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Coverage and Wage Effects

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Occupational Licensing in the European Union:

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We present the first EU-wide study on the prevalence and labour market impact of occupational regulation in the EU. Drawing on a new EU Survey of Regulated Occupations, we find that licensing affects about 22 percent of workers in the EU, although there is significant variability across member states and occupations. On average, licensing is associated with a 4 percent higher hourly wages. Using decomposition techniques we show that rent capture accounts for one third of this effect and the remaining is attributed to signalling. We find considerable heterogeneity in the wage gains by occupation and level of educational attainment. Finally, occupational licensing increases wage inequality. After accounting for composition effects, licensing increases the standard deviation of wages by about 0.02 log points.

JEL codes: J44, J31,

Keywords: Occupational regulation, licensing, wages.

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1. Introduction

Occupational regulation is a labour market institution that has attracted considerable debate within academic and policy cycles. The current policy interest derives from its potential to serve as a strong incentive for employers and workers to invest more heavily in skills and as a means to safeguard consumer interests. However, economists have also pointed out the potential role of rent-seeking activities by occupational groups and have warned against its labour market effects (e.g. Friedman 1962; Maurizi 1974; Graddy 1991; Shapiro 1986). While there is now a well-developed empirical literature in the US assessing the labour market outcomes of occupational regulation, the paucity of such evidence in the European context is striking. This is a surprising omission given that, as we shall show below, entry to a significant proportion of EU jobs is restricted through licensing. As such, the importance of this labour market institution extends beyond academic curiosity and deserves more attention than it currently receives.

On the other hand, this gap in the literature is not entirely unjustifiable. Since recently in Europe researchers have been lacking comprehensive data that identifies regulated individuals, the characteristics of the regulatory regime they are subject to and documents their individual and labour market characteristics. This paper addresses this gap. We explore the first ever EU Survey of Regulated Occupations (EU-SOR), which consists of a nationally representative sample that covers the labor force within the EU28 member states and asks detailed questions about occupational regulation. We are interested in three key themes: incidence of regulation in the EU labour market, its effect on wage determination and its effect on wage inequality.

Prior to EU-SOR, researchers have been restricted to imputing the regulation status of a worker based on her reported occupation (e.g. Gittleman and Kleiner 2016; Koumenta *et al.* 2014). While informative, the precision of such procedure is likely to be compromised by the possibility that some of those classified as working in a licensed occupation were in fact not licensed. For example, an engineer working in a multinational company in the automotive industry might not need to be licensed, although the engineering profession is generally subject to licensing. This highlights the difference between coverage and individual attainment of licensed status. Moreover, the codes usually used to classify occupations do not necessarily describe licensed professions, as defined by licensing regulations. By explicitly asking the respondents to report their regulation status, EU-SOR enables us to address this measurement

problem. In this paper, we contribute to the literature in three ways. First, we provide the first ever EU estimates of the prevalence of occupational licensing in the EU and estimate the wage premium associated with licensing (the most restrictive form of regulation) and certification (its less restrictive counterpart). Second, we decompose the wage premium using the Oaxaca-Blinder decomposition and in doing so, provide more systematic descriptions of the wage gap between licensed and non-licensed workers than currently offered. Third, we contribute to a less well-developed line of enquiry in the occupational regulation literature, namely the impact of licensing on the wage distribution. We do so using the Di Nardo, Fortin and Lemieux (1996) decomposition method, which is itself a new approach to estimating such effects within the occupational regulation literature. Throughout our analysis, we compare our findings with those in the US, where the literature is more advanced, to establish any differences or similarities between these two labour market contexts.

2. Related Literature

Entry requirements associated with licensing regulate the supply of labour in the market. This is achieved in two ways. First, entry to the occupation is restricted to those practitioners whose skills or character are above the minimum requirements. Second, regulators may revoke the license if performance of incumbents is deemed to fall short of meeting the professional standards. The implication of these arrangements is that the entry requirements associated with licensing reduces the pool of practitioners thus creating monopoly rents within the occupation (Pagliero 2013, 2011). As such, the wage effect of regulation is borne by the artificial creation of entry barriers in the occupation, as opposed to the standard human capital returns in the labour market. Research on the wage effect of regulation has a relatively long tradition, but improvements in measurement have resulted in two empirical developments: (i) better estimations of the wage premium associated with licensing (ii) detection of potential differential effects of licensing on wage determination by occupation.

With regards to the former, in the US, Kleiner and Krueger (2013) using a self-reported measure of regulation status find its effect on wages to be around the 11% mark. Gittleman and Kleiner (2016) exploit the introduction of questions on occupational regulation in large-scale national surveys. Using longitudinal data and a rich set of labour market controls they find wage effects of about 7.5% considerably lower than previous estimates. Further, early studies

present licensing as having a homogeneous wage effect, without any consideration on the basis of occupation and licensing regimes. More recently, researchers have become more alert to the existence of some degree of heterogeneity in the effect of licensing on wages. According to Kleiner (2013), the ability of occupations to capture rents depends on factors associated with the political economy of the regulatory regime, such as the strictness of entry barriers or the amount of time the occupation has been subject to regulation. Empirically, it is becoming increasingly common to observe occupational variations on the wage effect of licensing. For example, Timmons and Thornton use a cross-state U.S. survey radiologic technologists and find the wage effect of licensing to be 6.9% (Timmons and Thornton 2007), while the same figure for massage therapists stands at 16.2 % (Timmons and Thornton 2013).

In his comparison of average incomes across licensed and non-licensed occupations, Kleiner (2000) calculates the licensing premium among dentists, and lawyers vis-à-vis other comparable occupations. Despite many similarities in the educational licensing requirements for dentists and lawyers, the wage effect is 30% for the former and 10% for the later. In the UK context too, Koumenta *et al.* (2014) find significant variations in the wage premium amongst dentists, pharmacists, accountants, architects, security guards, teachers and plumbers (ranging from 9% to 19%). Although these studies allude to potential heterogeneity in the effect of licensing on wages, they fall short of a systematic examination by occupational classification. Finally, our data source enables us to go even further in understanding the effect of regulation in the labour market by examining its effect on returns to education. Does licensing create a distortion in the returns to education and if so, how does this pattern vary by the level of educational attainment?

A less well-developed theme is the impact of licensing on different parts of the income distribution. Licensing can result in the creation of rents through the monopoly effect discussed above. Any such economic rents can aggravate income inequality if they are unequally distributed amongst income groups, for example, those at the top of the income distribution fare better than those at the bottom. Empirically, such a line of enquiry parallels that used to study the effect of unionism (another labour market institution associated with rent-capture) on wage dispersion. For example, in his classic work on the effects of unions, Freeman (1991) finds that despite the inequality-increasing effect of unions on the difference between union members and non-members, the overall effect of unions on income inequality is negative. Does licensing have a similar effect on wage dispersion? Recent analyses by Kleiner and Krueger

(2013) and Gittleman and Kleiner (2016) for example find that licensing does not reduce wage dispersion in the US labour market.

Also less common in empirical analysis is the effect of certification on wages. As a policy alternative to licensing, certification is less restrictive in that it presents consumers with a choice between practitioners whose credentials have been vetted by the state or a professional body and those who do not meet such criteria. In theory, we would expect its effect on wages to depend on the extent to which consumers are willing to pay a premium for practitioners meeting these standards and is therefore difficult to determine a priori.

3. The survey and the sample

The data used for this study is based on the EU-SOR, the first ever survey commissioned by the European Commission dedicated to capturing the extent of occupational regulation in the EU. The questionnaire items are drawn from questions successfully tested in the US-based Westat survey of regulated occupations (Kleiner and Krueger 2013), and further developed to suit the specific research context. To test the final instrument, a pilot study was carried out which suggested some revisions to the questionnaire, including shortening its length and some minor adjustments to the item wording.

The survey covers the civilian population of the respective nationalities of the EU member states, resident in each of the 28 member states, aged 15 years and over who at the time were working or looking for a job. The survey was carried out in the period between March to April 2015 by means of telephone interviews (Computer Assisted Telephone Interviews) using a multi-stage random probability sample design. In every country, respondents were called on fixed lines and mobile phones and in each household, the respondent was drawn at random following the ‘last birthday rule’.

A total of 26,640 individuals were interviewed providing data on their regulation status, the characteristics of the regulation regime (e.g. entry and renewal requirements) as well as detailed information on a variety of individual characteristics. The data has several important strengths for our analysis. In addition to providing us with a self-reported measure of the regulation status of the individual, the large sample size increases the external validity and precision of our estimates. The breadth of information about individuals and their labour market circumstances

improves our ability to control for observable heterogeneity that might be correlated with regulation status and earnings.

The response rate was 28%. The response rate is higher than the 17.9% obtained by Westat, its American counterpart (Kleiner and Krueger 2013), analogous to that of commercial surveys and in a context of declining response rates to telephone surveys (see for example Curtin *et al.* 2005) overall very satisfactory.⁴ We proceed to examine the credibility of our data by comparing the mean proportion of respondents in the EU-SOR with those reported in the EU Labour Force Survey⁵ (EULFS) for the same year (Table 1). In Column 3, we estimate the difference in the means across a range of indicators relating to individual and labour market characteristics. The two samples are closely matched, which increases our confidence regarding the representativeness of our sample.

We repeat the same exercise in relation to earnings. Respondents in our survey are asked to provide an estimate of their net monthly earnings from their main paid job (converted to euros at the current exchange rate where necessary) and the number of hours of work in a typical week. The number of hours is recorded as less than 15 hours per week, then in 5-hour intervals up to 45, with the last category corresponding to more than 45 hours. We compute the hourly net wage by dividing the reported wage by the estimated number of hours worked in a month (4.35*the midpoint of each category of weekly hours worked). In Table 1, column 1 the mean annual net wage is computed for a hypothetical full time worker working 40 hours per week and 52 weeks per year. The corresponding figure from Eurostat (column 2) is computed starting from gross wages and applying the average income tax for a single worker with average taxable income. As before, the difference between the two calculations is negligible.

Table 1 about here

⁴ Nevertheless, it is important to consider the possibility of non-response errors. Using meta-analytic techniques of relevant studies, the literature finds no consistent relationship between response rates and non-response bias in large surveys (Groves 2006). Further, the higher response rates do not guarantee high data quality and should also be supplemented by measures of representativeness (Schouten et al. 2009).

⁵ Details about the EU Labour Force Survey can be found here:

<http://ec.europa.eu/eurostat/web/microdata/european-union-labour-force-survey>

Finally, survey weights were developed by TNS (the organisation responsible for the implementation of the survey) to compensate for variation in selection probabilities and non-response bias.⁶

4. Methodology

We estimate cross sectional wage regressions of the general form

$$Y_i = b_0 + b_1 Licensed_i + X_i b_2 + u_i \quad (1)$$

where Y_i denotes the log hourly wage of worker i , the matrix X_i includes gender, education, union membership, work experience, working status, country, occupation, and industry fixed effects. The coefficient b_1 measures the impact of the indicator variable *Licensed*, which measures whether worker i is subject to occupational licensing.

This approach assumes that the impact of occupational regulation is uniform across occupations, and that regulation cannot affect the return to other individual characteristics (the vector b_2). This assumption is restrictive, since regulation may affect differently workers in different occupations. Moreover, it may induce changes in the coefficients of other variables such as education or work experience. A more general model allows for different coefficients b_1 and b_2 for licensed and unlicensed workers.

Individuals in the survey can be partitioned into two exclusive groups denoted by $g=L, N$. Individuals in group L are individuals who need a license to do their job, while those in group N do not. The coefficients from the group-specific wage regressions

$$Y_{gi} = \beta_{g0} + X_{gi} \beta_{g1} + u_{gi} \quad (2)$$

can be used to decompose the difference in average outcomes between group L and group N ,

$$\Delta = \bar{Y}_L - \bar{Y}_N, \quad (3)$$

⁶ For all countries surveyed, a national weighting procedure using marginal and intercellular weighting was carried out based on a comparison between the sample and the universe. The universe description was derived from Eurostat population data or from national statistics offices. In all countries, gender, age, region and size of locality were introduced in the iteration procedure. For international weighting (i.e. EU averages), the official population figures as provided by Eurostat or national statistic offices were used.

into the part explained by differences in characteristics X across the two groups (Δ_X), and the structural component (Δ_S) that is due to differences in the coefficients β_{g0} and β_{g1} across the two groups,

$$\Delta = \Delta_X + \Delta_S \quad (4)$$

$$\Delta_X = (\bar{X}_L - \bar{X}_N) \hat{\beta}_{N1}$$

$$\Delta_S = (\hat{\beta}_{L0} - \hat{\beta}_{N0}) + \bar{X}_L (\hat{\beta}_{L1} - \hat{\beta}_{N1}).$$

Hence, we can estimate by OLS the the wage regressions (2) and then decompose the overall change in wages into what is driven by X , that is Δ_X , and what is driven by having a license, Δ_S (Oaxaca 1973 and Blinder 1973). More generally, one can decompose the entire distribution of wages and study the impact of licensing on any quantile of the wage distribution (DiNardo, Fortin and Lemieux 1996).

Cross sectional wage regressions have the advantage of being representative of all occupations. However, they are based on the usual assumption that $E(u/X)=0$. Hence, they cannot account for unobserved characteristics that could be related to the selection into licensing occupations. Decomposition methods rely on the same assumption. They provide interesting descriptive results, which can be interpreted as causal only under this fairly strong assumption.

5. The prevalence of occupational licensing

The following two questions are used in the EU-SOR to classify workers into three groups: (i) licensed; (ii) certified (or accredited), and (iii) unregulated:

“In addition to this education, do you have a professional certification, licence or did you have to take an exam which is required to practice your occupation?”⁷

⁷ In addition to specific training, interviewers received the following instructions: “A professional certification or licence shows you are qualified to perform a specific job and may give you the right to enter a regulated profession or professional association. Only include certifications or licences obtained by the respondent as an individual. Examples include “licensed medical doctor” and “licensed taxi driver [...]”.

- | |
|--|
| 1. Yes.....(39.65%) |
| 2. No – but currently in process of obtaining one..... (0.95%) |
| 3. No..... (59.21%) |
| 4. Don't know/No answer(0.19%) |

To distinguish between licensing and certification, those who answer 1 or 2 to the above question were then asked:

“Without this professional certification, licence or exam would you be legally allowed to practice your occupation?” ⁸

- | |
|--------------------------------------|
| 1. Yes.....(45.19%) |
| 2. No..... (52.55%) |
| 3. Don't know/No answer(2.26%) |

A worker is classified as ‘licensed’ if she answers (1) or (2) in the first question and (2) in the second. A worker is classified as ‘certified’ if she answers (1) or (2) in the first question and (1) or (3) in the second, and ‘unregulated’ otherwise.

To ensure the validity of the survey instrument we derived the key questions from the previously validated instrument used in the Westat survey in the US by Kleiner and Krueger (2013). Second, the questionnaire was subject to piloting in all EU28 member states and no issues were raised in relation to the questions on regulation status. Further, it is encouraging that the ‘Don’t know/No answer’ responses are small, suggesting that respondents could understand the question. Finally, the proportion of missing values in the data is similar to that observed for other questions such as ‘economic activity of the firm or organization’ and ‘occupation’, again suggesting that the questions were well understood.

We estimate that just under half (43%) of the EU workforce is subject to some form of regulation. In particular, 22% of workers are licensed (Table 2). The proportion of licensed workers in the EU is broadly comparable to the most recent US estimates where, depending on the data source, it ranges from 29% (Kleiner and Krueger 2013) to 20% (Gittleman *et al.*

⁸ Instructions to the interviewer: *Refer to the respondent's specific occupation and personal circumstances. Refer to the current laws and regulations affecting the respondent's occupation (current main paid job).*

2018)⁹. It is also comparable to other dominant labour market institutions such as trade unionism for which the latest estimates show an average level of union membership across the EU (weighted by the numbers employed in the different member states) to be 23% (Fulton 2015). As a policy alternative to licensing, certification seems considerably more widespread in the EU (22%) compared to Kleiner and Krueger's (6%) and Gittleman *et al.*'s (2018) estimates of 6% and 8% respectively. However, the former study only focuses on government certification and the later only private certification, while our estimates include both government and private certification. Hence, these figures are not directly comparable.

Table 2 about here

5.1. Who is licensed in the European Union?

We proceed with analysing the distribution of licensed, certified and unregulated workers based on key demographic and employment characteristics (Table 3). We find that licensing is more prevalent amongst those aged 40 to 64 years and male workers. Our results further indicate that the incidence of licensing is higher amongst employees in the public sector (32%) and the self-employed, and least common amongst those in private firms (16%). This is partly expected as many occupations with high information asymmetries and potential to cause harm to others are found in the public sector (e.g. medical occupations, teachers etc.) and amongst those in self-employment (which is usually correlated with the provision of personal services e.g. plumbers, lawyers etc.). This trend is further reflected in the distribution of licensing by industrial classification, where we find that licensing is most prevalent in health and in public administration and least common in the hotel, restaurants and retail industries. With respect to occupational groups the incidence of licensing is highest amongst plant and machine operators (35%), professionals (26%), and technicians and associated professionals (27%).

In the case of craft and related trades (20%) (but also to some extent for plant and machine operators), we might be capturing the legacy of the guilds, the institution that for many centuries provided the main route for entry to such occupations in Europe. Unsurprisingly, the

⁹ Kleiner and Krueger (2013) use direct measures of license attainment but their sample size and response rate are relatively small. Gittleman *et al.* (2018) use a large, nationally representative dataset, but the questions on credentials do not allow them to distinguish between licensing and certification with confidence.

lowest proportion of licensed workers is found amongst occupations where information asymmetries and negative externalities are lowest (i.e. elementary occupations) and in relatively ‘new’ occupational groups that lack a strong enough professional identity to organise and lobby (i.e. managers). Finally, we find a relatively even spread of licensing and certification among the various occupational groups.

Turning to education, licensing is common throughout the different levels of educational attainment. It is common among individuals with lower secondary education (24.7%), post-secondary education (26.8%), and advanced research qualification (24%). Interestingly, we find no stark differences between licensing and certification on one hand and educational attainment on the other. However, it is noteworthy that contrary to licensing and certification, a large proportion of unregulated workers are concentrated in the low education category (71%). Finally, licensing is slightly more common among union members than non-members, most likely driven by the higher incidence of licensing in the public sector where unionisation rates also tend to be high. Our results are broadly in line with the characteristics of licensed workers observed by Kleiner and Krueger (2013) for the US who also find a higher proportion of licensed workers in the public sector, amongst union members, and in the service industry¹⁰.

Table 3 about here.

To gauge the barriers to entry associated with working in a licensed occupation in the EU we estimate the proportion of individuals that are subject to requirements relating to education, but also additional hurdles such as entry examinations and work experience (Table 4). We find passing an exam to be widespread, affecting around 86% of licensed individuals. While for the majority work experience is not required (52%), over a quarter require work experience of more than two years. With regards to education, either lower secondary, upper secondary or university qualifications are required for about three quarters of those licensed, although the proportion of those requiring no educational credentials is not insignificant (19%). Overall, we find the restrictiveness of entry to licensed occupations in the EU to be comparable to that in the US both in terms of the forms it takes but also the proportions of those affected. Of course

¹⁰ Due to differences in the classification of educational attainment, comparisons between the two are difficult.

the presence of barriers to entry in itself is neither a guarantee of high quality services on one hand, nor a signal of occupational closure on the other since it is the level at which these requirements are set that is likely to determine such outcomes. Nevertheless, it is suggestive of the hurdles that individuals have to overcome to become licensed vis-à-vis those in unregulated occupations.

Table 4 about here.

Our data further provides us with information about the distribution of licensed workers across different member states (Table 5). Overall, the proportion of licensed workers ranges between 14% and 33% (Column 1). We find the largest proportion of licensed individuals in Germany (33%), Croatia (31%), and Ireland (29%) and the smallest proportion in Sweden (15%), Latvia (15%), and Denmark (14%). We further compare these data on individual attainment to the number of regulated professions in the EU Database of Regulated Occupations (Column 3).¹¹ Interestingly, we do not find a statistically significant correlation between the proportion of individuals subject to licensing and number of licensed occupations in each member state ($r = .13$, $p = n.s$). For example, whilst the incidence of licensing within a member state might initially appear low compared to others (as measured by the number of occupations subject to licensing), the actual prevalence of licensing can be substantial if employment in these categories is disproportionately large. We depict the geographical variability of the proportion of licensed workers (Figure 1). Licensing is most prevalent in some Central and Eastern European countries and there is no clear difference between North and South. Countries with high proportion of licensing seem to be located along a diagonal from North-West to South-East.

Table 5 about here

¹¹ The database is compiled and maintained by the European Commission and it is accessible via this link: http://ec.europa.eu/growth/tools-databases/regprof/index.cfm?action=map_regulations

Figure 1 about here

6. The Wage effects of Occupational Licensing

To examine whether licensing is associated with higher pay, we present estimates of log wage regressions (Table 6). In addition to the standard human capital controls, industry and detailed occupational controls, country fixed effects are also included in the models. In our most basic specification, the mean wage of licensed workers is about 9 log points higher than that of unregulated workers. The coefficient of licensing then significantly drops as controls are progressively included, suggesting that a large portion of the premium is coming from educational endowments and other labour market characteristics, rather than licensing per se. As such, in our more elaborate specifications, we find that having a licence is associated with approximately 4% higher hourly wages ($p < 0.05$). Such an effect is considerably lower in magnitude than the 18% licensing wage premium found by Kleiner and Krueger (2013) and closer to the more recent estimates of 10% by Kleiner and Vortnikov (2018) and 7% by Gittleman and Kleiner (2016).

Table 6 about here

6.2. Signalling or entry restrictions?

What is the mechanism that generates the observed wage gap between licensed and unlicensed workers? Occupational licensing may affect wages by improving human capital and providing a credible signal to consumers. However, it may also increase wages by restricting labour supply. In our data, we can observe a set of workers who report to hold a certification (on top of their educational achievements). This certification provides a signal of additional human capital, without necessarily being associated with a restriction in labour supply, as it is not a legal requirement. As a result of the restrictiveness of licensing, in a wage regression we expect the coefficient of the indicator variable for licensed workers to be larger than that of certified

workers. The difference between the two provides a measure of the impact of the legally enforced entry restrictions in increasing the wages of licensed workers.

The results from the wage regressions are shown in Table 7. We use the same specifications as in Table 6, but add an indicator variable for certification status. Interestingly, as with licensing, we find that certification has a positive and significant effect on wages. This is consistent with certification being associated with higher skills and having some signalling value in the labour market. However, in general, certification is associated with a smaller premium than licensing. In column 6, this difference is about two percentage points (0.0308, $p < 0.05$ for certification and 0.0489, $p < 0.01$ for licensing). Further, the difference between the coefficients of the ‘licensed’ and ‘certified’ dummies captures the impact of the legal requirement to hold a license, which is the main difference between certification and licensing. In fact, both licensing and certification provide a signal of worker quality. However, licensing also restricts entry into specific labor markets to licensed workers and it is therefore associated with a higher wages. We show a wage gap between licensed and unregulated workers of 4.89 log points, of which 37 percent can be attributed to entry restrictions and 63 percent to signalling¹².

Table 7 about here

In the analysis that follows, we disaggregate the wage effects of licensing and certification by occupation. This enables us to conduct within-occupation comparisons of those with licenses and certificates on one hand, and those without at major occupation level (1-digit). The first column in Table 8 includes controls for education, occupation, industry, work status, gender, union indicators, age, experience, and experience squared. The second specification (column 2) includes the indicator variable for certification, while the third column includes interactions of the certification dummy with an indicator variable for each occupation. Overall, we find that licensing is having a differential effect by occupation. The effect is of highest magnitude for craft and related trades occupations (19%) as well as elementary occupations (10%). Finally, the difference between the coefficients of ‘licensed’ and ‘certified’ is very heterogeneous

¹² We note that the standard error of the difference between the two coefficients is large.

across occupations. This difference is particularly large and statistically significant for craft and related trades workers, elementary occupations, and service and sales workers.

Table 8 about here

6.3 Occupational licensing and the return to education

In line with the literature on returns to education (Becker 1993), we have shown that even after controlling for human capital covariates in our wage regressions, the difference in wages due to education remains large. Yet, an unexplored line of enquiry in the empirical literature is the effect of occupational regulation on returns to education and in particular how this varies between licensed, certified and unregulated workers. We address this by estimating wage regressions similar to our previous models allowing for group-specific returns to education. We split workers into three groups: elementary and lower secondary education, upper secondary and tertiary (non-college) education, and college or higher. In Table 9, we report the coefficients we obtain when we interact the ‘licensing’ and ‘certification’ indicator variables with indicator variables for different levels of educational achievement. For unregulated workers, the average wage grows with education, particularly for those with more than upper secondary education. However, for licensed workers, we obtain different results (Figure 2). While those with elementary education earn more than unregulated workers, after post-secondary education we do not observe any growth in their returns to education. In fact, the growth in the return to education for licensed workers with post-secondary education is zero. From this, we conclude that there is no significant difference between the return to education for a licensed and unlicensed worker with upper secondary or post-secondary education. This pattern changes when we look at individuals with university degrees. Here, the return to a university degree is much larger for licensed workers compared to their unregulated counterparts, controlling for other observables. Hence, licensing flattens the returns to education for low levels of education, while it increases the growth in the return to education for university degrees and advanced research qualifications.

The differences in the returns to education between unregulated and regulated workers diminish when we look at certification. In particular, certified workers experience a steady growth in their wages as their education increases leading us to conclude that it is mainly

licensing that creates the distortion in the returns to education. This finding is consistent with our previous results relating to the heterogeneous effects of licensing across different occupational and educational categories.

Table 10 summarizes our results from the different wage regressions, with and without control variables. The overall licensing wage gap (the difference between licensed and unregulated workers) in columns 1 and 2 can be partly attributed to the signalling value of holding a license (the certification gap, between 56 and 63 percent of the overall gap), the rest being attributable to the legal requirement to hold a license (the legal requirement gap). Table 10 also reports the same figures for different educational groups, highlighting the heterogeneity of the gap across workers.

Table 9 about here

Figure 2 about here

Table 10 about here

6.3. Oaxaca-Blinder decomposition

The heterogeneity in wage premiums across occupations suggests that the linear model (1) may not capture some of the heterogeneous effects of licensing regulations. In fact, our results so far have highlighted the importance of heterogeneity of the licensing wage gap across occupations and educational groups. We now turn to the Oaxaca-Blinder decomposition, which does not constrain the effect of licensing to be constant for all workers, or even for workers within the same occupation or educational group.

The estimated coefficients of model (2) on the two groups (licensed and non-licensed) are reported in Table 11, together with the mean values of each variable. The table illustrates how licensing distorts the relative wage of different occupational groups. For example, ‘Managers’ are the reference category, hence the value of the coefficient for this group is equal to zero by assumption. Table 11 shows that licensed professionals earn on average 7 percent more than licensed managers, licensed craft workers 3 percent less, and licensed workers in elementary occupations 21 percent less.

Table 11 shows a very different pattern of relative wages for non-licensed workers. Non-licensed professionals earn 5.8 percent less than non-licensed managers, non-licensed craft workers earn 31.7 percent less, and non-licensed workers in elementary occupations 42.6

percent less. The occupations with the largest differences between the two figures are ‘Professionals’, ‘Craft and related trades’, ‘Service and sales workers’ and ‘Elementary occupations’. These differences are consistent with the idea that licensing confers a wage premium that is particularly large for some occupations.

Table 12 describes the results of the decomposition in equation (4) based on the estimated coefficients. Table 12 shows that the overall difference in log wages between licensed and non-licensed workers (about 9 percent) can be decomposed into the part that is due to characteristics of the workers (composition effects) and that due to differences in regression coefficients (wage structure effect). The wage structure effect can be interpreted as a generalized version of the “wage premium” discussed in previous paragraphs.

The composition effect accounts for 61% of the overall difference. Differences in occupation, age, and work experience are important determinants of the composition effect. The wage structure effect, due to differences in the estimated coefficients, accounts for about 39% of the overall effect. Differences in the coefficients of union membership, age, education dummies, occupation dummies, and industry dummies are the most important contributors to the wage structure effect. These results are in line with our previous results suggesting that the wage premium associated with licensing is very different across occupations.

Table 11 about here

Table 12 about here

6. Occupational Licensing and Wage Dispersion

Our final analysis concerns the effect of licensing on the entire wage distribution. We do so using the DiNardo, Fortin and Lemieux (1996) semiparametric decomposition method (DFL). In Figure 2 we depict the distribution of log hourly wages in the EU for licensed and non-licensed workers. We then decompose the difference between these two distributions into the composition effect and the wage structure effect. In Figure 3 we show the distribution for licensed workers and the estimated counterfactual density that would be obtained if these workers had the same characteristics as their non-licensed counterparts. The composition effect is equal to the difference between the two distributions. Finally, in Figure 4, we report the wage

distribution of non-licensed workers and the same counterfactual density. The difference between these two distributions corresponds to the impact of licensing, holding constant the characteristics of workers. This is the semiparametric version of the wage structure effect introduced in equation (4).

Figure 3 about here

Figure 4 about here

Figure 5 about here

The results of the DFL decomposition can be used to compute statistics from the three distributions. In Table 13, we report the standard deviation, the variance, and the distances between selected quantiles. Differences in these statistics provide estimates of the composition and wage structure effects. The wage structure effect of licensing implies a significant increase in wage inequality as measured by the standard deviation of log hourly wages (0.02 log points). Also the distance between the 99th and the 1st, the 95th and the 5th, the 90th and the 10th percentiles are increased by licensing. Columns 6 and 7 show that the wage structure effect leads to an increase in the dispersion of wages in both tails of the distribution. In line with previous results on mean wages, we find that the median wage is increased by the wage structure effect (column 8). Our results are in line with similar US studies by using different sets of data and different methodologies (e.g. Kleiner and Krueger (2013); Gittleman and Kleiner (2016); Kleiner and Vorotnikov (2018)).

Table 13 about here

7. Conclusions

We present the first ever estimates of the prevalence and wage effects of occupational regulation in the EU. We find that licensing affects about 22 percent of workers in the EU, albeit with significant variability across member states and occupations, leading us to conclude that it is an important labour market institution in this context. We further show that it has an effect on wages. In particular, licensing is associated with an aggregate wage premium of about 4% after accounting for observable characteristics of the workers, country and occupation fixed effects. This figure is somewhat lower than current US estimates. Overall, our analysis attributes approximately one third of the licensing wage gap to entry restrictions and the remaining to signalling.

We further present the first systematic analysis of its heterogeneous effect by occupation- for some groups such as crafts for example it can be as high as 19% while for professionals it drops to 6%- and by level of educational attainment. With regards to the latter, licensing compresses the returns to education for low educated individuals but increases the growth in the return to education for those with university degrees and above. Moreover, licensing disproportionately benefits those at the top of the income distribution, increasing the dispersion of wages. As such, occupational licensing differs from unionization, which is known to reduce wage dispersion. To the extent that pay inequality in the labour market is a concern for policy makers, then licensing requires further consideration.

We also account for the possible effect of certifications that are not legally required to practice an occupation but may signal the existence of labour market skills not fully captured by conventional education. Our estimates are in line with the most recent findings in the US in that certification is also associated with a wage premium, but of comparable magnitude to that of licensing. In that sense, certification is perhaps a better policy alternative in that it improves the skills of practitioners, signals the existence of a minimum standard to consumers while allowing them to choose whether they are willing to pay the premium associated with using a certified practitioner.

A key novelty of our approach is our ability to estimate the incidence of regulation based on self-reported measures of regulation status rather than rely on inferences from occupational classifications. However, the nature of our data does not allow us to rule out the possibility of selection bias on unobservables. Nevertheless, the limitations of the current study open up fruitful avenues for future research, particularly in the form of devising ways to explore exogenous variation in the licensing status.

References

- Becker, Gary (1993), *Human Capital: A Theoretical and Empirical Analysis*, with Special Reference to Education, 3rd edition, Chicago: The University of Chicago Press.
- Blinder, Alan S. (1973) Wage Discrimination: Reduced Form and Structural Estimates, *The Journal of Human Resources*, Vol. 8, No. 4, pp. 436-455.
- Curtin et al (2005) Changes in Telephone Survey nonresponse over the past quarter century, *Public Opinion Quarterly*, 69
- DiNardo, John, Nicole M. Fortin, and Thomas Lemieux. 1996. "Labor Market Institutions and the Distribution of Wages, 1973-1992: A Semiparametric Approach". *Econometrica* 64 (5): 1001-44.
- Forth, J., Bryson, A., Humphris, A., Kleiner, M. and Koumenta, M. (2011) *A Review of Occupational Regulation and its Impact*, UK Commission for Employment and Skills, London
- Fulton, L. (2015) Worker representation in Europe, available at <https://www.worker-participation.eu/National-Industrial-Relations/Across-Europe/Trade-Unions2>
- Freeman, R. B. (1991). *How much has de-unionisation contributed to the rise in male earnings inequality?* (No. w3826). National Bureau of Economic Research.
- Friedman, M. (1962). *Capitalism and freedom: With the assistance of Rose D. Friedman*. University of Chicago Press.
- Graddy, E. (1991). Toward a general theory of occupational regulation. *Social science quarterly*, 72(4), 676-695.
- Groves 2006 Nonresponse rates and nonresponse bias in household surveys, *public opinion quarterly* 70
- Gittleman, M., & Kleiner, M. M. (2016). Wage effects of unionization and occupational licensing coverage in the United States. *ILR Review*, 69(1), 142-172.

- Kleiner, M. M. (2000). Occupational licensing. *The Journal of Economic Perspectives*, 14(4), 189-202.
- Kleiner, M. and Krueger A. (2013) 'Analysing the Extent and Influence of Occupational Licensing on the Labor Market, *Journal of Labor Economics*, 31, 2.
- Kleiner, M.M. and Vorotnikov, E. (2018) Analyzing Occupational Licensing Among the States, *Journal of Regulatory Economics*, forthcoming
- Koumenta, M., Humphris, A., Kleiner, M. and Pagliero, M. (2014) Occupational Regulation in the UK and EU: Prevalence and Labour Market Impact, Department for Business, Innovation and Skills, London
- Maurizi, A. (1974). Occupational licensing and the public interest. *Journal of Political Economy*, 82(2, Part 1), 399-413.
- Oaxaca, Ronald (1973), Male-Female Wage Differentials in Urban Labor Markets, *International Economic Review*, Vol. 14, No. 3, pp. 693-709
- Pagliero, M. (2013) 'The Impact of Potential Labour Supply on Licensing Exam Difficulty', *Labour Economics*, 25, 141-152.
- Pagliero, M. (2011). What is the objective of professional licensing? Evidence from the US market for lawyers. *International journal of Industrial organization*, 29(4), 473-483.
- Schouten et al (2009) Indicators for the representativeness of survey response, *Survey Methodology* 35(1)
- Shapiro, C. (1986) 'Investment, Moral Hazard and Occupational Licensing', *Review of Economic Studies*, 53, 843-62.
- Timmons, Edward and Robert Thornton. "The Licensing of Barbers in the US," *British Journal of Industrial Relations*. 48(4), 2010.

TABLES

Table 1. Comparison of characteristics of EU workers in the Survey of Occupational Licensing and in the Eurostat Labour Force Survey (civilian employment)

Mean proportion of workers		EU-SOR Data	Eurostat data	difference
by educational attainment:				
	Less than primary, primary and lower secondary education (levels 0-2)	0.169	0.183	-0.014
	Upper secondary and post-secondary non-tertiary education (levels 3 and 4)	0.439	0.481	-0.042
	Tertiary education (levels 5-8)	0.392	0.332	0.060
by gender				
	Male	0.542	0.540	0.002
by age				
	From 15 to 39 years	0.436	0.427	0.009
	From 40 to 64 years	0.543	0.550	-0.007
	65 years or over	0.021	0.023	-0.003
by type of employment				
	Employees	0.851	0.850	0.001
	Self-employed persons with employees (employers)	0.043	0.042	0.001

	Self-employed persons without employees (own-account workers)	0.105	0.108	-0.002
				0.000
by industry	Agriculture	0.037	0.046	-0.009
	Manufacturing and construction	0.225	0.240	-0.015
	Education and health	0.225	0.185	0.040
	Trade	0.211	0.267	-0.056
	Finance and professional services and other services	0.225	0.194	0.031
	Public administration	0.078	0.069	0.009
by occupation	Managers	0.100	0.060	0.040
	Professionals	0.276	0.188	0.088
	Technicians and associate professionals	0.158	0.158	0.000
	Clerical support workers	0.096	0.097	-0.001
	Service and sales workers	0.140	0.167	-0.027
	Skilled agricultural, forestry and fishery	0.016	0.039	-0.022
	Crafts and related workers	0.107	0.116	-0.009
	Plant and machine operators and assemblers	0.051	0.074	-0.022
	Elementary occupations	0.055	0.092	-0.037
	Armed forces occupations	dropped	0.006	n/a
	No response	dropped	0.002	n/a
Mean Net Earnings		22,037	23,142	-1,105

Table 2. Proportion of licensed and certified workers in the European Union.

	Proportion	Std. Error
Licensed	0.219	0.0048
Certified	0.217	0.0049
Unregulated	0.564	0.0058

Source: EU Survey of Regulated Occupations. Civilian employed population age 15 or older.

Table 3. Proportion of licensed, certified, and unregulated workers by worker characteristics.

	Licensed	Certified	Unregulated
Gender			
Male	0.218	0.202	0.551
Female	0.220	0.230	0.580
Age			
From 15 to 39 years	0.195	0.205	0.600
From 40 to 64 years	0.239	0.224	0.537
65 years or over	0.200	0.286	0.514
Employment status			
Employee in a private firm	0.159	0.217	0.624
Employee in public/non-profit sector	0.322	0.217	0.462
Self-employed with employees	0.241	0.213	0.545
Self-employed without employees	0.220	0.217	0.563
Occupation			
Managers	0.127	0.210	0.663
Professionals	0.263	0.229	0.508
Technicians and associate professionals	0.271	0.236	0.493
Clerical support workers	0.145	0.169	0.686
Service and sales workers	0.218	0.214	0.568
Skilled agricultural, forestry and fishing	0.160	0.239	0.602
Craft and related trades workers	0.199	0.268	0.533
Plant and machine operators and assemblers	0.349	0.176	0.475
Elementary occupations	0.105	0.153	0.742
Industry			
Agriculture (A)	0.141	0.211	0.649
Manufacturing of products (B, C)	0.128	0.228	0.644
Construction or energy (D, E, F)	0.213	0.268	0.519
Wholesale or retail trade	0.106	0.199	0.695
Hotels and restaurants (I)	0.096	0.206	0.698
Transportation and communication	0.267	0.212	0.520
Finance, real estate (K, L)	0.242	0.217	0.541
Public administration (O)	0.349	0.198	0.453
Education (P)	0.271	0.226	0.503
Health and social work (Q)	0.367	0.196	0.438

Professional services	0.209	0.219	0.571
Cultural activities	0.148	0.210	0.641
Education			
Primary	0.123	0.165	0.712
Lower secondary	0.247	0.286	0.467
Upper secondary	0.209	0.208	0.583
Post-secondary	0.268	0.211	0.521
University (undergraduate/postgraduate)	0.215	0.204	0.580
PhD/advanced search qualification	0.240	0.163	0.597
Trade union membership			
Yes	0.280	0.224	0.496
No	0.201	0.214	0.585

Source: EU Survey of Regulated Occupations. Civilian employed population age 15 or older.

Table 4. Requirements to obtain a license.

	Proportion of Licensed Workers subject to the specific requirement	Std. error
Specific requirement:		
Entry examination	0.864	0.009
Educational requirement:		
No requirement	0.191	0.010
Primary education	0.024	0.003
Lower secondary	0.209	0.011
Upper secondary	0.279	0.011
Post-secondary education	0.046	0.006
University	0.247	0.011
PHD/ adv. research	0.005	0.001
Experience requirement:		
No work experience is/was required	0.524	0.013
Up to a year	0.094	0.006
More than 1 year up to 2 years	0.094	0.007
Longer than 2 years	0.288	0.012

Source: EU Survey of Regulated Occupations. Civilian employed population age 15 or older.

Table 5. The proportion of licensed workers by country.

	Proportion of Licensed Workers a (1)	Std. error (2)	Proportion of Licensed Occupations ^b (3)
Germany	0.329	0.017	67
Croatia	0.312	0.018	210
Ireland	0.293	0.019	63
Slovakia	0.268	0.016	308
Hungary	0.262	0.016	353
Netherlands	0.246	0.016	80
Czech Republic	0.244	0.015	351
Austria	0.222	0.015	144
Greece	0.218	0.016	n/a
Romania	0.217	0.018	132
Bulgaria	0.213	0.017	98
Luxemburg	0.210	0.020	21
Poland	0.205	0.014	345
Slovenia	0.202	0.015	125
United Kingdom	0.195	0.015	103
Italy	0.193	0.015	165
Estonia	0.192	0.014	98
Cyprus	0.185	0.021	96
Lithuania	0.175	0.013	70
Malta	0.172	0.019	n/a
Finland	0.167	0.013	127
Belgium	0.166	0.014	111
Spain	0.166	0.015	107
Portugal	0.165	0.014	202
France	0.160	0.013	238
Sweden	0.153	0.013	21
Latvia	0.151	0.012	266
Denmark	0.140	0.012	149

^a Source: EU Survey of Regulated Occupations. Civilian employed population age 15 or older.

^bSource: EU Database of Regulated Occupations.

Table 6. Coefficients from log wage regressions.

	(1)	(2)	(3)	(4)	(5)	(6)
licensed	0.0919*** (0.0224)	0.0509*** (0.0151)	0.0438*** (0.0148)	0.0397*** (0.0147)	0.0347** (0.0149)	0.0382** (0.0151)
union		0.0385** (0.0159)	0.00591 (0.0157)	0.0151 (0.0161)	0.0125 (0.0157)	0.0121 (0.0156)
male		0.174*** (0.0129)	0.173*** (0.0129)	0.165*** (0.0135)	0.148*** (0.0135)	0.149*** (0.0139)
age		0.0105*** (0.000682)	0.00669*** (0.000793)	0.00637*** (0.000761)	0.00628*** (0.000735)	0.00633*** (0.000725)
Lower secondary education (usually age 11-15)		0.142*** (0.0461)	0.133*** (0.0466)	0.0931** (0.0432)	0.0845* (0.0437)	0.0869** (0.0442)
Upper secondary education (usually age 16-19)		0.249*** (0.0423)	0.235*** (0.0429)	0.161*** (0.0405)	0.151*** (0.0409)	0.155*** (0.0413)
Post-secondary education (not university)		0.314*** (0.0489)	0.298*** (0.0490)	0.183*** (0.0470)	0.174*** (0.0473)	0.174*** (0.0481)
University (undergraduate and post-graduate)		0.579*** (0.0428)	0.570*** (0.0434)	0.378*** (0.0425)	0.359*** (0.0429)	0.355*** (0.0432)
PHD/ advanced research qualification		0.800*** (0.0536)	0.811*** (0.0550)	0.583*** (0.0544)	0.577*** (0.0540)	0.571*** (0.0542)
Experience			0.0180*** (0.00240)	0.0151*** (0.00233)	0.0146*** (0.00231)	0.0141*** (0.00225)
Experience ² /1,000			-0.314*** (0.0730)	-0.271*** (0.0712)	-0.260*** (0.0703)	-0.254*** (0.0683)
Employee in public sector or non-profit				-0.000385 (0.0137)	0.0253 (0.0188)	0.0256 (0.0185)

Self-employed with employees				0.182*** (0.0527)	0.194*** (0.0527)	0.202*** (0.0528)
Self-employed without employees				-0.0653* (0.0393)	-0.0464 (0.0385)	-0.0435 (0.0362)
Country f.e?	yes	yes	yes	yes	yes	yes
Occupation controls?				yes	yes	
Industry controls?					yes	yes
Detailed occupation controls?						yes
Observations	16,067	16,027	15,952	15,952	15,952	15,796
R-Squared	0.002	0.668	0.675	0.699	0.706	0.710

Note: The dependent variable is the log of hourly wage. Omitted indicator variables: Primary education, Employee in private firm or business.

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.

Table 7. Coefficients from log wage regressions (licensing and certification).

	(1)	(2)	(3)	(4)	(5)	(6)
licensed	0.109*** (0.0232)	0.0639*** (0.0157)	0.0571*** (0.0155)	0.0504*** (0.0154)	0.0452*** (0.0155)	0.0489*** (0.0157)
certified	0.0612** (0.0252)	0.0421** (0.0172)	0.0434** (0.0171)	0.0327** (0.0163)	0.0316** (0.0159)	0.0308* (0.0158)
union		0.0368** (0.0158)	0.00415 (0.0157)	0.0143 (0.0160)	0.0116 (0.0156)	0.0112 (0.0156)
male		0.173*** (0.0129)	0.172*** (0.0129)	0.164*** (0.0136)	0.148*** (0.0135)	0.148*** (0.0139)
age		0.0104*** (0.000674)	0.00660*** (0.000784)	0.00630*** (0.000755)	0.00622*** (0.000729)	0.00628*** (0.000719)
Lower secondary education (usually age 11-15)		0.140*** (0.0461)	0.131*** (0.0465)	0.0913** (0.0431)	0.0829* (0.0437)	0.0856* (0.0442)
Upper secondary education (usually age 16-19)		0.248*** (0.0424)	0.234*** (0.0429)	0.160*** (0.0405)	0.151*** (0.0408)	0.155*** (0.0413)
Post-secondary education (not university)		0.313*** (0.0489)	0.297*** (0.0490)	0.183*** (0.0470)	0.174*** (0.0472)	0.174*** (0.0481)
University (undergraduate and post-graduate)		0.578*** (0.0428)	0.569*** (0.0434)	0.379*** (0.0425)	0.360*** (0.0429)	0.356*** (0.0433)
PHD/ advanced research qualification		0.803*** (0.0538)	0.813*** (0.0552)	0.587*** (0.0545)	0.581*** (0.0542)	0.575*** (0.0544)
Experience			0.0180*** (0.00241)	0.0151*** (0.00234)	0.0146*** (0.00232)	0.0141*** (0.00225)
Experience ² /1,000			-0.314*** (0.0733)	-0.271*** (0.0714)	-0.260*** (0.0705)	-0.254*** (0.0685)

Employee in public sector or non-profit				-0.00228 (0.0138)	0.0242 (0.0190)	0.0246 (0.0186)
Self-employed with employees				0.182*** (0.0527)	0.194*** (0.0527)	0.202*** (0.0528)
Self-employed without employees				-0.0661* -0.0393	-0.0468 (0.0385)	-0.0436 (0.0363)
Country f.e?	yes	yes		yes	yes	yes
Occupation controls?				yes	yes	
Industry controls?					yes	yes
Detailed occupation controls?						yes
Observations	16156	16116	16041	16041	16041	15875
R-squared	0.003	0.668	0.676	0.699	0.706	0.711
Licensed - Certified s.e.	0.0473825 (0.029455)	0.021733 (0.0199376)	0.013736 0.01948	0.017663 0.018712	0.013588 0.018886	0.018093 0.018885

Note: The dependent variable is the log of hourly wage. Omitted indicator variables: Primary education, Employee in private firm or business. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table 8. Coefficients from log wage regressions (licensing and certification) with interactions.

	(1)	(2)	(3)
licensed x managers	-0.0933 (0.0677)	-0.08471 (0.0679)	-0.0781 (0.0693)
licensed x professionals	0.046553 (0.0255)	0.057031 (0.0257)	0.062564 (0.0262)
licensed x Technicians and associate professionals	-0.0125 (0.0317)	0.000237 (0.0325)	-0.00051 (0.0351)
licensed x Clerical support workers	-0.00907 (0.0651)	-0.00032 (0.0649)	0.000717 (0.0653)
licensed x Service and sales workers	0.078359 (0.0301)	0.089778 (0.0305)	0.086503 (0.0322)
licensed x Skilled agricultural	0.030306 (0.2351)	0.041184 (0.2360)	0.037242 (0.2323)
licensed x Craft and related trades workers	0.172144 (0.0396)	0.184986 (0.0400)	0.192386 (0.0419)
licensed x Plant and machine operators	-0.04952 (0.0535)	-0.03835 (0.0537)	-0.05984 (0.0559)
licensed x Elementary occupations	0.120484 (0.0809)	0.126519 (0.0808)	0.098676 (0.0822)
certified		0.032714 (0.0160)	
certified x managers			0.0645 (0.0553)
certified x professionals			0.050384 (0.0354)
certified x Technicians and associate professionals			0.032273 (0.0346)
certified x Clerical support workers			0.041332 (0.0461)
certified x Service and sales workers			0.025043 (0.0450)
certified x Skilled agricultural			0.021177 (0.2102)
certified x Craft and related trades workers			0.056795 (0.0377)
certified x Plant and machine operators			-0.03404 (0.0434)
certified x Elementary occupations			-0.12061 (0.0710)
Difference between licensing and certification:			

Managers	-0.11742	-0.14267
	(0.0688)	(0.0794)
Professionals	0.024317	0.01218
	(0.0285)	(0.0379)
Technicians and associate professionals	-0.03248	-0.03278
	(0.0330)	(0.0366)
Clerical support workers	-0.03304	-0.04062
	(0.0667)	(0.0760)
Service and sales workers	0.057064	0.06146
	(0.0320)	(0.0451)
Skilled agricultural	0.00847	0.016066
	(0.2365)	(0.3004)
Craft and related trades workers	0.152272	0.135591
	(0.0410)	(0.0462)
Plant and machine operators	-0.07106	-0.0258
	(0.0548)	(0.0597)
Elementary occupations	0.093805	0.219284
	(0.0822)	(0.0979)

Note: The dependent variable is the log of hourly wage. The coefficients of education, occupation, industry, work status, gender, union indicators, age, experience, and experience squared are not reported. Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 9. Regression coefficients with interactions with education dummies.

	(1)
licensed	0.131*** (0.0376)
certified	0.0776** (0.0367)
Licensed x Upper secondary education and Post-secondary education (not university)	-0.126*** (0.0427)
Licensed x University education (and higher)	-0.0708 (0.0436)
Certified x Upper secondary education and Post-secondary education (not university)	-0.0684 (0.0430)
Certified x University education (and higher)	-0.0493 (0.0476)
Upper secondary education and Post-secondary education (not university)	0.131*** (0.0254)
University education (and higher)	0.320*** (0.0283)
union	0.0104 (0.0157)
male	0.150*** (0.0140)
age	0.00639*** (0.000716)
Experience	0.0140*** (0.00225)
Experience ² /1,000	-0.255*** (0.0684)
Employee in public sector or non-profit	0.0238 (0.0186)
Self-employed with employees	0.204*** (0.0530)
Self-employed without employees	-0.0426 (0.0366)
Country f.e?	yes
Occupation controls?	
Industry controls?	yes
Detailed occupation controls?	yes
Observations	15,795
R-squared	0.709

Note: The dependent variable is the log of hourly wage. See Figure 1 for graphical representation. Omitted indicator variables: Primary and lower secondary education, Employee in private firm or business. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 10. The licensing, certification, and legal requirement wage gaps (summary table).

	(1)	(2)	(3)
Overall licensing wage gap (Licensed - Unregulated)	0.109	0.0489	
Primary and lower secondary education			0.131
Upper secondary and Post-secondary education (not university)			0.005
University education (and higher)			0.060
Certification gap (Certified - Unregulated)	0.0612	0.0308	
Primary and lower secondary education			0.078
Upper secondary and Post-secondary education (not university)			0.009
University education (and higher)			0.028
Legal requirement gap (Licensed - Certification)	0.0478	0.0181	
Primary and lower secondary education			0.053
Upper secondary and Post-secondary education (not university)			-0.004
University education (and higher)			0.032
	no controls	controls	controls

Note: the table summarizes estimated wage differences across groups of workers (see Tables 7-10) without controlling for worker characteristics (column 1) and controlling for worker characteristics (columns 2 and 3). In column 3, wage differences are reported by educational group.

Table 11. Means and regression coefficients from log wage regressions.

	(1)	(2)	(3)	(4)	(5)	(6)
	Licensed	Non-	Licensed	Licensed	Non-	Non-licensed
	Means	licensed	coeff.	s.e.	licensed	s.e.
		Means			coeff.	
union	0.317	0.237	-0.032	0.026	0.026	0.019
age	43.291	41.567	0.004	0.001	0.007	0.001
Experience	12.560	10.863	0.015	0.003	0.015	0.003
Experience ² /1,000	0.271	0.225	-0.167	0.082	-0.294	0.088
male	0.559	0.535	0.123	0.026	0.152	0.015
Education (primary education omitted):						
Lower secondary education (usually age 11-15)	0.153	0.139	-0.036	0.106	0.082	0.047
Upper secondary education (usually age 16-19)	0.353	0.366	0.004	0.099	0.163	0.044
Post-secondary education (not university)	0.075	0.064	0.002	0.118	0.197	0.050
University (undergraduate and post-graduate)	0.381	0.378	0.264	0.104	0.351	0.046
PHD/ advanced research qualification	0.023	0.022	0.455	0.119	0.579	0.060
Occupation (managers omitted):						
Professionals	0.320	0.260	0.068	0.063	-0.058	0.028
Technicians and associate professionals	0.188	0.145	-0.032	0.067	-0.141	0.030
Clerical support workers	0.064	0.109	-0.148	0.085	-0.235	0.030
Service and sales workers	0.150	0.141	-0.144	0.065	-0.338	0.031
Skilled agricultural	0.009	0.014	-0.353	0.221	-0.383	0.085
Craft and related trades workers	0.098	0.111	-0.031	0.074	-0.317	0.032
Plant and machine operators	0.085	0.046	-0.192	0.091	-0.275	0.033
Elementary occupations	0.027	0.062	-0.209	0.095	-0.426	0.041
Industry (agriculture omitted):						
Manufacturing of products	0.078	0.148	0.164	0.082	0.277	0.061

Construction or energy	0.083	0.085	0.207	0.087	0.304	0.064
Wholesale or retail trade	0.051	0.137	0.068	0.089	0.193	0.062
Hotels and restaurants	0.015	0.037	-0.055	0.113	0.081	0.076
Transportation and communication	0.068	0.056	0.215	0.089	0.326	0.064
Finance, real estate	0.044	0.040	0.104	0.110	0.336	0.067
Public administration	0.144	0.073	0.148	0.084	0.199	0.062
Education	0.137	0.103	0.079	0.088	0.163	0.067
Health and social work	0.220	0.108	0.061	0.083	0.208	0.063
Professional services (e.g. legal)	0.120	0.141	0.082	0.085	0.268	0.062
Cultural activities (including sport)	0.020	0.041	-0.040	0.106	0.092	0.067
Work status (employee in private firm omitted):						
Employee in public sector or non-profit	0.496	0.294	0.022	0.037	0.029	0.022
Self-employed with employees	0.036	0.033	0.195	0.089	0.205	0.062
Self-employed without employees	0.084	0.081	0.001	0.061	-0.053	0.046
constant	1.000	1.000	1.967	0.158	1.674	0.088

Note: The table reports the mean of the variables for licensed and non-licensed workers in columns 1 and 2. Columns 3 and 4 report the coefficients and standard errors of a wage regression for licensed workers. Columns 5 and 6 report the coefficients and standard errors of a wage regression for non-licensed workers. Country fixed effects are not reported. Number of obs. = 15951.

Use coefficients to produce the

Table 12. Oaxaca-Blinder decomposition results.

	(1) Estimated values	(2) s.e.	(3) t	(4) Proportion of total
Differential				
Predicted log wage licensed	2.1669	0.0195	111.36	
Predicted log wage non-licensed	2.0773	0.0108	192.09	
Difference	0.0896	0.0223	4.03	100%
Explained composition effects attributable to				
Union	0.0021	0.0016	1.33	
Age	0.0119	0.0032	3.69	
Work experience	0.0113	0.0026	4.33	
Gender	0.0037	0.0025	1.47	
Education	0.0030	0.0041	0.72	
Occupation	0.0085	0.0048	1.78	
Industry	0.0027	0.0056	0.47	
Work status	0.0063	0.0045	1.39	
Country	0.0050	0.0157	0.32	
Total	0.0545	0.0183	2.98	61%
Unexplained wage structure effect attributable to				
Union	-0.0184	0.0102	-1.81	
Age	-0.1367	0.0671	-2.04	
Work experience	0.0320	0.0276	1.16	
Gender	-0.0159	0.0168	-0.95	
Education	-0.1250	0.1081	-1.16	
Occupation	0.1365	0.0620	2.2	
Industry	-0.1195	0.0953	-1.25	
Work status	0.0011	0.0236	0.05	
Country	-0.0123	0.0377	-0.33	
Constant	0.2932	0.1805	1.62	
Total	0.0351	0.0154	2.28	39%

Note: The table uses non-licensed workers as reference group. The estimated coefficients and mean values of the variables are reported in Table xx. Robust standard errors are reported in column 2.

Table 13. Licensing and wage inequality: aggregate decomposition results.

	(1) sd	(2) var	(3) p99-p1	(4) p95-p5	(5) p90-p10	(6) p50-p5	(7) p95-p50	(8) Median
Licensed workers	0.8569	0.7343	3.7768	2.8273	2.2264	1.4093	1.418	1.9841
Non-licensed workers	0.8451	0.7142	3.6706	2.7049	2.2114	1.3481	1.3568	1.8417
Counter factual	0.8698	0.7565	3.8243	2.8685	2.2476	1.4118	1.4568	1.8679
Total effect	0.0118	0.0201	0.1062	0.1224	0.015	0.0612	0.0612	0.1424
Composition effect	-0.0128	-0.0221	-0.0475	-0.0412	-0.0212	-0.0025	-0.0387	0.1162
Wage structure effect	0.0246	0.0422	0.1537	0.1637	0.0362	0.0637	0.0999	0.0262

Note: DFL decomposition results. The explanatory variables include union, education, occupation, industry, work status, country indicators, age, experience, experience squared.

FIGURES

Figure 1. The proportion of licensed workers in the EU.

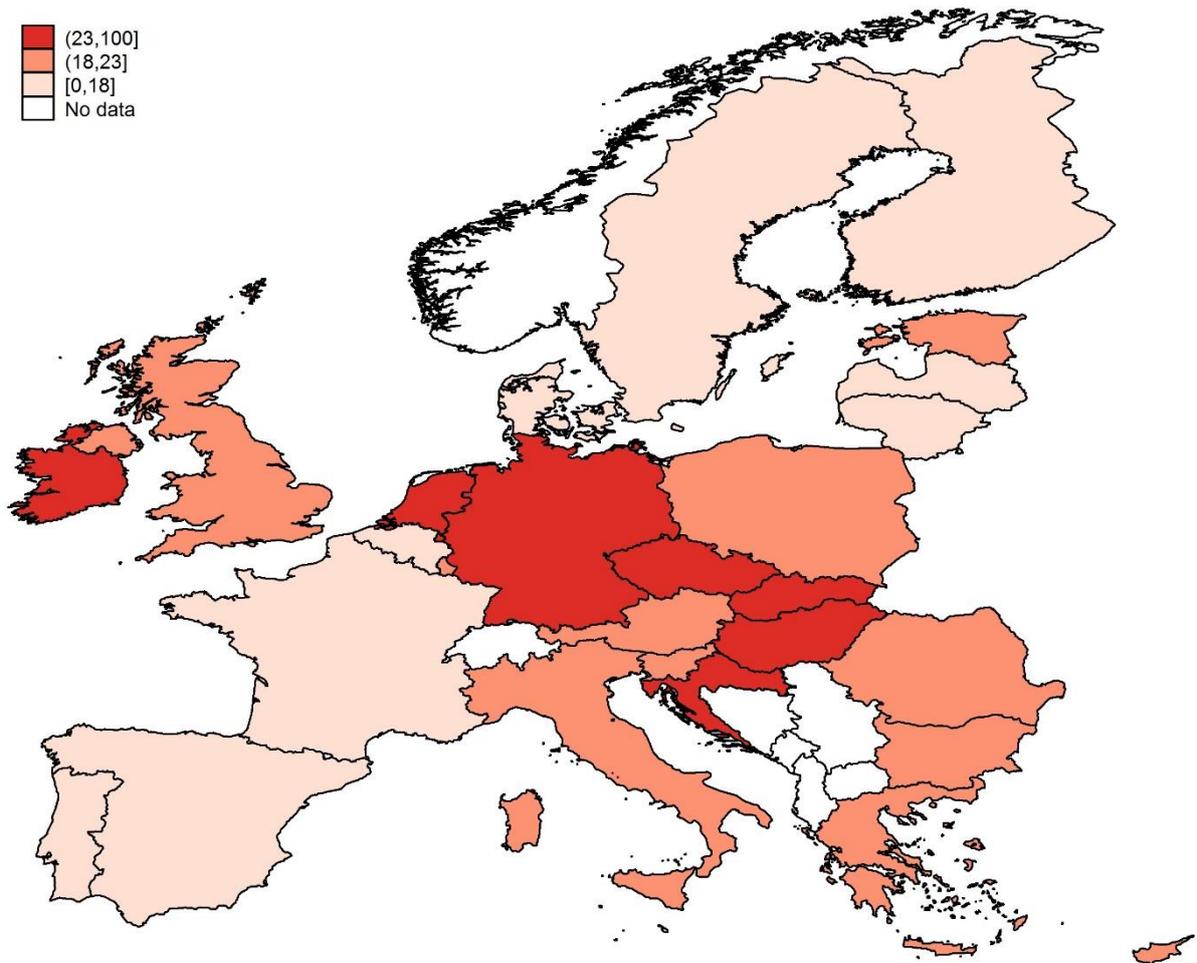
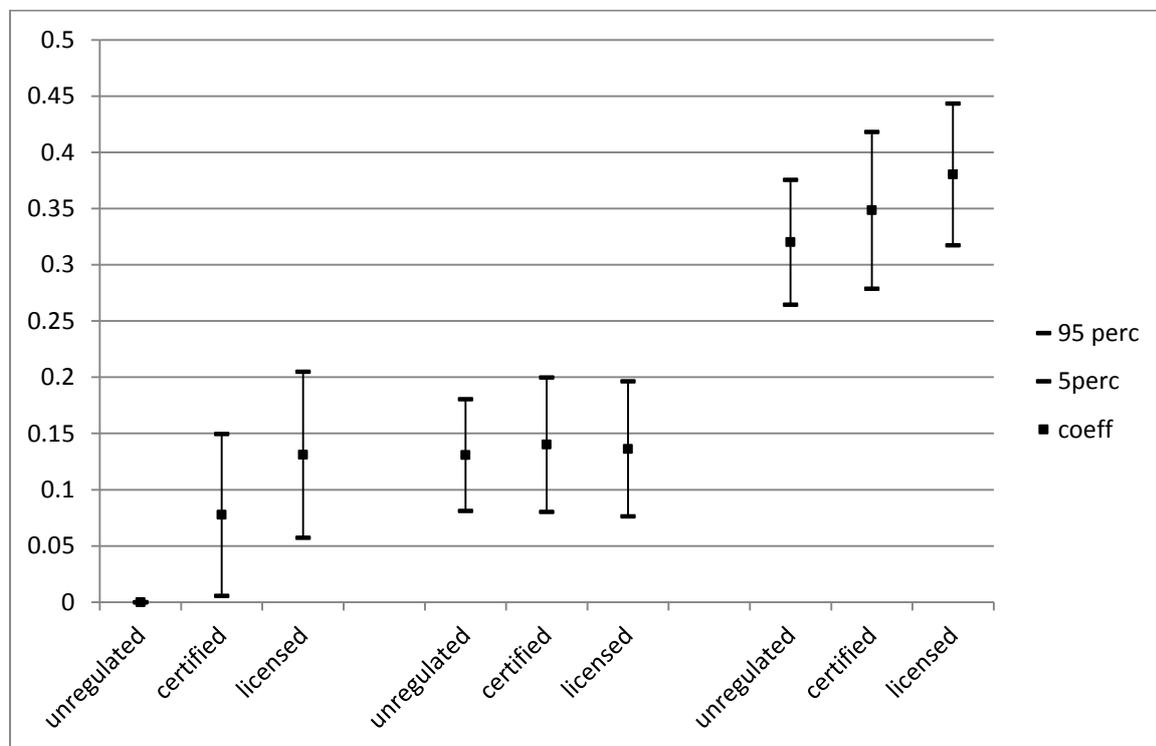


Figure 2. The wage effects of licensing and certification by education.



Note: Figure reports the wage effects of licensing and certification relative to unregulated workers for workers with elementary or lower secondary education, upper secondary and tertiary (non-college) education, and college or higher.

Figure 3. Log wage distribution for licensed and non-licensed workers.

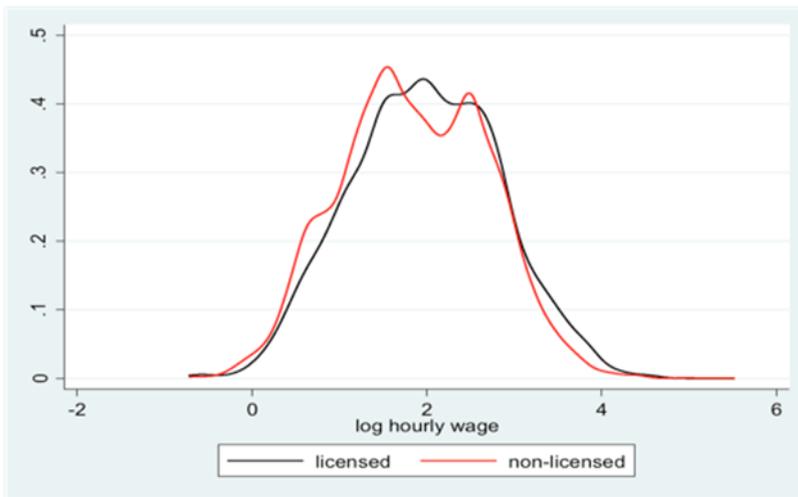


Figure 4. The composition effect on the log wage distribution.

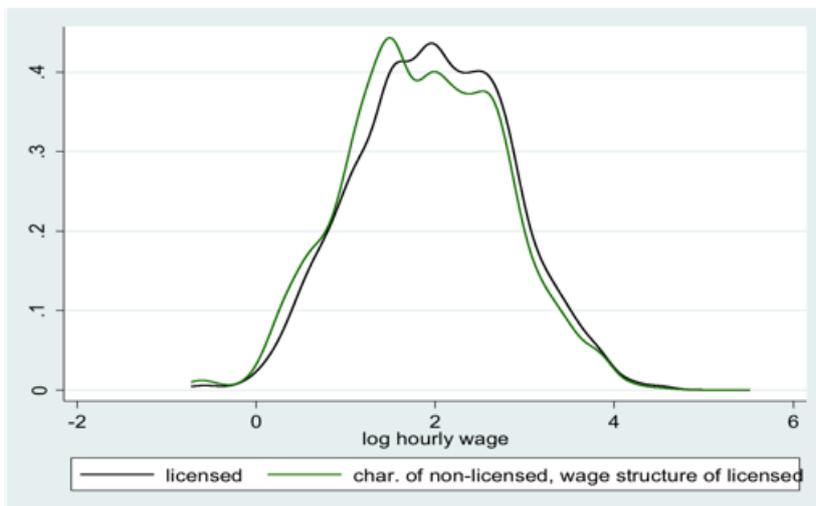


Figure 5. The wage structure effect on the log wage distribution.

