observed restriction across states (for each occupation). Missing values are replaced with the median across states (for a few occupations a limited number of variables was dropped due to missing information and weights adjusted accordingly).
Source: Occupational Licensing Database from the National Conference of State Legislatures.

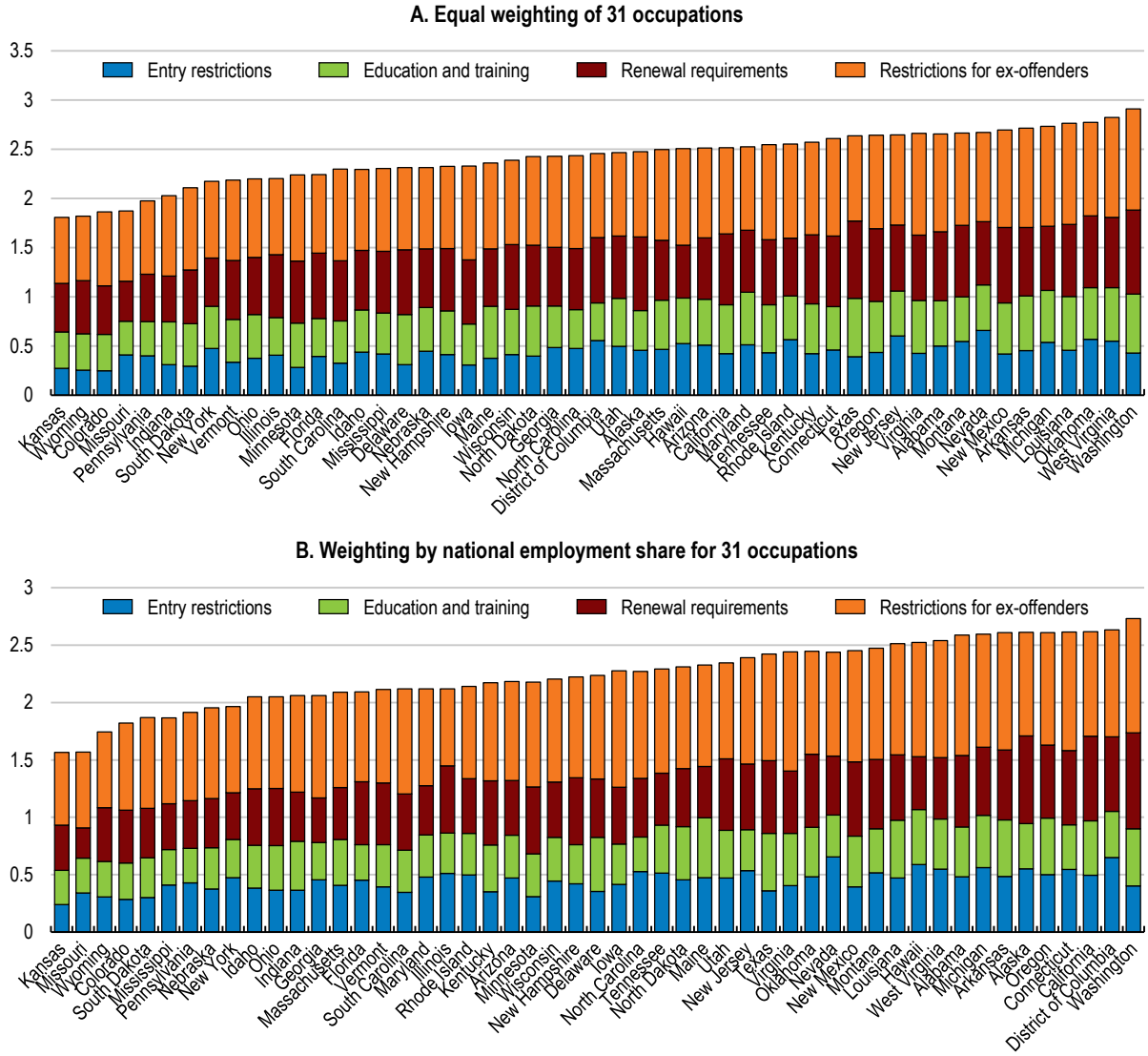
51. Four of the 15 indicators are provided on a yes/no form, while the remaining eleven indicators take several categories or are measured on a continuous scale (e.g. hours of training). In the first step, all variables are rescaled to the 0-6 interval, with 6 being the most restrictive requirement observed across states for each occupation and 0 being no regulation or a lower bound (e.g. 15 for minimum age). Second, the rescaled variables are aggregated using the weights reported in Table 4 for each occupation.

52. Radiologic technologists in Virginia has the most stringent regulation across all occupations and states, scoring 5.1 by the indicator. Private detectives in Connecticut and Oregon are next with 4.6 and 4.5, respectively. Among licensed occupations, HVAC contractors in Tennessee and barbers in Maryland have the lowest score with 1.1.

53. To obtain an indicator for each state, a simple average is computed across the 31 available occupations (Figure 18, Panel A). Equal weighting may provide the best measure of the overall level of state regulation since the database used only covers a small subset of all licensed occupations. Nevertheless, the number of truck drivers is much higher than the number of private detectives, which is taken into account by weighting occupations by their relative employment shares (national level is applied to use the same weight for all states and avoid potential endogeneity from using state level employment shares). The alternative weighting provides a slightly different ranking (Figure 18, Panel B) (correlation is 0.86). Figure A.3 in Annex A presents the state rankings by the four subcomponents.

Figure 18. The strictness of occupational licensing regulation across states

Average occupational licensing strictness across 31 occupations (0-6 scale), 2017



Note: See Table 4 for details on construction of the indicator. See Figure 11 to Figure 17 for details on the 31 occupations and underlying measures of strictness.
Source: OECD calculations based on Occupational Licensing Database from the NCSL.

54. The state of Washington has the strictest regulation and Kansas the most lenient regulation according to the indicator (unweighted or weighted). Restrictions for ex-offenders make the largest contribution to the indicator for most states, while entry restrictions and education and training requirements make the smallest on average. The latter partly reflects the substantial variation in training and experience requirements (Figure 14), implying that one state with a very high requirement will put the bar for the most restrictive level (score 6) high. However, in terms of differences across states, entry restrictions display the largest coefficient of variation, while restrictions for ex-offenders has the lowest variation.

55. The ranking is largely consistent with the result from a similar exercise by Carpenter et al. (2018); see Figure A.4 in Annex A. They reviewed the licensing burdens for 102 low- and middle-income

occupations in 2017, focusing on five requirements (fees, education/experience, exams, minimum grade and minimum age).

56. The composite indicator is used below in the empirical analysis. For this purpose, a similar mapping as in Figure 2 is applied to obtain a measure of licensing strictness at the state-industry level. For each occupation, the composite indicator (scale 0-6) is linked to the occupational employment statistics (OES data from BLS) to obtain a weighted measure for the strictness of licensing for each state-industry cell. The indicator used in the empirical analysis is thus restricted to the 0-6 interval, with 0 reflecting no licensed employment in the state-industry at all and 6 reflecting all employees being subject to licensing and the type of regulation being the most restrictive observed across all states and all occupations. In practice, the measure is below one for all state-industry observations since it is based on 31 occupations only and no state stands out as the most restrictive in all dimensions.

5. Empirical analysis of licensing across states and industries

57. The empirical analysis exploits the variation in licensing regulation across states and industries to quantify the association between occupational licensing and job mobility and average earnings. The main part of the analysis controls for observables in a given state-industry (job destination, job origin or job stayer position). The second part of the analysis focuses on job-to-job flows only and is two-sided as it controls for observables in both the job origin state-industry and the job destination state-industry. Both models are estimated for the full set of occupational licensing indicators, covering the extensive and the intensive margin.

5.1. Main analysis

58. The main part of the analysis uses the following empirical model:

$$y_{sjit} = \beta_0 + \beta_1 OL^k_{sjt} + \beta_2 X_{sit} + \beta_3 u_{st} + \gamma_s + \gamma_j + \gamma_t + \varepsilon_{sjit}$$

where *s* refers to state; *j* refers to industry; *i* refers to worker or firm characteristics; and *t* refers to time. For the cross-sectional analysis, the time dimension is eliminated and averages over time are used. The variables included in the model are:

- y_{sjit} is one of the eight dependent variables for job mobility and average earnings listed in Figure 1, Panel B (excluding two-sided job-to-job hire and earnings growth for job-to-job moves). All mobility rates are defined as the number of hires (separations) divided by employment in the destination (origin) state-industry. Earnings growth for job stayers is calculated as the log difference between two consecutive quarters, with earnings deflated by the PCE index.
- OL^k_{jst} is one of eight available indicators for occupational licensing. Three indicators for the extensive margin (the share of licensed employment by state-industry), *k = NCSL, COS, RF* (Table 2; Figure 2). Five indicators for the intensive margin (strictness of occupational licensing) composed of the overall indicator and its four subcomponents, *k = strictness, entry, education-training, renewal, ex-offenders* (Table 4). For the intensive margin, the model is also estimated with the four sub-components jointly included to assess their relative importance.
- X_{sit} is indicators for basic worker or firm characteristics provided with the J2J Data (Box 1). The dependent variables are made available in the form of five different tabulations by: i) sex and age groups; ii) sex and educational attainment; iii) race and ethnicity; iv) employer firm age; iv) employer firm size. As a result, five separate estimations have to be used since the data do not allow for combining the worker and firm characteristics in the same estimation.
- u_{st} is the state unemployment rate sourced from the BLS and included to control for business cycle effects.

- $\gamma_s, \gamma_j, \gamma_t$ is a set of state, industry and time controls and ε_{sjit} is an error term.

59. Three different versions of the model are estimated to exploit cross-sectional variation as well as time variation from compositional changes in occupational shares within industries. In all cases, the model is estimated by weighted regression and standard errors are clustered at the state-industry level. Because the J2J Data is provided in semi-aggregate form, each cell is weighted by the relevant employment level to give e.g. tabulations for California higher weight than the corresponding cells for Vermont.

Cross-section estimation

60. The main source of variation is differences in licensing across states and industries since information on regulation is only available at one point in time (Table 2). The first approach is thus a cross-sectional model based on averaged values of all the variables across the three latest available years (2015 Q2-2018 Q1 for most states). For the RF licensing indicator recorded in 2007, the three earliest available years (2012 Q1-2014 Q4) are applied. Averages across shorter and longer periods yield very similar estimation results (not reported).

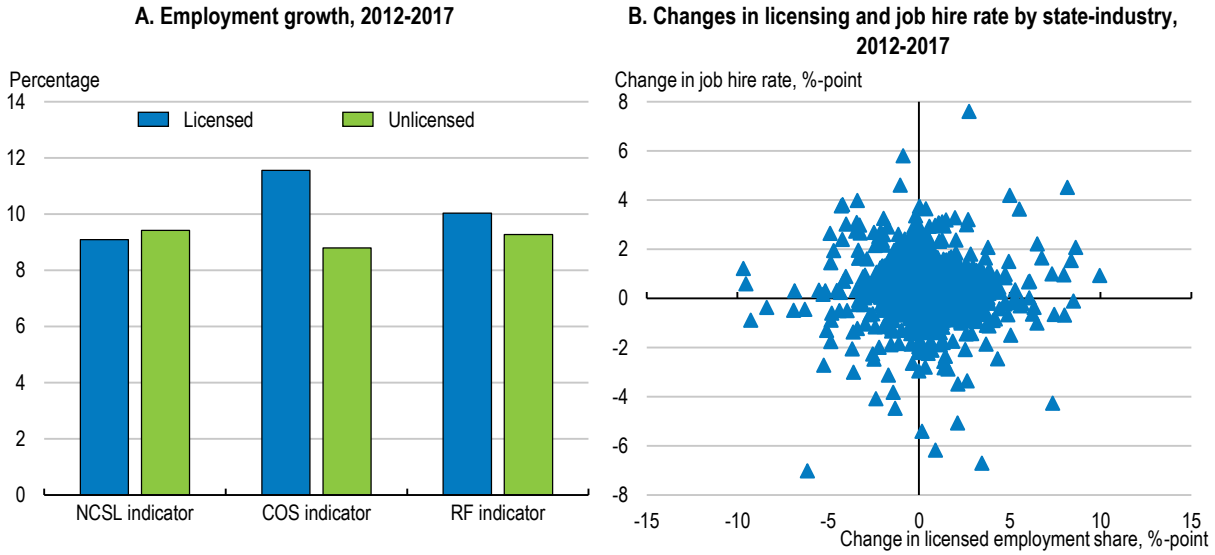
61. The main concern for consistent estimation in the cross-section model is potential endogeneity of the occupational licensing indicator. This could derive from reverse causality since the dependent variable (job mobility) will affect the employment composition within industries and thus by construction the licensing indicator. However, the use of averages across time is likely to reduce this problem. Another concern is omitted variable bias since the cross-section model only allows for control of separate state and industry fixed effects. The estimate of licensing could thus be biased if job mobility is affected by other state-industry specific factors not accounted for in the model.

Within state-industry estimation

62. The second source of variation is changes in industry-by-occupation composition, which introduces some time variation in the constructed licensing indicators (Section 2.3). For instance, insurance sales agents are licensed in all states and their share of employment in the finance and insurance industry increased from 5.9% in 2012 to 6.4% in 2017 at the national level. In e.g. California the share of licensed employment increased by 1.7 percentage point in the finance and insurance industry according to the constructed NCSL-based indicator, mainly driven by insurance sales agents. This can be correlated with the corresponding change in job mobility to draw inference. For the finance and insurance industry in California, the job hire rate declined by 0.3 percentage point from 2012 to 2017. The time variation thus provides suggestive evidence of a negative correlation between licensed employment and the job hire rate in this particular example. However, it should be stressed that this type of time variation is not comparable to genuine time variation arising from regulatory changes in licensing.

63. The degree of time variation in licensed employment shares is relatively small as can be seen from Figure 19. Panel A shows the overall growth in licensed and unlicensed employment from 2012 to 2017, which differs slightly across indicators due to difference in their occupational coverage (Table 2). Panel B shows the change in the share of licensed employment for each state-industry based on the COS indicator against the associated change in the job hire rate. For the vast majority of state-industry cells, the changes are within a few percentage points and no correlation with the job hire rate is detected with the simple scatter plot.

Figure 19. The within state-industry variation from changes in employment composition is small



Note: Changes in licensed employment derive from changes in the occupational shares within each state-industry. Licensing regulation for each occupation is unchanged over time. Panel A shows total employment growth based on annual averages from the J2J Data and the constructed licensing indicators. Panel B shows the total change in licensed employment share for each state-industry from 2012 to 2017 based on the COS indicator.
Source: OECD calculations based on data from National Council of State Legislatures, careeronestop.org, Summers (2007), Occupational Employment Statistics, BLS; and Job-to-Job Flows database, Census Bureau.

64. This empirical strategy is implemented by replacing the separate state and industry controls in the model above (γ_s, γ_j) by joint state-industry controls (γ_{sj}). Cross-sectional variation in licensing will thus be eliminated by the state-industry controls and inference will only rely on time variation (within estimator). The model is estimated for the period 2012-2017, using annual averages from the quarterly J2J Data since the licensing indicators are only available at annual frequency. Although controls for basic worker characteristics and time are included, the strategy imposes strong assumptions on homogeneity of occupations within industries. Implicitly, it is assumed that all occupations within a state-industry are valid control groups for each other in the sense that they would have the same job mobility and average earnings in the absence of licensing. This is clearly a rough approximation and can be critical, especially in earnings regressions for which compositional changes can result in spurious estimations.

65. The within estimates should be interpreted with caution due to the strong assumptions and likely presence of endogeneity problems. Changes in occupational shares within industries are by construction correlated with hires and separations (the dependent variable), which can cause bias from reverse causality. On the other hand, the approach allows for the control of state-industry specific effects, which may reduce the bias from omitted variables. Moreover, during the time period 2012-2017 the United States experienced a strong expansion with an almost 10% increase in total employment. Cyclical factors are thus likely to be the main source for the observed changes in employment compositions, which all else equal reduces the risk of reverse causality.

Pooled cross-section estimation

66. A final set of estimates is obtained from a pooled cross-section model, allowing for the use of variation from both the cross-section and time dimension. This is useful since it exploits all available information and since it is a useful comparison to the cross-section estimation based on averaged variables. The model with separate state and industry controls presented above is estimated for the period

2012 Q1-2018 Q1. In this case, quarterly observations from the J2J Data are used directly combined with licensing indicators, which only vary across years. The pros and cons of this approach are similar to those of the cross-section model. The estimates also turn out to be very similar to cross-section model, which is not surprising given the limited time variation in the constructed licensing indicators (Figure 19).

5.2. Two-sided job-to-job analysis

67. The second part of the analysis applies the most comprehensive version of the J2J Data (Box 1) to analyse job-to-job moves further. The two-sided empirical model takes the following form:

$$\begin{aligned} y_{odj_oj_dit} = {} & \beta_0 + \beta_1 OL^k_{oj_ot} + \beta_2 \Delta OL^k_{odj_oj_dt} 1(o = d) 1\left(j_o \neq j_d\right) \\ & + \beta_3 \Delta OL^k_{odj_oj_dt} 1(o \neq d) 1(j_o = j_d) + \beta_4 \Delta OL^k_{odj_oj_dt} 1(o \neq d) 1(j_o \neq j_d) \\ & + \beta_5 1(o = d) 1(j_o \neq j_d) + \beta_6 1(o \neq d) 1(j_o = j_d) + \beta_7 1(o \neq d) 1(j_o \neq j_d) \\ & + \beta_8 X_{odit} + \beta_9 u_{ot} + \beta_{10} u_{dt} + \beta_{11} dist_{od} + \beta_{12} dist^2_{od} + \gamma_o + \gamma_d + \gamma_{j_o} + \gamma_{j_d} + \gamma_t + \varepsilon_{odj_oj_dit} \end{aligned}$$

where *o* and *d* refer to the origin and destination states; j_o and j_d refer to origin and destination industry; *i* refers to worker or firm characteristics; and *t* refers to time. As above, the time dimension is eliminated and averages over time are used for cross-sectional analysis. The variables included are:

- $y_{odj_oj_dit}$ is either the origin-destination job-to-job hire rate or the origin-destination average earnings growth listed in Figure 1, Panel B. The job-to-job hire rate is computed as the number of hires between the origin and destination state-industry divided by employment in the destination state-industry. Earnings growth is computed as the log difference between average earnings in the quarter before and the quarter after the job move, with earnings deflated by the PCE index.
- $OL^k_{oj_dt}$ is one of eight available indicators for occupational licensing in the origin state-industry. $\Delta OL^k_{odj_oj_dt}$ is the difference in the licensing indicator between the destination and origin state-industry.
- $1(.)$ is an indicator function used to capture within/between state job moves and within/between industry job moves.
- X_{odit} is basic worker and firm characteristics as above.
- u_{ot} and u_{dt} are origin and destination state unemployment rates as above.
- $dist_{od}$ and $dist^2_{od}$ is the geographical distance and its square between the origin and destination state. The geographical reference point is the centre of population for each state sourced from the Census Bureau.
- $\gamma_o, \gamma_d, \gamma_{j_o}, \gamma_{j_d}, \gamma_t$ is a set of origin-destination state, industry and time controls and $\varepsilon_{odj_oj_dit}$ is an error term.

68. The model includes occupational licensing by level and change components to capture the starting position and the implications of licensing differences across states for worker mobility and earnings outcomes. Furthermore, the approach breaks down the change in licensing to distinguish between job moves within and between industries. This is useful since more than half of all job-to-job moves take place across industries (Hermansen, 2020) and licensing varies substantially across industries (Figure 7). In this way, the occupational licensing terms can be given the following interpretation:

- Within state and within industry is the benchmark job-to-job move with no change in licensing regulation. The applied indicators only display (small) changes over time from the compositional changes in occupation-industry employment. This is captured by $OL^k_{oj_ot}$.
- Movements across states and industries are captured by including the change in licensing between origin and destination state-industry, interacted by indicators for the type of job move:

- Within state and between industries move, $\Delta OL^{k}_{j_o j_d t} 1(o = d) 1\left(j_o \neq j_d\right)$.
- Between states and within industry move, $\Delta OL^{k}_{j_o j_d t} 1(o \neq d) 1\left(j_o = j_d\right)$, which is the main term of interest since it provides the clearest measure of policy differences across states.
- Between states and between industries move, $\Delta OL^{k}_{j_o j_d t} 1(o \neq d) 1\left(j_o \neq j_d\right)$.

69. As above, three different versions of the model are estimated. First, a cross-sectional model based on averages over the last three available years (first three available years for the RF indicator) and inclusion of separate controls for origin and destination states and industries. Second, a within estimator is implemented by including a control for each pair of origin state-industry and destination state-industry (51 x 19 x 51 x 19 combinations in total), again using averaged annual observations from the J2J Data. Lastly, a pooled cross-section model is estimated using quarterly J2J Data observations. The estimation algorithm by Correia (2014) is used to handle the large number of controls.

6. Job mobility results

70. The job mobility results are summarised in Tables B.1-B.8 in Annex B. More than 800 different estimations are performed to cover all the combinations of dependent variables (7), worker/firm characteristics (5), licensing indicators (8) and state/industry/time controls (3). The detailed output results are available upon request. The following sections discuss the main estimation results and provide some quantifications to assess the economic importance.

6.1. Job hire and job separation rates

71. A higher share of licensed employment (the extensive margin) is associated with lower job hire and lower job separation rates. This is seen from Annex B, Table B.1 and Table B.2, reporting the estimates of β_1 from the empirical model in Section 5.1. The negative association holds across almost all the different specifications and for all three estimation strategies (cross-section, within state-industry and pooled cross-section). The NCSL-indicator yields the largest and most precise effects, which presumably reflects that this is the least noisy measure (Section 2.1) and mainly covers lower- and middle-income occupations for which job mobility may be crucial to move up the job ladder. The COS-indicator with the most complete coverage of occupations also yields significant estimates in most specifications, but the estimates are generally four times smaller than the NCSL-based estimates. Lastly, the RF-indicator recorded a decade before the other indicators also produce negative estimates, but they are only significant in the within state-industry estimations.

72. Occupational licensing is expected to reduce labour market fluidity since it works as an entry barrier and workers are required to make job-specific investments, which is likely to reduce job-to-job mobility among workers in licensed jobs. Around half of all job hires in the J2J Data are job-to-job hires, implying only a short or no unemployment period between the job moves. The other half reflect hires from nonemployment, meaning no recording of previous employment for at least a full quarter.

73. Both dimensions of hiring are estimated to be negatively associated with occupational licensing and with similar magnitudes in the cross-sectional estimations (Table B.1). For the within state-industry estimations, only the job-to-job hire channel yields significant estimates. A similar pattern is found for the link between job separations and the share of licensed employment (Table B.2), although the association with job-to-job separations tend to be larger than with separations to nonemployment. In a recent study for Italy, licensing regulation was also found to affect both the job-to-job and nonemployment channels, but with a larger impact on job-to-job mobility (Mocetti et al., 2019).

The strictness indicator point to different implications of licensing requirements for mobility

74. More strict occupational licensing regulation (the intensive margin) is also associated with lower job hire and lower job separation rates (Table B.3). The estimates are of similar magnitude across the cross-section and within state-industry estimations. Moreover, negative and significant estimates are also obtained with the subcomponents of the indicator applied one-by-one instead of the overall indicator (see additional results in Annex D, Table D.1). Although the licensing strictness measure is indirect and only covers 29 occupations, the coherent results suggest that the database collected by the NCSL is of high quality and all subcomponents provide useful signals as proxies for the overall impact of licensing regulation.

75. The four dimensions of regulation covered by the strictness indicator have different implications for job hires and job separations according to the results from a joint estimation (Table B.4 and Table B.5). The cross-section and pooled cross-section estimations yield similar results, while the within state-industry estimations are signed in the same way, but are insignificant in most cases. This is likely to reflect the limited time variation and a demanding empirical specification trying to disentangle the relationship with four variables with sizeable positive correlation.

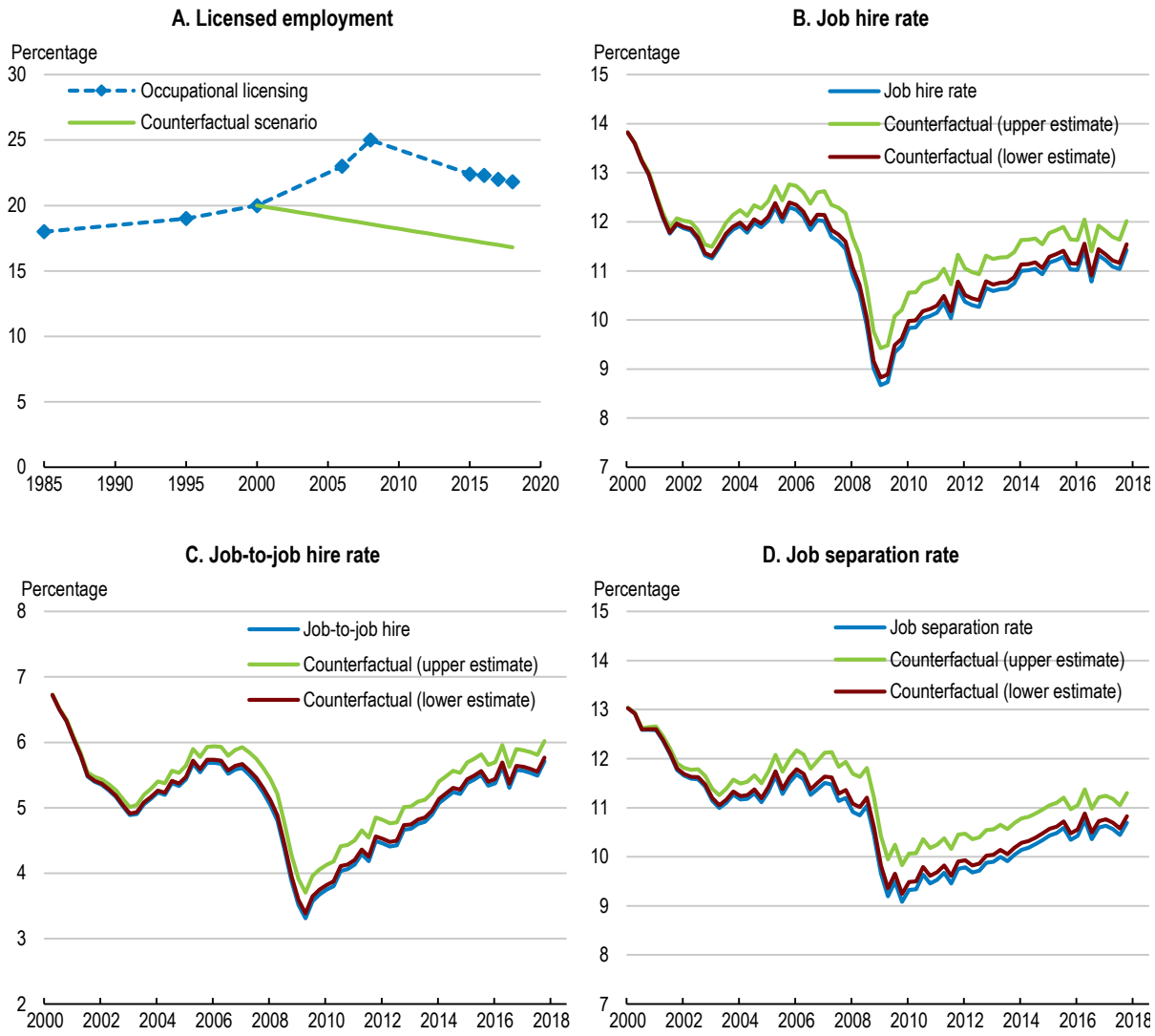
76. Higher entry restrictions (from initial fees, minimum ages, “good moral clauses” and states not recognising licences obtained in other states) has a negative association with total job hire and job-to-job hire. The same holds for renewal requirements (fees and continuing education). By contrast, education and training requirements (degree, exams, hours of training and experience) is found to be positively associated with job-to-job mobility. This may reflect that such requirements can increase human capital and this may lead to better job opportunities.

77. Restrictions for individuals with a criminal record (permanent exclusions, lack of standards for background checks and for relevance of previous convictions) stands out with a negative and significant association with nonemployment hire. This supports the notion that such restrictions can be detrimental to a sizeable population group (cf. Section 4.1), which may have implications at the macro-level.

Estimated associations are economically important

78. A reform simulation illustrates the economic magnitude of the estimated associations (Figure 20). The exercise asks what would have happened to the job hire and separation rates in a counterfactual reform scenario that would have reduced occupational licensing from covering around 20% of employment in 2000 to 16.8% in 2018 (Panel A), corresponding to a 5 percentage point reduction compared to the level in 2018. This would clearly have been a sizeable reform and is used for illustration only. The calculations take estimates at face value and assumes causality, which is not supported by the empirical strategy as discussed above.

Figure 20. What could reduced coverage of occupational licensing have done to job mobility?



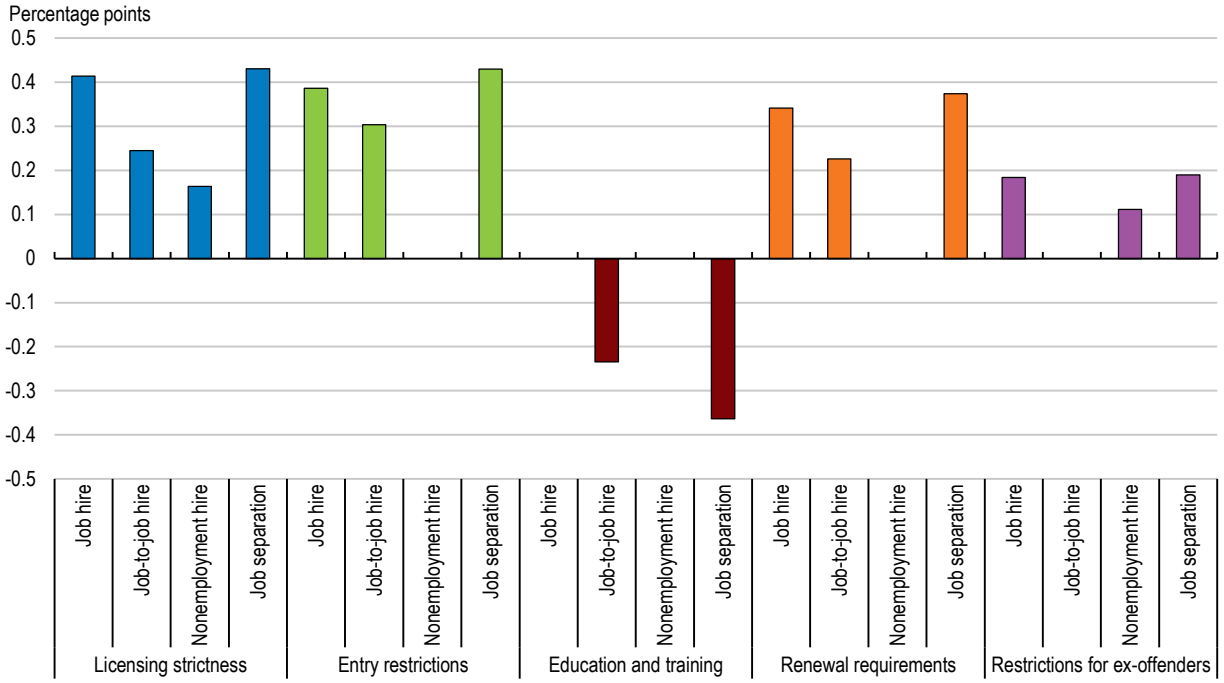
Note: Upper and lower bound estimates reflect the estimates from the cross-sectional estimation with control for sex/age or sex/education using the NCSL- and COS-indicator, respectively (Table B.1 and Table B.2 in Annex B).
Source: OECD calculations based on Job-to-Job Flow database from the Census Bureau.

79. The simulated 5 percentage points reduction in licensed employment is associated with a 0.6 percentage point increase in the job hire rate; a 0.3 percentage point increase in the job-to-job hire rate; and a 0.6 percentage point increase in the job separation rate in 2018 (all upper estimates from the NCSL-indicator). These are all economically important effects. For instance, the counterfactual increase in the job hire rate corresponds to a quarter of the decline observed from 2000 to 2018 (Figure 20, Panel B).

80. The estimates for strictness of licensing are also of economically important magnitude (Figure 21). A back-of-an-envelope calculation illustrates what could happen to job mobility measures if the state with the highest strictness level deregulated to the median regulation level observed across states. Again, this is for illustration only since it makes strong assumptions of causality and applies estimates obtained at the state-industry level to the overall measure of state level regulation.

Figure 21. What could reduced strictness of occupational licensing do to job mobility?

Simulated effect of the most regulated state in each dimension moving to the median state regulation level



Note: The five policy experiments are based on the constructed strictness indicator (Figure 18) and its subcomponents (Annex A, Figure A.3). Licensing strictness reflects Washington reducing the indicator from 2.9 to the median level of 2.4 in North Carolina. Entry restrictions reflects Nevada reducing the sub-indicator from 2.6 to the median level of 1.7 in Virginia. Education and training reflects Washington reducing the sub-indicator from 2.4 to the median level of 1.8 in Minnesota. Renewal requirements reflects Washington reducing the sub-indicator from 3.4 to the median level of 2.5 in Utah. Restrictions for ex-offenders reflects Alabama reducing the sub-indicator from 4.2 to the median level of 3.6 in Georgia. The calculations apply estimates from the cross-sectional estimations with control for sex/age or sex/education. Insignificant estimates at the 5% level are set to zero. For simplicity, the share of licensed employment is set to the national level at 21.8% in all calculations.
Source: OECD calculations based on results from Table B.3-Table B.5; Figure 18 and Figure A.3.

81. With the caveats in mind, the calculations suggest that the job hire rate could increase by 0.4 percentage point (around 3% increase) if the state of Washington, with the highest strictness level, deregulated to a median level as in Georgia, North Carolina and Utah (Figure 18). This is mainly driven by the job-to-job hire rate. The next block in Figure 21, repeats the exercise for entry restrictions. Here Nevada reducing to Virginia's level for entry restrictions could increase job hire and job separation rates by around 0.4 percentage point. Reducing education and training requirements from the highest level in Washington to Minnesota's level, could have reverse effects and reduce the job-to-job hire rate by 0.2 percentage point and the separation rate by almost 0.4 percentage point. Loosening renewal requirements would also have an economically important impact on the job hire and job separation rates. Lastly, easing restrictions for ex-offenders could have a minor, but still economically important effect of 0.1 percentage point (around a 2% increase) on the nonemployment hire rate.

6.2. Origin-destination job-to-job hire rates

82. The two-sided analysis of job-to-job hire rates also finds a negative association with the extent and strictness of licensing in most specifications (Table B.6 and Table B.7). Results are overall in line with the descriptive evidence, showing that workers are less likely to make interstate job-to-job moves to states with a higher coverage of licensing (Table 3). This is clearest seen by the estimates for differences in the share of licensed employment between the same industries in different states (third column, Table B.6). A larger positive gap is associated with less job-to-job move to the more licensed state-industry, with significant estimates for both the NCSL and COS-indicator.

83. Quantifying the economic importance of the estimates is more difficult. First, the origin-destination job-to-job hire rate is much lower and more dispersed than above since it is defined as the number of job-to-job hires between a specific origin state-industry and a specific destination state-industry divided by destination employment. For instance, 30 people moved from manufacturing in Florida to construction in Georgia in 2017 Q4, which divided by employment of 176,112 in construction in Georgia yields an origin-destination job-to-job hire rate of 0.02%. By contrast, the job-to-job hire rate illustrated in Figure 20, Panel C aggregates job-to-job hires across all origins. Second, a policy simulation has to be partial focusing on just one state-industry since the estimation model (cf. Section 5.2) includes differences in licensing indicators across states and industries. If all states reduced licensing proportionally, it would thus have no impact on the difference terms in the model. Finally, it should be stressed that the origin-destination exercise demands a lot from the indirect industry approach used in this paper. Differences in industry averages may hide important differences in mobility across occupations within the industry, which cannot be captured with the available data.

84. With these remarks, one can again consider a 5 percentage points reduction in the share of licensed employment in a particular state-industry. Estimates by the COS-indicator suggest that this could increase the origin-destination job-to-job hire rate by 0.002-0.003 percentage point for between states and within industries moves. Since the average origin-destination job-to-job hire rate for this type of move is around 0.01% (using destination employment as weights), such an effect would correspond to a 15-30% increase and thus be economically important. The NCSL-indicator yields even larger estimates, but since it only covers a subset of occupations, the licensing differences across states and industries and associated estimates could be inflated by a few particular occupations.

Larger differences in strictness is associated with lower interstate job-to-job moves

85. The cross-section estimations for origin-destination job-to-job hire and licensing strictness also show lower mobility towards state-industries with comparatively higher strictness (Table B.7). The estimates are again sizeable, a likely reflection of the use of a particular set of occupations covered by the NCSL indicator. The results for licensing strictness subcomponents are in line with the ones from the main empirical model (Table B.8). In particular, higher entry restrictions and higher renewal requirements are associated with lower between state and within industry job-to-job moves, while education and training requirements yields positive, but mostly insignificant estimates.

86. Results for job-to-job moves between industries are more mixed and sometimes positive, which is not surprising given the large variation in licensing across industries and potentially diverse motives for such job-to-job moves. As licensing regulation do not vary over time and the data only record workers that actually make a job-to-job move (i.e. no exogenous variation), selection among job-to-job movers is likely to have a large influence on this set of results.

7. Average earnings results

87. Results for average earnings are summarised in Tables C.1-C.6 in Annex C. Again, almost 400 different estimations are performed to cover all the combinations of dependent variables (3), worker/firm characteristics (5), licensing indicators (8) and state/industry/time controls (3). The detailed output results are available upon request. Overall, the earnings estimations are much more uncertain and results more ambiguous compared to the job mobility results. This is not surprising given that the average earnings measure cannot control for differences in full-time and part-time work. Moreover, as discussed above occupational licensing can be expected to have both a positive and negative impact on earnings growth (Section 3.2).

7.1. Stable job stayers

88. The results for average earnings among stable job stayers are generally mixed and inconclusive (Table C.1). The cross-section estimates yield a negative, but insignificant association between earnings and the share of licensed employment for the NCSL and COS indicators. By contrast, the within state-industry estimates are positive and significant for the NCSL-indicator. The magnitude of the estimates are sizeable, corresponding to a 15-30% difference in average earnings between licensed and unlicensed workers. For average earnings growth (quarter-on-quarter) among stable job stayers, estimates have varying signs and are insignificant in almost all cases (Table C.1).

89. Closer examination of the data shows that the health sector drives the positive effect on the earnings level. Excluding the health industry reduces the within state-industry estimates to a 10-15% earnings difference between licensed and unlicensed workers (results not reported), which is in line with most of the existing literature, but none of the estimates are significant in this case. The reason is that the share of licensed employment in the health sector declined in most states, while average earnings reported in the J2J Data increased much slower than in other industries. This reflects a lower share of nursing assistants (licensed), which is mainly offset by a higher share of personal care aids (not covered in the NCSL database). The latter group is likely to compose a sizeable amount of part-time employment, which could explain the weak earnings development in the health sector. Since the J2J Data only provides total quarterly earnings, an increase in part-time work would reduce average earnings. In sum, the estimated positive association between the share of licensed employment and average earnings for job stayers is likely to be substantially upward biased due to the developments in the health sector.

90. Similar conclusions derive from estimations with the strictness indicator of occupational licensing (Table C.2). The health sector also drive a positive and significant effect in the within state-industry estimations for the earnings level, while cross-sectional estimates are negative and insignificant. The four dimensions of regulation covered by the strictness indicator provide some suggestive results in the joint estimation (Table C.3), albeit they should be interpreted carefully given the measurement challenges. Restrictions for ex-offenders has a positive and significant association with the earnings level in the cross-section estimation, which could reflect that this component provides a clear signal of entry barriers, allowing incumbents to increase wages. Education and training requirements are found to be associated with lower earnings growth in the cross-section estimations. This could appear inconsistent with the positive association between training and job-to-job hire above. However, selection could play a role since the group of stable job stayers are defined as individuals in the same job for at least four consecutive quarters. For this group, higher education and training requirements may reflect a situation for which the training is very job-specific and reduces outside options and thus bargaining power and wage growth.

91. Since both the earnings variables and the licensing indicators are measured with sizeable noise, it may not be too surprising that the earnings analysis mostly yields insignificant estimates. On the other hand, occupational licensing is likely to have two opposite effects on earnings as discussed above, which may also be an explanation. Restricting entry to an occupation will reduce supply of services and allow

providers to increase prices and wages. Against this, reduced competition and lower job mobility is likely to weigh on productivity growth (von Rueden et al., 2019) and reduce the scope for earnings growth in the longer term. Disentangling these effects requires more comprehensive earnings data, but is an important area for future research.

7.2. Job-to-job earnings growth

92. The results for job-to-job earnings growth are likewise mixed and inconclusive (Table C.4-Table C.6). In addition to the noisy measure of average earnings, a further challenge arises from the fact that observed job-to-job movers are not random, making it difficult to isolate the influence of occupational licensing on earnings growth. Some people will only move if offered higher earnings, others may be laid off and be forced to accept lower-paid jobs and lastly hours worked could change significantly between jobs, disturbing the earnings growth measure. However, the mostly insignificant results are in line with the scarce existing studies that have found no wage gain from moving from an unlicensed to a licensed occupation (Gittleman and Kleiner, 2016).

93. With these caveats in mind, the cross-section estimations nevertheless suggest an impact of licensing on earnings growth from interstate job-to-job moves within industries (Table C.4). All three indicators of the share of licensed employment produce negative estimates, implying lower earnings growth if the destination state-industry has a higher coverage of licensing, but only the NCSL-indicator is significant in all specifications. This could reflect lower productivity growth because of weaker reallocation of labour resources and reduced competition. The NCSL-estimate corresponds to a 0.6-0.9 percentage point increase in job-to-job earnings growth from a 5 percentage point reduction in licensed employment relative to the origin state-industry.

94. By contrast, for job-to-job moves between states and between industries a higher extent of licensing is mostly associated with higher earnings. This could reflect selection effects, especially among youth, if interstate job-to-job moves and change of industry mainly reflect movements up the job ladder.

95. The strictness indicator yield similar results with lower earnings gains within industries and higher earnings gains between industries for movements to more licensed states (Table C.5). For the subcomponents of the indicator (Table C.6), it is noteworthy that renewal requirements have opposite signs for earnings growth among job stayers and job-to-job movers. In the former case, a negative association was estimated, while in the latter case a positive association is found for job-to-job moves across states and within industries. This may reflect an upfront compensation for job takers in licensed occupations with high renewal requirements, while such requirements reduces productivity growth and thus earnings growth among job stayers.

96. The most interesting question regarding job-to-job earnings growth may nonetheless be the never realised earnings gains for those that do not move because of occupational licensing. Since licensing is found to be associated with significantly lower job-to-job hire rates and lower interstate job-to-job moves to more licensed states, such effects could be quantitatively important for aggregate earnings. Further analysis of this is beyond the scope of this paper, but an important topic for future research.

8. References

Abdul Ghani, A. (2019), “The Impact of the Nurse Licensing Compact on Inter-State Job Mobility in the United States”, in: OECD (2019), *OECD Economic Survey of the United States: Key Research findings*, OECD Publishing, Paris, http://doi.org/10.1787/9789264310278-en

Anderson, D.M., R. Brown, K.K. Charles and D.I. Rees (2016), “The Effect of Occupational Licensing on Consumer Welfare: Early Midwifery Laws and Maternal Mortality”, *NBER Working Paper*, No. 22456.

Blair, P. and B. Chung (2018a), "How Much of Barrier to Entry Is Occupational Licensing?", *NBER Working Paper Series*, No. 25262.

Blair, P. and B. Chung (2018b), "Job Market Signaling through Occupational Licensing", *NBER Working Paper Series*, No. 24791.

Carpenter, D. et al. (2018), "The Continuing Burden of Occupational Licensing in the United States", *Economic Affairs*, Vol. 38/3, pp. 380-405.

Correia, S. (2014), "REGHDFE: Stata module to perform linear or instrumental-variable regression absorbing any number of high-dimensional fixed effects", Statistical Software Components S457874, Boston College of Economics, revised 10 March 2019.

Council of State Governments (2019), *Promising Practices on Licensure Mobility*, report.

Craddock, L. (2008), ""Good Moral Character" as a Licensing Standard", *Journal of the National Association of Administrative Law Judiciary*, Vol. 28/2, pp. 449-469.

Farronato, C., A. Fradkin, B. Larsen and E. Brynjolfsson (2018), "Consumer Protection in an Online World: When Does Occupational Licensing Matter?", mimeo.

Federal Trade Commission (2018), "Options to Enhance Occupational License Portability", *Policy Perspectives*.

Federman, M., D. Harrington and K. Krynski (2006), "The Impact of State Licensing Regulations on Low-Skilled Immigrants: The Case of Vietnamese Manicurists", *AEA Papers and Proceedings*, Vol. 96/2, pp. 237-241.

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

Gittleman, M, M. Klee and M. Kleiner (2018), "Analyzing the Labor Market Outcomes of Occupational Licensing", *Industrial Relations*, Vol. 57/1, pp. 57-100.

Gittleman, M. and M. Kleiner (2016), "Wage Effects of Unionization and Occupational Licensing Coverage in the United States", *ILR Review*, Vol. 69/1, pp. 142-172.

Haltiwanger, J., H. Hyatt and E. McEntarfer (2018), "Who Moves Up the Job Ladder?", *Journal of Labor Economics*, Vol. 36/S1, pp. S301-S336.

Hermansen, M. (2020), "Job Mobility in the United States", *OECD Economics Department Working Paper*s, forthcoming.

Hyatt, H. et al. (2017), "Job-to-Job Flows: New Statistics on Worker Reallocation and Job Turnover", U.S. Census Bureau.

Johnson, J. and M. Kleiner (2017), "Is Occupational Licensing a Barrier to Interstate Migration?", *NBER Working Paper*, No. 24107.

Kilmer, M. (2018), "A Look at Occupational Licensing Reform across the United States", Arkansas Center for Research in Economics.

Klee, M. (2013), "How Do Professional Licensing Regulations Affect Practitioners? New Evidence", U.S. Bureau of Labor Statistics, SEHSD Working Paper, No. 2013-30.

Kleiner, M. (2017), "The influence of occupational licensing and regulation", *IZA World of Labor*, No. 2017:392.

Kleiner, M. and A. Krueger (2010), "The Prevalence and Effects of Occupational Licensing", *British Journal of Industrial Relations*, Vol. 48/4, pp. 676-687.

Kleiner, M. and A. Krueger (2013), "Analyzing the Extent and Influence of Occupational Licensing on the Labor Market", *Journal of Labor Economics*, Vol. 31/2, pp. S173-S202.

Kleiner and Vorotnikov (2017), "Analyzing occupational licensing among the states", *Journal of Regulatory Economics*, Vol. 52/2, pp. 132-158.

Koumenta, M. and M. Pagliero (2017), "Measuring Prevalence and Labour Market Impacts of Occupational Regulation in the EU", European Commission.

Law, M. and S. Kim (2005), "Specialization and Regulation: The Rise of Professionals and the Emergence of Occupational Licensing Regulation", *Journal of Economic History*, Vol. 65/3, pp. 723-756.

Mocetti, S., L. Rizzica and G. Roma (2019), "Regulated Occupations in Italy: Extent and Labor Market Effects", *Bank of Italy Occasional Papers*, No. 495.

Morikawa, M. (2018), "Occupational licenses and labor market outcomes in Japan", *Japan & The World Economy*, Vol. 48, pp. 45-56.

Mulholland, S. and A. Young (2016), "Occupational Licensing and Interstate Migration", *Cato Journal*, Vol. 36/1, pp. 17-31.

National Council of State Legislatures (2017), "The State of Occupational Licensing: Research, State Policies and Trends".

National Council of State Legislatures (2019a), "Barriers to Work: Improving Access to Licensed Occupations for Veterans and Military Spouses".

National Council of State Legislatures (2019b), "Barriers to Work: Improving Access to Licensed Occupations for Low-Income, Unemployed and Dislocated Workers".

National Council of State Legislatures (2019c), "Barriers to Work: Improving Employment in Licensed Occupations for Individuals with Criminal Records".

OECD (2016), *OECD Economic Surveys: United States 2016*, OECD Publishing, Paris, http://dx.doi.org/10.1787/eco_surveys-usa-2016-en

Rhode, D. (2018), "Virtue and the Law: The Good Moral Character Requirement in Occupational Licensing, Bar Regulation, and Immigration Proceedings", *Law & Social Inquiry*, Vol. 43/3, pp. 1027-1058.

Shannon, S. et al. (2017), "The Growth, Scope, and Spatial Distribution of People with Felony Records in the United States, 1948-2010", *Demography*, Vol. 54/5, pp. 1795-1818.

Shapiro, C. (1986), "Investment, Moral Hazard, and Occupational Licensing", *Review of Economic Studies*, Vol. 53, pp. 843-862.

Summers, A. (2007), "Occupational Licensing: Ranking the States and Exploring Alternatives", *Policy Study 361*, Reason Foundation.

Thornton, R. and E. Timmons (2015), "The de-licensing of occupations in the United States", *Monthly Labor Review*, U.S. Bureau of Labor Statistics.

Vallas, R. and S. Dietrich (2014), One Strike and You're Out: How We Can Eliminate Barriers to Economic Security and Mobility for People with Criminal Records, Center for American Progress.

von Rueden, C., G. Nicoletti, I. Bambalaite (2019), "Occupational Entry Regulations and their Effects on Productivity in Services: Measurement and Firm-Level Evidence", *OECD Productivity Working Papers*, forthcoming.

White House (2015), Occupational Licensing: A Framework for Policymakers, report prepared by Department of the Treasury Office of Economic Policy, Council of Economic Advisors and Department of Labor.

Annex A. Supplementary figures and tables

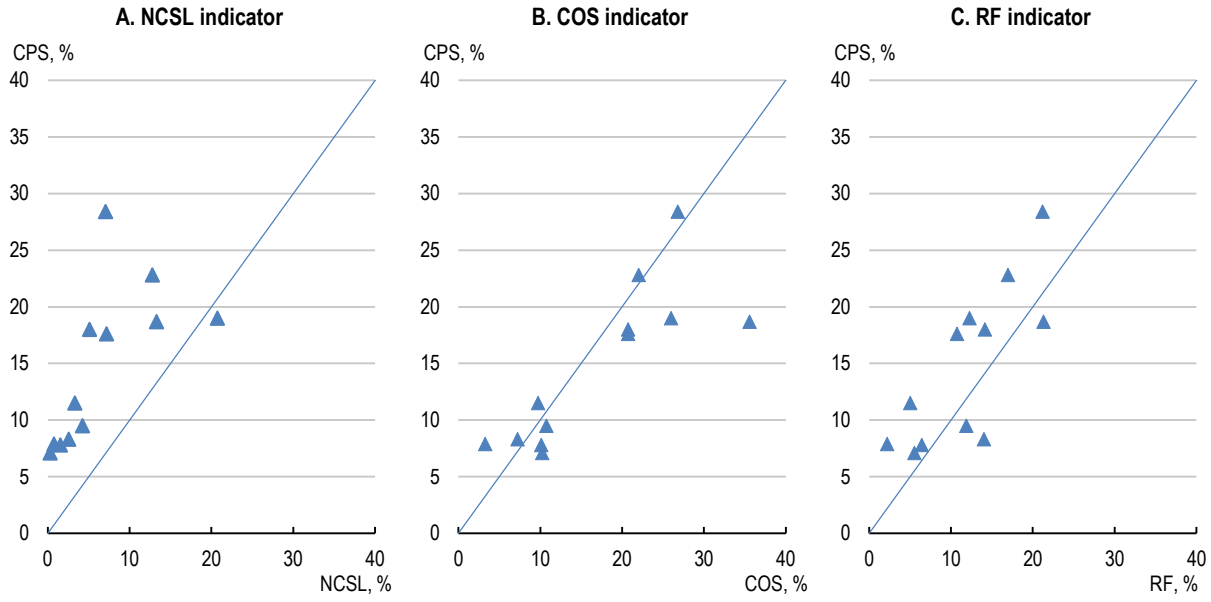
97. The indicators for the share of licensed employment constructed in Section 2.3 are compared with available survey-based measures below. Asking people directly if they hold a licence may give a better estimate than the indirect mapping applied in this paper. Yet, surveys tend to suffer from non-participation and small samples. Another issue is that employees may not know if they hold a licence or their job requires a licence.

98. Figure A.1 provides an overall assessment of the fit with licensing across industries at the national level estimated on the basis of survey responses from the CPS. As expected, the NCSL measure based on 29 occupations results in a share of licensed employment across industries below the economy-wide measure from the CPS. The COS and RF measures capture the industry levels fairly well, but with some upward bias for the COS, which is to be expected as discussed in the main text.

99. Figure A.2 relates the three measures of licensed employment to a survey-based measure of the share of licensing across states (Kleiner and Vorotnikov, 2017). The survey estimates by states were obtained in 2013 as part of a workforce survey covering 9850 respondents (CPS survey weights applied to make it representative by state) and is thus also measured with substantial noise. As such, it may not be surprising that the correlation with the indirect measures applied in this paper is very weak.

Figure A.1. Licensing indicators match CPS industry estimates fairly well

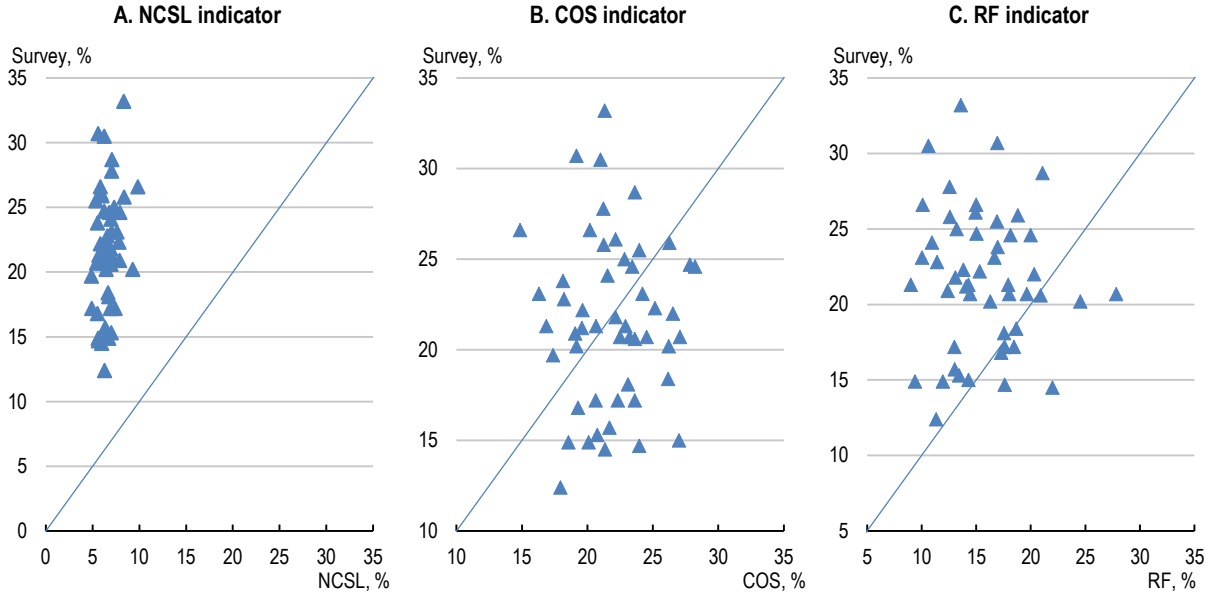
Licensed employment (%) by industry according to constructed indicators and to the CPS, 2018



Note: NAICS industries applied in this paper have been aggregated to match Census 2012 industry grouping applied in the CPS.
Source: OECD calculations and BLS Current Population Survey.

Figure A.2. Licensing indicators match available state survey measures poorly

Licensed employment (%) by state according to constructed indicators and to available survey, 2013



Source: OECD calculations and Kleiner and Vorotnikov (2017).

Table A.1. Interstate job-to-job moves across low and high licensed industries

Job-to-job hire rate for low and high licensed state-industries, percentage of employment, average 2012-2018

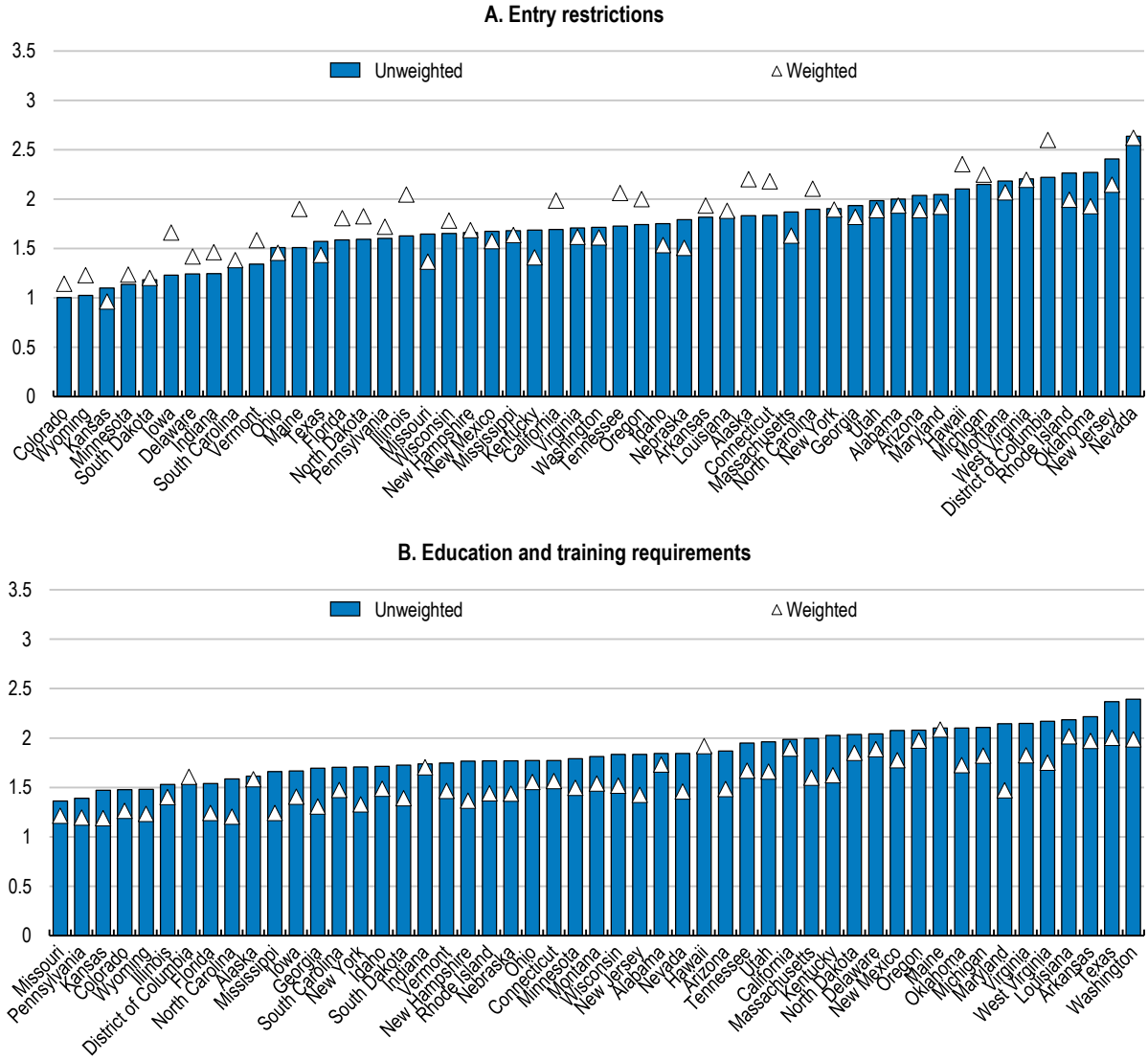
Average across high and low licensing state-industries (unweighted average)			Aggregation of high and low licensing state-industries (weighted average)		
	Destination state-industry			*Destination state-industry*	
Origin state-industry	Low licensing	High licensing	*Origin state-industry*	Low licensing	High licensing
Within state-industry	1.58	1.58	Within state-industry	1.70	1.66
Within state, between industries			*Within state, between industries*		
Low licensing	1.26	0.82	Low licensing	1.61	1.08
High licensing	0.82	1.13	High licensing	1.17	1.57
Between states, within industry			*Between states, within industry*		
Low licensing	0.16	0.15	Low licensing	0.21	0.18
High licensing	0.21	0.18	High licensing	0.20	0.17
Between states, between industries			*Between states, between industries*		
Low licensing	0.20	0.17	Low licensing	0.25	0.21
High licensing	0.28	0.24	High licensing	0.24	0.20
Job-to-job hire rate	**4.51**	**4.27**	**Job-to-job hire rate**	**5.38**	**5.07**

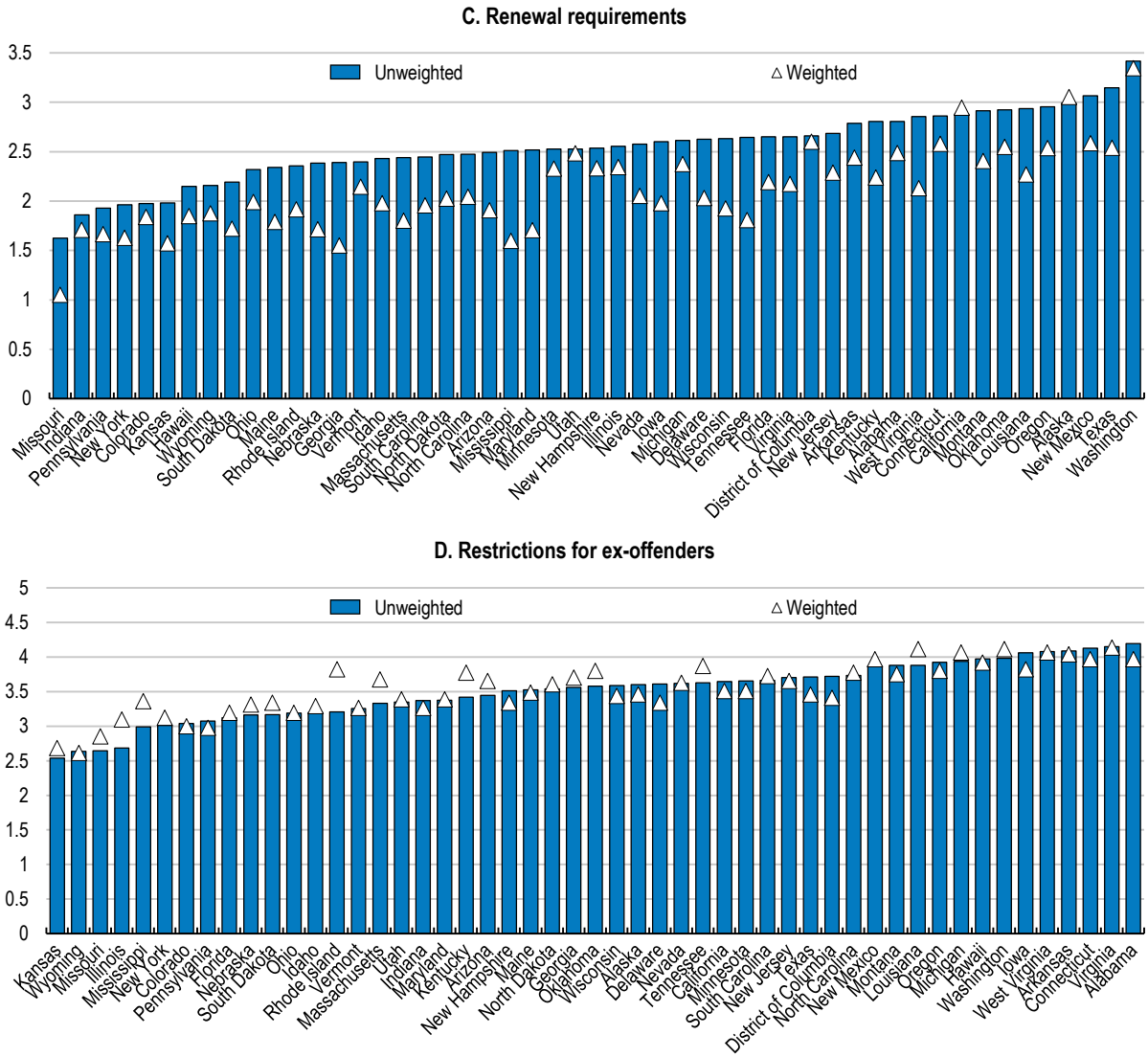
Note: For each industry, states are classified as "high" and "low" licensed according to the estimated share of licensed employment (average 2012-2018). The threshold is set to approximate 50% of states and 50% of national employment in the high and low category for the unweighted and weighted average, respectively

Source: OECD calculations based on data from careeronestop.org and Occupational Employment Statistics, BLS; and Job-to-Job Flows Database, Census Bureau.

Figure A.3. Subcomponents of occupational licensing strictness indicator

Subcomponents of indicator for strictness of licensing for 31 occupations by state (0-6 scale), 2017

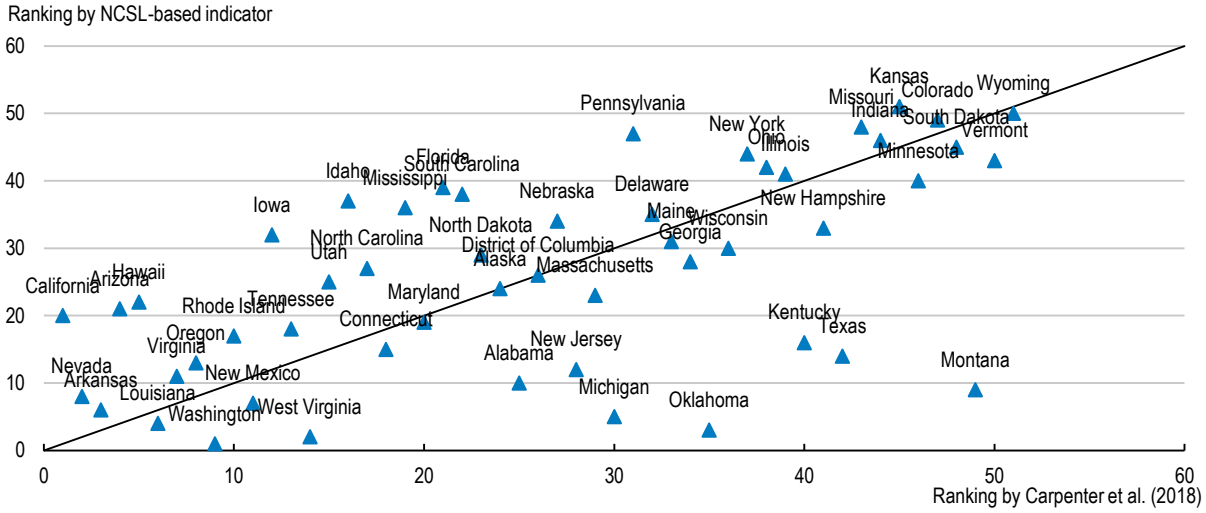




Note: Unweighted refers to simple average across the 31 occupations, weighted refers to an employment weighted average using national employment shares for the 31 occupations.
Source: OECD calculations based on Occupational Licensing Database from the NCSL.

Figure A.4. State rankings by two occupational licensing strictness indicators

Ranking from most to least occupational licensing strictness



Note: The vertical axis ranks states according to the unweighted strictness indicator from Figure 18, Panel A. The horizontal axis reports the ranking from Carpenter et al. (2018), which is based on 102 low- and middle-income occupations and combines the number and burden of licensing requirements across states.
Source: Carpenter et al. (2018); Figure 18.

Annex B. Job mobility estimation results

Table B.1. Job hire rates and extent of occupational licensing

		(1) Cross-section estimation Variation across states and industries only						(2) Within state-industry estimation Time variation in employment composition only						(3) Pooled cross-section estimation Cross-section and time variation combined					
Dependent variable	**Control for**	**NCSL**		**COS**		**RF**		**NCSL**		**COS**		**RF**		**NCSL**		**COS**		**RF**	
Job hire rate	Sex/age	-0.109	***	-0.024	**	-0.016		-0.087	**	-0.032	**	-0.040	**	-0.105	***	-0.021	**	-0.014	
	Sex/education	-0.118	***	-0.025	**	-0.015		-0.086	**	-0.032	**	-0.042	**	-0.113	***	-0.022	**	-0.013	
	Race/ethnicity	-0.134	***	-0.031	**	-0.020		-0.091	**	-0.028	*	-0.034	**	-0.129	***	-0.027	**	-0.018	
	Firm age	-0.129	***	-0.025	**	-0.017		-0.078	**	-0.025		-0.030		-0.126	***	-0.022	**	-0.015	
	Firm size	-0.132	***	-0.026	**	-0.017		-0.090	**	-0.027	*	-0.034	*	-0.127	***	-0.023	**	-0.015	
	No controls	-0.135	***	-0.028	**	-0.019		-0.094	**	-0.030	*	-0.037	*	-0.130	***	-0.025	**	-0.016	
Job-to-job hire rate	Sex/age	-0.060	***	-0.012	*	-0.010	*	-0.044	**	-0.023		-0.035	*	-0.054	**	-0.010	*	-0.008	
	Sex/education	-0.062	***	-0.013	**	-0.009	*	-0.049	**	-0.022		-0.036	*	-0.057	***	-0.012	**	-0.008	
	Race/ethnicity	-0.068	***	-0.016	**	-0.011	**	-0.050	**	-0.021		-0.032	*	-0.063	***	-0.015	**	-0.010	
	Firm age	-0.065	***	-0.013	*	-0.010	*	-0.045	*	-0.020		-0.031		-0.061	***	-0.012	**	-0.008	
	Firm size	-0.066	***	-0.014	**	-0.010	*	-0.052	**	-0.022		-0.034	*	-0.061	***	-0.013	**	-0.009	
	No controls	-0.069	***	-0.015	**	-0.011	*	-0.052	**	-0.022		-0.033		-0.063	***	-0.013	**	-0.009	
Nonemployment	Sex/age	-0.048	***	-0.013	**	-0.006		-0.031	*	-0.006		-0.001		-0.048	***	-0.011	**	-0.006	
hire rate	Sex/education	-0.055	***	-0.012	**	-0.005		-0.025		-0.007		-0.002		-0.054	***	-0.010	**	-0.005	
	Race/ethnicity	-0.064	***	-0.014	**	-0.008		-0.029		-0.005		0.002		-0.063	***	-0.013	**	-0.008	
	Firm age	-0.061	***	-0.012	**	-0.007		-0.022		-0.003		0.005		-0.062	***	-0.010	**	-0.006	
	Firm size	-0.063	***	-0.012	**	-0.007		-0.025		-0.003		0.004		-0.063	***	-0.010	*	-0.006	
	No controls	-0.064	***	-0.014	**	-0.007		-0.030		-0.005		0.001		-0.064	***	-0.012	**	-0.007	
State controls		x		x		x								x		x		x	
Industry controls		x		x		x								x		x		x	
State-industry controls								x		x		x							
Time controls								x		x		x		x		x		x	
Time period		Av. 2015-2018		Av. 2015-2018		Av. 2012-2014		2012-2017						2012 Q1 - 2018 Q1					
Observations		951-15186		951-15186		936-14945		5627-89944		5627-89944		5537-88505		23398-374145		23398-374145		23023-368148	
Variables		71-79		71-79		71-79		955-963		955-963		940-948		96-104		96-104		96-104	
Clusters		951		951		937		947		947		932		947		947		932	
R^2		0.82-0.95		0.82-0.95		0.81-0.95		0.87-0.99		0.87-0.99		0.87-0.99		0.68-0.85		0.68-0.85		0.68-0.85	

Note: Each cell reports the estimate of β_1 from a separate model for the association between job hire and the share of licensed employment by state and industry. Columns indicate the applied source of licensing information. Standard errors are clustered at the state-industry level and significant estimates at the 1%; 5% and 10% level are reported by ***; ** and *, respectively.

Table B.2. Job separation rates and extent of occupational licensing

		(1) Cross-section estimation Variation across states and industries only			(2) Within state-industry estimation Time variation in employment composition only			(3) Pooled cross-section estimation Cross-section and time variation combined		
Dependent variable	**Control for**	**NCSL**	**COS**	**RF**	**NCSL**	**COS**	**RF**	**NCSL**	**COS**	**RF**
Job separation rate	Sex/age	-0.117 ***	-0.026 **	-0.015	-0.077 **	-0.048 **	-0.060 **	-0.114 ***	-0.025 **	-0.015
	Sex/education	-0.120 ***	-0.027 **	-0.015	-0.079 **	-0.047 **	-0.061 **	-0.118 ***	-0.026 **	-0.014
	Race/ethnicity	-0.131 ***	-0.031 **	-0.019	-0.083 **	-0.044 **	-0.055 **	-0.129 ***	-0.030 **	-0.018
	Firm age	-0.127 ***	-0.027 **	-0.016	-0.076 **	-0.043 **	-0.054 **	-0.125 ***	-0.026 **	-0.016
	Firm size	-0.128 ***	-0.028 **	-0.016	-0.082 **	-0.044 **	-0.056 **	-0.126 ***	-0.026 **	-0.016
	No controls	-0.132 ***	-0.029 **	-0.017	-0.085 **	-0.046 **	-0.057 **	-0.129 ***	-0.028 **	-0.017
Job-to-job	Sex/age	-0.071 ***	-0.015 **	-0.008	-0.048 **	-0.029 *	-0.043 **	-0.070 ***	-0.014 **	-0.009
separation rate	Sex/education	-0.072 ***	-0.016 **	-0.008	-0.052 **	-0.028 *	-0.044 **	-0.072 ***	-0.015 **	-0.009
	Race/ethnicity	-0.078 ***	-0.018 **	-0.010	-0.053 **	-0.027 *	-0.041 **	-0.078 ***	-0.018 **	-0.011
	Firm age	-0.076 ***	-0.016 **	-0.009	-0.051 **	-0.027	-0.040 *	-0.075 ***	-0.015 **	-0.009
	Firm size	-0.076 ***	-0.017 **	-0.009	-0.055 **	-0.029 *	-0.043 **	-0.075 ***	-0.016 **	-0.010
	No controls	-0.079 ***	-0.018 **	-0.010	-0.055 **	-0.028	-0.042 *	-0.078 ***	-0.017 **	-0.010
Nonemployment	Sex/age	-0.042 ***	-0.010 **	-0.006	-0.023	-0.016 **	-0.013	-0.043 ***	-0.011 **	-0.006
separation rate	Sex/education	-0.044 ***	-0.010 **	-0.006	-0.021	-0.016 **	-0.014	-0.044 ***	-0.010 **	-0.005
	Race/ethnicity	-0.049 ***	-0.011 **	-0.008	-0.023 *	-0.015 **	-0.011	-0.049 ***	-0.012 **	-0.007
	Firm age	-0.047 ***	-0.010 **	-0.007	-0.020	-0.014 *	-0.010	-0.047 ***	-0.010 **	-0.006
	Firm size	-0.048 ***	-0.010 **	-0.007	-0.020	-0.013 *	-0.010	-0.049 ***	-0.010 **	-0.006
	No controls	-0.049 ***	-0.011 **	-0.007	-0.023	-0.015 *	-0.012	-0.049 ***	-0.011 **	-0.006
State controls		x	x	x				x	x	x
Industry controls		x	x	x				x	x	x
State-industry controls					x	x	x			
Time controls					x	x	x	x	x	x
Time period		Av. 2015-2018	Av. 2015-2018	Av. 2012-2014	2012-2017			2012 Q1 - 2018 Q1		
Observations		951-15186	951-15186	936-14945	5627-89944	5627-89944	5537-88505	22451-374145	22451-374145	22091-368148
Variables		71-79	71-79	71-79	955-963	955-963	940-948	96-104	96-104	96-104
Clusters		951	951	937	947	947	932	947	947	932
R^2		0.83-0.93	0.83-0.93	0.83-0.92	0.88-0.99	0.88-0.99	0.88-0.99	0.6-0.9	0.6-0.89	0.6-0.89

Note: Each cell reports the estimate of β_1 from a separate model for the association between job separation and the share of licensed employment by state and industry. Columns indicate the applied source of licensing information. Standard errors are clustered at the state-industry level and significant estimates at the 1%; 5% and 10% level are reported by ***; ** and *, respectively.

Table B.3. Job mobility and strictness of occupational licensing

		(1) Cross-section estimation	(2) Within state-industry estimation	(3) Pooled cross-section estimation
Dependent variable	Controls for	Licensing strictness	Licensing strictness	Licensing strictness
Job hire rate	Sex/age	-0.040 ***	-0.034 **	-0.039 ***
	Sex/education	-0.042 ***	-0.033 **	-0.042 ***
	Race/ethnicity	-0.046 ***	-0.034 **	-0.046 ***
	Firm age	-0.044 ***	-0.029 **	-0.044 ***
	Firm size	-0.045 ***	-0.034 **	-0.045 ***
	No controls	-0.047 ***	-0.035 **	-0.046 ***
Job-to-job hire rate	Sex/age	-0.024 ***	-0.018 *	-0.022 ***
	Sex/education	-0.025 ***	-0.020 **	-0.023 ***
	Race/ethnicity	-0.026 ***	-0.020 **	-0.025 ***
	Firm age	-0.025 ***	-0.018 *	-0.024 ***
	Firm size	-0.025 ***	-0.021 **	-0.024 ***
	No controls	-0.026 ***	-0.021 *	-0.025 ***
Nonemployment hire rate	Sex/age	-0.016 ***	-0.012	-0.016 ***
	Sex/education	-0.017 ***	-0.009	-0.017 ***
	Race/ethnicity	-0.019 ***	-0.010	-0.020 ***
	Firm age	-0.018 ***	-0.007	-0.019 ***
	Firm size	-0.019 ***	-0.009	-0.020 ***
	No controls	-0.020 ***	-0.010	-0.020 ***
Job separation rate	Sex/age	-0.042 ***	-0.031 **	-0.041 ***
	Sex/education	-0.043 ***	-0.032 **	-0.043 ***
	Race/ethnicity	-0.045 ***	-0.033 **	-0.045 ***
	Firm age	-0.044 ***	-0.031 **	-0.044 ***
	Firm size	-0.044 ***	-0.033 **	-0.044 ***
	No controls	-0.046 ***	-0.034 **	-0.046 ***
Job-to-job separation rate	Sex/age	-0.027 ***	-0.019 **	-0.027 ***
	Sex/education	-0.027 ***	-0.020 **	-0.028 ***
	Race/ethnicity	-0.029 ***	-0.021 **	-0.029 ***
	Firm age	-0.028 ***	-0.020 **	-0.028 ***
	Firm size	-0.027 ***	-0.022 **	-0.028 ***
	No controls	-0.029 ***	-0.021 **	-0.029 ***
Nonemployment separation rate	Sex/age	-0.014 ***	-0.010 *	-0.014 ***
	Sex/education	-0.014 ***	-0.009 *	-0.014 ***
	Race/ethnicity	-0.015 ***	-0.010 *	-0.015 ***
	Firm age	-0.015 ***	-0.008	-0.015 ***
	Firm size	-0.015 ***	-0.009 *	-0.015 ***
	No controls	-0.015 ***	-0.010 *	-0.015 ***
State controls		x		x
Industry controls		x		x
State-industry controls			x	
Time controls			x	x
Time period		Average 2015-2018	2012-2017	2012 Q1 - 2018 Q1
Observations		951-15186	5627-89944	22451-374145
Variables		71-79	955-963	96-104
Clusters		951	947	947
R^2		0.82-0.95	0.87-0.99	0.6-0.9

Note: Each cell reports the estimate of β_1 from a separate model for the association between job hire/separation and the strictness of licensing by state and industry. Standard errors are clustered at the state-industry level and significant estimates at the 1%; 5% and 10% level are reported by ***; ** and *, respectively.

Table B.4. Job hire rates and subcomponents of occupational licensing strictness

		(1) Cross-section estimation Variation across states and industries only				(2) Within state-industry estimation Time variation in employment composition only				(3) Pooled cross-section estimation Cross-section and time variation combined			
Dependent variable	Control for	Entry restrictions	Education-training	Renewal requirements	Restrictions ex-offenders	Entry restrictions	Education-training	Renewal requirements	Restrictions ex-offenders	Entry restrictions	Education-training	Renewal requirements	Restrictions ex-offenders
Job hire rate	Sex/age	-0.019 **	0.022 *	-0.018 **	-0.013 **	-0.028	0.020	-0.004	-0.018	-0.019 **	0.018	-0.018 **	-0.011 *
	Sex/education	-0.020 **	0.020	-0.018 **	-0.013 **	-0.032	0.018	-0.006	-0.014	-0.020 **	0.017	-0.018 **	-0.011 *
	Race/ethnicity	-0.021 **	0.023 *	-0.018 *	-0.017 **	-0.034	0.022	-0.002	-0.018	-0.021 **	0.021	-0.017 *	-0.016 **
	Firm age	-0.021 **	0.024 *	-0.024 **	-0.012 *	-0.038 *	0.033	-0.009	-0.014	-0.020 **	0.019	-0.022 **	-0.011
	Firm size	-0.023 **	0.027 **	-0.022 **	-0.014 *	-0.039 *	0.024	-0.003	-0.015	-0.023 **	0.023 *	-0.021 **	-0.012 *
	No controls	-0.021 **	0.023 *	-0.020 **	-0.016 **	-0.036	0.023	-0.003	-0.017	-0.021 **	0.020	-0.019 **	-0.014 **
Job-to-job hire rate	Sex/age	-0.015 **	0.018 **	-0.012 **	-0.007 *	-0.021	0.028	-0.017	-0.006	-0.015 **	0.015 *	-0.011 **	-0.005
	Sex/education	-0.017 **	0.018 **	-0.013 **	-0.005	-0.022	0.029	-0.017	-0.007	-0.017 **	0.015 *	-0.012 **	-0.004
	Race/ethnicity	-0.017 **	0.019 **	-0.013 **	-0.007 *	-0.022	0.031	-0.016	-0.009	-0.017 **	0.016 **	-0.012 **	-0.006
	Firm age	-0.017 **	0.020 **	-0.016 **	-0.005	-0.024	0.035	-0.019	-0.007	-0.017 **	0.016 **	-0.014 **	-0.004
	Firm size	-0.018 **	0.020 **	-0.013 **	-0.006	-0.024	0.032	-0.017	-0.008	-0.017 ***	0.017 **	-0.012 **	-0.005
	No controls	-0.017 **	0.020 **	-0.014 **	-0.006	-0.023	0.031	-0.016	-0.008	-0.017 **	0.016 **	-0.013 **	-0.005
Nonemployment hire rate	Sex/age	-0.004	0.004	-0.006	-0.006 *	-0.005	-0.006	0.009	-0.009	-0.003	0.003	-0.006 *	-0.006 *
	Sex/education	-0.003	0.002	-0.004	-0.008 **	-0.008	-0.009	0.009	-0.004	-0.003	0.002	-0.005	-0.008 **
	Race/ethnicity	-0.003	0.003	-0.005	-0.010 **	-0.010	-0.007	0.010	-0.006	-0.003	0.004	-0.005	-0.010 **
	Firm age	-0.003	0.004	-0.007 *	-0.007 *	-0.012	-0.001	0.007	-0.004	-0.003	0.003	-0.007 *	-0.008 **
	Firm size	-0.004	0.006	-0.008 **	-0.008 *	-0.013	-0.006	0.010	-0.004	-0.004	0.006	-0.008 **	-0.008 *
	No controls	-0.003	0.003	-0.005	-0.009 **	-0.011	-0.006	0.010	-0.006	-0.003	0.004	-0.006	-0.009 **
State controls		x								x			
Industry controls		x								x			
State-industry controls						x							
Time controls						x				x			
Time period		Average 2015-2018				2012-2017				2012 Q1 - 2018 Q1			
Observations		951-15186				5627-89944				23398-374145			
Variables		74-82				958-966				99-107			
Clusters		951				947				947			
R^2		0.82-0.95				0.87-0.99				0.68-0.85			

Note: The four subcomponents of licensing strictness are included jointly, i.e. each row report estimates from the same estimation model for job hire. Standard errors are clustered at the state-industry level and significant estimates at the 1%; 5% and 10% level are reported by ***; ** and *, respectively.

Table B.5. Job separation rates and subcomponents of occupational licensing strictness

		(1) Cross-section estimation Variation across states and industries only				(2) Within state-industry estimation Time variation in employment composition only				(3) Pooled cross-section estimation Cross-section and time variation combined			
Dependent variable	Control for	Entry restrictions	Education-training	Renewal requirements	Restrictions ex-offenders	Entry restrictions	Education-training	Renewal requirements	Restrictions ex-offenders	Entry restrictions	Education-training	Renewal requirements	Restrictions ex-offenders
Job separation rate	Sex/age	-0.021 **	0.028 **	-0.019 **	-0.015 **	-0.024	0.050 *	-0.039 **	-0.010	-0.020 **	0.021 *	-0.019 **	-0.012 *
	Sex/education	-0.023 **	0.028 **	-0.020 **	-0.014 **	-0.026	0.049 *	-0.040 **	-0.008	-0.021 **	0.021 *	-0.020 **	-0.012 *
	Race/ethnicity	-0.023 **	0.030 **	-0.019 **	-0.017 **	-0.028	0.052 *	-0.037 *	-0.011	-0.022 **	0.024 *	-0.019 **	-0.015 **
	Firm age	-0.023 **	0.030 **	-0.023 **	-0.013 *	-0.030	0.057 *	-0.041 **	-0.009	-0.022 **	0.024 *	-0.023 **	-0.011 *
	Firm size	-0.024 **	0.032 **	-0.023 **	-0.014 *	-0.032	0.052 *	-0.038 *	-0.010	-0.023 **	0.026 **	-0.022 **	-0.012 *
	No controls	-0.023 **	0.030 **	-0.022 **	-0.015 **	-0.029	0.052 *	-0.037 *	-0.011	-0.022 **	0.024 *	-0.021 **	-0.014 **
Job-to-job separation rate	Sex/age	-0.013 **	0.023 **	-0.016 **	-0.010 **	-0.030 *	0.023	-0.023	0.005	-0.014 **	0.018 **	-0.015 **	-0.008 *
	Sex/education	-0.015 **	0.024 **	-0.017 **	-0.008 *	-0.030 *	0.024	-0.024	0.004	-0.016 **	0.018 **	-0.016 **	-0.006
	Race/ethnicity	-0.015 **	0.025 **	-0.017 **	-0.010 **	-0.031 *	0.025	-0.023	0.003	-0.016 **	0.020 **	-0.015 **	-0.008 *
	Firm age	-0.016 **	0.025 **	-0.019 **	-0.008	-0.032 *	0.027	-0.024	0.004	-0.016 **	0.020 **	-0.017 **	-0.006
	Firm size	-0.016 **	0.025 **	-0.016 **	-0.009 *	-0.032 *	0.026	-0.023	0.003	-0.016 **	0.020 **	-0.015 **	-0.007
	No controls	-0.015 **	0.025 **	-0.018 **	-0.009 *	-0.032 *	0.025	-0.023	0.003	-0.016 **	0.020 **	-0.017 **	-0.007 *
Nonemployment separation rate	Sex/age	-0.007 *	0.004	-0.004	-0.005 *	0.007	0.028 **	-0.016 *	-0.014 *	-0.005	0.002	-0.004	-0.004
	Sex/education	-0.006 *	0.004	-0.003	-0.006 *	0.006	0.027 *	-0.016 *	-0.012	-0.005	0.002	-0.003	-0.005 *
	Race/ethnicity	-0.007 *	0.005	-0.003	-0.007 **	0.005	0.028 **	-0.015	-0.013 *	-0.005	0.003	-0.003	-0.007 **
	Firm age	-0.006 *	0.005	-0.005	-0.005 *	0.004	0.031 **	-0.017 *	-0.013	-0.005	0.003	-0.005	-0.005
	Firm size	-0.007 *	0.007	-0.006	-0.005	0.003	0.028 **	-0.015	-0.012	-0.006	0.005	-0.006 *	-0.005
	No controls	-0.007	0.005	-0.004	-0.006 *	0.004	0.028 *	-0.015	-0.013	-0.005	0.003	-0.004	-0.006 *
State controls		x								x			
Industry controls		x								x			
State-industry controls						x							
Time controls						x				x			
Time period		Average 2015-2018				2012-2017				2012 Q1 - 2018 Q1			
Observations		951-15186				5627-89944				22451-374145			
Variables		74-82				958-966				99-107			
Clusters		951				947				947			
R^2		0.84-0.93				0.88-0.99				0.6-0.9			

Note: The four subcomponents of licensing strictness are included jointly, i.e. each row report estimates from the same estimation model for job separation. Standard errors are clustered at the state-industry level and significant estimates at the 1%; 5% and 10% level are reported by ***; ** and *, respectively.

Table B.6. Origin-destination job-to-job hire rate and extent of occupational licensing

Estimated effects of the difference in licensed employment share on origin-destination job-to-job hire, by moves within and between states and industries

		(1) Cross-section estimation Variation across states and industries only								(2) Within state-industry estimation Time variation in employment composition only								(3) Pooled cross-section estimation Cross-section and time variation combined							
Licensing	Control for	Origin		WS-BI		BS-WI		BS-BI		Origin		WS-BI		BS-WI		BS-BI		Origin		WS-BI		BS-WI		BS-BI	
NCSL-based	Sex/age	-0.331	***	-0.115	*	-0.442	***	-0.273	***	-0.195	***	-0.047		-0.052		-0.062	*	-0.056	**	-0.009		-0.086	***	-0.062	***
indicator	Sex/education	-0.147	**	-0.044		-0.195	***	-0.140	***	-0.091	**	-0.001		-0.016		-0.026		-0.033	**	0.002		-0.052	***	-0.038	***
	Race/ethnicity	-0.081	**	0.001		-0.121	***	-0.080	**	-0.077	**	0.000		-0.016		-0.032	**	-0.021	*	0.012		-0.038	***	-0.025	**
	Firm age	-0.036		-0.022		-0.068	***	-0.049	**	-0.071	***	-0.022	*	-0.026	**	-0.042	***	-0.016	**	0.003		-0.025	***	-0.017	***
	Firm size	-0.077	**	-0.038	**	-0.130	***	-0.078	***	-0.082	***	-0.032	**	-0.025	**	-0.052	***	-0.019	**	-0.001		-0.030	***	-0.021	***
	No controls	-0.050	**	0.008		-0.077	***	-0.059	***	-0.047	***	0.013		-0.009		-0.017	**	-0.017	*	0.014		-0.030	***	-0.020	**
COS-based	Sex/age	-0.085	*	0.005		-0.063	**	-0.058	**	-0.041		0.020		0.011		-0.003		-0.019		-0.036	**	-0.019	**	-0.006	
indicator	Sex/education	-0.047	*	-0.021		-0.035	**	-0.026	**	-0.020		0.029		0.005		0.000		-0.012		-0.044	***	-0.014	**	-0.003	
	Race/ethnicity	-0.031		-0.031	**	-0.027	**	-0.016		-0.018		0.030	*	0.001		-0.004		-0.009		-0.049	***	-0.014	***	-0.002	
	Firm age	-0.012		0.001		-0.014	*	-0.018	**	-0.013		0.008		0.002		-0.007		-0.005		-0.004		-0.006	**	-0.003	
	Firm size	-0.022		-0.003		-0.023	**	-0.025	**	-0.023	**	-0.001		-0.006		-0.013	**	-0.007		-0.005	*	-0.007	**	-0.003	
	No controls	-0.019		-0.041	***	-0.020	**	-0.012	*	-0.010		0.031	**	0.000		-0.001		-0.007		-0.053	***	-0.013	***	-0.001	
RF-based	Sex/age	-0.035		-0.003		-0.028		-0.022		-0.069	*	0.023		0.013		0.003		-0.007		-0.090	***	-0.012	*	0.008	
indicator	Sex/education	-0.012		-0.040	**	-0.012		0.007		-0.035		0.034		0.006		0.005		-0.004		-0.105	***	-0.009	**	0.007	
	Race/ethnicity	-0.008		-0.067	***	-0.009		0.009		-0.025		0.038	*	0.003		0.000		-0.003		-0.115	***	-0.009	**	0.006	*
	Firm age	-0.004		0.004		-0.010		-0.003		-0.023	**	0.009		0.003		-0.009		-0.002		-0.012	***	-0.003	**	0.002	
	Firm size	-0.005		0.002		-0.007		-0.003		-0.027	**	0.000		-0.002		-0.011		-0.002		-0.013	***	-0.004	**	0.002	
	No controls	-0.005		-0.087	***	-0.011	**	0.004		-0.016		0.037	**	0.000		0.002		-0.002		-0.122	***	-0.009	***	0.004	*
Origin state controls		x																x							
Destination state controls		x																x							
Origin industry controls		x																x							
Destination industry controls		x																x							
Origin-destination states-industries										x															
Time controls										x								x							
Time period		Av. 2015-2018 (NCSL and COS), Av. 2012-2014 (RF)								2012-2017								2012 Q1 - 2018 Q1							
Observations		89585-357140								1426478-2934364								6495024-31049754							
Variables		148-158								81256-163800								174-184							
Clusters		36939-100597								81236-163788								646077-663418							

R^2	0.27-0.61	0.36-0.99	0.2-0.59

Note: The dependent variable is the origin-destination job-to-job hire rate, calculated as the number of hires from an origin state-industry to a destination state-industry divided by employment in the destination state-industry. Each row report the estimates of the level and difference in the share of licensed employment by state and industry associated with a job-to-job move: i) level of licensing in origin state-industry (Origin); ii) difference in licensing for moves within state and between industries (WS-BI); iii) difference in licensing for moves between states and within industry (BS-WI); iv) difference in licensing for moves between states and between industries (BS-BI). All estimates have been scaled by 100. Standard errors are clustered at the origin-destination states-industries level (all pairwise combinations) and significant estimates at the 1%; 5% and 10% level are reported by ***; ** and *, respectively.

Table B.7. Origin-destination job-to-job hire rate and strictness of occupational licensing

Estimated effects of the difference in licensing strictness on origin-destination job-to-job hire, by moves within and between states and industries

	(1) Cross-section estimation Variation across states and industries only								(2) Within state-industry estimation Time variation in employment composition only								(3) Pooled cross-section estimation Cross-section and time variation combined							
Control for	Origin		WS-BI		BS-WI		BS-BI		Origin		WS-BI		BS-WI		BS-BI		Origin		WS-BI		BS-WI		BS-BI	
Sex/age	-0.114	**	-0.041	*	-0.139	***	-0.084	***	-0.075	***	-0.021		-0.017		-0.025	*	-0.019	*	-0.009		-0.029	***	-0.019	**
Sex/education	-0.050	**	-0.019		-0.064	***	-0.042	**	-0.035	**	-0.001		-0.005		-0.011		-0.011	*	-0.007		-0.018	***	-0.012	**
Race/ethnicity	-0.023		-0.002		-0.035	***	-0.021	**	-0.030	**	0.000		-0.005		-0.013	**	-0.007		-0.004		-0.013	***	-0.007	**
Firm age	-0.010		-0.006		-0.020	**	-0.014	**	-0.026	***	-0.010	**	-0.007		-0.016	***	-0.006	**	0.001		-0.008	***	-0.006	**
Firm size	-0.022	**	-0.009		-0.035	***	-0.021	**	-0.031	***	-0.014	**	-0.008	*	-0.019	***	-0.006	**	0.000		-0.009	***	-0.006	**
No controls	-0.014		-0.002		-0.024	***	-0.016	**	-0.018	**	0.006		-0.003		-0.007	**	-0.006		-0.004		-0.011	***	-0.006	**
Origin state controls	x																x							
Destination state controls	x																x							
Origin industry controls	x																x							
Destination industry controls	x																x							
Origin-destination states-industries									x															
Time controls									x								x							
Time period	Average 2015-2018								2012-2017								2012 Q1 - 2018 Q1							
Observations	100597-357140								1450802-2934364								6628794-31049754							
Variables	148-158								82670-163800								174-184							
Clusters	41667-100597								82650-163788								663417-663418							
R^2	0.27-0.61								0.36-0.99								0.2-0.59							

Note: The dependent variable is the origin-destination job-to-job hire rate, calculated as the number of hires from an origin state-industry to a destination state-industry divided by employment in the destination state-industry. Each row report the estimates of the level and change in the share of licensed employment by state and industry associated with a job-to-job move: i) level of licensing in origin state-industry (Origin); ii) change in licensing for moves within state and between industries (WS-BI); iii) change in licensing for moves between states and within industry (BS-WI); iv) change in licensing for moves between states and between industries (BS-BI). All estimates have been scaled by 100. Standard errors are clustered at the origin-destination states-industries level (all pairwise combinations) and significant estimates at the 1%; 5% and 10% level are reported by ***; ** and *, respectively.

Table B.8. Origin-destination job-to-job hire rate and subcomponents of licensing strictness

Estimated effects of the difference in licensed employment share on origin-destination job-to-job hire, by moves within and between states and industries

		(1) Cross-section estimation Variation across states and industries only								(2) Within state-industry estimation Time variation in employment composition only								(3) Pooled cross-section estimation Cross-section and time variation combined							
Licensing	Control for	Origin		WS-BI		BS-WI		BS-BI		Origin		WS-BI		BS-WI		BS-BI		Origin		WS-BI		BS-WI		BS-BI	
Entry restrictions	Sex/age	-0.030		0.074	**	-0.065	**	-0.070	**	-0.070		-0.002		-0.033		-0.067	**	-0.002		0.071	**	-0.015	**	-0.013	*
	Sex/education	-0.012		0.085	**	-0.031	**	-0.037	**	-0.046		0.004		-0.021		-0.030	*	-0.002		0.067	**	-0.011	**	-0.009	**
	Race/ethnicity	-0.010		0.090	***	-0.023	**	-0.025	**	-0.035	*	0.010		-0.013		-0.021		-0.002		0.067	**	-0.010	**	-0.008	**
	Firm age	0.001		0.014	*	-0.010		-0.011	**	-0.027	**	-0.001		-0.011		-0.021	**	-0.002		0.011	**	-0.004	*	-0.003	
	Firm size	-0.004		0.009		-0.016	**	-0.010		-0.025		-0.001		-0.006		-0.014		-0.001		0.013	**	-0.004	*	-0.003	
	No controls	-0.003		0.091	***	-0.013	**	-0.014	**	-0.022	*	0.016		-0.009		-0.015	*	-0.001		0.065	**	-0.008	**	-0.005	**
Education-training	Sex/age	0.113	*	0.031		0.028		0.003		0.066		0.038		0.066		0.087	**	0.027		0.015		0.010		0.003	
	Sex/education	0.056		0.025		0.018		0.000		0.033		0.012		0.040	*	0.055	**	0.017	*	0.006		0.008		0.003	
	Race/ethnicity	0.044	*	0.027		0.020		0.003		0.025		0.010		0.030	*	0.033	*	0.016	*	0.002		0.009		0.005	
	Firm age	0.030	**	0.011		0.025	**	0.007		0.017		0.014		0.014		0.025	**	0.008	*	0.005		0.003		0.002	
	Firm size	0.030	*	0.011		0.016		-0.001		0.017		0.012		0.017		0.020		0.008		0.006		0.002		0.001	
	No controls	0.025	*	0.012		0.016		0.005		0.018		0.005		0.017		0.021	*	0.011	*	-0.007		0.008	*	0.004	
Renewal requirements	Sex/age	-0.085	**	0.011		-0.074	***	-0.070	**	-0.025		0.011		-0.007		-0.032		-0.010		0.088	***	-0.024	***	-0.018	***
	Sex/education	-0.038	**	0.057	**	-0.047	***	-0.038	***	-0.016		0.019		-0.009		-0.025		-0.005		0.095	***	-0.017	***	-0.012	***
	Race/ethnicity	-0.017		0.077	***	-0.030	***	-0.024	**	-0.008		0.023		-0.004		-0.012		-0.003		0.098	***	-0.014	***	-0.010	***
	Firm age	-0.013	*	-0.001		-0.017	**	-0.016	**	-0.003		-0.003		0.010		-0.009		-0.003		0.013	***	-0.006	***	-0.006	***
	Firm size	-0.018	**	-0.004		-0.018	**	-0.017	**	-0.008		-0.002		-0.006		-0.011		-0.003		0.014	***	-0.007	***	-0.006	***
	No controls	-0.009		0.088	***	-0.026	***	-0.015	**	-0.006		0.024		-0.001		-0.008		-0.002		0.100	***	-0.013	***	-0.007	***
Restrictions for ex-offenders	Sex/age	-0.041		-0.081	**	-0.015		0.029		-0.035		-0.040		-0.027		-0.008		-0.016		-0.101	***	0.002		0.004	
	Sex/education	-0.020		-0.101	***	0.002		0.017		-0.009		-0.023		-0.009		-0.004		-0.010		-0.097	***	0.003		0.003	
	Race/ethnicity	-0.015		-0.106	***	0.002		0.014		-0.011		-0.026		-0.011		-0.008		-0.008		-0.096	***	0.003		0.003	
	Firm age	-0.010		-0.014	**	-0.006		0.005		-0.012		-0.010		-0.015	*	-0.008		-0.004		-0.015	***	0.000		0.001	
	Firm size	-0.012		-0.012		-0.009		0.004		-0.012		-0.013		-0.008		-0.009		-0.004		-0.017	***	0.000		0.001	
	No controls	-0.012		-0.107	***	0.003		0.005		-0.007		-0.023		-0.006		-0.004		-0.006	*	-0.092	***	0.003		0.002	

Origin state controls	x		x
Destination state controls	x		x
Origin industry controls	x		x
Destination industry controls	x		x
Origin-destination states-industries		x	
Time controls		x	x
Time period	Average 2015-2018	2012-2017	2012 Q1 - 2018 Q1
Observations	100597-357140	760670-2934364	6628794-31049754
Variables	160-170	82682-163812	186-196
Clusters	41667-100597	82650-163788	663417-663418
R^2	0.27-0.61	0.36-0.99	0.2-0.59

Note: The dependent variable is the origin-destination job-to-job hire rate, calculated as the number of hires from an origin state-industry to a destination state-industry divided by employment in the destination state-industry. Each row report the estimates of the level and difference in the share of licensed employment by state and industry associated with a job-to-job move: i) level of licensing in origin state-industry (Origin); ii) difference in licensing for moves within state and between industries (WS-BI); iii) difference in licensing for moves between states and within industry (BS-WI); iv) difference in licensing for moves between states and between industries (BS-BI). All estimates have been scaled by 100. Standard errors are clustered at the origin-destination states-industries level (all pairwise combinations) and significant estimates at the 1%; 5% and 10% level are reported by ***; ** and *, respectively.

Annex C. Earnings estimation results

Table C.1. Job stayer average earnings and extent of occupational licensing

		(1) Cross-section estimation Variation across states and industries only			(2) Within state-industry estimation Time variation in employment composition only			(3) Pooled cross-section estimation Cross-section and time variation combined		
Dependent variable	**Control for**	**NCSL**	**COS**	**RF**	**NCSL**	**COS**	**RF**	**NCSL**	**COS**	**RF**
ln(average earnings)	Sex/age	-0.117	-0.091	0.061	0.289 **	0.147	0.087	-0.152	-0.099	0.056
	Sex/education	-0.085	-0.091	0.051	0.213 *	0.137	0.131	-0.115	-0.095	0.046
	Race/ethnicity	-0.085	-0.089	0.075	0.361 **	0.140	0.101	-0.104	-0.095	0.068
	Firm age	-0.031	-0.112	0.057	0.420 **	0.180	0.155	-0.052	-0.120	0.055
	Firm size	0.000	-0.113	0.054	0.405 **	0.151	0.129	-0.028	-0.117	0.054
	No controls	-0.063	-0.116	0.058	0.365 **	0.154	0.125	-0.087	-0.123	0.054
Average earnings growth (qoq)	Sex/age	0.000	0.001	-0.001	0.004	0.009	0.021	-0.004	-0.004	0.002
	Sex/education	-0.002	0.000	-0.002	0.001	0.007	0.019	-0.006	-0.004 *	0.001
	Race/ethnicity	-0.004	0.000	-0.002	-0.006	0.006	0.020	-0.008	-0.005 *	0.001
	Firm age	-0.005	0.001	-0.003	-0.003	0.000	0.014	-0.006	-0.004	0.001
	Firm size	-0.004	0.000	-0.002	-0.007	0.006	0.022	-0.006	-0.004	0.002
	No controls	-0.003	0.001	-0.002	0.003	0.007	0.023	-0.006	-0.004	0.002
State controls		x	x	x				x	x	x
Industry controls		x	x	x				x	x	x
State-industry controls					x	x	x			
Time controls					x	x	x	x	x	x
Time period		Av. 2015-2018	Av. 2015-2018	Av. 2012-2014	2012-2017			2012 Q1 - 2018 Q1		
Observations		951-15054	951-15054	937-14829	5627-89920	5627-89920	5537-88485	23398-373218	23398-373218	23023-367285
Variables		71-79	71-79	71-79	955-963	955-963	940-948	96-104	96-104	96-104
Clusters		951	951	937	947	947	932	947	947	932
R^2		0.32-0.94	0.32-0.94	0.3-0.95	0.29-0.99	0.29-0.99	0.29-0.99	0.16-0.93	0.16-0.93	0.16-0.93

Note: Each cell reports the estimate of β_1 from a separate model for the association between average earnings and the share of licensed employment by state and industry. Columns indicate the applied source of licensing information. Standard errors are clustered at the state-industry level and significant estimates at the 1%; 5% and 10% level are reported by ***; ** and *, respectively.

Table C.2. Job stayer average earnings and strictness of occupational licensing

		(1) Cross-section estimation	(2) Within state-industry estimation	(3) Pooled cross-section estimation
Dependent variable	Controls for	Licensing strictness	Licensing strictness	Licensing strictness
ln(average earnings)	Sex/age	-0.041	0.117 **	-0.046
	Sex/education	-0.032	0.086 *	-0.035
	Race/ethnicity	-0.023	0.140 **	-0.022
	Firm age	-0.013	0.161 **	-0.013
	Firm size	0.003	0.152 **	0.001
	No controls	-0.021	0.141 **	-0.022
Average earnings growth (qoq)	Sex/age	-0.001	0.006	-0.002
	Sex/education	-0.002	0.005	-0.002
	Race/ethnicity	-0.002	0.004	-0.003 *
	Firm age	-0.003	0.006	-0.002
	Firm size	-0.002	0.003	-0.002
	No controls	-0.002	0.009	-0.002
State controls		x		x
Industry controls		x		x
State-industry controls			x	
Time controls			x	x
Time period		Average 2015-2018	2012-2017	2012 Q1 - 2018 Q1
Observations		951-15054	5627-89920	23398-373218
Variables		71-79	955-963	96-104
Clusters		951	947	947
R^2		0.32-0.94	0.29-0.99	0.16-0.93

Note: Each cell reports the estimate of β_1 from a separate model for the association between average earnings and the strictness of licensing by state and industry. Standard errors are clustered at the state-industry level and significant estimates at the 1%; 5% and 10% level are reported by ***; ** and *, respectively.

Table C.3. Job stayer earnings and subcomponents of occupational licensing strictness

		(1) Cross-section estimation Variation across states and industries only								(2) Within state-industry estimation Time variation in employment composition only				(3) Pooled cross-section estimation Cross-section and time variation combined			
Dependent variable	Control for	Entry restrictions		Education-training		Renewal requirements		Restrictions ex-offenders		Entry restrictions	Education-training	Renewal requirements	Restrictions ex-offenders	Entry restrictions	Education-training	Renewal requirements	Restrictions ex-offenders
ln(average earnings)	Sex/age	-0.071		-0.074		-0.102		0.122	**	-0.010	0.055	-0.019	0.067	-0.065	-0.059	-0.083	0.096 *
	Sex/education	-0.069		-0.049		-0.100		0.115	**	0.017	0.081	-0.004	0.009	-0.060	-0.038	-0.081	0.089 *
	Race/ethnicity	-0.068		-0.070		-0.126		0.150	**	0.019	0.067	-0.045	0.081	-0.057	-0.056	-0.108	0.126 **
	Firm age	-0.069		-0.059		-0.135		0.158	**	0.034	0.101	-0.072	0.089	-0.061	-0.042	-0.113	0.132 **
	Firm size	-0.053		-0.075		-0.109		0.148	**	0.022	0.110	-0.084	0.092	-0.046	-0.059	-0.090	0.123 **
	No controls	-0.063		-0.069		-0.126		0.147	**	0.032	0.073	-0.050	0.076	-0.054	-0.051	-0.107	0.121 **
Average earnings growth (qoq)	Sex/age	0.003	**	-0.006	**	-0.004	*	0.003		-0.012	-0.020	0.005	0.018	0.001	-0.001	-0.005 **	0.003
	Sex/education	0.003	*	-0.006	**	-0.004	*	0.002		-0.006	-0.019	0.005	0.014	0.001	0.000	-0.005 **	0.002
	Race/ethnicity	0.003	*	-0.007	**	-0.004	*	0.003		-0.015	-0.028	0.002	0.024	0.001	-0.001	-0.005 **	0.002
	Firm age	0.003		-0.007	**	-0.004	*	0.003		-0.009	-0.031	0.005	0.023	0.001	-0.001	-0.006 **	0.003
	Firm size	0.003		-0.007	**	-0.003		0.002		-0.022	-0.031	-0.002	0.032	0.000	-0.001	-0.004 *	0.002
	No controls	0.003		-0.008	**	-0.004		0.004		-0.005	-0.031	0.006	0.023	0.001	-0.001	-0.006 **	0.003
State controls		x												x			
Industry controls		x												x			
State-industry controls										x							
Time controls										x				x			
Time period		Average 2015-2018								2012-2017				2012 Q1 - 2018 Q1			
Observations		951-15054								5627-89920				23398-373218			
Variables		74-82								958-966				99-107			
Clusters		951								947				947			
R^2		0.32-0.94								0.29-0.99				0.16-0.93			

Note: The four subcomponents of licensing strictness are included jointly, i.e. each row report estimates from the same estimation model for average earnings. Standard errors are clustered at the state-industry level and significant estimates at the 1%; 5% and 10% level are reported by ***; ** and *, respectively.

Table C.4. Earnings growth from job-to-job moves and extent of occupational licensing

Estimated effects of the difference in licensed employment share on job-to-job earnings growth, by moves within and between states and industries

		(1) Cross-section estimation Variation across states and industries only				(2) Within state-industry estimation Time variation in employment composition only				(3) Pooled cross-section estimation Cross-section and time variation combined			
Licensing	Control for	Origin	WS-BI	BS-WI	BS-BI	Origin	WS-BI	BS-WI	BS-BI	Origin	WS-BI	BS-WI	BS-BI
NCSL-based	Sex/age	-0.029	0.037	-0.172 ***	0.146 **	-0.111 **	0.075 *	-0.067	0.109	0.000	0.034	-0.076 **	0.105 ***
indicator	Sex/education	-0.029	0.036	-0.146 ***	0.378 ***	-0.120 **	0.081 *	-0.054	-0.032	-0.005	0.023	-0.076 **	0.111 ***
	Race/ethnicity	-0.038	0.018	-0.118 ***	0.142 ***	-0.123 **	0.074	-0.053	0.100	-0.018	0.023	-0.081 **	0.091 ***
	Firm age	-0.033	0.031	-0.122 ***	0.083 **	-0.121 **	0.069	-0.075	0.008	-0.019	0.026	-0.073 **	0.068 **
	Firm size	-0.031	0.043	-0.153 ***	0.002	-0.135 **	0.103 **	-0.077	0.144	-0.020	0.035	-0.085 **	0.055 **
	No controls	-0.040	0.023	-0.109 ***	0.093 **	-0.117 **	0.064	-0.014	0.053	-0.023	0.014	-0.069 **	0.095 ***
COS-based	Sex/age	0.005	-0.024	-0.028	0.008	0.015	0.002	-0.104 **	-0.027	0.015	-0.023 *	-0.028 *	-0.013
indicator	Sex/education	0.004	-0.025	-0.013	0.128 **	0.009	0.002	-0.076	-0.043	0.016	-0.030 **	-0.013	0.009
	Race/ethnicity	0.000	-0.028 *	-0.016	0.026	0.013	-0.007	-0.073	0.049	0.011	-0.022	-0.027 *	-0.026 *
	Firm age	0.000	-0.029 *	-0.021	-0.008	0.038	-0.008	-0.059	0.059	0.010	-0.027 *	-0.031 **	-0.030 **
	Firm size	0.001	-0.025	-0.038 *	-0.096 **	0.025	0.016	-0.089 *	0.046	0.010	-0.025 *	-0.035 **	-0.033 **
	No controls	0.000	-0.023	-0.024	-0.011	-0.001	-0.022	-0.063	0.050	0.013	-0.023	-0.026 *	-0.008
RF-based	Sex/age	0.001	0.014	-0.009	0.040	0.114 **	0.000	-0.042	-0.166 **	0.004	0.018	-0.013	-0.029 **
indicator	Sex/education	0.003	0.015	-0.003	0.109 *	0.110 **	-0.014	-0.085	-0.168 **	0.006	0.012	-0.002	0.002
	Race/ethnicity	0.001	0.013	-0.021	0.048 **	0.109 **	-0.010	-0.026	-0.061	0.003	0.020	-0.024 *	-0.048 ***
	Firm age	0.003	0.024	-0.029 **	-0.003	0.110 **	-0.013	-0.033	-0.068	0.006	0.022	-0.025 **	-0.036 **
	Firm size	-0.002	0.029 *	-0.037 **	-0.050	0.110 **	0.011	-0.049	-0.116	0.004	0.022	-0.025 **	-0.039 **
	No controls	0.001	0.018	-0.021	-0.001	0.102 **	-0.016	-0.071	-0.055	0.004	0.018	-0.021 *	-0.024 *
Origin state controls		x								x			
Destination state controls		x								x			
Origin industry controls		x								x			
Destination industry controls		x								x			
Origin-destination states-industries						x							
Time controls						x				x			
Time period		Av. 2015-2018 (NCSL and COS), Av. 2012-2014 (RF)				2012-2017				2012 Q1 - 2018 Q1			
Observations		36803-106976				723918-2575781				3655596-12389719			
Variables		148-158				76713-158619				174-184			
Clusters		12882-40928				76693-158607				484542-528691			

R^2	0.64-0.77	0.47-0.75	0.14-0.26

Note: The dependent variable is the log change in average earnings the quarter after and prior to a job-to-job move. Each row report the estimates of the level and change in the share of licensed employment by state and industry associated with a job-to-job move: i) level of licensing in origin state-industry (Origin); ii) change in licensing for moves within state and between industries (WS-BI); iii) change in licensing for moves between states and within industry (BS-WI); iv) change in licensing for moves between states and between industries (BS-BI). Standard errors are clustered at the origin-destination states-industries level (all pairwise combinations) and significant estimates at the 1%; 5% and 10% level are reported by ***; ** and *, respectively.

Table C.5. Earnings growth from job-to-job moves and strictness of occupational licensing

Estimated effects of the difference in licensing strictness on job-to-job earnings growth, by moves within and between states and industries

	(1) Cross-section estimation Variation across states and industries only				(2) Within state-industry estimation Time variation in employment composition only				(3) Pooled cross-section estimation Cross-section and time variation combined			
Control for	Origin	WS-BI	BS-WI	BS-BI	Origin	WS-BI	BS-WI	BS-BI	Origin	WS-BI	BS-WI	BS-BI
Sex/age	-0.004	0.010	-0.041 **	0.041 **	-0.031 *	0.037 **	-0.017	0.047	0.003	0.009	-0.011	0.034 ***
Sex/education	-0.003	0.009	-0.032 **	0.121 ***	-0.033 *	0.040 **	0.001	-0.003	0.001	0.006	-0.013	0.035 ***
Race/ethnicity	-0.005	0.003	-0.028 **	0.051 ***	-0.033 *	0.039 **	-0.003	0.059 *	-0.001	0.007	-0.014	0.030 ***
Firm age	-0.004	0.007	-0.027 **	0.031 **	-0.034 *	0.034 *	-0.017	0.016	0.000	0.007	-0.013	0.020 **
Firm size	-0.005	0.011	-0.034 **	0.000	-0.039 **	0.047 **	-0.014	0.068	-0.002	0.010	-0.016	0.014
No controls	-0.006	0.004	-0.026 **	0.033 **	-0.030	0.036 **	0.015	0.033	-0.002	0.003	-0.012	0.033 ***
Origin state controls	x								x			
Destination state controls	x								x			
Origin industry controls	x								x			
Destination industry controls	x								x			
Origin-destination states-industries					x							
Time controls					x				x			
Time period	Average 2015-2018				2012-2017				2012 Q1 - 2018 Q1			
Observations	40928-106976				736367-2575781				3729230-12389719			
Variables	148-158				78072-158619				174-184			
Clusters	14025-40928				78052-158607				496281-528691			
R^2	0.64-0.76				0.47-0.75				0.14-0.25			

Note: The dependent variable is the log change in average earnings the quarter after and prior to a job-to-job move. Each row report the estimates of the level and difference in the share of licensed employment by state and industry associated with a job-to-job move: i) level of licensing in origin state-industry (Origin); ii) difference in licensing for moves within state and between industries (WS-BI); iii) difference in licensing for moves between states and within industry (BS-WI); iv) difference in licensing for moves between states and between industries (BS-BI). Standard errors are clustered at the origin-destination states-industries level (all pairwise combinations) and significant estimates at the 1%; 5% and 10% level are reported by ***; ** and *, respectively.

Table C.6. Earnings growth from job-to-job moves and subcomponents of licensing strictness

Estimated effects of the difference in licensed employment share on job-to-job earnings growth, by moves within and between states and industries

		(1) Cross-section estimation Variation across states and industries only								(2) Within state-industry estimation Time variation in employment composition only								(3) Pooled cross-section estimation Cross-section and time variation combined							
Licensing	Control for	Origin		WS-BI		BS-WI		BS-BI		Origin		WS-BI		BS-WI		BS-BI		Origin		WS-BI		BS-WI		BS-BI	
Entry restrictions	Sex/age	0.006		-0.015		-0.008		-0.103	**	-0.046		-0.054	*	-0.021		-0.061		0.002		-0.007		-0.007		-0.054	***
	Sex/education	0.003		-0.017		-0.005		-0.091	*	-0.039		-0.034		0.011		-0.171	**	-0.002		-0.012		-0.008		-0.039	***
	Race/ethnicity	0.007		-0.017		-0.008		-0.068	***	-0.054		-0.034		0.014		-0.183	**	0.001		-0.013		-0.014		-0.054	***
	Firm age	0.008		-0.017		-0.009		-0.068	***	-0.051		-0.040		-0.004		-0.208	**	0.000		-0.017		-0.018		-0.051	***
	Firm size	0.003		-0.023		-0.020		-0.106	***	-0.048		-0.035		0.057		-0.089		-0.002		-0.016		-0.018		-0.050	***
	No controls	0.007		-0.016		-0.016		-0.058	***	-0.058		-0.025		-0.004		-0.198	***	0.000		-0.016		-0.014		-0.055	***
Education-training	Sex/age	-0.012		0.002		-0.018		0.024		-0.027		-0.093	**	-0.112		-0.039		-0.013		-0.038	**	-0.026		0.014	
	Sex/education	-0.016		0.003		-0.016		0.095		-0.008		-0.070		-0.121		-0.146		-0.012		-0.039	**	-0.023		0.025	*
	Race/ethnicity	-0.012		-0.003		-0.011		0.070	**	-0.001		-0.063		-0.056		-0.118		-0.008		-0.028		-0.015		0.016	
	Firm age	-0.011		-0.001		-0.009		0.085	**	-0.017		-0.078		-0.163		-0.125		-0.006		-0.029	*	-0.013		0.002	
	Firm size	-0.006		0.005		-0.011		0.092	**	-0.009		-0.054		-0.099		0.001		-0.003		-0.038	**	-0.015		-0.007	
	No controls	-0.008		-0.006		-0.009		0.048	**	0.003		-0.053		-0.094		-0.127		-0.005		-0.028		-0.010		0.021	
Renewal requirements	Sex/age	0.026		0.043	**	0.078	***	-0.054		0.128	**	0.018		0.052		0.093		0.028	*	0.031	**	0.069	***	0.109	***
	Sex/education	0.028	*	0.037	**	0.078	***	-0.084	*	0.108	**	-0.003		0.069		0.144	*	0.026	*	0.031	**	0.065	***	0.086	***
	Race/ethnicity	0.026	*	0.036	**	0.061	***	0.007		0.113	**	0.001		0.040		0.177	**	0.026	*	0.032	**	0.062	***	0.097	***
	Firm age	0.021		0.034	**	0.062	***	0.028		0.129	**	0.001		0.079		0.122		0.025	*	0.032	**	0.057	***	0.092	***
	Firm size	0.017		0.037	**	0.073	***	0.018		0.119	**	-0.015		0.100		0.066		0.023		0.035	**	0.065	***	0.092	***
	No controls	0.024		0.033	**	0.058	***	0.043	**	0.112	**	-0.010		0.079		0.156	**	0.028	*	0.030	**	0.058	***	0.089	***
Restrictions for ex-offenders	Sex/age	-0.020		-0.015		-0.080	***	0.114	***	-0.073	**	0.089	**	0.013		0.020		-0.015		0.003		-0.045	***	-0.022	**
	Sex/education	-0.018		-0.010		-0.077	***	0.152	***	-0.074	**	0.084	**	0.001		0.059		-0.011		0.005		-0.045	***	-0.020	**
	Race/ethnicity	-0.021	*	-0.012		-0.059	***	0.038	**	-0.074	**	0.077	**	-0.015		0.071		-0.017		0.001		-0.042	***	-0.018	*
	Firm age	-0.018		-0.008		-0.061	***	0.013		-0.078	**	0.084	**	0.009		0.099	*	-0.016		0.004		-0.037	**	-0.017	*
	Firm size	-0.015		-0.006		-0.071	***	0.026		-0.081	**	0.089	**	-0.071		0.050		-0.015		0.007		-0.043	***	-0.018	**
	No controls	-0.022	*	-0.008		-0.051	***	0.007		-0.071	**	0.073	**	-0.001		0.078	*	-0.019		0.001		-0.041	***	-0.012	

Origin state controls	x		x
Destination state controls	x		x
Origin industry controls	x		x
Destination industry controls	x		x
Origin-destination states-industries		x	
Time controls		x	x
Time period	Average 2015-2018	2012-2017	2012 Q1 - 2018 Q1
Observations	40928-106976	736367-2575781	3729230-12389719
Variables	160-170	78084-158631	186-196
Clusters	14025-40928	78052-158607	496281-528691
R^2	0.64-0.76	0.47-0.75	0.14-0.25

Note: The dependent variable is the log change in average earnings the quarter after and prior to a job-to-job move. Each row report the estimates of the level and difference in the share of licensed employment by state and industry associated with a job-to-job move: i) level of licensing in origin state-industry (Origin); ii) difference in licensing for moves within state and between industries (WS-BI); iii) difference in licensing for moves between states and within industry (BS-WI); iv) difference in licensing for moves between states and between industries (BS-BI). Standard errors are clustered at the origin-destination states-industries level (all pairwise combinations) and significant estimates at the 1%; 5% and 10% level are reported by ***; ** and *, respectively.

Annex D. Additional estimation results

Table D.1. Job hire rates and subcomponents of licensing strictness in separate estimations

		(1) Cross-section estimation Variation across states and industries only				(2) Within state-industry estimation Time variation in employment composition only				(3) Pooled cross-section estimation Cross-section and time variation combined			
Dependent variable	Control for	Entry restrictions	Education-training	Renewal requirements	Restrictions ex-offenders	Entry restrictions	Education-training	Renewal requirements	Restrictions ex-offenders	Entry restrictions	Education-training	Renewal requirements	Restrictions ex-offenders
Job hire rate	Sex/age	-0.034 ***	-0.025 **	-0.030 ***	-0.022 ***	-0.044 ***	-0.027 **	-0.028 **	-0.022 **	-0.033 ***	-0.026 **	-0.029 ***	-0.022 ***
	Sex/education	-0.036 ***	-0.027 **	-0.031 ***	-0.023 ***	-0.044 ***	-0.026 *	-0.027 **	-0.020 **	-0.035 ***	-0.028 **	-0.030 ***	-0.023 ***
	Race/ethnicity	-0.039 ***	-0.030 **	-0.033 ***	-0.026 ***	-0.047 ***	-0.026 *	-0.027 **	-0.022 **	-0.038 ***	-0.031 **	-0.033 ***	-0.026 ***
	Firm age	-0.037 ***	-0.027 **	-0.034 ***	-0.024 ***	-0.045 **	-0.018	-0.024 *	-0.018 **	-0.037 ***	-0.030 **	-0.034 ***	-0.024 ***
	Firm size	-0.039 ***	-0.027 **	-0.034 ***	-0.025 ***	-0.048 ***	-0.024 *	-0.027 **	-0.021 **	-0.038 ***	-0.028 **	-0.033 ***	-0.024 ***
	No controls	-0.039 ***	-0.030 **	-0.034 ***	-0.026 ***	-0.049 **	-0.027 *	-0.028 **	-0.022 **	-0.038 ***	-0.031 **	-0.034 ***	-0.026 ***
Job-to-job hire rate	Sex/age	-0.022 ***	-0.012 **	-0.018 ***	-0.013 ***	-0.028 **	-0.010	-0.016 *	-0.010 *	-0.021 ***	-0.012 **	-0.017 ***	-0.012 ***
	Sex/education	-0.024 ***	-0.012 **	-0.019 ***	-0.013 **	-0.030 **	-0.011	-0.017 *	-0.011 *	-0.023 ***	-0.013 **	-0.018 ***	-0.012 **
	Race/ethnicity	-0.025 ***	-0.013 **	-0.019 ***	-0.014 ***	-0.031 **	-0.012	-0.017 *	-0.012 *	-0.024 ***	-0.014 **	-0.018 ***	-0.013 ***
	Firm age	-0.024 ***	-0.012 *	-0.020 ***	-0.013 **	-0.030 **	-0.008	-0.016	-0.010	-0.023 ***	-0.013 **	-0.019 ***	-0.012 **
	Firm size	-0.024 ***	-0.012 *	-0.019 ***	-0.013 **	-0.032 **	-0.012	-0.018 *	-0.012 **	-0.023 ***	-0.012 **	-0.018 ***	-0.012 **
	No controls	-0.025 ***	-0.013 **	-0.020 ***	-0.014 **	-0.031 **	-0.012	-0.018 *	-0.012 *	-0.024 ***	-0.014 **	-0.019 ***	-0.013 ***
Nonemployment hire rate	Sex/age	-0.011 **	-0.013 **	-0.011 ***	-0.009 ***	-0.012	-0.013	-0.009	-0.008 *	-0.011 **	-0.013 **	-0.012 ***	-0.009 ***
	Sex/education	-0.011 **	-0.015 ***	-0.012 ***	-0.011 ***	-0.010	-0.010	-0.007	-0.006	-0.011 **	-0.015 **	-0.012 ***	-0.011 ***
	Race/ethnicity	-0.013 **	-0.016 ***	-0.013 ***	-0.012 ***	-0.012	-0.010	-0.007	-0.007	-0.013 **	-0.016 **	-0.013 ***	-0.012 ***
	Firm age	-0.012 **	-0.015 ***	-0.013 ***	-0.011 ***	-0.011	-0.006	-0.005	-0.005	-0.012 **	-0.016 ***	-0.014 ***	-0.011 ***
	Firm size	-0.014 **	-0.015 **	-0.014 ***	-0.011 ***	-0.012	-0.008	-0.006	-0.006	-0.014 **	-0.015 **	-0.014 ***	-0.011 ***
	No controls	-0.013 **	-0.016 ***	-0.013 ***	-0.012 ***	-0.013	-0.010	-0.007	-0.007	-0.013 **	-0.017 ***	-0.014 ***	-0.012 ***
State controls		x								x			
Industry controls		x								x			
State-industry controls						x							
Time controls						x				x			
Time period		Average 2015-2018				2012-2017				2012 Q1 - 2018 Q1			
Observations		951-15186				5627-89944				23398-374145			
Variables		71-79				955-963				96-104			
Clusters		951				947				947			
R^2		0.82-0.95				0.87-0.99				0.68-0.85			

Note: The four subcomponents of licensing strictness are included one by one in separate models for job hire. Standard errors are clustered at the state-industry level and significant estimates at the 1%; 5% and 10% level are reported by ***; ** and *, respectively.

Table D.2. Job separation rates and subcomponents of licensing strictness in separate estimations

		(1) Cross-section estimation Variation across states and industries only				(2) Within state-industry estimation Time variation in employment composition only				(3) Pooled cross-section estimation Cross-section and time variation combined			
Dependent variable	Control for	Entry restrictions	Education-training	Renewal requirements	Restrictions ex-offenders	Entry restrictions	Education-training	Renewal requirements	Restrictions ex-offenders	Entry restrictions	Education-training	Renewal requirements	Restrictions ex-offenders
Job separation rate	Sex/age	-0.036 ***	-0.024 **	-0.031 ***	-0.023 ***	-0.044 ***	-0.020 *	-0.030 **	-0.018 **	-0.035 ***	-0.026 **	-0.031 ***	-0.023 ***
	Sex/education	-0.038 ***	-0.024 **	-0.032 ***	-0.024 ***	-0.045 ***	-0.021 *	-0.030 **	-0.018 **	-0.036 ***	-0.027 **	-0.032 ***	-0.023 ***
	Race/ethnicity	-0.039 ***	-0.026 **	-0.033 ***	-0.026 ***	-0.047 ***	-0.021 *	-0.030 **	-0.019 **	-0.038 ***	-0.029 **	-0.033 ***	-0.025 ***
	Firm age	-0.038 ***	-0.024 **	-0.034 ***	-0.023 ***	-0.047 ***	-0.017	-0.029 **	-0.017 **	-0.037 ***	-0.027 **	-0.033 ***	-0.023 ***
	Firm size	-0.039 ***	-0.023 **	-0.033 ***	-0.024 ***	-0.049 ***	-0.020 *	-0.030 **	-0.019 **	-0.038 ***	-0.026 **	-0.033 ***	-0.024 ***
	No controls	-0.040 ***	-0.026 **	-0.034 ***	-0.025 ***	-0.049 ***	-0.021 *	-0.031 **	-0.019 **	-0.039 ***	-0.029 **	-0.034 ***	-0.025 ***
Job-to-job separation rate	Sex/age	-0.023 **	-0.013 **	-0.021 ***	-0.015 ***	-0.031 **	-0.011	-0.018 **	-0.009 *	-0.023 ***	-0.015 **	-0.021 ***	-0.014 ***
	Sex/education	-0.025 ***	-0.013 **	-0.022 ***	-0.015 **	-0.033 **	-0.012	-0.019 **	-0.010 *	-0.025 ***	-0.015 **	-0.022 ***	-0.014 ***
	Race/ethnicity	-0.026 ***	-0.014 **	-0.023 ***	-0.016 ***	-0.034 **	-0.012	-0.019 **	-0.011 *	-0.026 ***	-0.016 **	-0.022 ***	-0.016 ***
	Firm age	-0.025 ***	-0.012 *	-0.023 ***	-0.015 **	-0.034 **	-0.010	-0.019 **	-0.010 *	-0.025 ***	-0.015 **	-0.022 ***	-0.015 ***
	Firm size	-0.025 ***	-0.012 *	-0.022 ***	-0.015 ***	-0.035 **	-0.012	-0.020 **	-0.011 **	-0.025 ***	-0.015 **	-0.021 ***	-0.015 ***
	No controls	-0.026 ***	-0.014 **	-0.023 ***	-0.016 **	-0.034 **	-0.012	-0.020 **	-0.011 *	-0.026 ***	-0.016 **	-0.023 ***	-0.015 ***
Nonemployment separation rate	Sex/age	-0.012 **	-0.010 **	-0.009 **	-0.008 ***	-0.010	-0.007	-0.010 **	-0.007 **	-0.011 **	-0.011 **	-0.010 ***	-0.008 ***
	Sex/education	-0.012 **	-0.011 **	-0.009 **	-0.008 ***	-0.010	-0.006	-0.009 *	-0.006 *	-0.011 **	-0.012 **	-0.009 **	-0.008 ***
	Race/ethnicity	-0.012 **	-0.011 **	-0.010 **	-0.009 ***	-0.011	-0.006	-0.009 **	-0.007 *	-0.012 **	-0.012 **	-0.010 **	-0.009 ***
	Firm age	-0.012 **	-0.011 **	-0.010 ***	-0.008 ***	-0.010	-0.004	-0.008 *	-0.006 *	-0.011 **	-0.012 **	-0.010 ***	-0.008 ***
	Firm size	-0.013 ***	-0.010 **	-0.011 ***	-0.009 ***	-0.011	-0.005	-0.008 *	-0.006 *	-0.012 **	-0.011 **	-0.011 ***	-0.009 ***
	No controls	-0.012 **	-0.011 **	-0.010 **	-0.009 ***	-0.011	-0.007	-0.009 *	-0.007 *	-0.012 **	-0.012 **	-0.010 **	-0.009 ***
State controls		x								x			
Industry controls		x								x			
State-industry controls						x							
Time controls						x				x			
Time period		Average 2015-2018				2012-2017				2012 Q1 - 2018 Q1			
Observations		951-15186				5627-89944				22451-374145			
Variables		71-79				955-963				96-104			
Clusters		951				947				947			
R^2		0.83-0.93				0.88-0.99				0.6-0.9			

Note: The four subcomponents of licensing strictness are included one by one in separate models for job separation. Standard errors are clustered at the state-industry level and significant estimates at the 1%; 5% and 10% level are reported by ***; ** and *, respectively.

Table D.3. Origin-destination job-to-job hire rate and subcomponents of licensing strictness in separate estimations

Estimated effects of the difference in licensed employment share on origin-destination job-to-job hire, by moves within and between states and industries

		(1) Cross-section estimation Variation across states and industries only								(2) Within state-industry estimation Time variation in employment composition only								(3) Pooled cross-section estimation Cross-section and time variation combined							
Licensing	Control for	Origin		WS-BI		BS-WI		BS-BI		Origin		WS-BI		BS-WI		BS-BI		Origin		WS-BI		BS-WI		BS-BI	
Entry	Sex/age	-0.085	**	0.000		-0.111	***	-0.075	***	-0.098	***	-0.021		-0.035	**	-0.056	***	-0.014		0.015		-0.024	***	-0.016	**
restrictions	Sex/education	-0.037	**	0.013		-0.052	***	-0.038	**	-0.051	***	0.000		-0.017	*	-0.027	**	-0.009		0.015		-0.016	***	-0.010	**
indicator	Race/ethnicity	-0.020		0.024		-0.032	***	-0.022	**	-0.042	***	0.002		-0.014	*	-0.023	**	-0.006		0.017		-0.013	***	-0.008	**
	Firm age	-0.006		0.001		-0.017	**	-0.012	**	-0.036	***	-0.010		-0.012	**	-0.026	***	-0.004	*	0.005	**	-0.007	***	-0.004	**
	Firm size	-0.016	*	-0.001		-0.027	***	-0.015	**	-0.039	***	-0.013	*	-0.012	**	-0.025	***	-0.004		0.005	*	-0.007	***	-0.004	**
	No controls	-0.011		0.025	**	-0.021	***	-0.015	**	-0.026	***	0.009		-0.008	*	-0.014	**	-0.005		0.018		-0.011	***	-0.006	**
Education-	Sex/age	-0.060		-0.047		-0.110	***	-0.062	**	-0.060	**	-0.021		-0.002		-0.003		-0.007		-0.026	*	-0.020	**	-0.013	
training	Sex/education	-0.023		-0.034	*	-0.047	**	-0.030	*	-0.026	*	-0.003		0.005		0.001		-0.004		-0.026	**	-0.011	**	-0.008	
indicator	Race/ethnicity	-0.002		-0.019		-0.020	*	-0.011		-0.022	*	-0.002		0.002		-0.005		0.000		-0.024	*	-0.006		-0.003	
	Firm age	0.002		-0.005		-0.007		-0.007		-0.020	**	-0.009		-0.004		-0.010	*	-0.002		0.000		-0.006	**	-0.004	*
	Firm size	-0.009		-0.007		-0.023	**	-0.018	**	-0.026	**	-0.013	**	-0.004		-0.015	**	-0.002		-0.002		-0.007	**	-0.005	*
	No controls	-0.003		-0.024		-0.013	*	-0.009		-0.012	*	0.003		0.001		-0.002		-0.001		-0.026	**	-0.005		-0.003	
Renewal	Sex/age	-0.064	**	-0.016		-0.073	***	-0.046	***	-0.047	**	-0.011		-0.010		-0.017	*	-0.008		0.006		-0.017	***	-0.009	**
requirements	Sex/education	-0.027	**	-0.001		-0.037	***	-0.022	**	-0.023	**	0.002		-0.003		-0.008		-0.004		0.007		-0.011	***	-0.006	**
indicator	Race/ethnicity	-0.011		0.009		-0.021	***	-0.011	**	-0.019	**	0.003		-0.003		-0.008	**	-0.003		0.008		-0.008	***	-0.004	**
	Firm age	-0.006		-0.003		-0.012	**	-0.008	**	-0.016	***	-0.006	*	-0.002		-0.010	***	-0.003	*	0.003		-0.005	***	-0.003	***
	Firm size	-0.013	**	-0.004		-0.018	***	-0.012	***	-0.019	***	-0.008	**	-0.005		-0.012	***	-0.003	*	0.002		-0.005	***	-0.003	**
	No controls	-0.006		0.010		-0.016	***	-0.008	**	-0.011	**	0.006		-0.001		-0.004	*	-0.002		0.008		-0.007	***	-0.003	**
Restrictions for	Sex/age	-0.061	**	-0.025	*	-0.068	***	-0.040	**	-0.046	**	-0.015		-0.012		-0.013		-0.012	**	-0.015	**	-0.012	**	-0.009	**
ex-offenders	Sex/education	-0.027	**	-0.018	*	-0.028	***	-0.019	**	-0.021	**	-0.002		-0.003		-0.005		-0.007	**	-0.014	**	-0.007	**	-0.006	**
indicator	Race/ethnicity	-0.014		-0.011		-0.015	**	-0.009		-0.018	**	-0.002		-0.004		-0.007	**	-0.005		-0.012	*	-0.005	**	-0.003	*
	Firm age	-0.007		-0.004		-0.010	**	-0.006	*	-0.016	***	-0.006	**	-0.006	*	-0.010	***	-0.003	**	-0.001		-0.004	***	-0.003	**
	Firm size	-0.013	**	-0.005		-0.018	***	-0.011	**	-0.019	***	-0.009	**	-0.006	*	-0.012	***	-0.004	**	-0.001		-0.004	***	-0.003	**
	No controls	-0.009	*	-0.012	*	-0.009	**	-0.008	**	-0.011	**	0.002		-0.002		-0.004	*	-0.004	*	-0.012	**	-0.004	**	-0.003	*
Origin state controls					x																x				
Destination state controls					x																x				
Origin industry controls					x																x				
Destination industry controls					x																x				
Origin-destination states-industries													x												
Time controls													x								x				
Time period		Average 2015-2018								2012-2017								2012 Q1 - 2018 Q1							

Observations	100597-357140	1450802-2934364	6628794-31049754
Variables	148-158	82670-163800	174-184
Clusters	41667-100597	82650-163788	663417-663418
R^2	0.27-0.61	0.36-0.99	0.2-0.59

Note: The dependent variable is the origin-destination job-to-job hire rate, calculated as the number of hires from an origin state-industry to a destination state-industry divided by employment in the destination state-industry. Each row report the estimates of the level and difference in the share of licensed employment by state and industry associated with a job-to-job move: i) level of licensing in origin state-industry (Origin); ii) difference in licensing for moves within state and between industries (WS-BI); iii) difference in licensing for moves between states and within industry (BS-WI); iv) difference in licensing for moves between states and between industries (BS-BI). All estimates have been scaled by 100. Standard errors are clustered at the origin-destination states-industries level (all pairwise combinations) and significant estimates at the 1%; 5% and 10% level are reported by ***; ** and *, respectively.

Table D.4. Job stayer earnings and subcomponents of licensing strictness in separate estimations

		(1) Cross-section estimation Variation across states and industries only				(2) Within state-industry estimation Time variation in employment composition only				(3) Pooled cross-section estimation Cross-section and time variation combined			
Dependent variable	Control for	Entry restrictions	Education-training	Renewal requirements	Restrictions ex-offenders	Entry restrictions	Education-training	Renewal requirements	Restrictions ex-offenders	Entry restrictions	Education-training	Renewal requirements	Restrictions ex-offenders
ln(average	Sex/age	-0.057	-0.047	-0.061	0.017	0.095	0.133 *	0.095 *	0.079 **	-0.057	-0.049	-0.056	0.008
earnings)	Sex/education	-0.052	-0.029	-0.055	0.020	0.072	0.099	0.072 *	0.053 *	-0.050	-0.032	-0.050	0.011
	Race/ethnicity	-0.045	-0.027	-0.059	0.035	0.124 **	0.154 **	0.110 **	0.095 **	-0.040	-0.025	-0.052	0.029
	Firm age	-0.041	-0.013	-0.057	0.042	0.144 **	0.178 **	0.124 **	0.109 **	-0.037	-0.010	-0.048	0.036
	Firm size	-0.023	-0.009	-0.038	0.046	0.130 **	0.173 **	0.115 **	0.105 **	-0.021	-0.008	-0.032	0.038
	No controls	-0.042	-0.026	-0.058	0.034	0.130 *	0.154 *	0.110 *	0.095 **	-0.039	-0.023	-0.051	0.028
Average	Sex/age	0.001	-0.004 **	-0.002	0.000	0.005	0.007	0.006	0.006	0.000	-0.002	-0.003	0.000
earnings	Sex/education	0.001	-0.004 **	-0.002 *	0.000	0.006	0.005	0.006	0.005	-0.001	-0.002	-0.003 *	0.000
growth (qoq)	Race/ethnicity	0.000	-0.005 **	-0.003 *	-0.001	0.003	0.004	0.003	0.006	-0.001	-0.003	-0.004 **	-0.001
	Firm age	0.000	-0.005 **	-0.003 *	-0.001	0.008	0.005	0.006	0.007	-0.001	-0.002	-0.004 *	0.000
	Firm size	0.000	-0.005 **	-0.003	-0.001	0.000	0.004	0.002	0.006	-0.001	-0.002	-0.003	0.000
	No controls	0.001	-0.005 **	-0.003	0.000	0.013	0.008	0.009	0.009	-0.001	-0.002	-0.003 *	0.000
State controls		x								x			
Industry controls		x								x			
State-industry controls						x							
Time controls						x				x			
Time period		Average 2015-2018				2012-2017				2012 Q1 - 2018 Q1			
Observations		951-15054				5627-89920				23398-373218			
Variables		71-79				955-963				96-104			
Clusters		951				947				947			
R^2		0.32-0.94				0.29-1				0.16-0.93			

Note: The four subcomponents of licensing strictness are included one by one in separate models for average earnings. Standard errors are clustered at the state-industry level and significant estimates at the 1%; 5% and 10% level are reported by ***; ** and *, respectively.

Table D.5. Earnings growth from job-to-job moves and subcomponents of licensing strictness in separate estimations

Estimated effects of the difference in licensed employment share on job-to-job earnings growth, by moves within and between states and industries

		(1) Cross-section estimation Variation across states and industries only								(2) Within state-industry estimation Time variation in employment composition only								(3) Pooled cross-section estimation Cross-section and time variation combined							
Licensing	Control for	Origin		WS-BI		BS-WI		BS-BI		Origin		WS-BI		BS-WI		BS-BI		Origin		WS-BI		BS-WI		BS-BI	
Entry	Sex/age	0.001		0.000		-0.028	**	0.005		-0.035		0.028		-0.008		0.025		0.003		0.002		-0.008		0.002	
restrictions	Sex/education	0.001		-0.001		-0.021	*	0.076	***	-0.036	*	0.035	*	0.018		-0.042		0.000		-0.002		-0.011		0.005	
indicator	Race/ethnicity	0.001		-0.005		-0.020	*	0.013		-0.042	*	0.034	*	0.009		0.003		0.000		-0.002		-0.015		-0.001	
	Firm age	0.002		-0.003		-0.021	*	-0.003		-0.039	*	0.029		0.004		-0.039		0.000		-0.003		-0.017	*	-0.007	
	Firm size	-0.002		-0.004		-0.030	**	-0.035	**	-0.044	*	0.038	*	0.016		0.027		-0.002		-0.001		-0.019	*	-0.011	
	No controls	0.000		-0.005		-0.023	**	0.002		-0.042	*	0.033		0.022		-0.025		-0.001		-0.006		-0.013		0.001	
Education-	Sex/age	-0.011		0.013		-0.047	**	0.089	**	-0.030		0.033	*	-0.041		0.061		-0.004		-0.005		-0.022		0.044	***
training	Sex/education	-0.011		0.013		-0.039	**	0.205	***	-0.030		0.037	*	-0.028		0.005		-0.004		-0.007		-0.023		0.046	***
indicator	Race/ethnicity	-0.012		0.005		-0.033	*	0.098	***	-0.025		0.037	*	-0.020		0.083	*	-0.005		-0.002		-0.019		0.042	***
	Firm age	-0.011		0.010		-0.031	*	0.078	***	-0.029		0.030		-0.056		0.040		-0.003		-0.002		-0.016		0.026	**
	Firm size	-0.009		0.017		-0.036	*	0.053	**	-0.035	*	0.047	**	-0.054		0.101	*	-0.003		-0.003		-0.021		0.015	
	No controls	-0.010		0.004		-0.028	*	0.063	***	-0.021		0.034	*	-0.004		0.054		-0.004		-0.005		-0.015		0.048	***
Renewal	Sex/age	0.006		0.021	**	0.008		0.025		-0.005		0.033	**	-0.012		0.053		0.011		0.018	**	0.020	**	0.053	***
requirements	Sex/education	0.008		0.019	**	0.012		0.089	***	-0.009		0.034	**	0.007		0.015		0.010		0.015	*	0.017	**	0.051	***
indicator	Race/ethnicity	0.006		0.014		0.010		0.051	***	-0.008		0.034	**	0.000		0.074	**	0.008		0.016	*	0.016	*	0.048	***
	Firm age	0.004		0.016	*	0.011		0.037	***	-0.006		0.029	*	-0.008		0.029		0.008		0.017	**	0.015	*	0.038	***
	Firm size	0.003		0.020	**	0.012		0.008		-0.012		0.039	**	0.001		0.067	*	0.007		0.020	**	0.016	*	0.033	***
	No controls	0.005		0.014		0.010		0.041	***	-0.005		0.031	*	0.021		0.048	*	0.009		0.013		0.016	*	0.050	***
Restrictions for	Sex/age	-0.008		0.002		-0.047	***	0.035	**	-0.029	**	0.032	**	-0.010		0.030		-0.003		0.005		-0.019	**	0.016	**
ex-offenders	Sex/education	-0.007		0.003		-0.041	***	0.086	***	-0.030	**	0.034	**	-0.001		0.003		-0.003		0.004		-0.020	**	0.018	**
indicator	Race/ethnicity	-0.009		-0.001		-0.033	***	0.034	***	-0.029	**	0.033	**	-0.004		0.042	*	-0.006		0.003		-0.020	**	0.015	**
	Firm age	-0.008		0.002		-0.034	***	0.020	**	-0.031	**	0.030	**	-0.011		0.021		-0.005		0.004		-0.017	**	0.009	
	Firm size	-0.007		0.005		-0.042	***	0.003		-0.034	**	0.038	***	-0.021		0.047	*	-0.005		0.007		-0.021	**	0.006	
	No controls	-0.009		0.000		-0.029	***	0.020	**	-0.027	**	0.030	**	0.007		0.027		-0.006		0.002		-0.018	**	0.017	**
Origin state controls		x																x							
Destination state controls		x																x							
Origin industry controls		x																x							
Destination industry controls		x																x							
Origin-destination states-industries										x															
Time controls										x								x							
Time period		Average 2015-2018								2012-2017								2012 Q1 - 2018 Q1							

Observations	40928-106976	736367-2575781	3729230-12389719
Variables	148-158	78072-158619	174-184
Clusters	14025-40928	78052-158607	496281-528691
R^2	0.64-0.76	0.47-0.75	0.14-0.25

Note: The dependent variable is the origin-destination job-to-job hire rate, calculated as the number of hires from an origin state-industry to a destination state-industry divided by employment in the destination state-industry. Each row report the estimates of the level and difference in the share of licensed employment by state and industry associated with a job-to-job move: i) level of licensing in origin state-industry (Origin); ii) difference in licensing for moves within state and between industries (WS-BI); iii) difference in licensing for moves between states and within industry (BS-WI); iv) difference in licensing for moves between states and between industries (BS-BI). All estimates have been scaled by 100. Standard errors are clustered at the origin-destination states-industries level (all pairwise combinations) and significant estimates at the 1%; 5% and 10% level are reported by ***; ** and *, respectively.