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# **BrExit or BritaIn: Is the UK more Attractive to Supervisors? An Analysis of Wage Premium to Supervision across the EU**

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## **Abstract**

We define the wage premium to supervision (WPS) as the extra wage that supervisors earn relative to their subordinates, and estimate it at different quantiles of wage distribution for 26 European economies, comparatively focusing on the UK. We find that, by compensating supervisory positions according to the wage, the WPS increases wage inequality across most of the economies studied. Further, over 10% of the WPS depends upon the economic context. Our results suggest that, regarding the WPS, the UK is more rewarding than the other economies. We discuss implications for immigration and policymakers in relation to the post-Brexit process.

**Keywords:** Wage premium to supervision, Counterfactual density estimation, Role of economic context, Talent attraction, Brexit

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## 1. Introduction

Labour mobility within the European Union (EU) has been growing since the beginning of the 21<sup>st</sup> century, and has been strongly promoted by globalisation and cross-border operations. The mobility of workers is one of the pillars of EU membership, and it is therefore inevitable that a major part of the public debate, before and after the UK's departure from the EU, has centred on the potential loss of freedom of movement. To date, a critical point of discussion throughout the course of the Brexit negotiation process between the EU and the UK has been whether workers from the EU could continue to stay in or to move to the UK, and, conversely, whether British citizens could stay in or move to other EU labour markets post Brexit.

According to the 2016 Annual Report on Intra-EU Labour Mobility, in 2015, the year prior to the Brexit referendum, 11.3 million people of working age were living in an EU country different from that for which they hold nationality (Fries-Tersch et al. 2016). As of January 2020, the consequences of the Brexit process are only just beginning to come into effect, and the intra-EU mobility issue remains to be fully clarified and operationalised. The Migration Advisory Committee (MAC), in its final report on European migration in the UK (MAC 2018), proposed a differentiated strategy based on immigrant skill level as part of the post-Brexit migration policy: a scenario 'based on what skills you have to offer, not which country you come from' was recommended by Boris Johnson, the PM during the Brexit process (Boris Johnson's talk at the Conservative Party conference in 2018). In January 2020, the British government expressed the intention to implement a points-based immigration system, similar to that active in Australia, and based on the following criteria: citizens of EU states will not be favoured over non-EU citizens; a total of 70 points need to be achieved in order to be granted a work permit: of these, 20 points will be awarded for securing a job offer before entering the UK; 20 points will be associated to the necessary level of skills to secure that job; 10 points for speaking English; and the last 20 points for reaching the threshold of an annual salary of 26,600 GBP (Home Office, 2020).<sup>1</sup> The declared inspiring principle for this immigration policy is to crowd-in skilled workers and crowd-out unskilled workers.

However, EU economies compete to attract high-skilled workers: 'the war for talent is especially prevalent amongst knowledge workers as the economy has shifted from an industrial economy to a knowledge economy' (Schlechter et al. 2014: 2). In this competition, some employment systems and economic contexts in certain economies are more attractive than others, because, notwithstanding language barriers, they offer a higher wage premium to supervision

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<sup>1</sup>The UK's points-based immigration system: policy statement. Home Office. UK Visa and Immigration. Published 19 February 2020. <https://www.gov.uk/government/publications/the-uks-points-based-immigration-system-policy-statement/the-uks-points-based-immigration-system-policy-statement>.

(WPS). Since almost the beginning of the nineties, the proportion of skilled immigrants in the UK has risen significantly; a considerable number are talented and highly qualified employees in supervisory positions (D'Amuri and Peri 2014). In our study, we investigate the hypothesis that, in regard to the wage premium to supervision (WPS), which is the extra wage that supervisors earn because of their role relative to other employees, the UK is more attractive to skilled workers than other economies. Should this be the case the above-mentioned immigration policy may not necessarily satisfy its objectives, because the proportion of highly skilled immigrants is already higher in the UK than in other EU economies owing to the better compensation schemes offered. It is proposed that this immigration policy may have the unintended effect of reducing the number of skilled supervisors willing to work in the UK. We formulate and answer the following research questions: how much do different systems pay supervisors on account of their specific role? Does the WPS increase with wage, thereby increasing inequality? How much of the WPS can be attributed to the context of the economic system where they work? Does the UK pay a higher WPS in order to increase its attractiveness to skilled supervisors? Despite their importance, these questions remain unanswered. The empirical literature identifies several individual and labour market characteristics that are likely to shape wage distribution, and, therefore, to have an impact on wage inequality (Di Nardo et al. 1996; Botero et al. 2004; Menezes-Filho et al. 2008). However, researchers interested in corporate finance and labour economics tend to focus on the determinants of the premium for employees at the top of the wage hierarchy by studying the compensation for chief executive officers (among many others, see Jensen and Murphy 1990; Tosi et al. 2000; Aggarwal and Samwick 2003). However, none of these studies focus on the contribution of the WPS in shaping the distribution of wages. The focus of the present article is to clarify the peculiarities of the labour market in the UK and various EU member states that are relevant to the strategy the employment systems in the UK will adopt to attract supervisors.

Our study additionally assesses the validity of the theoretical analysis of the WPS, which has puzzled researchers since Calvo and Wellisz (1979), who considered it as exogenous to the firm, i.e. determined by contextual elements such as laws, practices, and conventions aimed at protecting workers and redistributing income (Rosen 1982; Waldman 1984; Ricart i Costa 1988; Ulman 1992, Bernhardt 1995, Marsden and Belfield 2010). Such elements include the specification of permissible types of employment contracts, salary limits, working hours and working conditions, industrial relations regulations, and social protection standards (Betcherman 2013). Acemoglu and Newman (2002) suggest that WPS depends not only on the external context but also on the internal organisation of the firm, and that it is likely to shape the distribution of income in the economy. De Fraja (2004) argues that it is likely to be determined jointly with the number of ranks in the firm, as

both depend upon the degree of competition in the labour market. Beaudry and Francois (2010) assert that the acquisition of supervisory skills is central for enhancing productivity and achieving higher economic growth, and that the incentive to acquire these skills depends crucially on the premium the task pays. This view is consistent with the abundant management literature on the key role played by supervisors in increasing job satisfaction, supporting positive behaviour, and enhancing the performance of employees (Gillet et al. 2013).

We build upon counterfactual density estimation, which can be applied both to measure the WPS attributed to each supervisor in different country systems and to explain the contextual reasons for the differences. We adapt the methodology to international comparisons. We propose a data-driven heuristic criterion for selecting the smoothing parameter in conjunction with the kernel density estimator when many economies are under analysis. We also offer a method for estimating the impact of the context on the WPS in all the country systems. In doing so, we take the UK our benchmark country both because of the already significant capability of its economy to attract skilled individual, and for the likely implications of the immigration policy following the finalisation of the Brexit process. The approach we propose yields comparable and robust estimates of the impact of context on the WPS.

The rest of this paper is organised as follows. First, we describe the role of supervisors in business organisations, the data collection process, and the preliminary evidence that motivates our analysis. In the subsequent section, we present our method for estimating the distribution of wages in 26 European country systems and the WPS in each system, and illustrate how the methodology can be extended to estimate the impact of the context on the WPS. Next, we present our results. Finally, we discuss the theoretical contribution and policy implications of our findings with reference to the possible immigration policy that the UK might adopt in the framework of the Brexit process. We conclude by outlining suggestions for future research.

## **2. Literature, data, and motivation**

### **2.1. The importance of the supervisory role**

The role of a supervisor mainly involves organising and overseeing the work of other employees (Acemoglu and Newman 2002; Beaudry and Francois 2010). Studies in various European countries show a certain degree of consistency in the definition of supervisors' tasks and duties; they depict a role marked by significant complexity and diversified impact. For example, Guerrero and Sire (2001), focusing on the motivation for training among 335 employees in France, found that the supervisor plays a significant role in enhancing the motivation to train. Moncada et al. (2014), who

applied the Copenhagen Psychosocial Questionnaire II to 5,110 Spanish workers, showed that social support from supervisors was inversely correlated with mental health problems, stress, and burnout. Along the same lines, Galletta et al. (2011) studied 1,240 nurses in three hospitals in northern Italy, finding that perception of supervisors' actions was a significant predictor of employees' job satisfaction, and that supervision played a moderating role in the relationship between care adequacy and job satisfaction. 'The supervisor role is important in order to promote the improvement processes of the unit, to take into account nurses' work-related needs, and to support the staff members to perform better in their own work' (Galletta et al. 2011: 189). Prins et al. (2007), investigating 158 medical residents in a university medical centre in the Netherlands, found that dissatisfaction with emotional support from the supervisor had a greater impact on burnout in comparison with dissatisfaction with emotional, appreciative, and informative support from fellow residents, nurses, and patients. Roxana (2013) investigated the relationship between emotional demands and job satisfaction among 255 banking employees in Romania, and found evidence that supervisor (and co-worker) support can mediate the effect of emotional demands on job satisfaction.

Research in various countries and industries shows that supervisors play a critical role in shaping employees' perceptions and organisational functioning. From a more systemic point of view, recent studies have also evidenced a link between the role of supervisors and the level of creativity and innovation in different countries and industries. In their meta-analysis of 80 studies, Hammon et al. (2011) signally observed that supervisory support influenced individual creative and innovative performance. Similar conclusions were reached by Škerlavaj et al. (2014) in their study of a manufacturing company in Slovenia: analysis of data for 165 employees and their 24 direct supervisors showed that employees perceiving less supervisory support were less able to enhance their creativity, while those who perceived greater support displayed a nearly linear positive correlation between their idea generation and implementation, 'with a steeper slope and only slightly U-shaped curvilinearity' (p. 993). Consistent results were found in the services sector by Binnewies and Gromer (2012) through a longitudinal study of 89 German teachers, which indicated that supervisory support, together with co-worker support, was a good predictor of idea promotion and idea generation. The convergent trend of these studies is toward the importance of supervisors as individuals with distinctive skills in motivating and supporting people, as well as in stimulating and enhancing creativity and innovation within an organisation. The UK is among the EU leaders in innovation according to the 2018 European Innovation Scoreboard; therefore, we argue that in order to maintain this position post Brexit, attention should be paid to the choice of the immigration policy because a restrictive immigration policy in connection with Brexit might contribute to

perceptions of the British labour market as less attractive to skilled individuals, particularly EU workers.

## **2.2. Data**

Our empirical exercise uses the EU-SILC database released in 2009. This homogenised survey, which supplanted the European Community Household Panel (ECHP) in 2005, has three main advantages over other similar datasets. First, the set of economies is fully comparable because the survey builds on common guidelines, definitions, and procedures, with information on 440,400 individuals in 26 European countries (Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, the Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, and the UK). Bulgaria and Romania did not take part because they only joined the EU in January 2007. Second, the EU-SILC database covers 26 EU member states, whereas the old ECHP only covered 14 economies. The dataset holds information on many of these new entrants. Our comparison therefore covers many European states with heterogeneous contexts in relation to the organisation of economic activity. Finally, the EU-SILC definition of supervisor closely follows the theoretical definition of supervisor used in Leonard (1987), Acemoglu and Newman (2002), and Beaudry and Francois (2010):

Supervisory responsibility includes formal responsibility for supervising a group of other employees (other than apprentices), whom they supervise directly, sometimes doing some of the work they supervise. It implies that the supervisor or foreman takes charge of the work, directs the work and sees that it is properly done (2006: 193).

Table 1 reports the average wage for supervisors and other employees, as well as the ratio of supervisors to production workers for the 26 European economies. As common in research on wage distribution, we exclude students, people undertaking compulsory military service, self-employed workers, and people outside the age bracket of 25–65 years. We also exclude individuals with missing values for any of the variables used. This selection resulted in a sample of 126,435 individuals, of whom 31,689 are supervisors.

## **2.3. Motivation**

The difference in the average (log) wage between supervisors and production workers ranges from 41% in Slovenia to more than 100% in Portugal and Cyprus. The percentage of employees with supervisory responsibilities ranges from 12.9% in Latvia to 65.3% in Austria. These differences are substantial, both between economies at different stages of development and between economies classified as developed by the OECD. Slovakia pays the lowest wage for supervisors, while the highest is paid in Luxembourg. The lowest wage for the subsample of production employees is paid

in Latvia, and the highest in Denmark. The mean difference in wages between the two groups of employees varies from 34% in Slovenia to 71% in Portugal.

PLEASE INSERT TABLE 1 ABOUT HERE

The differences in wages reported in Table 1 are not informative of the WPS for each supervisor, for two reasons. First, average values are used. The average premium for supervision represents an estimate of the premium attributed to each supervisor in the economy. However, by nature, the premium differs at different quantiles of the wage distribution in order to provide greater incentives to supervision. This suggests that the WPS raises wage inequality. None of the studies we are aware of has elucidated the potential role of the WPS in determining the shape of the wage distribution in an economy. In the literature to date, the most important aspects of the impact of WPS on the distribution of wages, which in this type of analysis are of policy relevance, have been largely neglected. Second, the differences reported in Table 1 fail to gauge WPS because other characteristics of the supervisors are not held constant. Economics literature has shown that several individual and labour market characteristics are likely to shape the distribution of wages and to, therefore, have an impact on inequality (Di Nardo et al. 1996; Botero et al. 2004; Menezes-Filho et al. 2008): the counterfactual density estimation approach is designed precisely for this purpose.

### 3. Empirical framework

Silverman (1986) suggests estimating the non-parametric distribution of wages as

$$\hat{f}_{N_j, \bar{h}}(w_0) = \frac{1}{N_j \bar{h}} \sum_{i=1}^{N_j} K\left(\frac{w_i - w_0}{\bar{h}}\right), \quad (1)$$

where  $N_j$  is the number of observations for country  $j \in J$ ,  $w_0$  is the evaluation point,  $w_i$  is (the ln of) wage of the  $i$ -th individual in the  $j$ -th economy,  $\bar{h}$  is the average of the optimal bandwidths for the  $J$  economies, and  $K(\cdot)$  is the kernel density function. The function  $K(\cdot)$  satisfies the condition  $\int_{-\infty}^{\infty} K(p) dp = 1$ . Many alternative kernel functions can be used, each with specific advantages and disadvantages. We use the Gaussian kernel, i.e. the height of the standard normal distribution evaluated at  $(w - w_0)$  given the bandwidth  $h$ , because of its property of monotonicity of peaks and troughs with respect to bandwidth changes. For the bandwidth,  $h$ , we use the average of the optimal bandwidths, because cross-country comparison of distributions of wages must be performed under the same bandwidth selector and width (Marron and Schmitz, 1992). To decide what bandwidth selector to adopt, we report the analysis of the first two moments and the distributions of the optimal bandwidth under the most common bandwidth selectors in Figure 1. Panel 1 shows the



distribution of the cross-validation bandwidths; Panel 2 that obtained using Silverman's rule of thumb (1986); Panel 3 that of the plug-in smoothing parameter of Sheather and Jones (1992); and Panel 4 the distribution of the bandwidths under normal distribution of wages.

Results suggest that the mean of the cross-validation bandwidths, 0.19235, is greater than that calculated under assumption of normality (0.14258). Therefore, applying cross validation entails a serious risk of over-smoothing several wage distributions. This distribution of bandwidths is also bimodal, which implies that the average bandwidth does not represent the individual bandwidths well: in other words, its use will under-smooth the distributions of samples whose optimal bandwidth is located at the right of the mean, and over-smooth those whose optimal bandwidth lies to its left. The evidence, therefore, suggests that cross-validation is an unattractive choice for our case. A similar consideration applies, although to a lesser extent, to the Sheather and Jones (1992) bandwidth selector. Although the average bandwidth calculated with this method (0.08179) is lower than under the normality assumption, the distribution has a peak on the left tail, again suggesting that some distributions will be over-smoothed. The analysis suggests taking, as the heuristic criterion, the bandwidth selectors whose distribution is well-behaved, whose mean is lower than that computed under the hypothesis of normally distributed wages, and which minimise the distance between the estimate obtained via the (individual) 'optimal' and the (common) 'suboptimal' smoothing parameters. This argument indicates that, in our case, the best approach is Silverman's rule of thumb. In the following sections, we report the results based on the average of the smoothing parameters recovered using the bandwidth  $h = 0.09345$ .

PLEASE INSERT FIGURE 1 ABOUT HERE

Figure 2 reports the results for the different country systems. As examples, we report the distribution of wages in the UK, Germany, and Poland for the subsamples of supervisors and production workers, and their smoothed differences. Germany is taken as an example of an old EU founding member, and Poland as both an Eastern European new entrant and the most represented country of immigrants in the UK, both by birth and nationality. Results suggest that the difference in unconditional WPS is higher in the UK and Poland than in Germany. Further, the WPS differs for supervisors located at different quantiles of the wage distribution.

PLEASE INSERT FIGURE 2 ABOUT HERE

Preliminary evidence shows that the WPS differs for supervisors earning different wages, with supervisors located at the right tail of the distribution of wages earning a higher WPS. However, the difference between the distributions for supervisors and non-supervisors cannot be

taken to be the WPS as such, because it does not adequately consider the differences in personal characteristics between the two groups. The decision to be a supervisor depends on the individual's ability to discharge this responsibility; as a result, skilled individuals systematically self-select into this role (Cameron and Heckman 1998). If the individual skills and experience of supervisors and other employees differ systematically, the former self-select into more rewarding tasks, and the difference between wages is an unknown combination of the WPS and the reward for individual skills and experience endowment. To build a credible measure for individual skill endowment, as in Picchio and Mussida (2011), we use the International Standard Classification of Occupations (ISCO-88). These variables are associated with the type of job chosen by the employee. The categories range from relatively low-skilled jobs, such as plant and machine operators and assemblers, to higher skilled jobs, such as professionals, legislators, and senior officials, as well as CEO/non-CEO positions. The variables refer explicitly to the required skill level:

The basis for the classification in the ISCO-88 scheme is the nature of the job itself and the level of skills required. A job is defined as the set of tasks and duties to be performed. Skills are the abilities to carry out the tasks and duties of a job. Skills consist of two dimensions: skills level and domain specialization (EU-SILC 2009:183).

In addition to skills, there are other systematic differences between supervisors and production workers. In some economies, the possibility of self-selecting tasks depends on experience and/or schooling. Table 2 reports information on job characteristics (% of individuals in permanent and full-time positions), individual characteristics (age, % of males, marital and citizenship status, education, and skill level), and the firm's characteristics (% with more than 10 employees, sector of economic activity) for the three economies.

PLEASE INSERT TABLE 2 ABOUT HERE

Results suggest that supervisors have higher skills and schooling than production workers. There are, however, differences between the three economies under examination. The UK is the only country where the supervisors are, on average, younger than production employees. In Germany, most supervisors have tertiary education; in contrast, in the UK and Poland, most supervisors are educated to the upper secondary level. The UK has the largest difference, in terms of skills, between supervisors and productive employees, suggesting that this context is more likely to facilitate skilled employees to self-select into supervisory positions. In Germany, by contrast, experience matters more for promotion to supervisory positions.

The preliminary analysis above clarifies why the differences between the distributions of wages of supervisors and productive employees, as shown in Figure 2, are not due only to the supervisory position. Variables such as skills, schooling, and experience are relevant to whether an

individual is appointed as a supervisor. Moreover, they are relevant to different extents in different contexts. To control for these differences, Di Nardo et al. (1996) propose comparing the distribution of wages of supervisors and productive employees with the distribution of wages that would prevail if no individual were a supervisor; in other words, with *other things being equal*, i.e. what they define as the counterfactual distribution of wages. The difference between the actual distribution of wages and the counterfactual distribution of wages would then be attributable only to the supervisory position, and the WPS would then be measured as the horizontal difference between the two distributions.

The authors show that the counterfactual distribution for the  $j$ -th economy can be obtained by appropriately reweighting the distribution of the subsample of individuals that are not supervisors,  $N_j^{ns}$ :

$$\hat{f}_{N_j^{ns}, \bar{h}}(w) = \frac{1}{N_j^{ns}} \sum_{i=1}^{N_j^{ns}} \frac{\hat{\theta}_j^{ns}(x_j)}{\bar{h}} K\left(\frac{w_i - w_0}{\bar{h}}\right), \quad (2)$$

where  $ns$  observations are the non-supervisor employees in the  $j$ -th economy. In Equation (2),

$$\hat{\theta}_j^{ns}(x) = \frac{\widehat{Pr}(s_j = 0)}{\widehat{Pr}(s_j = 0|x_j)} = \frac{1 - \widehat{Pr}(s_j = 1)}{1 - \widehat{Pr}(s_j = 1|x_j)}, \quad (3)$$

is a vector of weights. In Equation (3),  $\widehat{Pr}(\cdot)$  stands for fitted probability. The set of weights,  $\hat{\theta}_j^{ns}(x)$ , is the crucial element in building the counterfactual distribution of wages. It is the ratio of the unconditional probability of not supervising other employees,  $\widehat{Pr}(s_j = 0)$ , and the probability of not supervising other employees conditional to a set of characteristics,  $x_j$ , which is estimated building on the following probit model:

$$Pr(s_j = 1|x_j) = \Phi(x_j), \quad (4)$$

where  $\Phi$  is the cumulative normal distribution. What is the role of the set of weights in Eq. (3)? The ratio between the two probabilities in Eq. (3) is different from 1, unless  $s_j$  is independent of  $x_j$ . However, the evidence suggests this is hardly the case: supervisors are more likely to self-select in the role, and therefore the probability of being a supervisor is likely dependent on individual characteristics such as education, work experience, skills, and the sector in which the firm operates. This reweighting function plays the role of holding all the characteristics, other than being a supervisor, constant.

Therefore, the estimate of the probit model must be as complete and flexible as possible. We note that the exercise we perform requires the same specification of the regression model for fitting

the probability of being a supervisor. Therefore, when deciding the preferred model for each economy, we do not adopt the standard general-to-specific approach. This approach is indeed likely to make the resulting preferred model specific to the economy. We choose between the alternative models by maximising the number of accurate predictions, and test the joint significance of the following groups of variables:

- (i) individual characteristics: education (4 categories: lower secondary, upper secondary, post-secondary, at least tertiary); work experience (and its square, cube, and quartic); gender; marital status; and citizenship (2 dummies: national/non-national, European/non-European)
- (ii) job characteristics (part time, full time, temporary, permanent)
- (iii) firm characteristics (size measured by 3 dummies, 13 economic sector dummies)
- (iv) individual skills (4 dummies measuring the skills required for the task).<sup>2</sup>

The decision to supervise other employees depends also on the monetary compensation offered for this responsibility. Hence, wage is another variable that can facilitate controlling results for self-selection into supervisory jobs. Wage is likely to be determined jointly with the probability of being a supervisor; therefore, its use is conditional on the availability of a set of instruments to be used in a 2SLS approach. A common challenge in analyses building upon cross-sectional surveys, such as ours, is to find one or more credible instruments. This problem is even more challenging here, because the instrument must be valid (and the same) for the 26 economies to be compared. For the purpose of multi-comparison, the literature suggests variables relating to the individual's health, building on the idea that poor health has a substantial impact on compensation and labour market participation, but is not correlated to the probability of supervising other employees, as proposed by Currie and Madrian (1999), because health limits their occupation, but not their ability to perform the tasks specific to their chosen job. In the EU-SILC survey, physical well-being is measured as limitation on activities due to health problems and general health (including health status and chronic illness or condition), on a scale from 1 to 5, with higher values indicating poorer health. The variable is not statistically significant in the probit model, suggesting that the exclusion restriction is likely to hold. Correlation analysis (not reported) supports the hypothesis that the variable is strongly correlated with the wage and uncorrelated with the probability of being a supervisor.

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<sup>2</sup>The literature on the gender wage gap suggests that this problem should be handled by a panel data approach (Fortin et al. 2011). In our case, however, this is not feasible because the EU-SILC survey data are cross-sectional. In our context, panel data are unattractive in any case: 1) the probability model is non-linear, so the assumption of separability is unlikely to hold; and 2) disentangling individual effects is problematic, because individual fixed effects can be computed only if the individual has had both statuses (supervisor and non-supervisor) over the time span available.

The discussion above serves as an important reminder decomposition methods should not be used to infer the direction of causality. The Oaxaca (1973) and Blinder (1973) decomposition of the mean, which we generalise to the entire wage distribution, measures the association between wages and employee characteristics. However, this approach does not identify causation, and this is again clear when considering the role played by the conditional probability in Eq. (3). When estimating any probability model, the researcher is typically interested in estimating the determinants of the dependent variable; however, this is not the case here. A regression analysis of the type reported in Eq. (3) is usually seen in the gender wage gap literature, where the dependent variable is the employee's gender, nationality, or even race, i.e. variables that would have been clearly nonsensical to attempt to explain.

Once we have an estimate of the WPS for each economy, we aim to obtain an estimate of the role of context in determining the WPS. Theory indeed suggests that the economic context is among the determinants of cross-country differences in WPS (Acemoglu and Newman 2002; De Fraja 2004). To estimate how context influences the WPS, it is necessary to have a measure of, say, how much a Polish supervisor would earn if, other things being equal, s/he were working in the UK. This amount, when compared with the WPS s/he earns in Poland, would reveal the impact of the Polish context against the British context. Fortin et al. (2011) argue that this exercise must be carried out in two steps. First, we estimate the counterfactual distribution that would prevail if all Polish employees worked in the UK, by fitting the probability of being in the UK. As above, the key to cross-country comparison is the reweighting function, which keeps all conditioning variables for both Poland and the UK such that:

$$\hat{\theta}_{POL}^{UK}(x) = \frac{\widehat{Pr}(UK = 1|x)}{\widehat{Pr}(POL = 1|x)} \times \frac{\widehat{Pr}(POL = 1)}{\widehat{Pr}(UK = 1)}. \quad (5)$$

Here, the two unconditional probabilities,  $\hat{p}(UK = 1)$  and  $\hat{p}(POL = 1)$ , are equal to the number of observations for Poland and the UK over the sum of Poland and the UK, respectively. A similar exercise is proposed by Di Nardo et al. (1996) in the framework of the gender wage gap literature. The authors focus on a single economy and construct counterfactual distributions at different points in time. The impact of any given factor on changes in the wage distribution over time is determined by considering a counterfactual state of the world where the distribution of this factor remains constant. Also in the gender wage gap framework, Blau and Kahn (1996b) propose, instead, a comparison between economies at the same point in time. As in our case, they regard the British economy as the benchmark and ask what the average wage gap would be for Polish women working

in the British context. Therefore, building upon Di Nardo et al. (1996), we propose a generalisation of the approach of Blau and Kahn (1996b) to the entire distribution.

The second step consists of estimating what Polish supervisors would earn in the UK, holding other factors constant. To estimate this, we interact weights in Eq. (5) with weights in Eq. (3), applying the condition  $j = POL$ :

$$\hat{\theta}_{POL}^{ns}(x)\hat{\theta}_{POL}^{UK}(x) = \frac{\widehat{Pr}(UK = 1|x)}{\widehat{Pr}(POL = 1|x)} \times \frac{\widehat{Pr}(POL = 1)}{\widehat{Pr}(UK = 1)} \times \frac{1 - \widehat{Pr}(s_{POL} = 1)}{1 - \widehat{Pr}(s_{POL} = 1|x_{POL})}. \quad (6)$$

Using the set of weights in Eq. (6) in Eq. (1) leads to:

$$\hat{f}_{N_{POL}^{ns}, \bar{h}}(w) = \frac{1}{N_{POL}^{ns}} \sum_{i=1}^{N_{POL}^{ns}} \frac{\hat{\theta}_{POL}^{ns}(x)\hat{\theta}_{POL}^{UK}(x)}{\bar{h}} K\left(\frac{w_i - w_0}{\bar{h}}\right), \quad (7)$$

which is the wage distribution that would prevail in Poland if there were no supervisors and if the UK context were applicable to all individuals. The horizontal difference between the distributions of wages in Eq. (7) and those in Eq. (2) reveals the impact of the context on Polish supervisors (Blau and Kahn 1996a; Gottschalk and Joyce 1998; Katz and Autor 1999). We note that because the counterfactual WPS is computed as the difference between premia, any residual bias due to self-selection is further dissipated.

## 5. Empirical results

In Table 3, columns (a) to (f) report the results from estimating our auxiliary probit model in Eq. (3) for Poland. Column (a) refers to the model in which the independent variables are (i) individual characteristics; (ii) job characteristics; and (iii) firm characteristics. The results indicate that the variables we use to model the probability of being a supervisor fit the data reasonably well. All three sets of variables are statistically significant. The pseudo- $R^2$  is about 11%, not dissimilar to that reported in papers using microdata similar to ours (Veall and Zimmermann 2006). The percentage of correct predictions is higher than 80%.

As observed above, these results are likely to be driven, at least partially, by the self-selection of skilled individuals into supervisory positions. To control for this potential problem, we add (iv) the (log of) wage to the set of regressors described in (i), (ii), and (iii). The results in column (b) show that the variable is statistically significant. The measures of goodness-of-fit increase significantly: the pseudo- $R^2$  increases by almost 50%, while the percentage of correct predictions rises to 81%. Column (c) shows that the set of variables suggested by Picchio and Mussida (2011) to control for unobservable skills are also highly significant. Further, they improve

goodness-of-fit more than the wage variable. The pseudo- $R^2$  increases by more than 120%, and the correct prediction rate rises to almost 85%.

PLEASE INSERT TABLE 3 ABOUT HERE

Column (d) gives the results where both the set of ISCO variables and the log of wage are included. The F-statistics for (log of) wage and those for joint statistical significance of the coefficients of the ISCO dummies are lower than their counterparts in columns (b) and (c), respectively. Compared with column (c), the improvement in the pseudo- $R^2$  and especially in correct predictions is only marginal. The results given in columns (b) and (d) are questionable, because the wage is likely to be jointly determined with the probability of being a supervisor. This calls for an instrumental variable approach in modelling the conditional probability in Eq. (6), as suggested by Fortin et al. (2011). Column (e) reports the results when the log of wage is instrumented by health status. The variable is statistically significant at the 10% level. The percentage of correct predictions does not diverge greatly from that obtained for previous models. Interestingly, the Hausman and Wu test for exogeneity does not reject the null hypothesis that the variable can be treated as exogenous. Column (f) shows that if the set of dummies controlling for unobserved skills is included, the percentage of correct predictions is not dissimilar to that reported in column (b). The coefficient associated with the (log of) wage decreases sharply and loses statistical significance.

Columns (g) to (n) report the results for the UK observations. The pattern is very similar to that for Poland. Column (g) suggests that the model adapts reasonably well to the data. Column (h) indicates that addition of the (log of) wage to the set of regressors greatly improves both the pseudo- $R^2$  and the correct prediction rate. Column (i) shows that adding the ISCO variables improves both statistics even more substantially: the pseudo- $R^2$  is over 150% higher, and the correct prediction rate improves from 62.5 to 58.1% relative to the model in column (g). Instrumenting the (log of) wage by the health variable is problematic for the UK; the results in column (m) show that the Hausman and Wu test rejects the null hypothesis only at the 10% level, suggesting that it is risky to treat the variable as exogenous. This reinforces the consideration that, notwithstanding the suggestion in Currie and Madrian (1999), the necessary exclusion restriction is unlikely to hold for all the economies. In the rest of the paper, therefore, we use the parameters from columns (b) and (h); those drawn from the other models are applied for robustness exercises. The argument for this approach is that the models in columns (b) and (h) have the highest pseudo- $R^2$  values and, most importantly, the highest correct prediction rates, which is in fact why the approach calls for the auxiliary probit model in Eq. (8) in the first instance.

Figure 3 shows the estimates for the actual and counterfactual distributions for the UK (Panel 1; with smoothed difference in Panel 2) and Poland (Panels 3 and 4, respectively), illustrating the impact of the WPS on the wage distribution. The counterfactual distribution in the UK is to the left of the actual distribution. The evidence supports the hypothesis that the extra amount paid for the supervisory job, the WPS, shifts the wage distribution to the right. The smoothed difference shows that the impact is greater on the right tail, consistent with the hypothesis that the WPS increases with wage. Both the actual and counterfactual distributions in Poland are shifted to the left with respect to the UK, consistent with the hypothesis that the latter pays higher wages and is therefore already an attractive labour market for supervisors. The effect of supervisory jobs on wage distribution in Poland is smaller than in the UK, for all wage levels. Among the remaining economies, the premium is larger in Austria, Belgium, Cyprus, Denmark, Iceland, and Slovenia, and likely to be smaller in Hungary, Germany, and Italy. Finally, Luxembourg shows a statistically significant premium only at a high salary level. Table 4 reports results of the Kolmogorov-Smirnov test for the null hypothesis that the counterfactual and the actual distribution are equal, rejecting it for all the economies except Belgium, Ireland, Lithuania, the Netherlands, Slovakia, and Sweden.

PLEASE INSERT FIGURE 3 ABOUT HERE

Table 5 reports testing of the hypothesis that the premium is statistically significant, and given an estimate of the average WPS. Ireland turns out to pay the highest average premium (23.4%), followed by the UK (23.2%) and Cyprus (20%). Among the economies where the premium is statistically significant, it is lowest in Latvia (6.4%) and Estonia (7%).

PLEASE INSERT TABLE 4 ABOUT HERE

The rest of Table 5 shows the estimated impact of the premium at the deciles of the distribution of wages. Here, the economies can be roughly divided into three groups. In the first group of 13 economies, premia are lowest between the 10th percentile and the median, and are therefore likely to take a J-shape. In the second group of 6 economies (Estonia, Hungary, Latvia, Lithuania, Luxembourg, and Portugal), the premium tends to increase monotonically over all the deciles (with the exception of the first decile for Hungary and Luxembourg). The third group consists of 5 countries where the curve is U-shaped (UK, Ireland, Cyprus, Norway, and France). A single country, Germany, has a backward J-shaped pattern, with the highest value at the lowest decile. Remarkably, all the economies have a higher WPS at the highest quantile than at the median. For 11 of the 26 economies, the WPS is higher at the median than at the first decile. The highest



WPS at the first decile is paid by Cyprus and at the ninth decile by Portugal; the lowest WPS at those deciles is paid by Slovakia and Slovenia, respectively. The evidence rebuts the hypothesis of an equal WPS for individuals located at the same deciles of the wage distribution in different economies, but supports the hypothesis that the WPS augments the degree of wage inequality.

PLEASE INSERT TABLE 5 ABOUT HERE

We ran several robustness checks. We additionally considered the impact of our choice of bandwidth selector, given that this decision is crucial for estimating and comparing distributions in the non-parametric framework. We repeated the entire exercise using the three alternative bandwidth selectors, and calculated the (percentage) difference in premia. We also examined how the results differ if the geometric average and the average weighted by bandwidth selector are considered instead of the simple average. In Table 6, we report the difference between the WPS using the simple average of the bandwidths calculated by Silverman's rule of thumb (1986) and the average computed under the other three automatic bandwidth selectors – namely Sheather and Jones' plug-in method (1992), the cross-validation method, and the normal distribution assumption. In addition to those for the UK and Poland, we also report the results for the economies with the lowest and highest individual 'optimal' bandwidth for each of the three other selection methods, as well as for the economies with the most and the fewest observations, namely Italy and Slovenia, because the estimates are sensitive to sample size.

We present 16 robustness exercises. The percentage differences between the premium calculated via the average of the rule of thumb bandwidth and that computed using the Sheather and Jones method are greater for economies with smaller numbers of observations. This occurs especially at the fourth decile of the distribution and at the median. These differences are substantial at the leftmost deciles of the distribution of wages for Slovakia. For Italy and Poland, the differences are very small, suggesting that the difference between the estimates decreases as the sample size increases (the survey covered 12,310 individuals for Italy and 9,385 for Poland). In short, the choice of the Sheather and Jones (1992) selector does not significantly affect our results. The differences relative to our preferred bandwidth selector are more pronounced when the normal distribution and cross-validation methods are applied. These divergences are evident for the UK and for Italy, especially on the left tail of the distribution with a bandwidth selected assuming normal distribution of the data. They are less evident for the Polish and the Czech wage distributions (because these are the economies with the lowest normal bandwidth). The differences when the cross-validation method is applied are somewhat more widely diffused along the distribution, and most notably for Slovenia, Norway (the economy with the lowest cross-validation bandwidth), and

Portugal (the economy with the highest). These results suggest that the cross-validation approach is likely to have the same smoothing impact as the normal selector on all the densities.

PLEASE INSERT TABLE 6 ABOUT HERE

Figure 4, Panel 1, presents the actual distribution of wages in Poland and the counterfactual distribution that would prevail if, other characteristics being equal, all the Polish employees worked in the UK. Panel 2 reports the wage distribution that would prevail both if none were supervisors and none were working in the UK. From these distributions, we calculate the WPS that Polish supervisors would earn if they worked in the UK. The analysis is repeated for each of the 25 sample economies, using the UK as the reference economy in all cases.

PLEASE INSERT FIGURE 4 ABOUT HERE

The results are presented in Table 7. Remarkably, all the counterfactual WPS values are substantially higher than the actual WPS values. The difference between the latter (reported in Table 5) and what they would earn in the UK (reported in Table 7) is the fraction of the WPS that can be attributed to the difference between the British and the Polish context. We report these differences in Table 8. Analysis of these differences suggests that, apart from Ireland, the effect of context on the average WPS is positive; accordingly, a supervisor working in the UK rather than in the country in which s/he holds nationality would earn a higher premium. Latvia and Slovakia are the economies for which this increase is the largest. The results at the single deciles show a more detailed picture. First, all are positive, except for 4 deciles in Ireland and Luxembourg, 2 (the extremes) in Cyprus, and 1 (the ninth decile) in Portugal. That is, the effect of the British context on WPS is positive vis-à-vis almost all countries, at almost all deciles. Second, the economies can be roughly divided into two groups: one group – Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Portugal, and Slovakia – shows an inverted-U pattern, the context having a greater impact at the median quantiles; the other group shows similar impact at all deciles.

PLEASE INSERT TABLE 7 ABOUT HERE

PLEASE INSERT TABLE 8 ABOUT HERE

## **6. Discussion and conclusion**

We have constructed an ideal dataset for comparisons of the WPS across EU economies. The EU-SILC database reports information on supervisory positions, wages, and a set of individual characteristics for 26 European economies, with a comparative focus on the UK. Information is collected using the same questionnaire and applying common guidelines, definitions, and

procedures. Some interesting theoretical contributions and policy implications emerge from our findings.

On the theoretical side, by extending the counterfactual density estimation approach and applying it to our dataset, we offer two extensions of the methodology. The first consists of a data-driven heuristic criterion for selecting the smoothing parameter in conjunction with the kernel density estimator. We suggest taking the criterion that minimises the distance between the estimate obtained via the (individual) optimal and the (common) suboptimal smoothing parameter. Our second methodological extension consists of a method for estimating the impact of the broader context on the WPS in different country systems. Our approach is shown to yield comparable and robust estimates of the distribution of wages in the different economies and a clear estimate of the impact of context on the WPS.

In addition, our results suggest that the WPS is higher at the right tail of the wage distribution, in accordance with the thesis that it varies between individuals earning different wages within EU economies and that the premium is higher for higher wages. The premium differs between skilled individuals at the same quantiles of the distribution but in different economies. If we extend our findings to the question, based purely on the analysis of WPS, of whether Brexit will trigger a brain drain of skilled individuals from the British labour market, the results suggest that supervisors should stay in the UK, which pays the highest premium at all the deciles on the right tail. The evidence suggests that the premium is likely to heighten inequality, and rebuts the hypothesis that the EU market for supervisory positions is a true common market. Our evidence indicates that context affects the WPS differently in different economies and at different deciles of the wage distribution. Our results hold for a number of robustness checks, namely endogeneity, the magnitude of the bandwidth, the specification of the probability models, and, finally, assumptions concerning confidence intervals.

In terms of the implications for immigration and industrial policy, our study might provide novel considerations, along different dimensions, for the current post-Brexit debate in the UK. The British labour market is already attractive to supervisors because it rewards them, other conditions being equal, with larger incentives. This is particularly important because it is recognised that high-skilled workers facilitate the self-sustained growth of innovation and productivity, and also make larger contributions to public finances because they pay high taxes as a result of their high wages. However, whether the UK's WPS edge will be sufficient to retain the present group of supervisors, or to attract new ones from abroad, will depend heavily on a series of tangible and intangible elements, above and beyond the announced changes. The tangible factors concern the extent to which the new immigration policy favours, in operational and administrative terms, the entry of

new skilled workers, particularly from the EU. Eventually, skilled employees may elect to leave UK-based supervisory positions, and potential skilled immigrants may be discouraged from coming to the UK, owing to the more complex post-Brexit legal immigration requirements. The fear generated simply by the promise of implementing a more restrictive immigration policy has produced a new trend: ‘in the twelve months to June 2018, according to the Office of National Statistics, the number of non-EU citizens who are in the UK on a long-term basis rose by 248,000. By contrast the number of citizens from elsewhere in the EU who are in the UK on a long-term basis, rose by only 74,000’ (Butcher and Schraer 2018). The intangible element in this context is the shared values of British society that contribute to whether foreign skilled workers perceive the UK as welcoming and inclusive. The relatively higher wage premium may prove to be a necessary, but not sufficient, condition for retaining current middle managers and attracting others from outside the UK. Much will depend on the UK’s economic policy choices and its ability to maintain an open and inclusive society. Finally, based on our results, we argue that the over-emphasis on the new immigration policy aimed at crowding-in skilled workers might be rebalanced by minimising the crowding-out effect on unskilled workers ‘as a reduction of unskilled EU migration post-Brexit would, however, be disruptive in the short term for some sectors of the economy, and hurt business as a whole’ (Koch, 2016, p .2).

This would be particularly critical for example in agriculture, food manufacturing and large distribution procurement channel, sectors where the presence of EU unskilled immigrants is at least of 15% of the workforce. In this context, an integration between immigration policies and vocational training plans is better suited to respond to the needs of the British labour market, in which several sectors suffer significant mismatch and shortage of workers in frontline and operational positions. Due to the COVID-19 pandemic emergency that the UK (and much of the world) is facing since March 2020, those are also the sectors that are already experiencing a higher and unexpected tension in workforce shortage. This tension is the result of a combination of two phenomena: first, the increasing demand of mainly unskilled workforce in the food chain mainly through large distribution due to the imposed closing down of restaurants; second, the departure of hundreds of thousands of EU immigrants particularly concerned with the early and minimizing response of the British government to the health emergency. In such a context, the COVID-19 pandemic has already highlighted the importance of (EU) unskilled workers in maintaining key operations and essential supply chains. Policy makers should take advantage of this experience to define a legal framework that better responds to the needs of the British labour market.

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**Table 1. Wage for supervisors and productive employees, and supervisors to productive employees ratio**

This table reports the average monthly wage for supervisors and productive employees; the proportionate wage difference between supervisors and other employees; the ratio of supervisors to productive employees; and the total number of observations for each economy.

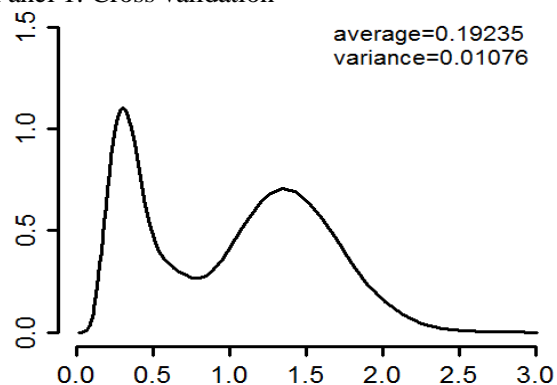
Economy	Wage (Euros)			Supervisors to Productive Employees	Observations (#)
	Supervisors	Production Employees	Difference		
Austria	2559.1	1620.0	0.580	0.653	5,146
Belgium	3213.4	2000.0	0.607	0.406	4,524
Cyprus	2284.1	1140.1	1.003	0.411	3,412
Czech Republic	826.7	513.5	0.610	0.246	7,244
Denmark	4393.0	3081.0	0.426	0.210	2,796
Estonia	655.8	415.1	0.580	0.181	4,563
Finland	3434.1	1953.0	0.758	0.311	3,716
France	2405.9	1563.8	0.538	0.499	6,796
Germany	2911.43	1601.0	0.819	0.248	9,068
Greece	2344.6	1187.2	0.975	0.189	2,818
Hungary	646.8	374.6	0.727	0.235	6,015
Iceland	3851.8	2644.3	0.457	0.952	1,329
Ireland	3626.6	1897.3	0.911	0.564	3,120
Italy	2473.6	1563.9	0.582	0.326	12,310
Latvia	578.2	329.9	0.753	0.129	3,341
Lithuania	612.2	344.4	0.778	0.207	3,969
Luxembourg	4694.6	2392.4	0.962	0.398	3,564
Netherlands	3376.9	2199.4	0.535	0.411	4,001
Norway	4119.2	2680.1	0.537	0.470	2,929
Poland	685.40	395.44	0.733	0.191	10,158
Portugal	1543.8	758.7	1.035	0.259	2,631
Slovakia	547.5	360.3	0.520	0.170	5,040
Slovenia	1427.7	1016.0	0.405	0.390	221
Spain	1895.7	1167.9	0.623	0.258	9,035
Sweden	2730.2	1858.7	0.469	0.240	3,333
UK	3477.61	1923.11	0.808	0.388	6,574



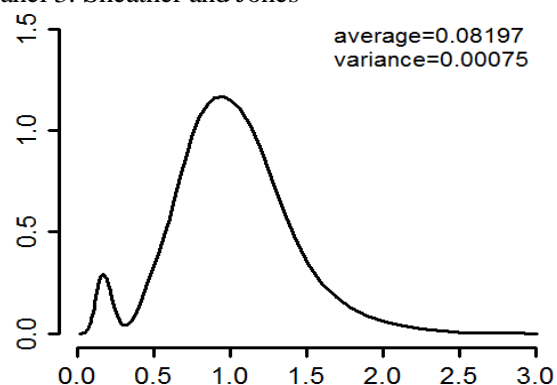
**Figure 1**

**Distributions of the bandwidth for the 26 economies under alternative selector methods**

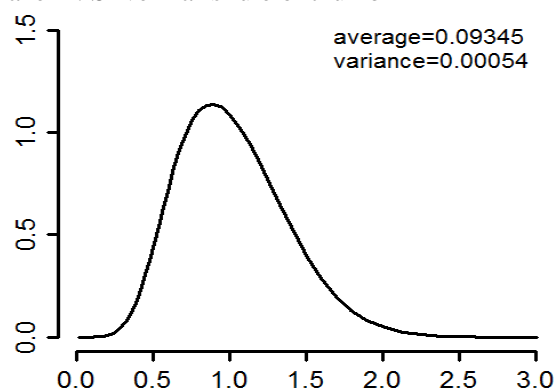
Panel 1: Cross validation



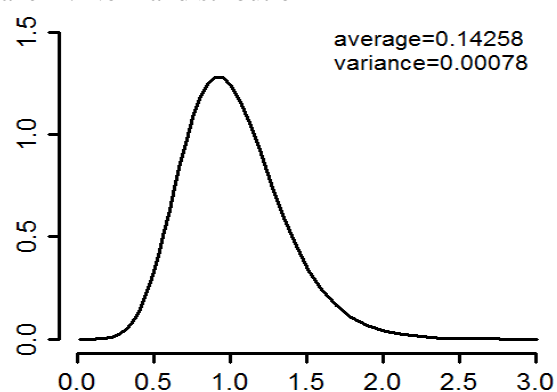
Panel 3: Sheather and Jones



Panel 2: Silverman's rule of thumb

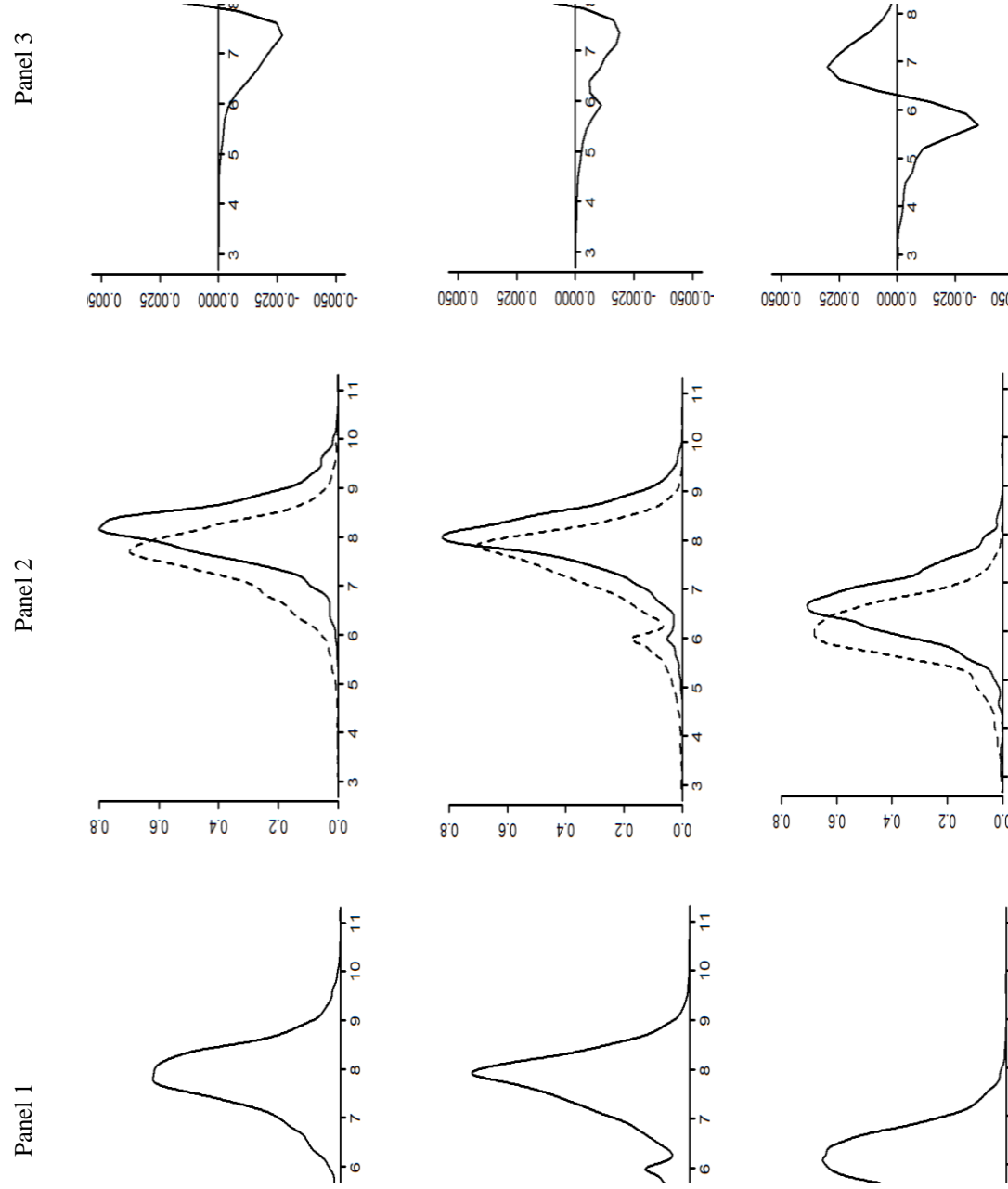


Panel 4: Normal distribution



**Figure 2. Distribution of wages (sample economies)**

; the distribution of wages in the UK, Germany, and Poland (Panel 1), the distribution of wages for the subsample ; (Panel 2, full line and dotted line, respectively), and that with smoothed differences (Panel 3).



**Table 2. Descriptive statistics (sample economies)**

This table reports information on our sample's job characteristics (% of individuals with a permanent position, and a full-time position), individual characteristics (average age, % of males, marital status, local status, educational level, skill level), and firm characteristics (% with more than 10 employees, sector of economic activity).

Variable	Economy	UK		Germany		Poland	
	Sample	Supervisors	Productive Employees	Supervisors	Productive Employees	Supervisors	Productive Employees
Job characteristics							
Permanent position		98.59	95.60	95.00	90.33	87.98	70.99
Full-time position		70.86	88.98	85.98	63.10	97.57	92.21
Individual characteristics							
Age (average)		43.78	44.31	45.14	44.73	42.75	40.73
Gender (% male)		55.09	43.56	66.16	42.29	58.15	52.83
Married		65.40	62.38	92.32	92.28	77.24	72.79
Local		96.87	96.27	98.26	97.46	99.85	99.90
Education	Primary	0.00	0.00	0.40	0.74	1.34	8.41
	Lower secondary	4.98	13.70	1.79	6.04	0.00	0.01
	Upper secondary	48.59	58.45	34.96	49.26	48.66	66.61
	Post-secondary non tert.	3.64	4.30	7.59	8.43	5.99	5.49
	Tertiary	42.79	23.55	55.27	35.52	44.01	19.48
Skills (ISCO-88)	Level 4	72.18	32.17	62.95	45.15	65.27	27.47
	Level 3	16.85	39.04	18.26	28.05	14.45	20.77
	Level 2	5.17	7.96	12.23	12.09	11.09	24.00
	Level 1	5.80	20.84	6.56	14.71	9.18	27.76
Firm characteristics							
Firm size (% > 10 employees)		86.17	82.62	83.88	80.65	67.08	60.18
Sector of economic activity							
	Agriculture and fishing	0.71	0.70	1.03	1.24	1.96	2.67
	Manufacturing, mining, electricity	14.47	15.91	26.79	20.43	26.78	29.54
	Construction	6.27	5.02	6.83	4.61	6.40	9.44
	Wholesale, retail trade, repair services	10.23	14.10	14.20	14.55	11.15	12.46
	Hotels and restaurants	2.98	2.14	2.28	1.64	2.32	1.84
	Transport, storage, and comm.	5.17	6.91	5.40	6.22	8.41	7.78
	Financial intermediation	4.86	4.72	5.63	6.13	3.72	2.15
	Real estate, renting, business act.	11.95	10.49	8.48	9.05	6.66	4.88
	Public administration and defence	12.07	10.02	6.88	8.92	12.13	7.12
	Education	11.29	13.53	4.33	6.16	10.01	11.01
	Health and social work	14.81	12.51	12.46	14.06	6.71	7.00
	Other	4.70	3.95	5.71	6.99	3.77	4.11

**Table 3. Results of auxiliary probit regressions**

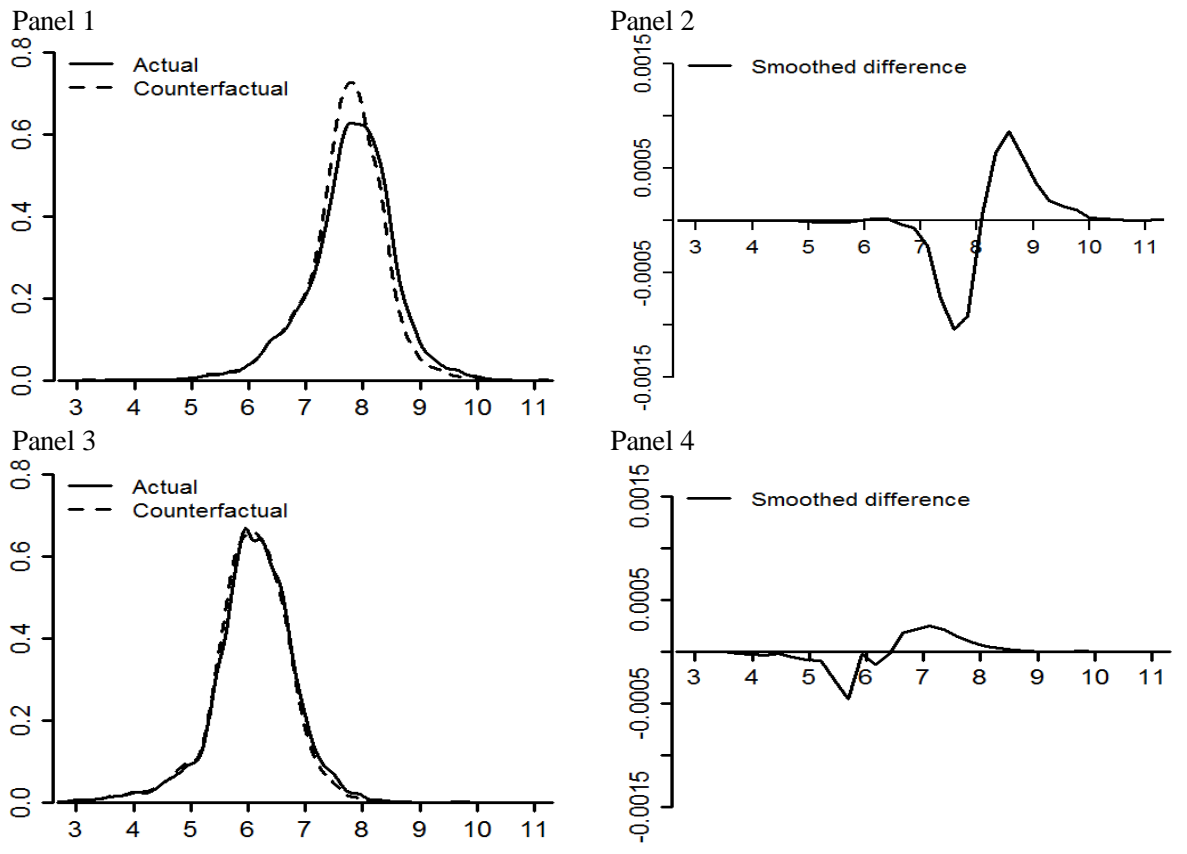
Columns (a) to (f) report results of the Likelihood Ratio tests from estimating the probit model for Poland. Column (a) reports the model where variables controlling for individual, job, and firm characteristics are included in the set of regressors. Column (b) reports results where the (log of) wage is added to the latter. Column (c) reports results where the set of variables ISCO is added to the set of regressors instead of the (log of) wage. Column (d) reports results where both the former and the latter are included in the set of regressors. Columns (e) and (f) respectively report results estimating the models in (b) and (d) and instrumenting the (log of) wages using the variable health. Columns (g) to (n) report the respective specifications for the UK. Robust  $p$  values are reported in brackets.

Chi-square statistic for joint exclusion of the characteristics of:	Sample Model	Poland						United Kingdom					
		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(l)	(m)	(n)
i. The individual (gender, marital status, national, EU citizenship, education, exp, exp2, exp3, exp4)		723.58 (0.000)	298.77 (0.000)	277.58 (0.000)	122.25 (0.000)	34.5 (0.000)	21.8 (0.000)	391.82 (0.000)	84.37 (0.000)	93.32 (0.000)	31.24 (0.002)	59.25 (0.000)	27.29 (0.000)
ii. The job (part/full time, temp/perm)		132.76 (0.000)	22.12 (0.000)	83.53 (0.000)	17.29 (0.000)	8.36 (0.015)	5.57 (0.049)	272.53 (0.000)	30.04 (0.000)	176.21 (0.000)	41.29 (0.000)	32.37 (0.000)	43.65 (0.000)
iii. The firm (4 dummies for firm size, 13 dummies for the activity sector)		163.90 (0.000)	149.24 (0.000)	201.32 (0.000)	173.63 (0.000)	129.8 (0.000)	25.85 (0.000)	89.39 (0.000)	151.33 (0.000)	114.69 (0.000)	146.71 (0.000)	66.44 (0.000)	61.36 (0.000)
iv. (Log of) Wage			311.18 (0.000)		183.37 (0.000)				570.35 (0.000)		224.04 (0.000)		
v. The skills (26 dummies for the skills associated with the type of occupation)				467.54 (0.000)	339.73 (0.000)		574.6 (0.000)			647.72 (0.000)	301.41 (0.000)		926.3 (0.000)
iv'. (Log of) Wage - instrumented with health						3.610 (0.089)	0.669 (0.894)					3.980 (0.075)	0.500 (0.616)
Pseudo-R <sup>2</sup>		0.109	0.142	0.158	0.177			0.089	0.153	0.162	0.187		
Correct prediction rate		0.719	0.730	0.736	0.742	0.820	0.844	0.581	0.618	0.625	0.638	0.686	0.715
H <sub>0</sub> : (Log of) Wage is exogenous ( $\chi^2$ -stat)						0.010	0.260					1.990	3.730

Pseudo-R<sup>2</sup> is the McFadden R<sup>2</sup> adjusted for the number of coefficients estimated except the intercept.

**Figure 3. The counterfactual distribution of wages for the UK and Poland**

This figure reports the actual and counterfactual distributions of wages with smoothed differences for the UK and Poland.



**Table 4. Test for significance of the wage premium for supervision across 26 EU economies**

This table reports the Kolgomorov and Smirnov (KS) statistics for equality of actual and counterfactual distributions.  $p$ -values are reported in brackets.

Country	KS statistic	Country	KS statistic	Country	KS statistic	Country	KS statistic
Austria	0.059 (0.030)	France	0.081 (0.000)	Latvia	0.120 (0.000)	Slovakia	0.044 (0.192)
Belgium	0.029 (0.687)	Germany	0.063 (0.018)	Lithuania	0.043 (0.210)	Slovenia	0.092 (0.000)
Cyprus	0.122 (0.000)	Greece	0.104 (0.000)	Luxembourg	0.083 (0.001)	Spain	0.050 (0.100)
Czech Republic	0.063 (0.018)	Hungary	0.054 (0.059)	Netherlands	0.048 (0.121)	Sweden	0.039 (0.316)
Denmark	0.115 (0.000)	Iceland	0.134 (0.000)	Norway	0.054 (0.059)	UK	0.083 (0.000)
Estonia	0.152 (0.000)	Ireland	0.068 (0.016)	Poland	0.133 (0.000)		
Finland	0.093 (0.000)	Italy	0.081 (0.001)	Portugal	0.063 (0.02)		

**Table 5. The wage premium for supervision across 26 EU economies**

This table reports the wage premium for supervision at the mean and at deciles of the distribution of wages.

Economy	Average WPS	WPS at deciles								
		10	20	30	40	50	60	70	80	90
Austria	0.181	0.168	0.182	0.158	0.151	0.155	0.169	0.177	0.197	0.233
Belgium	0.137	0.127	0.100	0.100	0.097	0.101	0.110	0.125	0.147	0.194
Cyprus	0.202	0.313	0.182	0.168	0.162	0.168	0.175	0.188	0.213	0.267
Czech Republic	0.094	0.060	0.063	0.070	0.072	0.073	0.077	0.084	0.106	0.138
Denmark	0.075	0.058	0.048	0.046	0.047	0.052	0.060	0.068	0.082	0.116
Estonia	0.070	0.034	0.045	0.053	0.058	0.062	0.065	0.075	0.090	0.121
Finland	0.134	0.137	0.088	0.071	0.070	0.082	0.101	0.130	0.170	0.210
France	0.143	0.157	0.114	0.093	0.093	0.102	0.112	0.126	0.178	0.190
Germany	0.149	0.208	0.179	0.144	0.138	0.127	0.113	0.111	0.123	0.153
Greece	0.108	0.093	0.068	0.065	0.078	0.106	0.106	0.106	0.114	0.158
Hungary	0.104	0.070	0.043	0.065	0.077	0.086	0.088	0.098	0.125	0.167
Iceland	0.183	0.178	0.185	0.164	0.152	0.151	0.157	0.171	0.187	0.232
Ireland	0.234	0.243	0.273	0.210	0.198	0.196	0.195	0.218	0.241	0.247
Italy	0.113	0.103	0.096	0.076	0.073	0.078	0.087	0.098	0.113	0.159
Latvia	0.064	0.032	0.041	0.047	0.051	0.061	0.059	0.059	0.064	0.100
Lithuania	0.099	0.039	0.059	0.073	0.088	0.101	0.103	0.104	0.117	0.154
Luxembourg	0.192	0.178	0.101	0.117	0.172	0.206	0.212	0.218	0.224	0.254
Netherlands	0.125	0.099	0.125	0.116	0.104	0.099	0.104	0.115	0.120	0.146
Norway	0.137	0.161	0.135	0.126	0.101	0.093	0.095	0.106	0.122	0.167
Poland	0.109	0.094	0.067	0.072	0.084	0.094	0.105	0.112	0.120	0.157
Portugal	0.146	0.060	0.053	0.071	0.079	0.101	0.134	0.180	0.246	0.330
Slovakia	0.061	0.031	0.048	0.038	0.037	0.049	0.051	0.053	0.074	0.098
Slovenia	0.095	0.076	0.066	0.061	0.061	0.065	0.071	0.076	0.091	0.078
Spain	0.075	0.060	0.059	0.053	0.047	0.048	0.053	0.063	0.078	0.121
Sweden	0.075	0.060	0.059	0.053	0.047	0.048	0.053	0.063	0.078	0.121
UK	0.232	0.236	0.246	0.215	0.199	0.204	0.220	0.231	0.233	0.251

**Table 6. Comparison with alternative bandwidth selectors**

This table reports the differences in the estimated premium between the average bandwidth under Silverman's (1986) rule of thumb and other bandwidth selectors at the average and at deciles.

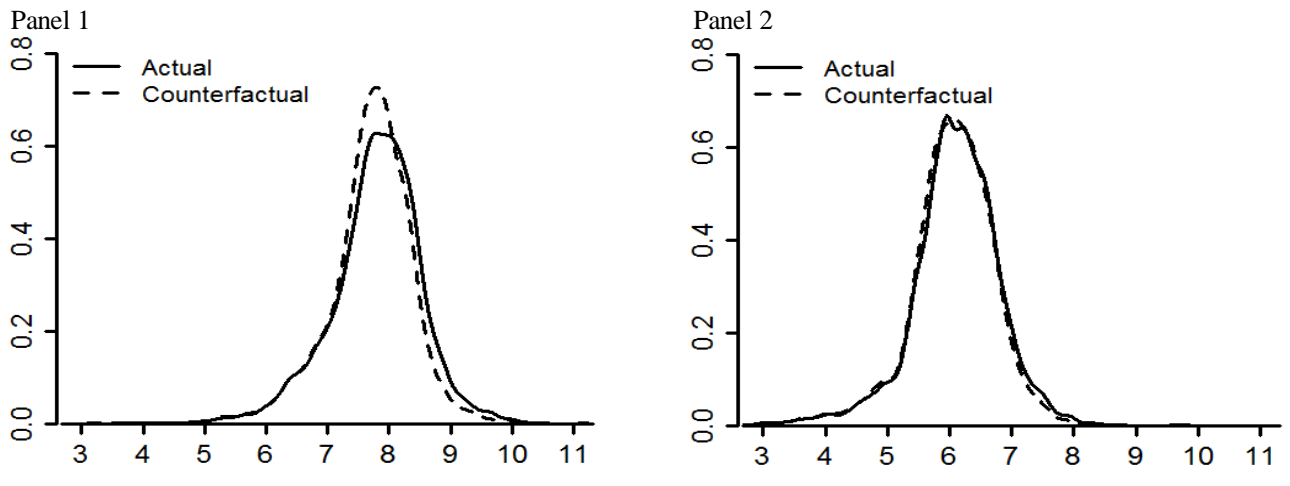
Economy	Difference in the average WPS	Differences in the WPS at deciles of the distribuion of wages								
		10	20	30	40	50	60	70	80	90
Difference from average: Sheather and Jones' (1992) plug in method										
Poland	0.000	-0.010	-0.005	-0.012	0.011	-0.002	0.008	-0.008	0.011	-0.006
UK	0.000	0.003	0.017	0.004	0.003	0.002	-0.004	-0.005	0.003	-0.004
Slovakia <sup>1</sup>	0.000	0.059	-0.044	0.085	0.032	-0.021	0.004	0.011	-0.013	-0.005
Slovenia <sup>2,3</sup>	0.000	0.022	0.022	-0.050	-0.214	0.116	-0.003	-0.004	-0.035	0.049
Italy <sup>3</sup>	0.000	-0.002	-0.008	0.020	0.005	0.004	0.004	0.002	0.006	-0.001
Difference from average: normality assumption										
Poland	0.000	0.015	-0.011	0.041	-0.025	-0.011	-0.016	0.018	-0.033	0.021
UK	0.001	0.012	-0.097	-0.023	-0.015	-0.006	0.017	0.018	-0.011	0.012
Czech Republic <sup>1</sup>	0.004	-0.022	-0.004	0.014	-0.004	-0.023	-0.025	-0.024	0.016	0.013
Slovenia <sup>2,3</sup>	0.000	0.039	-0.032	0.191	1.529	-0.407	-0.011	0.074	0.110	-0.233
Italy <sup>3</sup>	0.036	-0.030	-0.031	-0.084	-0.008	0.017	0.016	0.011	-0.003	0.025
Difference from average: cross-validation method										
Poland	0.000	0.012	-0.033	0.066	-0.034	-0.031	-0.024	0.019	-0.053	0.032
UK	0.002	-0.005	-0.210	-0.057	-0.034	-0.008	0.034	0.034	-0.015	0.023
Norway <sup>1</sup>	0.000	0.042	-0.033	-0.075	-0.113	-0.100	-0.085	-0.043	-0.026	0.075
Portugal <sup>2</sup>	0.000	-0.165	-0.099	-0.085	-0.050	0.017	0.047	0.010	0.122	-2.422
Slovenia <sup>3</sup>	0.206	1.708	3.016	4.593	15.942	-2.990	-0.445	0.081	0.283	0.794
Italy <sup>3</sup>	0.035	-0.032	-0.032	-0.139	-0.064	-0.031	-0.020	-0.014	-0.023	0.033

Notes: <sup>1</sup>Slovakia, Czech Republic, and Norway have the lowest bandwidths under the Sheather and Jones (1992) approach, the assumption of normality, and the cross-validation method, respectively. <sup>2</sup>Slovenia has the highest bandwidth under the Sheather and Jones (1992) approach and the normality assumption; Portugal has the highest bandwidth under the cross-validation method. <sup>3</sup>Slovenia and Italy have the lowest and the highest numbers of observations, respectively.



**Figure 4. Counterfactual distribution of wages - Poland**

This figure reports the actual and counterfactual distribution of wages in Poland under the assumption that all Polish workers were working in the UK (Panel 1) and that all Polish supervisors were working in the UK (Panel 2).



**Table 7. Counterfactual WPS**

This table reports the wage premium to supervision (WPS) measured at the mean and at deciles of the distribution of wages. The WPS values are calculated with respect to the British case. These premiums are computed on the basis of the assumption that workers of these nationalities were all in employment in the UK, and that there were no British supervisors.

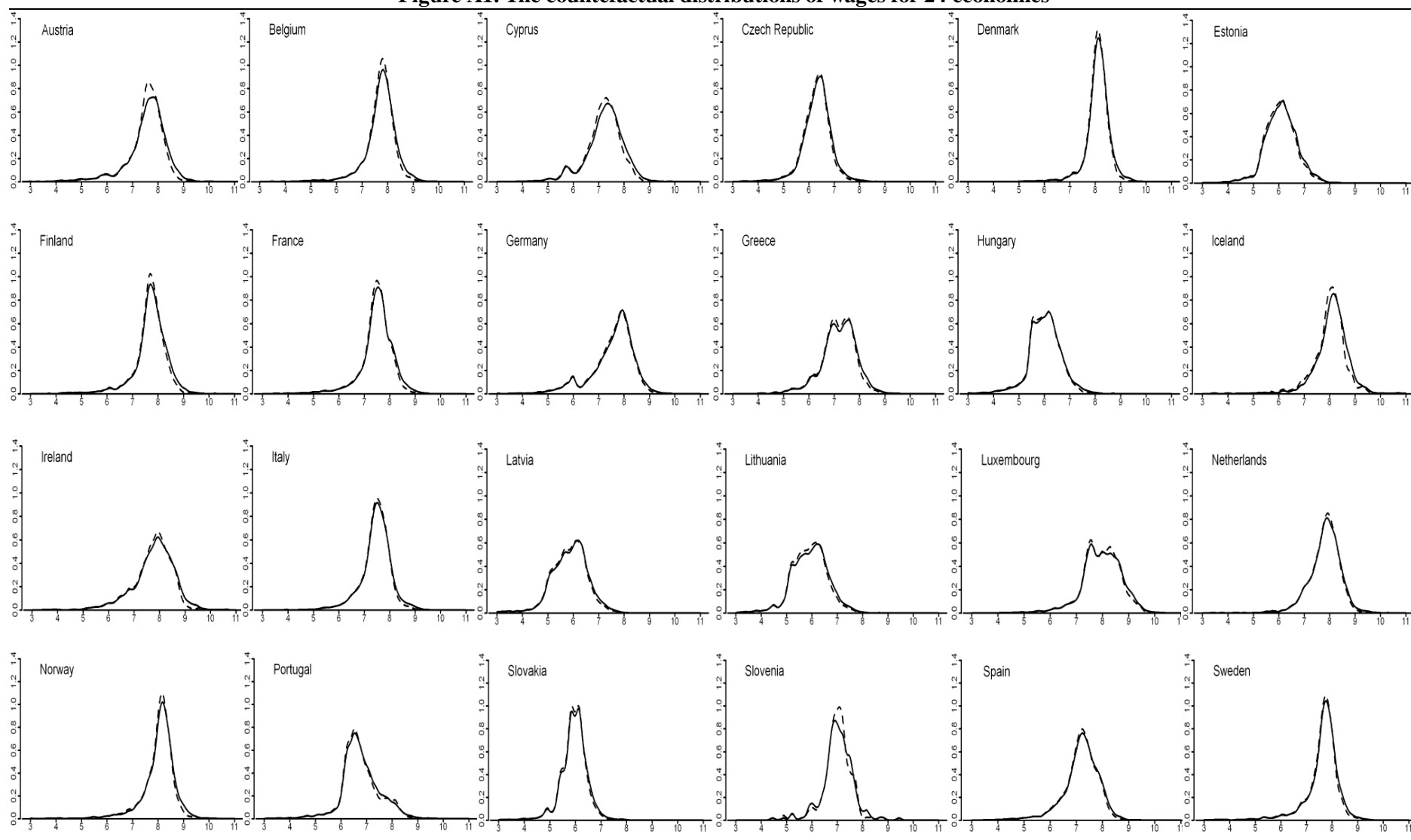
Economy	Counterfactual average WPS	Counterfactual WPS at deciles								
		10	20	30	40	50	60	70	80	90
Austria	0.208	0.207	0.215	0.186	0.175	0.180	0.193	0.208	0.227	0.239
Belgium	0.191	0.195	0.173	0.153	0.144	0.149	0.164	0.185	0.209	0.244
Cyprus	0.236	0.218	0.217	0.216	0.213	0.212	0.220	0.242	0.256	0.253
Czech Republic	0.245	0.106	0.125	0.137	0.165	0.249	0.430	0.380	0.311	0.296
Denmark	0.159	0.194	0.172	0.142	0.131	0.126	0.122	0.128	0.140	0.185
Estonia	0.284	0.119	0.168	0.217	0.321	0.468	0.394	0.306	0.302	0.285
Finland	0.195	0.202	0.182	0.145	0.133	0.145	0.171	0.200	0.224	0.242
France	0.190	0.196	0.164	0.136	0.139	0.149	0.166	0.207	0.222	0.237
Germany	0.191	0.276	0.209	0.182	0.170	0.160	0.156	0.162	0.177	0.201
Greece	0.226	0.178	0.179	0.221	0.214	0.205	0.215	0.242	0.263	0.260
Hungary	0.282	0.081	0.154	0.194	0.252	0.409	0.509	0.345	0.305	0.290
Iceland	0.231	0.241	0.240	0.214	0.204	0.211	0.219	0.223	0.222	0.250
Ireland	0.231	0.238	0.254	0.212	0.197	0.201	0.211	0.225	0.232	0.251
Italy	0.162	0.142	0.133	0.109	0.110	0.120	0.135	0.156	0.193	0.267
Latvia	0.322	0.179	0.256	0.291	0.498	0.503	0.351	0.301	0.298	0.280
Lithuania	0.301	0.156	0.241	0.272	0.404	0.486	0.350	0.291	0.290	0.275
Luxembourg	0.209	0.216	0.182	0.161	0.171	0.199	0.212	0.220	0.216	0.239
Netherlands	0.185	0.180	0.185	0.169	0.157	0.156	0.165	0.177	0.183	0.207
Norway	0.195	0.221	0.205	0.181	0.176	0.178	0.168	0.162	0.167	0.205
Poland	0.257	0.112	0.126	0.162	0.197	0.245	0.367	0.451	0.328	0.309
Portugal	0.255	0.124	0.192	0.285	0.324	0.290	0.258	0.261	0.263	0.258
Slovakia	0.293	0.123	0.111	0.157	0.257	0.565	0.527	0.338	0.311	0.292
Slovenia	0.224	0.212	0.230	0.207	0.194	0.197	0.216	0.229	0.232	0.248
Spain	0.191	0.165	0.152	0.144	0.149	0.168	0.189	0.203	0.218	0.252
Sweden	0.180	0.175	0.172	0.144	0.126	0.130	0.147	0.173	0.207	0.231

**Table 8. Contextual impact on the WPS**

This table reports the impact of context on wage premium to supervision (WPS) at the mean and at deciles of the distribution of wages.

Economy	Average impact of the context	Impact of context at deciles								
		10	20	30	40	50	60	70	80	90
Austria	0.027	0.039	0.034	0.028	0.024	0.025	0.024	0.031	0.029	0.006
Belgium	0.054	0.068	0.073	0.053	0.047	0.048	0.054	0.060	0.063	0.050
Cyprus	0.033	-0.095	0.035	0.048	0.051	0.044	0.046	0.054	0.042	-0.015
Czech Republic	0.151	0.046	0.062	0.067	0.093	0.176	0.353	0.296	0.205	0.158
Denmark	0.085	0.136	0.124	0.096	0.084	0.073	0.062	0.060	0.058	0.069
Estonia	0.214	0.085	0.123	0.163	0.263	0.406	0.329	0.231	0.212	0.164
Finland	0.061	0.065	0.094	0.074	0.063	0.064	0.070	0.070	0.054	0.033
France	0.047	0.038	0.050	0.043	0.046	0.047	0.054	0.080	0.044	0.047
Germany	0.043	0.068	0.030	0.038	0.032	0.032	0.042	0.051	0.055	0.048
Greece	0.118	0.086	0.111	0.156	0.136	0.099	0.109	0.136	0.148	0.102
Hungary	0.178	0.011	0.111	0.129	0.174	0.322	0.421	0.246	0.180	0.123
Iceland	0.047	0.063	0.056	0.050	0.051	0.060	0.062	0.052	0.035	0.018
Ireland	-0.003	-0.004	-0.020	0.002	-0.001	0.005	0.017	0.007	-0.009	0.005
Italy	0.050	0.038	0.037	0.033	0.037	0.042	0.048	0.058	0.081	0.108
Latvia	0.258	0.147	0.216	0.245	0.447	0.442	0.292	0.243	0.234	0.181
Lithuania	0.202	0.117	0.182	0.198	0.316	0.385	0.248	0.187	0.173	0.121
Luxembourg	0.017	0.037	0.081	0.043	-0.001	-0.007	0.000	0.002	-0.008	-0.015
Netherlands	0.060	0.081	0.060	0.053	0.053	0.057	0.061	0.063	0.062	0.060
Norway	0.057	0.060	0.071	0.055	0.075	0.086	0.073	0.056	0.045	0.039
Poland	0.148	0.018	0.060	0.090	0.113	0.151	0.262	0.339	0.208	0.152
Portugal	0.109	0.064	0.138	0.215	0.244	0.189	0.124	0.081	0.017	-0.073
Slovakia	0.232	0.092	0.063	0.120	0.220	0.516	0.476	0.285	0.237	0.194
Slovenia	0.128	0.136	0.164	0.146	0.133	0.133	0.145	0.153	0.141	0.169
Spain	0.117	0.105	0.092	0.091	0.102	0.120	0.136	0.140	0.140	0.130
Sweden	0.106	0.116	0.113	0.091	0.079	0.082	0.094	0.110	0.129	0.109

**Figure A1. The countefactual distributions of wages for 24 economies**



**Figure A2. The smoothed differences between distributions of wages for 24 economies**

