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Exploring changes in the employment structure and wage inequality in Western Europe using the unconditional quantile regression

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Abstract The aim of this paper is to explore how shifts in employment structure affect earnings dynamics and wage inequality throughout the wage distribution in four European countries (France, Germany, Italy, and the United Kingdom). Through UQR on the EU-SILC data, the analysis achieves two purposes: (1) understanding the primary forces of the wage and wage inequality generating process; (2) evaluating the changes over time in the marginal quantile of wage distribution and the changes in inequality at different points of the distribution. The results highlight the role of the occupational patterns in wage dynamics. France and Germany show decreasing patterns of wage inequality, despite having opposite changes in wages. Their respective well-defined structures (upgrading of occupations and job polarisation) have an equalising effect on the wage distribution. The United Kingdom and Italy show increasing patterns of wage inequality although maintaining opposite changes in wages. While the relative upgrading in the United Kingdom has only slowed inequality growth, the more hybrid pattern of Italian employment structure has contributed to raise the overall inequality.

Keywords Wage inequality · RIF-regression · Unconditional quantile regression · Decomposition

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1 Background and introduction

The ongoing global crisis and the rising headwinds to growth and occupation have wiped out years of economic, financial and social progress for the entire world economy (ILO 2014). With the real GDP falling by 4% in 2009, industrial production dropped back to the levels of the 1990s, and there was a heavy price paid in terms of losses of jobs (Blanchard 2003), skills (Greenstone and Looney 2011), working hours and earnings (Eurofound 2012; De Beer 2012) in most EU Member States (European Commission 2013). Youth unemployment was 21.8%, and the total jobless rate was the highest since records began (Eurostat 2013).

The crisis is likely to leave deep traces on the economic performance of each country even though its impact on employment, income distribution and inequality (Tóth 2014) varies considerably by country, and within the same country, workers with varying levels of skills suffer with different intensity (Eurofound 2015). Many researchers have inspected the evolution over time and space of income inequality and how it plays out in alternative institutional contexts (Alesina and Rodrik 1994; Piketty 2003; Abel and Deitz 2012; Tóth 2014). Since the 1970s and after a lengthy period of stability, inequality in the United States has significantly grown along the entire income distribution (Juhn et al. 1993; DiNardo et al. 1996; Piketty and Saez 2003) giving rise to what Noah (2013) defines as the Great Divergence. Similar trends also appear in Europe as a whole. However, it is necessary to make specific evaluations for each country because the general growth of inequality has characterised the European States to different extents, timings, and intensities (Acemoglu 2002). Many drivers may be contributing to this trend in income inequality, which is particularly affected by the earnings from work (OECD 2015), and reflects the position of individuals in the labour market, their skills and opportunities, and the returns that they receive (Tóth 2014).

Despite the general feeling that inequalities are at a historic high either as a consequence of the recession or as the prime reason for the slow recovery (Stiglitz 2013), income inequality has increased markedly since the mid-1980s (European Parliament 2015; Krugman 2013) and has involved even the most egalitarian countries of Northern Europe (Blomgren and Kangas 2014; Fritzell et al. 2014; OECD 2011a; Tóth 2014). In this respect, at least three of the five headline goals of the Europe 2020 strategy for smart, sustainable and inclusive growth—employment rate (75% for 20- to 64-year-olds), education (reducing rates of early school leaving below 10% and increasing at least 40% of 30- to 34-year-olds completing third level) and poverty (lifting 20 million people out of poverty)—relate directly to employment, productivity and inequality, with a focus on the target of "new skills for new jobs" taking the idea of "more and better jobs" from the earlier Lisbon agenda.

Globalisation, institutional changes (Fortin and Lemieux 1997; Freeman 2008; Lemieux 2008), technological advances and their skills-biased effects on labour demand (Goldin and Katz 2008) are the primary forces behind the increase of income inequality and the reshaping of occupational structures (Autor et al. 1998;

Acemoglu 2002; Acemoglu and Autor 2011; Eurofound 2014; Hurley et al. 2015; Zago 2015). Therefore, changes in income inequality may be contextualised as structural changes in employment composition, which give rise to alternative patterns of countries' labour markets in terms of job polarisation, upgrading or downgrading of occupations. A common trait is the decline in jobs requiring middle levels of competences, which are the most affected by the shrinking of jobs opportunities (Spitz-Oener 2006; Goos et al. 2009; Acemoglu and Autor 2011; Fernández-Macías 2012; Castellano et al. 2017; Garofalo et al. 2017). More precisely, job polarisation consists of a relative expansion in the demand of jobs occupying the top and bottom of the skills hierarchy and shrinking of the jobs in the middle (Autor 2003; Goos and Manning 2007). The upgrading of occupations favours high-qualified activities, i.e., those that increase the share of employment with respect to low-and middle-skill jobs (Autor 2010). More rarely, low-skill jobs grow faster than the rest, leading to downgrading of occupations (Hurley et al. 2015).

Our research hypothesis aims to link the structural occupational shifts that have occurred in four countries of Western Europe (France, Germany, Italy, and the United Kingdom) to the changes in their wage distribution and inequality between 2005 and 2013. The choice of this time frame allows one to obtain clues about the socio-economic scenario that foreshadowed the global crisis, whose effects continue to be felt, and their role in affecting the structure of the country's labour markets and patterns of wage inequality. More precisely, by ranking jobs according to skill level (low, middle-, and high-skill jobs), we explore first the type and direction (i.e., which jobs rose and which shrunk within each sub-group) of structural occupational changes, and then, we try to relate these shifts to the changes in wage distribution and inequality. For this purpose, in the realm of recentered influence function (RIF) models, the unconditional quantile regression (UQR) (Firpo et al. 2007, 2009; Fortin et al. 2011) enables us to understand the main wage determinants as well as the changes in their impact along the entire distribution. In fact, in addition to the within-group effect, UQR captures the between-group heterogeneity linked to the different sub-categories of employees based on their relative location along the wage distribution. This two-stage procedure also permits splitting the temporal changes in wage and wage inequality into composition and wage structure effects. The former captures the differences in wage (and wage inequality) due to the employees' endowments; the latter explains why different groups of employees are rewarded differently for the same individual endowments. A residual part of the decomposition (interaction) considers the leverage produced by both effects simultaneously.

The paper is organised as follows. Section 2 presents an extensive comparative analysis based on the EU-SILC data with a focus on the shifts in the structure of occupations in the most representative wage quantiles. Section 3 addresses the methodological issues of UQR and Sect. 4 shows the data source and variables. The leading determinants of individual earnings and wage inequality at several points of the corresponding distributions are argued in Sect. 5. Discussions and policy recommendations are drawn in light of the main country's labour-market characteristics in Sect. 6. Concluding remarks are presented in Sect. 7.

2 Exploring the changes in the employment structure

This section describes how the structure of employment changed in France, Germany, Italy, and the United Kingdom between 2005 and 2013 and explores how these shifts produced varying patterns in the labour market at the country level. For this purpose we use data from the European Union-Survey on Income and Living Conditions (EU-SILC, see Sect. 4).

The analysis focuses on employees (i.e., anyone who works for a public or private employer and receives compensation in the form of wage, salary, fee, payment by result or in kind), aged 16–64, irrespective of their activity sector, excluding those employed by military occupations. Someone who is working in a parent's firm and receives a regular wage is classified as an employee, and in the case of multiple jobs, any worker who allocates the greatest number of hours usually worked in the wage-employment category is considered employee. In many countries, inequality starts in the labour market, and changes in the distribution of wages are the key factors behind recent inequality trends (ILO 2015). Excluding the self-employed can be misleading because it may hide the duality of the labour market and the differences in the inequality levels (Parker 2004). Nevertheless, the adverse effects of income under-reporting (i.e., the practice of declaring lower earnings than actually received, usually for income tax purposes), which affects the self-employed more than employees for institutional reasons (Rees and Shah 1986; Bettio and Verashchagina 2009; Hurst et al. 2014), the great diversity in personal characteristics and labour-market settings between employees and the self-employed, and not least, the high heterogeneity of self-employment (Parker 2004; Castellano and Punzo 2013), made us decide to restrict the analysis to employees (Castellano and Punzo 2016).

In each country, the three groups of workers (high-, middle-and low-skilled), are defined according to the level of expertise required to perform their specific job. Borrowing the Eurostat classification, the average level of education is selected as a measure of skills required. The potential distortion due to the presence of skill-mismatched workers (Sicherman 1991; Hartog 2000; Chevalier 2003; OECD 2011a) is of negligible interest with respect to the objective given the strong correlation between the current average levels of education and skills required to perform the job (Eurostat 2010) and the equally high correlation between the mean education level and the minimum skill requirements (Ashton and Green 1996; OECD 2001).[1] More specifically, jobs are defined according to the International Standard Classification of Occupations (ISCO-08) and are rank-ordered in line with the mean level of education in the three broad categories of high-, middle-, and low-skill jobs. Eurostat (2010) demonstrated the reliability and accuracy of this grouping by comparing the EU-SILC and US occupational classifications, according to which minor differences in rankings exist, which might not be important for the purpose of examining changes in the employment share over time.

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[1] Autor (2003) and Autor et al. (2003) for the United States, Goos and Manning (2007) and Goos et al. (2009) for the United Kingdom classified workers in the three distinct groups of low-, middle- and high-skilled based on the average and median earnings, respectively.

Following Eurofound (2015), to evaluate the employment shifts between the starting and concluding period in greater detail in both qualitative and quantitative terms—that is, *how many* jobs and *which* occupations were modified over time— each group of high-, middle-and low-skilled workers is then defined for the main employment sub-categories (Tables 1, 2).

Figure 1 shows the percentage changes in employment shares between 2005 and 2013 for each of the three broad categories of employees by skill level in the four countries. To evaluate how differently the shifts in occupations were along the whole wage distribution, the percentage changes are also presented for the most representative quantiles (i.e., first and ninth deciles, first and third quartiles, and median). The results can be used to classify the four countries by the patterns of the labour market over time in terms of job polarisation and upgrading.

In France, the proportion of employees in high-qualification jobs increased along the wage distribution with a different intensity, mainly in the middle part, and the simultaneous shrinking of the low-and middle-skill qualifications, essentially from the median onwards, provides evidence of a labour-market structure characterised by upgrading of occupations within the selected period of time. However, at the lower quantiles of the distribution, the shares of low-and middle-skill workers remain substantially unchanged or, at least, slightly increased. As shown in Table 1, the growth in high-skill occupations is prevalent due to the increasing of technicians in each quantile, whereas corporate managers, teaching professionals, and, all the more so, professionals contribute to the upgrading mostly at the top of the wage distribution. At the bottom of the distribution, the increase in high-skill jobs is due to the increase in technicians. The decreasing trend of middle-skill activities, which is essentially due to clerks, is partly counterbalanced by the simultaneous and faster increase of managers of small enterprises at the middle and top of the wage distribution. In the sphere of low-skill activities, agricultural and machine operators are penalised the most, while other elementary occupations are constant, especially in the lower quantiles. Our results, which indicate upgrading of the occupational structure in France, partly reflect those of other studies. In particular, Acemoglu and Autor (2011), who rank occupations by wage level, classify the changes in the structure of the French labour market as an upgrading of occupations. The same Authors confirm for France one of the largest declines in middle-wage occupations in Europe, as already argued by Goos et al. (2009), in addition to a less-pronounced drop in low-paid activities in 1993–2006. Despite the rise of low-paid jobs in the pre-(1995–2006) and post-crisis periods (2008–2010) in France, Eurofound (2011) finds that growth in the top-paid jobs at the European level is mostly due to countries such as France where job destruction has been concentrated in middle-paid jobs.

In Germany, the middle-skill activities consistently decreased along the whole wage distribution; this decline, coupled with the growth at different paces in low-and high-skill activities throughout the distribution, drives the job polarisation in the German labour market. However, the increase in low-skill occupations is by far lower than the increase in high-skill jobs along the entire distribution. More precisely, professionals and technicians, on the one side, and machine operators on the other, are the sub-categories of workers that contribute most to the increasing

Table 1 Percent changes by occupation, 2005–2013, at the most representative quantiles—France and Germany. *Source*: Own elaborations on EU-SILC data

Modality	France				Germany			
	q10	q50	q90	Total	q10	q50	q90	Total
High-skill								
Corporate managers	− 43.03	78.82	25.22	19.27	− 66.63	− 22.22	− 33.95	− 26.47
Professionals	− 100.00	− 83.33	25.84	81.51	203.74	135.40	337.80	521.42
Teaching professionals	− 48.28	18.82	3.27	2.11	− 40.23	− 43.22	− 34.45	− 29.67
Technicians	113.87	219.60	56.07	44.76	96.47	238.65	136.33	114.58
Middle-skill								
Managers small enterprises	37.86	125.74	127.93	128.47	76.98	105.61	127.86	125.00
Clerks	− 26.33	− 25.79	− 32.32	− 33.63	− 37.21	− 43.36	− 46.18	− 47.19
Service workers	40.44	28.75	25.58	26.18	19.20	14.07	13.78	13.85
Low-skill								
Agricultural workers	− 59.16	− 37.52	− 37.33	− 35.87	− 42.78	− 40.85	− 34.54	− 35.13
Machine operators	− 38.94	− 46.10	− 22.86	− 23.52	147.30	98.92	56.92	57.08
Elementary occupations	29.16	12.63	14.03	14.72	− 28.13	− 29.46	− 32.22	− 32.40

job polarisation in Germany. The contraction of middle-skill jobs is primarily associated with the large decrease of clerks in the four countries involved in the analysis (Table 1). The pattern of job polarisation in Germany is quite consistent with the current literature (Goebel et al. 2010; Frick and Grabka 2008), which detects how mid-paid occupations have been decreasing in all periods since the 1990s (Fernández-Macías 2012). Acemoglu and Autor (2011) describe a polarised labour market in Germany, and novel evidence of job polarisation is also found by Senftleben-König and Wielandt (2014), even in the local labour markets. Similarly, Dustmann et al. (2009) and Spitz-Oener (2006) demonstrate that, in Germany, high-paid and high-skill occupations grew substantially over the 1980s and 1990s and that midrange jobs disappeared more quickly than those at the bottom end of labour market. Merz and Scherg (2014) find growing polarisation in Germany, especially in the decade 2001–2009, and give evidence of how the erosion of the middle class is receiving more attention in recent policy debate.

Based on the percentage changes by quantile (Fig. 1), it is evident that Italy experienced an outright deterioration in the employment structure, with a joint contraction of each of the three differently skilled categories of workers, with the exception of the high-skill jobs at the middle of the wage distribution. Indeed, in Italy, the proliferation of high-skill jobs only occurred between the first quartile and

Table 2 Percent changes by occupation, 2005–2013, at the most representative quantiles—Italy and the United Kingdom. *Source*: own elaborations on EU-SILC data

| Modality	Italy				The United Kingdom			
	q10	q50	q90	Total	q10	q50	q90	Total
High-skill								
Corporate managers	− 56.47	− 12.48	− 90.25	− 85.50	43.53	− 2.53	− 53.43	− 58.27
Professionals	− 100.00	− 99.82	− 98.85	− 92.89	− 96.54	− 39.82	41.79	90.25
Teaching professionals	− 54.71	9.67	− 49.12	− 39.12	29.75	92.47	105.94	96.82
Technicians	114.36	401.68	107.26	79.19	6.98	26.68	28.96	16.96
Middle-skill								
Managers small enterprises	− 44.28	26.77	− 8.51	− 4.03	18.72	83.18	56.09	60.79
Clerks	− 61.36	− 57.38	− 50.08	− 52.53	− 36.99	− 34.26	− 38.75	− 39.84
Service workers	− 30.76	− 30.08	− 28.06	− 29.87	1.02	0.66	1.35	2.13
Low-skill								
Agricultural workers	− 65.00	− 81.61	− 80.85	− 81.14	− 59.95	− 33.34	− 27.78	− 25.94
Machine operators	− 69.27	− 69.79	− 61.90	− 62.89	3.67	− 11.96	− 19.45	− 20.22
Elementary occupations	− 37.74	− 41.22	− 41.37	− 42.19	11.49	− 15.17	− 24.31	− 25.07
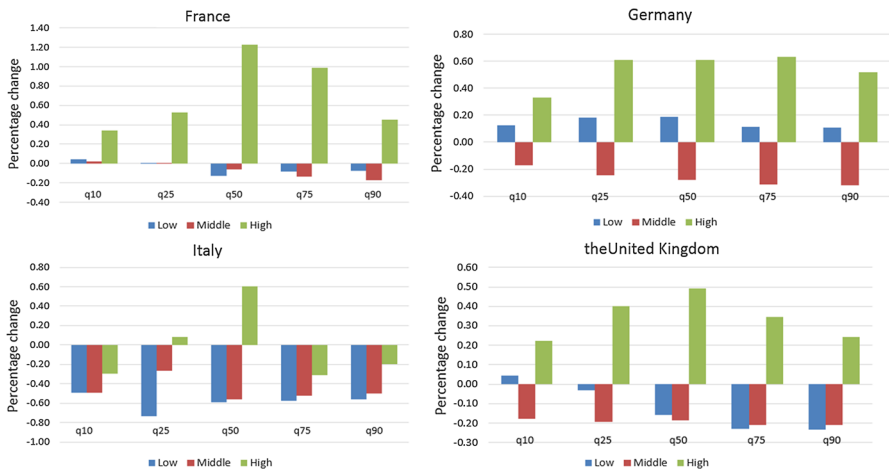
Fig. 1 Percentage changes in employment by skill levels, 2005–2013. *Source*: own elaborations on EU-SILC data

the median (due to increasing numbers of technicians and, marginally, teaching professionals), whereas more consistent decreases in both low-and middle-skill qualifications (with deeper decreases for agricultural and machine operators and clerks) occur along the entire distribution to a greater extent compared to France and the United Kingdom (Table 2). To conclude that there is a clear presence of upgrading in Italy, the number of employees in high-skill jobs would be significantly increased along the entire wage distribution and not just at the middle. Therefore, no clear conclusion can be made about the structure of the Italian labour market as a whole. In this respect, Eurofound (2011) sketches a hybrid pattern of the Italian labour market over the period 1995–2006 and downgrading over 2008–2010, which means that job destruction was greater in higher-paid jobs and lower-paid employment either grew or suffered relatively small declines. As argued by Eurofound (2014), this pattern continued into 2011–2013.

In the United Kingdom, middle-and low-skill jobs declined along the entire distribution, while middle-skill activities decreased rather uniformly throughout the quantiles, with substantial losses in the low-skill qualifications from the median onwards. However, a slight growth of low-skill activities occurred at the bottom of the wage distribution, denoting signals of polarisation of poorly paid jobs. The share of high-skilled employees consistently increased, mainly in the middle part of the wage distribution, indicating a labour market characterised by upgrading of occupations between 2005 and 2013 (Fig. 1). More precisely, teaching professionals and technicians, along the whole wage distribution, and professionals, at the top, contribute largely to the increasing high-skill qualifications. The contraction of middle-skill jobs is, once again, the result of the large decrease of clerks, while managers of small enterprises explain the middle and top of the wage distribution. All low-skill occupations decreased, except for machine operators and other elementary workers at the bottom (Table 2). In general, the UK labour market is characterised by upgrading of occupations, which seems partly in contrast with the literature that indicates the presence of job polarisation in the United Kingdom. Indeed, after research in the United States (Wright and Dwyer 2003; Autor et al. 2003), where the empirical evidence shows a gradual shift from upgrading to job polarisation (characterised by a steady hollowing out of middle-skill qualifications), studies concerning Great Britain were conducted. Despite the choice of median income (rather than the mean) as the parameter used to classify occupations in the United Kingdom, Goos and Manning (2007) obtain results that are substantially in line with those of the US market. Oesch and Rodriguez-Menés (2010) describe a slightly polarised pattern of occupational upgrading in Britain (Gallie 2004; Felstead et al. 2007), characterised by a stronger relative decline in the occupations in the middle than in those at the bottom. However, the patterns of occupation changes we outlined for Great Britain conform to the results of Oesch and Rodriguez-Menés (2010) over the years 1991–2008, who rank occupations into quintiles by median earnings, and some other studies covering different periods (OECD 2003; Eurofound 2008). The same Eurofound (2011) classifies the British labour market as hybrid polarisation/upgrading over the period 1995–2006.

A constant feature across countries is the substantial fall in jobs that have traditionally been held by middle-skill workers. This contrasts with the growth of

high-skill jobs (except for Italy, where the latter also decreased) and the stagnation or decline in low-skill jobs, except for Germany, where low-skill activities also increased even though to a lower extent than the high-skill jobs. However, the strong expansion at the top of the occupational hierarchy and the parallel collapse in the middle classify the German labour market as polarised. Large variations exist in the short-term patterns of employment shifts across the other countries, with upgrading in France and the United Kingdom, at least in the time span designated for this analysis, and a more irregular pattern in Italy.

Differences in the changes over time in the occupational structure help to explain why the tendency towards upgrading rather than job polarisation is more or less clear in the four countries and why different dynamics in the patterns of the labour market may occur in different periods of time. Some cross-national parallels may be drawn. The first one concerns the decreasing employment share of clerks, whose relative job losses are distributed quite equally across quantiles and may be considered as the most responsible for the observed decline in middle-skilled employees. The second one is related to the decreasing shares of agricultural workers across countries, which indicates the stagnation of low-skill activities. In Germany, the decline of those activities, coupled with that of other elementary occupations, is counterbalanced by the strong increase in machine operators. A third similarity is the simultaneous decrease in corporate managers, with certain exceptions (i.e., France from the median onwards), and the consistent increase in technicians along the whole distribution.

3 Methodology

One of the main goals of the present paper is to understand the leading determinants of changes in earnings and wage inequality at several points of the corresponding distributions in each country. With this aim in mind, UQR (Firpo et al. 2009; Fortin et al. 2011) on log-wage is performed. This multistage technique belongs to RIF models (Firpo et al. 2007, 2011), which allow one to estimate the impact of each explanatory variable on the distributional statistics of interest (e.g., Gini index, variance and quantile) and to decompose the variation in the wage distribution over time into the composition and the wage structure effects.

RIF regression overcomes the two main limitations of the Oaxaca–Blinder method (Blinder 1973; Oaxaca 1973). First, the estimations of wage structure and composition effects can be misleading if the linear model is unspecified (Barsky et al. 2002); second, the contribution of each covariate to the wage structure is highly sensitive to the choice of the base group (Oaxaca and Ransom 1999; Gardeazabal and Ugidos 2004). Other decomposition procedures remove these disadvantages, e.g., the Juhn et al. (1991, 1993) method based on the distribution of residuals, the DiNardo et al. (1996) technique, which generates counterfactual earnings distributions using reweighting factors, and the quantile-based decomposition by Machado and Mata (2005). However, the main shortcoming of these methods is their inability to trace the contribution provided by each covariate to the composition effect when they are used to compute the decomposition of various

distributional statistics (Firpo et al. 2007). Another aspect to consider is that the Oaxaca–Blinder method applies the decomposition only to the mean (Firpo et al. 2007), whereas RIF regression is well suited to the objective of this paper of analysing the changes of the wage distribution and inequality over time because it can obtain the decomposition for most of the distributional statistics. The *quantile* estimates the impact of changing the distribution of covariates on the marginal quantiles of the outcome variable (Firpo et al. 2009). This method is known as *unconditional quantile regression* (UQR) to distinguish it from the commonly used conditional quantile regression (Koenker and Bassett 1978; Koenker 2005). Both procedures share the ability to evaluate the impact of each covariate at different points in the wage distribution. However, one of the significant advantages of UQR is its ability to capture also the *between-group* effect, whereas the conditional quantile regression only addresses the within-group effect (where each group is represented by employees sharing the same values of covariates X, except for the explanatory variable). In brief, UQR can capture the between-group effect in addition to the within-group effect, which is linked to the contribution that each covariate has to the conditional mean of the dependent variable (log-wage, in this work) (Firpo et al. 2009). Taking into account these advantages, UQR is selected for this study.

Suppose that a sample of individuals is divided into two groups, 0 and 1. N_1 and N_0 are the number of units in each group, and the individuals are identified by the index $i = 1,…, N$. Y_{1i} is the wage of worker i of group 1, and Y_{0i} represents the wage that would be paid in group 0. An important aspect is that one can observe either Y_{1i} or Y_{0I}, but not both, because individual i is only observed in one of two groups. Consequently, the observed wage Y_i is defined as:

$$Y_i = Y_{1i} \cdot G_i + Y_{0i} \cdot (1 - G_i) \tag{1}$$

where $G_i = 1$ when worker i is observed in 2013, and $G_i = 0$ when the worker is observed in 2005.

In general, Y_i can be written without imposing a specific functional form considering the wage determination function of observed components X_i and some unobserved components ε_i:

$$Y_{gi} = f_g(X_i, \varepsilon_i), \quad for \quad g = 0, 1 \tag{2}$$

RIF regression replaces the dependent variable, Y, with the recentered influence function of the statistic of interest. Let v be the generic distributional statistic to study and IF the influence function (first-order directional derivate of v) introduced by Hampel (1974). The RIF regression is:

$$RIF(Y; v) = IF(Y; v) + v \tag{3}$$

The above expression can be written as:

$$E[RIF(Y; v)|X] = X\beta^v \tag{4}$$

where β^v represents the marginal effect of X on v.

In the specific case of the quantiles of the unconditional distribution of the outcome variable, the RIF regression equation can be rewritten as:

$$RIF(y; Q_\tau) = Q_\tau + \frac{\tau - \mathrm{II}\{y \leq Q_\tau\}}{f_y(Q_\tau)} \tag{5}$$

In this first step, the dependent variable Y is replaced by the estimated value of $\widehat{RIF}(Y_i, Q_\tau)$; the indicator variable $\mathrm{II}\{y \leq Q_\tau\}$ allows one to include employees in a specific quantile where the outcome variable is smaller or equal to Q_τ and to explain the determinants of the proportion of employees earning less than the threshold wage Q_τ.

Once the RIF regression is performed for each period ($G_i = 1; 0$), the overall wage gap over time can be measured as follows:

$$\hat{\Delta}_O^\tau = \bar{X}_1(\hat{\gamma}_{1,\tau} - \hat{\gamma}_{0,\tau}) + (\bar{X}_1 - \bar{X}_0)\hat{\gamma}_{0,\tau} = \hat{\Delta}_S^\tau + \hat{\Delta}_X^\tau \tag{6}$$

where the coefficient $\hat{\gamma}_{g,\tau}$ is obtained from the following expression:

$$\hat{\gamma}_{g,\tau} = \left(\sum_{i \in G} X_i \cdot X_i^T\right)^{-1} \sum_{i \in G} \widehat{RIF}(Y_{g,i}; Q_{g,\tau}) X_i, \quad g = 0, 1 \tag{7}$$

In this way, the overall wage gap over time is decomposed into two components: wage structure $((\hat{\Delta}_S^\tau)$ and composition effect $\left(\hat{\Delta}_X^\tau\right)$. The first term corresponds to the effect on Q_τ of a change from $f_1(\cdot, \cdot)$ to $f_0(\cdot, \cdot)$ while keeping the distribution of $(X, \varepsilon)|G = 1$ constant. Conversely, the composition effect keeps the wage structure $f_0(\cdot, \cdot)$ constant and measures the effect of changes from $(X, \varepsilon)|G = 1$ to $(X, \varepsilon)|G = 0$. However, the key term for decomposing the total wage gap is the counterfactual distributional statistic v_c (Firpo et al. 2007),[2] which represents the distributional statistic that would have prevailed if workers observed in group 1 had the wage structure of group 0.

Using the counterfactual distribution, the above mentioned components can be rewritten as:

$$\hat{\Delta}_S^\tau = \bar{X}_1\left(\hat{\gamma}_{1,\tau} - \hat{\gamma}_{0,\tau}^C\right) \quad \text{and} \quad \hat{\Delta}_X^\tau = \left(\bar{X}_0^C - \bar{X}_0\right)\hat{\gamma}_{0,\tau} \tag{8}$$

To identify the parameters of the counterfactual distributions, three weighing functions (DiNardo et al. 1996; Firpo et al. 2007) are estimated through the following normalisation procedures:

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[2] The conditions that allow one to identify the parameters of the counterfactual distribution are *ignorability*, which states that the distribution of the unobserved explanatory variables in the wage determination is the same across groups 1 and 0, and *overlapping support*, which requires that there be an overlap in observable characteristics across groups in the sense that there is no covariate that is only observed among individuals in group 1.

$$\widehat{\omega_1^*}(G_i) = \frac{\widehat{w_1}(G_i)}{\sum_{j=1}^N \widehat{w_1}(G_j)} = \frac{G_i}{N\hat{p}}; \tag{9}$$

$$\widehat{\omega_0^*}(G_i) = \frac{\widehat{w_0}(G_i)}{\sum_{j=1}^N \widehat{w_0}(G_j)} = \frac{1 - G_i}{N(1 - \hat{p})}; \tag{10}$$

$$\widehat{\omega_c^*}(G_i, X_i) = \frac{\widehat{w_c}(G_i)}{\sum_{j=1}^N \widehat{w_c}(G_j)} = \frac{(1 - G_i)\left(\frac{\hat{p}(X_i)}{1 - \hat{p}(X_i)}\right)}{\sum_{j=1}^N (1 - G_j)\left(\frac{\hat{p}(X_j)}{1 - \hat{p}(X_j)}\right)} \tag{11}$$

where $\hat{p} = N^{-1} \sum_{i=1}^N G_i$ and $\hat{p}(\cdot)$ is an estimator of the true probability of being in group 1 given X. $\widehat{\omega_1^*}(G_i)$ and $\widehat{\omega_0^*}(G_i)$ transform features of the marginal distribution of Y into features of the conditional distribution of Y_1 given $G = 1$ and of Y_0 given $G = 0$. $\widehat{\omega_c^*}(G_i, X_i)$ is a function to estimate the counterfactual distribution of Y_0 given $G = 1$.

Among the quantiles, the median $\left(q_\tau = \frac{1}{2}\right)$ is a leading example:

$$RIF(y; me) = me + \frac{\frac{1}{2} - \mathrm{II}\{y \le me\}}{f_y(me)} \tag{12}$$

The decomposition of the overall gap follows the same steps. Indeed, the gaps are computed as:

$$\hat{\Delta}_O^{me} = \bar{X}_1\left(\hat{\gamma}_{1,me} - \hat{\gamma}_{0,me}\right) + (\bar{X}_1 - \bar{X}_0)\hat{\gamma}_{0,me}$$

$$\hat{\Delta}_S^{me} = \bar{X}_1\left(\hat{\gamma}_{1,me} - \hat{\gamma}_{0,me}^C\right)$$

$$\hat{\Delta}_X^{me} = \left(\bar{X}_0^C - \bar{X}_0\right)\hat{\gamma}_{0,me} \tag{13}$$

The coefficients γ are estimated by replacing the dependent variable, Y, with the estimated value of $\widehat{RIF}(Y_i; me)$:

$$\hat{\gamma}_{g,me} = \left(\sum_{i \in G} \hat{\omega}_g(G_i)X_iX_i^T\right)^{-1} \sum_{i \in G} \hat{\omega}_g(G_i)\widehat{RIF}(Y_i; me_g)X_i \quad g = 0, 1 \tag{14}$$

$$\hat{\gamma}_{c,me} = \left(\sum_{i \in G} \hat{\omega}_C(G_i, X_i)X_iX_i^T\right)^{-1} \sum_{i \in G} \hat{\omega}_C(G_i, X_i)\widehat{RIF}(Y_i; me_C)X_i \tag{15}$$

4 Data and variables

Data are from the EU-SILC, which is currently the main European reference source for comparable socio-economic statistics at both the household and individual levels. In addition to a large set of personal socio-demographic and education information, the EU-SILC provides exhaustive and harmonised target data on employment status, type of occupation and activity sector, as well as on single-income components, taxes and contributions.

As described above, the changes in gross personal wages between 2005 and 2013 are evaluated by country using UQR. This methodology includes a preliminary step in which the marginal quantiles of log-wage are regressed on a set of individual characteristics, human capital, job background, and occupation type variables that potentially drive the observed wage at different points of the unconditional distribution. Table 3 shows more details on covariates. In addition, to perform a cross-country comparison in terms of wage inequality, the RIF regression of the Gini index on log-wage is also tested at different quantiles of the distribution on the same set of covariates.

Table 3 List of variables

Dimensions	Variables	Description
Individual characteristics	Gender	Dummy for gender (ref.: male)
	Couple	Dummy for marital status (ref.: married):
		Never married: 1 if employee has never been married and 0 otherwise
		Other married: 1 if employee has experienced marriage and 0 otherwise
	Health	Dummy for general health (ref.: suffer)
		Good health: 1 if employee do not suffer from any chronic illness and 0 otherwise
Human capital	Working experience	Number of years since starting the first regular job that a person has spent at work
	Education	Dummies for high level of education (ref.: higher levels):
		Low-and medium-level (ISCED97: from pre-primary to post-secondary non-tertiary education)
		high-level (first and second stage of tertiary education)
Job characteristics	Type of contract	Dummies for type of contract:
		Permanent job: 1 if employee has permanent contract and 0 otherwise
	Economic status	Dummies for employment status:
		Full time: 1 if employee is full time and 0 otherwise
Occupation type	Professional status	Ten dummies for professional status (ISCO classification):
		Elementary workers (ref.); Senior official; Manager of small enterprise; Professionals; Teaching professional; Technicians; Clerks; Service Workers; Skilled Agricultural; Machine Operators

The employees' wage, which is composed of cash, near cash and non-cash salaries, is specified in the gross form (i.e., the total earnings from work received during the reference period, before any deductions for tax or social insurance contribution).[3] Various forms of income are related through various national fiscal regimes, and specifying wage in the gross form enables us to compare more countries, regardless of the complexity of their tax rules. Under a different approach (e.g., using net income), the comparison among France, Germany, Italy, and the United Kingdom would not be suitable because of the different fiscal regimes (e.g., the French fiscal system is typically household-based, whereas in Italy, it is more individual-based). Wages are adjusted for inflation to guarantee their comparability over time in real terms.

The choice of personal labour earnings is motivated by interest in explaining the determinants of wage-generating (and wage inequality) processes in the individual capacity to earn income, regardless of how resources are pooled, how individuals share them within their households or how individuals participate in the decision process (Beninger and Laisney 2002). The adoption of a similar approach to labour supply behaviour—one that is consistently supported by many authors (Becker 1991; Samuelson 1956)—results from this paper's general aim to investigate personal earnings and wage inequalities in light of individuals' capacity to succeed in the labour market. This model enables us to overcome the potential problems that result from an exaggerated emphasis on the household as the basic unit of decision rather than on individual wellbeing. Additionally, labour-market earnings are the main income source for most individuals and are therefore crucial drivers of household income inequality (Fremeaux and Piketty 2014).

5 The driving forces behind the wage distribution and inequality

The quantile perspective allows us to explore on the one hand the primary forces of wage (and wage inequality) and on the other hand to evaluate how they affect the different groups of employees. For ease of presentation, the estimates from the UQR of log-wage at different quantiles by country (Tables 8, 9, 10, 11) and for Gini on log-wage from separate RIF regressions by quantile and by country (Tables 12, 13, 14, 15) are shown in Appendix. The tables show the estimated coefficients at the 10th, 50th, and 90th percentiles, along with their standard errors. After having discussed the role played by personal characteristics, human capital and job background in this Section, we discuss how the different types of occupations contribute to determine wage levels (Sect. 5.1) and wage inequality (Sect. 5.2) compared with more elementary jobs.

In general, the results show the crucial roles of gender, education and work experience in determining personal wages and inequalities and draw attention to the economic status, type of contract and type of job held as driving forces. Focusing on individual-level determinants, it is worth noting that being a man, being married and

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[3] For Italy, and exclusively for the year 2005, the gross wage was approximated using gross monthly income, considering the months during which the employee experienced paid employment.

enjoying good health play a significant role in employee earnings in nearly all the countries considered. In particular, the gender dimension is among the primary determinants of wage in each country and of wage inequality in Germany (2005) and Italy (2013), though no in France and the United Kingdom, where a different division of roles within couples and family-oriented or equal treatment policies provide women with different chances to reach leadership positions and thus better average salaries (Jenson and Sineau 2001; Lanquetin et al. 2000).

The estimates are also consistent with Mincerian models and their extensions (Mincer 1958, 1974; Becker 1962): differences in the levels of formal education and experience in the labour market affect personal earnings. In general, better education and more experience increase earnings and reduce inequalities. A major cause of earnings inequality is the lowest educated employees in each country, whereas the high-educated, who are normally also more skilled, are more oriented towards developing better careers and higher pay. Just as for formal education, work experience, which increases human capital accumulation throughout the life cycle, also increases personal earnings and lowers inequality. The negative sign of experience-squared on log-wage confirms the concavity of the earnings–experience relationship, according to which earnings tend to advance rapidly in the early years in the labour market, flatten in later years, and decline slightly thereafter.

Large wage differentials are associated with employment status and, above all, with different types of contract. Having a permanent contract and being a full-time employee are crucial to personal earnings; their effect is negatively sloped—it is smaller at the 90th than at the 10th percentile—and well-structured workers tend to increase wages for the low quantiles, where both the within-group and between-group effects are in the same direction (Firpo et al. 2009). Because part-time and temporary workers receive, on average, lower salaries with earnings trajectories that are less steep than their full-time and permanent counterparts, they contribute to increased wage inequality. Indeed, a high share of part-time and temporary employees affects the overall income distribution by increasing the weight of lower wages on the left side of the same distribution. In Germany, the rise of more precarious jobs became significant from 2003 onwards (Corneo et al. 2014) with the revisions of active labour-market policy carried out through the Hartz-reforms, which foresee, among other things, the deregulation of temporary employment and the creation of agencies to place people in work, even if it differs from their own profession, resulting in the broadening of minor occupations by means of social security exemption (Eichhorst and Marx 2011; Dlugosz et al. 2014). In Italy, the increasing share of temporary employees over time is also a potential result of deregulation undertaken since 1997 (e.g., Treu Package, Biagi Reform), which has sought to increase flexibility to new entries in the labour market but has increased the amount of fixed-term workers, primarily young people and women, with worse salaries and volatile employment. In France, the high minimum wage, which has continued to increase from 1980 to 2010, has helped decrease income inequality, while deregulation has led to the creation of a dual market with an increase in part-time work and short-term contracts. In the United Kingdom, the welfare reform "Universal Credit" has been a significant step forward in rationalising the benefit system and enhancing work incentives; nevertheless, the more flexible labour

market has dampened the impact of the weak economy on layoffs and has significantly increased involuntary part-time work (André et al. 2013). In brief, although small numbers of working hours and fixed-term contracts worsen wage inequality, differences in the levels of earnings inequality between employment contracts must be explained in light of the different institutional landscapes and labour-market trends, in terms of flexibility and insecurity of employment conditions, across countries (McCall 2000).

5.1 How does occupation affect wage levels?

For occupation types scaled according to skill level, one of the most striking findings is that all professions contribute to improving wage levels (Figs. 2, 3, 4, 5). The regression coefficients for occupation show, in general, that the returns are larger for the high-and middle-skill occupations, while they decrease, or become statistically insignificant, as one moves towards the less-skilled workers, such as agricultural workers and machine operators. In particular, for 2013, in France, Germany and Italy, the beta coefficients for teaching professionals are insignificant at the top end of the wage distribution, and for Britain, they fall steeply. Technicians show similar monotonically declining patterns, and more marked differences in the beta coefficients between 2005 and 2013 are detected for Italy and the United Kingdom, i.e., the advantage of being a technician, in terms of wage remuneration, is increased in 2013, especially in the first half of the wage distribution. German and French corporate managers have a slightly U-shaped effect on their personal wage along the distribution, with high impact at the bottom and top and lower impact in the middle (Figs. 2, 3). However, a notable difference between the two countries results from the reverse in returns between 2005 and 2013: in Germany, remunerations at the first half of the wage distribution decreased over time, while they increased in France. In Italy, after a flat beta coefficient pattern until the third quartile, the coefficient rapidly grows without significant differences over time. For the Great Britain, the reverse in returns between the 2 years is clear from the median onwards, where beta coefficients are lower for 2013.

German managers of small enterprises have similar patterns as their corporate counterparts in the first half of the wage distribution; in France, the rewards of managers of small enterprises are improved in 2013 from the first quartile onwards, though they narrow at the 95th percentile. In the United Kingdom, gaps in rewards over time are wide, similar to in France, with two important differences: they increase from the first decile and continue growing, even at the top end of the wage distribution. For Italy, the contribution of managers of small enterprises to wage-generation processes follows a flat pattern until the third quartile, and then sharply increases in 2013. Among high-skill jobs, the ability of professionals to generate earnings has increased in each country, albeit with differences along quantiles. A common feature across countries is the monotonic decreasing trend of clerks, whose beta values tend to zero as one moves to the right side of the wage distribution, indicating a larger impact on the lower than higher quantiles. The monotonicity indicates that within-and between-group effects have the same direction of decreasing wage generation compared with elementary employees. For low-skilled
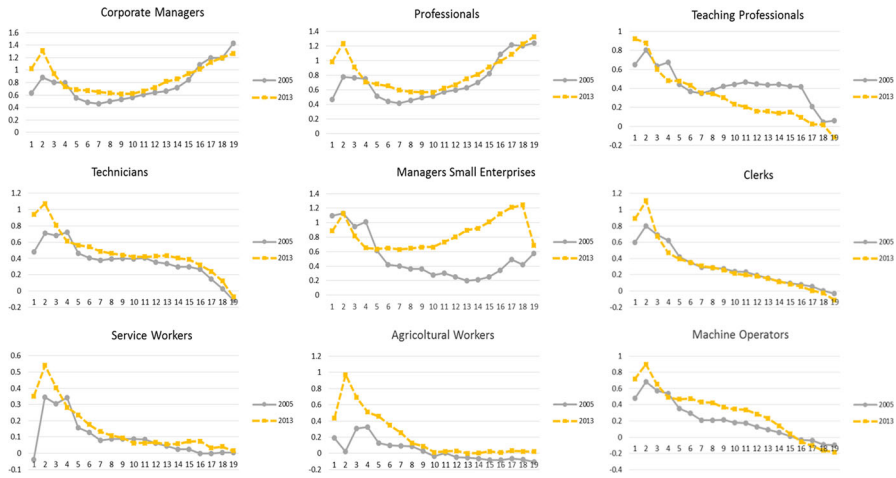
Fig. 2 UQR coefficients on log-wage along the wage distribution (x-axis: *τ-th ventile*). France, 2005–2013
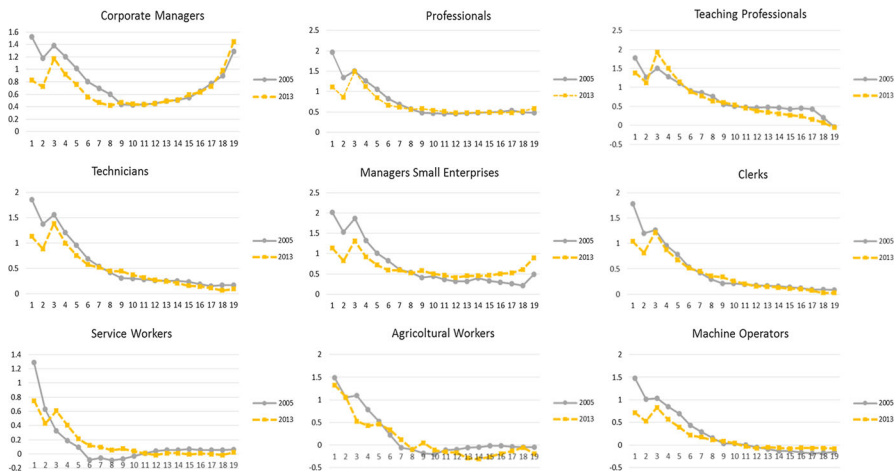
Fig. 3 UQR coefficients on log-wage along the wage distribution (x-axis: *τ-th ventile*). Germany, 2005–2013

activities, being an agricultural worker or machine operator has a stronger effect on the wage-generating process than being an elementary worker at the lower quantiles. The magnitude of the effect decreases in each country at the right side of the wage distribution, with insignificant beta values or values lower than zero at the top end. In other words, the advantage of being an agricultural worker or machine operator rather than an elementary worker becomes irrelevant as they move up the pay distribution.
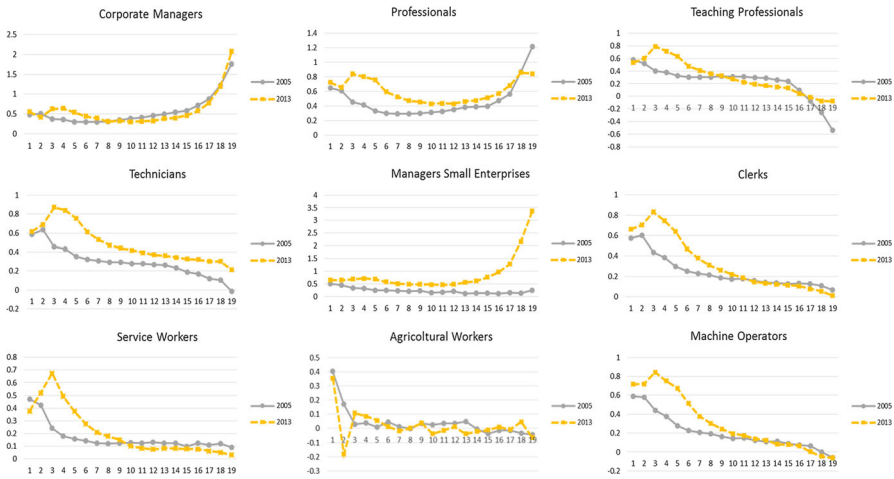
Fig. 4 UQR coefficients on log-wage along the wage distribution (x-axis: τ-*th ventile*). Italy, 2005–2013
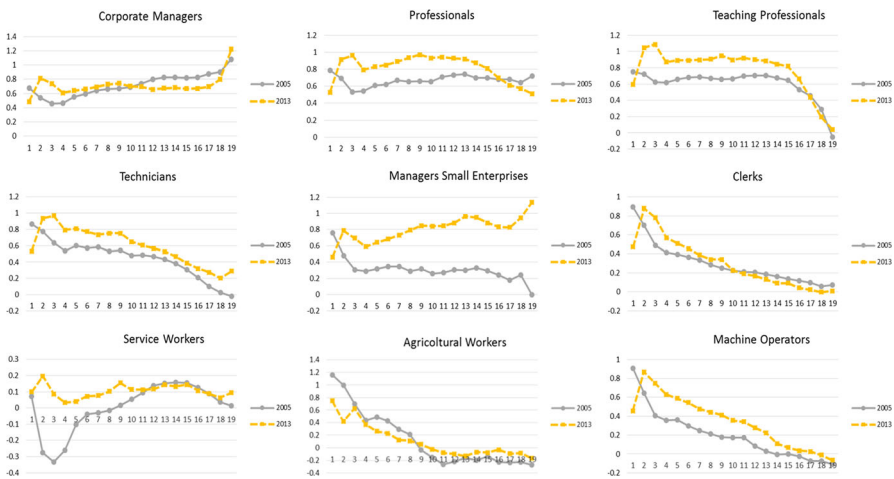
Fig. 5 UQR coefficients on log-wage along the wage distribution (x-axis: τ-*th ventile*). The United Kingdom, 2005–2013

Tables 4 and 5 show the overall differences in log-wages by country and their decomposition at most representative quantiles of distribution (10th, 50th and 90th quantile).

In France and Italy, real wages have grown between 2005 and 2013 even though with different patterns along the distributions. In both countries and along the whole distributions, the wage structure explains a higher share of the overall increase in real wages than the share due to the composition effect. In particular, for France, the growth of wages mainly occurred for the low-paid employees, which is potentially due to the relatively high minimum wage (approximately 60% of the overall full-time median wage) and the practice of protecting pay at the bottom of the labour

Table 4 UQR decomposition of log-wage. France and Germany, 2005–2013

| | France | | | | | | Germany | | | | | |
| | q10 | | q50 | | q90 | | q10 | | q50 | | q90 | |
	2013–2005	% share	2013–2005	% share	2013–2005	% share	2013–2005	% share	2013–2005	% share	2013–2005	% share
Total gap	.5364***	–	.3730***	–	.3676***	–	– .0991***	–	– .0788***	–	– .0674***	–
	(.0456)		(.0100)		(.0174)		(.0324)		(.0130)		(.0129)	
Composition effect	.2576***	48.04	.1150***	30.84	.1498***	40.76	.1062***	– 107.2	.0475***	– 60.32	– .0271***	40.32
	(.0234)		(.0060)		(.0091)		(.0148)		(.0089)		(.0067)	
Wage structure	.2389***	44.54	.2728***	73.12	.2504***	68.13	– .2048***	206.65	– .1306***	165.5	– .0682***	101.25
	(.0527)		(.0093)		(.0154)		(.0291)		(.0114)		(.0128)	
Interaction	.0398	7.42	– .0148***	– 3.96	– .0327***	8.89	– .0005	.55	.0042	– 5.43	.0280***	– 41.57
	(.0264)		(.0051)		(.0105)		(.0177)		(.0059)		(.0069)	

*Significant at 10%

**Significant at 5%

***Significant at 1%

Standard errors in brackets

Table 5 UQR decomposition of log-wage. Italy and the United Kingdom, 2005–2013

| | Italy | | | | | | The United Kingdom | | | | | |
| | q10 | | q50 | | q90 | | q10 | | q50 | | q90 | |
	2013–2005	% share	2013–2005	% share	2013–2005	% share	2013–2005	% share	2013–2005	% share	2013–2005	% share
Total gap	.0281	–	.3565***	–	.4073***	–	–.2354***	–	–.2122***	–	–.1332***	–
	(.0220)		(.0081)		(.0157)		(.0353)		(.0148)		(.0194)	
Composition effect	.0009	3.25	.0526***	14.76	.1102***	27.05	.1381***	–58.66	.0945***	–44.50	.1034***	–77.58
	(.0112)		(.0038)		(.0074)		(.0228)		(.0117)		(.0116)	
Wage structure	–.0176	–62.48	.2846***	79.83	.3010***	73.90	–.3758***	159.6	–.2545***	119.9	–.1834***	137.6
	(.0233)		(.0083)		(.0141)		(.0447)		(.0154)		(.02165)	
Interaction	.0448***	159.23	.0192***	5.41	–.0038	–.95	.0022	–.94	–.0522***	24.60	–.0532***	39.98
	(.0115)		(.0038)		(.0077)		(.0388)		(.0121)		(.0143)	

*Significant at 10%

**Significant at 5%

***Significant at 1%

Standard errors in brackets

market. In Italy, wage increases involve the bottom half of the distribution and become more stable thereafter even though the relative greatest wage growth concerns the high-paid employees.

As regards Germany, the analysis shows a small downward trend of wages in most quantiles, except for the increase in wages for the bottom 5% of employees. However, the wage gaps, which are not statistically significant in the second and third decile, tend to weaken from the bottom to the top of the distribution, denoting a stagnation of wages for the upper-middle earnings groups. The composition and wage structure effects contribute to wage gap at bottom end of the distribution in a similar way. From the first quartile onwards, wage structure has a greater influence on the downward wage variation: structural changes in the labour market play a major role in lowering wages of German workforce. In the middle part of the distribution, employees' characteristics (composition effect) counterbalance the effect of these changes in the employment structure. From around the third quartile onwards, both components have a negative sign and contribute, with unequal intensity, to the wage decrease between 2005 and 2013.

In the United Kingdom, the wage level decreased especially in the first half of the distribution. It means that wage reductions have involved low-paid employees more intensively than their high-paid counterparts. This decline in wage levels along the whole distribution is mainly due to wage structure that contrasts the possible positive action of composition effect in the wage-generating process.

5.2 How does occupation affect wage inequality?

Focusing on the contribution of the different types of jobs to wage inequality (Figs. 6, 7, 8, 9; Tables 12, 13, 14, 15), all professions contribute to improving earnings inequality compared to more elementary jobs. In Germany, although

Fig. 6 RIF-regression coefficients of Gini on log-wage along the wage distribution (x-axis: τ-*th ventile*). France, 2005–2013

Fig. 7 RIF-regression coefficients of Gini on log-wage along the wage distribution (x-axis: *τ-th ventile*). Germany, 2005–2013

Fig. 8 RIF-regression coefficients of Gini on log-wage along the wage distribution (x-axis: *τ-th ventile*). Italy, 2005–2013

managers (both corporate and small enterprises) and teaching professionals seem to aggravate existing earnings inequality at the lower quantiles in 2005, extensive wage inequality consistently affects the lowest rung of elementary occupations, likely due to the effect of Hartz reforms, which contribute to increased labour supply of low-skilled workers (Corneo et al. 2014). In France, almost all the high- and middle-skill employees improved their contribution to reducing inequality over time, except for teaching professionals in the central part of the distribution. In contrast, technicians and agricultural workers have a direct contribution to

Fig. 9 RIF-regression coefficients of Gini on log-wage along the wage distribution (x-axis: *τ-th ventile*). The United Kingdom, 2005–2013

inequality in 2013, mainly in the low-wage quantiles. Similarly, in Italy, wage inequality enhancement becomes stronger from 2005 to 2013 for the middle-skill (clerks and service workers) and low-skill employees (machine operators) and high-skill technicians, especially in the first quartile of the wage distribution. However, from the median onwards, the same activities start to reduce wage inequality. In the United Kingdom, as for Italy, some professional categories increase their impact on earnings inequality over time. It is not possible to identify a common trend across occupations within each group of low-, middle-, and high-skill, but there are specific occupations—in particular, professionals (high-skill), clerks (middle-skill) and machine operators (low-skill)—that have a direct contribution to increasing inequality in the first quartile of the wage distribution. These results are substantially in line with Wolff and Zacharias (2013), who demonstrate that the growth of income inequality between 1989 and 2000 was mostly due to the increase in inequality among occupations. This large amount of wage inequality suggests that the huge income gap between some occupational groups (e.g., the capitalist class and everyone else) is one of the main forces behind increasing inequality because of the stronger instability of unskilled workers and clerks compared to individuals in intermediate or managerial positions (Fremeaux and Piketty 2014).

Tables 6 and 7 show the decomposition of changes in the Gini index between 2005 and 2013 in the four countries covered at the most representative quantiles. The overall Gini index declined slightly in both Germany (− 8.05%) and in France (− 9.54%). In Germany, the decreasing inequality involves the entire wage distribution: the wage structure is less strong than the composition effect until the first quartile, and then the latter remains the only component with a positive contribution to improving inequality (the wage structure becomes insignificant). In France, wage inequality reduction has involved the upper half of distribution and it

Table 6 RIF decomposition of Gini log-wage by quantile. France and Germany, 2005–2013

| | France | | | | | | Germany | | | | | |
| | q10 | | q50 | | q90 | | q10 | | q50 | | q90 | |
	2013–2005	% share	2013–2005	% share	2013–2005	% share	2013–2005	% share	2013–2005	% share	2013–2005	% share
Total gap	.0029	–	–.0050***	–	–.0044***	–	–.0154***	–	–.0075***	–	–.0044***	–
	(.0030)		(.0011)		(.0007)		(.0021)		(.0009)		(.0007)	
Composition effect	–.0053**	–184.3	–.0061***	120.7	–.0046***	103.4	–.0046***	29.84	–.0052***	69.35	–.0043***	97.30
	(.0021)		(.0007)		(.0004)		(.0012)		(.0004)		(.0004)	
Wage structure	.0025	87.59	.0013	–26.57	–.0004	10.58	–.0102***	66.08	–.0024**	32.16	–.0008	19.83
	(.0040)		(.0012)		(.0007)		(.0024)		(.0009)		(.0007)	
Interaction	.0057*	196.7	–.0002	5.87	.0006	–14.01	–.0006	4.06	.0001	–1.52	.0007**	–17.13
	(.0034)		(.0009)		(.0004)		(.0017)		(.0005)		(.0003)	

*Significant at 10%

**Significant at 5%

***Significant at 1%

Standard errors in brackets

Table 7 RIF decomposition of Gini on log-wage by quantile. Italy and the United Kingdom, 2005–2013

| | Italy | | | | | | The United Kingdom | | | | | |
| | q10 | | q50 | | q90 | | q10 | | q50 | | q90 | |
	2013–2005	% share	2013–2005	% share	2013–2005	% share	2013–2005	% share	2013–2005	% share	2013–2005	% share
Total gap	.0121***	–	.0092***	–	.0076***	–	–.0051**	–	–.0025***	–	.0008	–
	(.0013)		(.0005)		(.0004)		(.0021)		(.0008)		(.0006)	
Composition effect	–.0012***	–10.67	–.0001	–1.68	.00007	1.02	–.0007	14.53	–.0026***	100.5	–.0028***	–339.3
	(.0004)		(.0002)		(.0074)		(.0015)		(.0005)		(.0006)	
Wage structure	.0116***	96.05	.0098***	106.8	.0084***	109.8	–.0053*	103.3	.0015	–58.85	.0028***	343.7
	(.0014)		(.0006)		(.0004)		(.0028)		(.0011)		(.0006)	
Interaction	.0017**	14.62	–.0004	–5.19	–.0008***	–10.86	.0009	–17.87	–.0015	58.33	.0007	95.6
	(.0007)		(.0003)		(.0002)		(.0024)		(.0009)		(.0006)	

*Significant at 10%

**Significant at 5%

***Significant at 1%

Standard errors in brackets

is explained only by the composition effect (the wage structure effect is never significant).

Italy is characterised by rising overall wage inequality along the entire distribution (22.40%), mainly for the very low-paid employees. The weak ability of the Italian labour market to transform individual endowments into better job opportunities and higher earnings is highlighted by the fact that the wage structure is the solely significant component of the inequality growth. In the United Kingdom, despite the rising overall wage inequality (2.51%), the low-and middle-paid employees experience decreasing levels of wage inequality over time. The increase in inequality is essentially due to the composition effect, which plays different roles based on the location of the employee along the distribution.

6 Discussion

The four countries share the crucial role of gender, education and work experience in determining wages and inequality, with economic status, type of contract and type of job held as the driving forces. In particular, gender is among the primary discriminants of wage, in favour of males in each country, and remains one of the driving forces of inequality in Germany and Italy. This indicates the need to enforce a gender-mainstreaming approach to support better sharing of family responsibilities and equal treatment of parental leave to fight gender-based stereotypes (Del Boca et al. 2009). Workers would be evaluated without gender bias to improve the opportunities of women aspiring to more attractive career prospects and to achieve higher managerial positions and thus better-remunerated jobs. In Britain, for example, the increasing participation of women in the labour market and the benefits accruing from the National Minimum Wage (Gosling and Lemieux 2004) have slowed the growth of inequality; however, the disparity in earnings within males remains one of the main factors that explain the changes in inequality (OECD 2011b).

Our results highlight the importance of job background characteristics. During the last years, national governments carried out many reforms with the aim to increase the flexibility of the labour market (e.g., French policies to weaken the labour-market rigidities, the Hartz reforms in Germany, the Treu Package and Biagi Reform in Italy, and Universal Credit in Britain). As a result, the number of employees with unsafe work contracts has grown. In fact, some of these reforms (e.g., the French labour market became more dual, with growing shares of flexible jobs) have stimulated the "casualisation" process of part of the workforce through the introduction of involuntary temporary and/or involuntary part-time employment with effects on wage levels and inequality.

Coherent to our results, which argue that permanent and full-time contracts increase wages for low-paid employees (and their effect becomes smaller as one moves to the top end of the wage distribution) and reduce inequality, it would be advisable to identify reforms aimed at improving the synergy between flexibility and security in the labour market. It means that some actions are needed (e.g., providing more protection for employees with fixed-term contracts and fewer hours worked) to balance the greater flexibility, as outlined in the country's labour

policies, and to achieve greater security in terms of well-structured jobs. The *Kurzarbeit*, implemented in Germany, is a good example of this kind of action. In fact, it has allowed the companies to maintain their qualified workforce in economically difficult times. In addition, through redeploying tasks and workloads among employees, it has helped to maintain and upgrade existing skills and to increase their internal flexibility. Another example is the *Cassa Integrazione Guadagni* in Italy, which put employees on full suspension from work. It improved external flexibility but failed to motivate workers to acquire new skills or to ensure the portability of the same skills to new occupations.

Constant attention to equal access to education and specific on-the-job training or lifelong learning, e.g., investments in individuals' endowments, could help workers to upgrade their skills and reduce the risk that their earnings may erode, thereby exacerbating inequality. Coupled with more effective social security systems, which combine the provision of adequate income support with the need to facilitate labour-market mobility and transition, this could be one of the best ways to reduce the number of working poor, usually coinciding with low-skilled workers. In this field, the quantile approach explains the differences among the most vulnerable groups of employees and the way through which their characteristics affect both the within-and between-job pay dispersion. The same approach may also enable assessment of the impact of labour-market reforms promoting flexibility on wage inequality for differently remunerated sub-categories of employees, whose heterogeneous nature should be emphasised. Accordingly, appropriate policy responses vary.

Our results also show how workers' skills (e.g., higher skills reduce wage inequality and increase wages) and employment opportunities run in parallel, which can help in defining policies to stimulate the country's labour market in both the short-and long-term (OECD 2010). From a political perspective, if the immediate objective is a match between the current supply and demand for workers' skills, the main challenge is in anticipating the transformations of industries that have a significant impact on job creation or job displacement and, therefore, the potential changes in demanding skills that could facilitate the implementation of policies. More precisely, measures have to be designed from a life cycle perspective with the aim of building up and improving individual skills and linking education to technical training to establish in advance the needs of enterprises and workers' aspirations, even in times of economic difficulty. However, in Germany and the United Kingdom, where the wage structure plays a crucial role in the shrinking inequality on the left side of the wage distribution, our results suggest some success of reform policies, such as Hartz reforms and the National Minimum Wage, in reducing inequality within the most vulnerable groups of employees. In Italy, attempts to promote work flexibility and low-skill employment have not always lived up to their desired effects, mainly for the poorest employees.

7 Conclusions

This paper has been designed to investigate the determinants of wages and wage inequality in four developed countries in Western Europe—France, Germany, Italy, and the United Kingdom—during the years of the global economic crisis

(2005–2013) in light of important shifts in the occupational structure of the countries' labour market. The shrinking in the demand of jobs occupying the middle of the skills hierarchy, which is primarily associated with the large decrease of clerks, is shared by each country. This contraction has favoured those jobs at the top and the bottom of the skills hierarchy (defining a job polarisation pattern in Germany) or just those at the top (France and, to a lesser extent, the United Kingdom are characterised by upgrading of occupation). In Italy, the joint contraction of all type of occupations, irrespective of skill level required, sets out a not well-defined (hybrid) structure.

Our results show that the recent trends in wages and wage inequality are mixed across the four countries, and their dynamics at the top and bottom of the wage distribution are more diverse than in the middle. France and Germany showed *decreasing* patterns of wage inequality, despite having opposite changes in wages within the same timeframe; similarly, the United Kingdom and Italy had *increasing* patterns of wage inequality while maintaining opposite changes in wages.

The employment structure can explain a fraction of wage inequality, mainly at the top of the wage distributions, and confirm the role of the institutional, socio-economic and policy frameworks of each country. In France and Germany, whose labour markets shared well-defined structures, the upgrading of occupations and job polarisation had an equalising effect on the wage distribution; instead, the relative upgrading in the United Kingdom has only slowed inequality growth. In Italy, the more hybrid pattern of the labour market has contributed to raising the overall inequality through the joint contraction of each of three differently skilled categories of workers. Quantifying the two components of changes in wage levels and inequality, the labour market structure had a greater influence on generating variation in the real salary in all countries, whereas the employees' characteristics mostly explained the variation in wage inequality, with different intensity along the distribution. Italy is the only country where the occupational structure significantly contributes to wage inequality.

The time interval (2005–2013) and the index (Gini), over which the occupational structures and wage inequality are evaluated, inevitably affect the results that remain valid in the context of the earnings of employees and cannot be extended to a general perspective of income inequality where other income components must be considered. These results form the basis to extend the analysis to a wider-ranging comparison across European countries, in which differences between employees and self-employed could be explored.

Appendix

Table 8 UQR of log-wage. France, 2005 and 2013

	2005			2013		
	q10	q50	q90	q10	q50	q90
Individual characteristics:						
Gender (1 if *male*)	.0595	.1500***	.1999***	.2049***	.1883***	.2593***
	(.0619)	(.0128)	(.0218)	(.0715)	(.0145)	(.0276)
Couple (ref. married)						
Never married	.0971	− .0658***	− .0882***	.0429	− .0550***	− .1306***
	(.0648)	(.0145)	(.0248)	(.0701)	(.0153)	(.0286)
Others (sep div wid)	− .0738	− .0036	− .0886***	− .0544	− .0148	− .0659
	(.0964)	(.0218)	(.0340)	(.1053)	(.0219)	(.0422)
Health (1 if *no suffer*)	.1007	.0588***	.0143	.0029	.0178	.0232
	(.0769)	(.0147)	(.0261)	(.0825)	(.0155)	(.0264)
Human capital:						
Experience (*years*)	.1587***	.0276***	.0232***	.1183***	.0215***	.0252***
	(.0112)	(.0019)	(.0032)	(.0130)	(.0020)	(.0034)
Experience squared (*squared years*)	− .0030***	− .0003***	− .0002***	− .0023***	− .0003***	− .00034***
	(.0002)	(.00004)	(.00007)	(.0002)	(.00004)	(.00007)
Education (ref: *high*, ISCED: 5;6)						
Medium (ISCED: 3;4)	− .2038***	− .1653***	− .2839***	− .2680***	− .1060***	− .2203***
	(.0755)	(.0157)	(.0332)	(.0858)	(.0173)	(.0343)
Low (ISCED: 1;2)	− .3778***	− .2634***	− .3984***	− .6088***	− .1761***	− .2583***
	(.0992)	(.0193)	(.0368)	(.1413)	(.0241)	(.0462)
Job characteristics:						
Type of contract (1 if *permanent*)	1.2398***	.1851***	.0082	1.4094***	.2053***	− .0311
	(.1118)	(.0155)	(.0216)	(.1359)	(.0177)	(.0279)

Table 8 continued

	2005			2013		
	q10	q50	q90	q10	q50	q90
Economic status (1 if *full-time*)	1.2825***	.2535***	.0855***	1.3446***	.2587***	.0903***
	(.1023)	(.0145)	(.0170)	(.1220)	(.0161)	(.0269)
Occupation (ref.: elementary)						
Corporate managers	.8824***	.5574***	1.1971***	1.3098***	.6212***	1.1979***
	(.1390)	(.0250)	(.0737)	(.1498)	(.0281)	(.0855)
Managers of small enterprises	1.1270***	.2765***	.4217**	1.1255***	.6624***	1.2431***
	(.2242)	(.1049)	(.1872)	(.1567)	(.0342)	(.2002)
Professionals	.7752***	.5112***	1.2038***	1.2368***	.5635***	1.2245***
	(.1530)	(.0262)	(.0730)	(.1635)	(.0299)	(.0917)
Teaching professionals	.8033***	.4427***	.0465	.8791***	.2325***	.0181
	(.1588)	(.0286)	(.0542)	(.1888)	(.0332)	(.0508)
Technicians/ass. professionals	.7088***	.3931***	.0263	1.0727***	.4187***	.1237***
	(.1495)	(.0255)	(.0396)	(.1464)	(.0250)	(.0381)
Clerks	.8001***	.2400***	.0036	1.1108***	.2148***	– .0273
	(.1285)	(.0193)	(.0190)	(.1460)	(.0227)	(.0278)
Service workers	.3458**	.0885***	.0048	.5404***	.0620***	.0408*
	(.1543)	(.0211)	(.0175)	(.1679)	(.0218)	(.0244)
Skilled agricultural	.0211	– .0341	– .0782***	.9708***	.0129	.0255
	(.2885)	(.0382)	(.0281)	(.2983)	(.0607)	(.0767)
Machine operator/assemblers	.6809***	.1797***	– .0895***	.8975***	.3467***	– .1619***
	(.1448)	(.0250)	(.0232)	(.1678)	(.0297)	(.0277)
Intercept	4.8056***	9.0389***	10.2218***	5.1818***	9.3471***	10.4289***
	(.1967)	(.0297)	(.0448)	(.2500)	(.0328)	(.0527)

Table 8 continued

| | 2005 | | | 2013 | | |
	q10	q50	q90	q10	q50	q90
N	9077	9077	9077	8935	8935	8935
Adj R-squared	.2362	.3828	.2799	.1971	.3457	.2708
Root MSE	2.3275	.4775	.8488	2.3363	.47602	.8893

*Significant at 10%

**Significant at 5%

***Significant at 1%

Standard errors in brackets

Table 9 UQR of log-wage. Germany, 2005 and 2013

	2005			2013		
	q10	q50	q90	q10	q50	q90
Individual characteristics:						
Gender (1 if *male*)	− .0826	.2630***	.2814***	.1446***	.2594***	.2338***
	(.0604)	(.0173)	(.0173)	(.0413)	(.0188)	(.0194)
Couple (ref. *married*)						
Never married	− .1436**	− .0273	− .1066***	.1807***	− .0576***	− .0812***
	(.0656)	(.0216)	(.0222)	(.0441)	(.0214)	(.0226)
Others (*sep div wid*)	.1166	.0088	− .1067***	.0802	− .0072	− .0340
	(.0771)	(.0235)	(.0239)	(.0557)	(.0236)	(.0264)
Health (1 if *no suffer*)	.0928*	.0248	.0775***	.1124**	.0625***	.0296
	(.0525)	(.0160)	(.0186)	(.0460)	(.0188)	(.0192)
Human capital:						
Experience (*years*)	.1396***	.0430***	.0150***	.0695***	.0396***	.0272***
	(.0102)	(.0027)	(.0027)	(.0073)	(.0027)	(.0025)
Experience squared (*squared years*)	− .0024***	− .0006***	− .0002***	− .0010***	− .0005***	− .0004***
	(.0001)	(.00005)	(.00006)	(.0001)	(.00005)	(.00005)
Education (ref: *high*, ISCED: 5;6)						
Medium (ISCED: 3;4)	− .0669	− .1681***	− .2968***	− .1086***	− .2497***	− .3680***
	(.0594)	(.0176)	(.0218)	(.0356)	(.0191)	(.0263)
Low (ISCED: 1;2)	− .8265***	− .3296***	− .2608***	− .6710***	− .3066***	− .3522***
	(.1366)	(.0311)	(.0234)	(.0966)	(.0346)	(.0296)
Job characteristics:						
Type of contract (1 if *permanent*)	.7417***	.3140***	.0660***	.4247***	.3893***	.0428**
	(.0992)	(.0221)	(.0172)	(.0808)	(.0256)	(.0173)

Table 9 continued

	2005			2013		
	q10	q50	q90	q10	q50	q90
Economic status (1 if *full-time*)	1.1394***	.6535***	.1686***	1.19810***	.6533***	.1362***
	(.0711)	(.0179)	(.0134)	(.0586)	(.0206)	(.0173)
Occupation (ref.: *elementary*)						
Corporate managers	1.1810***	.4274***	.9010***	.7231***	.4427***	.9816***
	(.1982)	(.0515)	(.0831)	(.1590)	(.0632)	(.0985)
Managers of small enterprises	1.5354***	.4373***	.2112	.8243***	.5038***	.6061***
	(.2024)	(.1127)	(.1792)	(.1498)	(.0574)	(.0851)
Professionals	1.3451***	.4719***	.4886***	.8615***	.5401***	.5200***
	(.1873)	(.0386)	(.0377)	(.1492)	(.0502)	(.0510)
Teaching professionals	1.2654***	.5085***	.2056***	1.1255***	.5354***	.0720
	(.2029)	(.0494)	(.0532)	(.1543)	(.0525)	(.0455)
Technicians/ass. professionals	1.3731***	.2980***	.1751***	.8881***	.3729***	.0653**
	(.1852)	(.0394)	(.0326)	(.1466)	(.0458)	(.0296)
Clerks	1.1976***	.2111***	.0898***	.8149***	.2554***	.0275
	(.1752)	(.0351)	(.0177)	(.1474)	(.0460)	(.0282)
Service workers	.6313***	– .0293	.0522***	.4297***	.0398	– .0160
	(.2039)	(.0386)	(.0193)	(.1577)	(.0463)	(.0262)
Skilled agricultural	1.0564***	– .2052***	– .0493	1.0571***	– .1114	– .0550
	(.3275)	(.0743)	(.0385)	(.2037)	(.1631)	(.1354)
Machine operator/assemblers	1.0129***	.0353	– .1759***	.5279***	.0405	– .0638**
	(.1929)	(.0480)	(.0222)	(.1582)	(.0494)	(.0289)
Intercept	4.6480***	8.7026***	10.3508***	5.4581***	8.5260***	10.3903***
	(.2500)	(.0483)	(.0405)	(.1859)	(.0604)	(.0475)

Table 9 continued

	2005			2013		
	q10	q50	q90	q10	q50	q90
N	11,047	11,047	11,047	10,476	10,476	10,476
Adj R-squared	.2463	.4627	.2039	.2236	.4112	.1983
Root MSE	2.0595	.6389	.8106	1.5639	.6713	.7848

*Significant at 10%

**Significant at 5%

***Significant at 1%

Standard errors in brackets

Table 10 UQR of log-wage. Italy, 2005 and 2013

	2005			2013		
	q10	q50	q90	q10	q50	q90
Individual characteristics:						
Gender (1 if *male*)	.1462***	.1640***	.2750***	.0299	.1764***	.2233***
	(.0299)	(.0089)	(.0207)	(.0338)	(.0126)	(.0239)
Couple (ref. *married*)						
Never married	− .1287***	− .1019***	− .1121***	− .0306	− .0045	− .0797***
	(.0313)	(.0106)	(.0229)	(.0357)	(.0148)	(.0257)
Others (*sep div wid*)	− .0565	− .0458***	− .0619*	− .1462***	.0038	.0193
	(.0508)	(.0160)	(.0355)	(.0537)	(.0194)	(.0394)
Health (1 if *no suffer*)	− .0124	.0236**	.0806***	.0069	.0290*	.1077***
	(.0276)	(.0097)	(.0234)	(.0389)	(.0150)	(.0237)
Human capital:						
Experience (*years*)	.0253***	.0209***	.0263***	.0496***	.0289***	.0269***
	(.0051)	(.0016)	(.0037)	(.0073)	(.0022)	(.0035)
Experience squared (*squared years*)	− .0004***	− .0003***	− .0003***	− .0008***	− .0003***	− .0003***
	(.0001)	(.00003)	(.00009)	(.0001)	(.00005)	(.00008)
Education (ref: *high*, ISCED: 5;6)						
Medium (ISCED: 3;4)	− .1467***	− .1284***	− .4564***	− .1087***	− .1657***	− .3145***
	(.0316)	(.0139)	(.0476)	(.0371)	(.0170)	(.0406)
Low (ISCED: 1;2)	− .3409***	− .2746***	− .6833***	− .2432***	− .3137***	− .5019***
	(.0406)	(.0157)	(.0492)	(.0522)	(.0216)	(.0430)
Job characteristics:						
Type of contract (1 if *permanent*)	.7048***	.1514***	.1258***	.9511***	.2510***	.0543***
	(.0617)	(.0128)	(.0195)	(.0782)	(.0166)	(.0203)

Table 10 continued

	2005			2013		
	q10	q50	q90	q10	q50	q90
Economic status (1 if *full-time*)	1.5252***	.2585***	.1291***	.9090***	.3391***	.1114***
	(.0731)	(.0111)	(.0179)	(.0690)	(.0144)	(.0183)
Occupation (ref.: *elementary*)						
Corporate managers	.5064***	.3857***	1.2189***	.4214**	.3071***	1.1933***
	(.0750)	(.0207)	(.1003)	(.1807)	(.0628)	(.1929)
Managers of small enterprises	.4627***	.1695***	.1423	.6554***	.4765***	2.1694***
	(.1213)	(.0467)	(.1798)	(.0984)	(.0493)	(.2006)
Professionals	.6098***	.3102***	.8637***	.6559***	.4295***	.8588***
	(.0789)	(.0238)	(.0807)	(.0916)	(.0287)	(.0695)
Teaching professionals	.5216***	.3075***	– .2562***	.6026***	.2720***	– .0715
	(.0862)	(.0254)	(.0666)	(.0947)	(.0292)	(.0470)
Technicians/ass. professionals	.6339***	.2763***	.1027***	.6900***	.4186***	.3008***
	(.0739)	(.0193)	(.0362)	(.0868)	(.0241)	(.0396)
Clerks	.6027***	.1753***	.1069***	.7046***	.2198***	.0539**
	(.0711)	(.0162)	(.0215)	(.0832)	(.0213)	(.0237)
Service workers	.4212***	.1268***	.1206***	.5193***	.1013***	.0513**
	(.0839)	(.0182)	(.0284)	(.0960)	(.0229)	(.0254)
Skilled agricultural	.1715	.0275	– .0320	– .1802	– .0383	.0472**
	(.2070)	(.0490)	(.0549)	(.3027)	(.0650)	(.0921)
Machine operator/assemblers	.5794***	.1445***	.0010	.7187***	.1951***	– .0470***
	(.0740)	(.0186)	(.0259)	(.0873)	(.0287)	(.0285)
Intercept	6.6441***	9.1675***	9.9993***	6.6584***	9.1466***	10.2634
	(.1100)	(.0272)	(.0630)	(.1342)	(.0355)	(.0545)

Table 10 continued

	2005			2013		
	q10	q50	q90	q10	q50	q90
N	14,996	14,996	14,996	11,670	11,670	11,670
Adj R-squared	.2809	.3042	.2012	.2242	.3495	.1950
Root MSE	1.1184	.3882	.9137	1.2228	.4769	.9006

*Significant at 10%

**Significant at 5%

***Significant at 1%

Standard errors in brackets

Table 11 UQR of log-wage. The United Kingdom, 2005 and 2013

	2005			2013		
	q10	q50	q90	q10	q50	q90
Individual characteristics:						
Gender (1 if *male*)	− .0855*	.2639***	.2496***	.0554	.2579***	.3155***
	(.0485)	(.0176)	(.0280)	(.0400)	(.0210)	(.0290)
Couple (ref. *married*)						
Never married	− .2315***	− .0927***	− .1173***	− .0717	− .0313	− .0411
	(.0509)	(.0196)	(.0299)	(.0463)	(.0236)	(.0335)
Others (*sep div wid*)	− .0378	− .0412*	− .0050	− .0595	− .0782***	− .1079***
	(.0661)	(.0242)	(.0412)	(.0621)	(.0293)	(.0408)
Health (1 if *no suffer*)	− .0209	.0850***	.1253***	− .0035	.1127***	.0054
	(.0701)	(.0242)	(.0311)	(.0408)	(.0195)	(.0270)
Human capital:						
Experience (*years*)	.0498***	.0224***	.0240***	.0426***	.0289***	.0317***
	(.0074)	(.0023)	(.0033)	(.0067)	(.0029)	(.0035)
Experience squared (*squared years*)	− .0011***	− .0004***	− .0004***	− .0007***	− .0004***	− .0005***
	(.0001)	(.00005)	(.00008)	(.0001)	(.00006)	(.00007)
Education (ref: *high*, ISCED: 5;6)						
Medium (ISCED: 3;4)	− .3109***	− .1629***	− .2524***	− .2159***	− .2189***	− .3337***
	(.0533)	(.0185)	(.0300)	(.0450)	(.0220)	(.0280)
Low (ISCED: 1;2)	− .3869	− .4154***	− .3069***	− .2716***	− .3069***	− .3988***
	(.4349)	(.0999)	(.0472)	(.0948)	(.0375)	(.0300)
Job characteristics:						
Type of contract (1 if *permanent*)	.8280***	.1522***	.0287	.0897	.1235***	.1446***
	(.1171)	(.0263)	(.0346)	(.1004)	(.0367)	(.0322)

Table 11 continued

	2005			2013		
	q10	q50	q90	q10	q50	q90
Economic status (1 if *full-time*)	2.2000***	.5176***	.1341***	1.9574***	.5492***	.0961***
	(.0884)	(.0198)	(.0211)	(.0781)	(.0231)	(.0210)
Occupation (ref.: *elementary*)						
Corporate managers	.5407***	.6864***	.9030***	.8145***	.7020***	.7989***
	(.1140)	(.0356)	(.0605)	(.1077)	(.0493)	(.0793)
Managers of small enterprises	.4809***	.2602***	.2441**	.7855***	.8411***	.9455***
	(.1747)	(.0732)	(.1119)	(.1054)	(.0525)	(.1025)
Professionals	.6913***	.6561***	.6431***	.9138***	.9305***	.5709***
	(.1176)	(.0386)	(.0690)	(.0998)	(.0388)	(.0503)
Teaching professionals	.7196***	.6648***	.2877***	1.0466***	.8973***	.1945***
	(.1400)	(.0438)	(.0709)	(.1123)	(.0482)	(.0599)
Technicians/ass. professionals	.7720***	.4788***	.0278	.9363***	.6474***	.2027***
	(.1309)	(.0427)	(.0492)	(.1022)	(.0419)	(.0449)
Clerks	.7012***	.2258***	.0572*	.8779***	.2278***	− .0034
	(.1176)	(.0326)	(.0325)	(.1047)	(.0365)	(.0261)
Service workers	− .2764*	.0526	.0352	.1965*	.1144***	.0630**
	(.1423)	(.0330)	(.0299)	(.1169)	(.0344)	(.0252)
Skilled agricultural	.9965***	− .1488	− .2277***	.4203	− .0220	− .0810
	(.2322)	(.1352)	(.0413)	(.4032)	(.1323)	(.0884)
Machine operator/assemblers	.6423***	.1720***	− .0729	.8687***	.3553***	− .0102
	(.1242)	(.048)	(.0469)	(.1093)	(.0548)	(.0467)
Intercept	6.1835***	9.1426***	10.4318***	6.2457***	8.6217***	10.164***
	(.1876)	(.0469)	(.0564)	(.1591)	(.0541)	(.0540)

Table 11 continued

	2005			2013		
	q10	q50	q90	q10	q50	q90
N	7418	7418	7418	8130	8130	8130
Adj R-squared	.2985	.3619	.1601	.3070	.3930	.1668
Root MSE	1.9447	.6535	1.0554	1.5473	.7253	1.0495

*Significant at 10%

**Significant at 5%

***Significant at 1%

Standard errors in brackets

Table 12 RIF-regression of Gini on log-wage by quantile. France, 2005 and 2013

	2005			2013		
	q10	q50	q90	q10	q50	q90
Individual characteristics:						
Gender (1 if *male*)	− .0045	− .0025	− .0017	.0027	− .0008	− .00171
	(.0041)	(.0016)	(.0010)	(.0059)	(.0018)	(.0011)
Couple (ref. *married*)						
Never married	− .0083*	− .0044**	− .0031***	− .0064	− .0028	− .0017
	(.0047)	(.0018)	(.0011)	(.0065)	(.0019)	(.0012)
Others (*sep div wid*)	.0045	.0007	.0009	− .0028	− .0005	− .0003
	(.0078)	(.0029)	(.0018	(.0090)	(.0030)	(.0018)
Health (1 if *no suffer*)	− .0065	− .0026	− .0018	− .0130**	− .0034**	− .0018
	(.0045)	(.0018)	(.0013)	(.0058)	(.0019)	(.0012)
Human capital:						
Experience (*years*)	− .0014**	− .0030***	− .0027***	.0003	− .0018***	− .0016***
	(.0005)	(.0002)	(.0001)	(.0006)	(.0002)	(.0001)
Experience squared (*squared years*)	.00002	.00005***	.00005***	− .00001	.00003***	.00003***
	(.00001)	(5.89e− 06)	(3.98e− 06)	(.00001)	(5.39e− 06)	(3.60e− 06)
Education (ref: *high*, ISCED: 5;6)						
Medium (ISCED: 3;4)	.0042	.0030	.0035**	.0027	.0043**	.0039***
	(.0051)	(.0022)	(.0014)	(.0070)	(.0022)	(.0013)
Low (ISCED: 1;2)	.0017	.0048**	.0054***	.0049	.0103***	.0091***
	(.0058)	(.0025)	(.0016)	(.0088)	(.0031)	(.0020)
Job characteristics:						
Type of contract (1 if *permanent*)	− .0124***	− .0204***	− .0252***	.0020	− .0197***	− .0236***
	(.0040)	(.0017)	(.0013)	(.0052)	(.0019)	(.0014)

Table 12 continued

	2005			2013		
	q10	q50	q90	q10	q50	q90
Economic status (1 if *full-time*)	− .0101**	− .0209***	− .0259***	.0030	− .0159***	− .0216***
	(.0041)	(.0016)	(.0012)	(.0053)	(.0018)	(.0013)
Occupation (ref.: *elementary*)						
Corporate managers	− .0029	− .0169**	− .0057*	.0057	− .0187***	− .0148***
	(.0182)	(.0069)	(.0029)	(.0356)	(.0065)	(.0029)
Managers of small enterprises	− .0033	− .0077	− .019***	− .0488	− .0082	− .0097
	(.0546)	(.0097)	(.0065)	(.0942)	(.0270)	(.0060)
Professionals	− .0017	− .0016	− .0028	− .0007	− .0109**	− .0148***
	(.0116)	(.0058)	(.0030)	(.0198)	(.0057)	(.0030)
Teaching professionals	− .0091**	− .0171***	− .0088***	− .0229*	− .0131***	− .0178***
	(.0113)	(.0049)	(.0027)	(.0116)	(.0038)	(.0026)
Technicians/ass. professionals	.0161	− .0030	− .0079***	.0144	− .009***	− .0144***
	(.0083)	(.0036)	(.0022)	(.0100)	(.0031)	(.0020)
Clerks	− .0016	− .0093***	− .0131***	− .0096	− .0135***	− .0179***
	(.0053)	(.0022)	(.0017)	(.0080)	(.0026)	(.0018)
Service workers	− .0027	− .0029	− .0051***	− .0026	− .0063**	− .0094***
	(.0051)	(.0023)	(.0019)	(.0066)	(.0025)	(.0019)
Skilled agricultural	.00663	.0006	− .0034	.0743***	.0036	− .0048
	(.0093)	(.0046)	(.0037)	(.0203)	(.0065)	(.0049)
Machine operator/assemblers	− .0029	− .0069**	− .0115***	.0002	− .0044	− .0150***
	(.0072)	(.0027)	(.0020)	(.0114)	(.0039)	(.0024)
Intercept	.0754***	.0985***	.1110***	.0627***	.0846***	.0989***
	(.0085)	(.0037)	(.0026)	(.0115)	(.0041)	(.0028)

Table 12 continued

| | 2005 | | | 2013 | | |
	q10	q50	q90	q10	q50	q90
N	901	4518	8163	879	5454	8039
Adj R-squared	.0281	.1737	.2306	.0196	.0775	.1300
Root MSE	.0526	.04885	.0442	.0727	.0541	.0459

*Significant at 10%

**Significant at 5%

***Significant at 1%

Standard errors in brackets

Table 13 RIF-regression of Gini on log-wage by quantile. Germany, 2005 and 2013

	2005			2013		
	q10	q50	q90	q10	q50	q90
Individual characteristics:						
Gender (1 if *male*)	.0048	.0044***	.0037***	− .0053	− .0016	− .0026***
	(.0037)	(.0016)	(.0011)	(.0037)	(.0013)	(.0009)
Couple (ref. *married*)						
Never married	.0196***	.0112***	.0061***	.0063	− .0037**	− .0031***
	(.0052)	(.0018)	(.0013)	(.0044)	(.0014)	(.0010)
Others (*sep div wid*)	− .0016	− .0020	− .0025	− .0003	− .0026	− .0012
	(.0064)	(.0022)	(.0015)	(.0046)	(.0018)	(.0013)
Health (1 if *no suffer*)	.0019	− .0016	− .0010	− .0132***	− .0061***	− .0038***
	(.0039)	(.0015)	(.0011)	(.0031)	(.0013)	(.0010)
Human capital:						
Experience (*years*)	− .0007	− .0027***	− .0036***	− .0013***	− .0021***	− .0023***
	(.0006)	(.0002)	(.0001)	(.0004)	(.0001)	(.0001)
Experience squared (*squared years*)	.00001	.00005***	.00006***	.00001	.00003***	.00003***
	(.00001)	(5.59e− 06)	(3.72e− 06)	(.00001)	(3.91e− 06)	(2.87e− 06)
Education (ref: *high*, ISCED: 5;6)						
Medium (ISCED: 3;4)	− .0037	.00004	.0005	− .0088**	.0023	− .0004
	(.0045)	(.0017)	(.0011)	(.0049)	(.0017)	(.0011)
Low (ISCED: 1;2)	.0008	.0147***	.0200***	− .0099**	.0157***	.0168***
	(.0053)	(.0024)	(.0018)	(.0053)	(.0021)	(.0015)
Job characteristics:						
Type of contract (1 if *permanent*)	.0013	− .0069***	− .0197***	.0008	− .0068***	− .0169***
	(.0037)	(.0016)	(.0014)	(.0035)	(.0015)	(.0013)

Table 13 continued

	2005			2013		
	q10	q50	q90	q10	q50	q90
Economic status (1 if *full-time*)	−.0203***	−.025***	−.0304***	−.0037	−.0218***	−.0323***
	(.0044)	(.0015)	(.0011)	(.0043)	(.0013)	(.0010)
Occupation (ref.: *elementary*)						
Corporate managers	.0186	−.016**	−.0270***	−.0096	−.0163***	−.0185***
	(.0185)	(.0063)	(.0037)	(.0170)	(.0061)	(.0040)
Managers of small enterprises	Omitted	−.0332**	−.0370***	−.0336*	−.0265***	−.0229***
		(.0157)	(.0087)	(.0200)	(.0059)	(.0035)
Professionals	−.0126	−.0324***	−.0324***	−.0211	−.0223***	−.0251***
	(.0079)	(.0034)	(.0024)	(.0084)	(.0035)	(.0025)
Teaching professionals	.0057	−.019***	−.0294***	−.0237***	−.0306***	−.0346***
	(.0116)	(.0050)	(.0031)	(.0087)	(.0034)	(.0026)
Technicians/ass. professionals	−.0114	−.0319***	−.0342***	−.019***	−.0230***	−.0261***
	(.0074)	(.0030)	(.0023)	(.0054)	(.0025)	(.0021)
Clerks	−.0136***	−.0277***	−.0302***	−.019***	−.0204***	−.0246***
	(.0048)	(.0024)	(.0020)	(.0049)	(.0024)	(.0021)
Service workers	−.0152***	−.0201***	−.0162***	−.0113**	−.0129***	−.0143***
	(.0052)	(.0027)	(.0023)	(.0046)	(.0025)	(.0022)
Skilled agricultural	−.0096	−.0240***	−.0251***	−.0207	−.0207**	−.0258***
	(.013)	(.0056)	(.0047)	(.0343)	(.0096)	(.0079)
Machine operator/assemblers	−.0204***	−.020***	−.0282***	−.004	−.0109***	−.0165***
	(.0075)	(.0034)	(.0025)	(.0050)	(.0026)	(.0022)
Intercept	.0573***	.1106***	.1454***	.0785***	.1076***	.1377***
	(.0088)	(.0039)	(.0030)	(.0085)	(.0036)	(.0029)

Table 13 continued

	2005			2013		
	q10	q50	q90	q10	q50	q90
N	1193	5518	9941	1062	5239	9429
Adj R-squared	.0609	.1813	.3005	.0531	.1678	.2700
Root MSE	.0549	.0500	.0473	.0434	.0404	.0401

*Significant at 10%

**Significant at 5%

***Significant at 1%

Standard errors in brackets

Table 14 RIF-regression of Gini on log-wage by quantile. Italy, 2005 and 2013

	2005			2013		
	q10	q50	q90	q10	q50	q90
Individual characteristics:						
Gender (1 if *male*)	− .0012	− .0021***	− .0019	.0041	.0021**	.0009
	(.0017)	(.0006)	(.0004)	(.0026)	(.0010)	(.0007)
Couple (ref. *married*)						
Never married	.00006	.0019***	.0021	.0008	.0012	.0006
	(.0018)	(.0007)	(.0004)	(.0030)	(.0011)	(.0007)
Others (sep div wid)	− .0062**	− .0012	.00004	.0056	.0048***	.0034***
	(.0029)	(.0011)	(.0007)	(.0040)	(.0017)	(.0011)
Health (1 if *no suffer*)	− .0049***	− .0008	− .00002	− .0058**	− .0012	− .0003
	(.0018)	(.0007)	(.0004)	(.0028)	(.0011)	(.0008)
Human capital:						
Experience (*years*)	− .0002	− .0003***	− .0004	− .0002	− .001***	− .0012***
	(.0002)	(.0001)	(.00007)	(.0004)	(.0001)	(.0001)
Experience squared (*squared years*)	− 1.03e−06	3.50e−06	8.17e−06	2.10e−06	.00001***	.00002***
	(7.80e−06)	(2.82e−06)	(1.88e−06)	(.00001)	(4.10e−06)	(2.84e−06)
Education (ref: *high*, ISCED: 5;6)						
Medium (ISCED: 3;4)	− .0034	.0022**	.0015	− .0052	.0001	.0009
	(.0035)	(.0012)	(.0007)	(.0042)	(.0015)	(.0009)
Low (ISCED: 1;2)	.0009	.0067***	.0047	− .0087*	.0017	.0027**
	(.0036)	(.0012)	(.0007)	(.0046)	(.0017)	(.0011)
Job characteristics:						
Type of contract (1 if *permanent*)	− .0093***	− .0149***	− .0152	− .0019	− .018***	− .0249***
	(.0015)	(.0007)	(.0005)	(.0024)	(.0012)	(.0009)

Table 14 continued

	2005			2013		
	q10	q50	q90	q10	q50	q90
Economic status (1 if *full-time*)	.0018	− .0183***	− .0254	.0067***	− .0110***	− .0215***
	(.0015)	(.0007)	(.0006)	(.0025)	(.0011)	(.0009)
Occupation (ref.: *elementary*)						
Corporate managers	− .0056	− .0077*	− .0026	− .0211*	− .0086	− .0099**
	(.0104)	(.0041)	(.0017)	(.0125)	(.0064)	(.0044)
Managers of small enterprises	− .0068	− .0069**	− .0085	− .0004	− .0038	− .0098
	(.0093)	(.0035)	(.0023)	(.0254)	(.0151)	(.0085)
Professionals	− .0097*	− .0104***	− .0102	− .0113	− .0088***	− .0116***
	(.0056)	(.0020)	(.0013)	(.0077)	(.0030)	(.0017)
Teaching professionals	− .0100	− .0081***	− .0072	− .0054	− .0086***	− .0127***
	(.0076)	(.0026)	(.0013)	(.0062)	(.0023)	(.0015)
Technicians/ass. professionals	.0081**	− .0070***	− .0091	.0067	− .0057***	− .0120***
	(.0034)	(.0012)	(.0008)	(.0051)	(.0019)	(.0013)
Clerks	.0010	− .0078***	− .0099	.0047	− .0092***	− .0140***
	(.0020)	(.0008)	(.0006)	(.0033)	(.0014)	(.0011)
Service Workers	.0017	− .0058***	− .0061	0 .0011	− .0068***	− .0098***
	(.0022)	(.0010)	(.0008)	(.0031)	(.0015)	(.0012)
Skilled agricultural	− .0022	− .0016	− .0030	− .0055	− .0014	− .0013
	(.0044)	(.0022)	(.0017)	(.0075)	(.0043)	(.0035)
Machine operator/assemblers	.0013	− .0082***	− .0100	.0057	− .0098***	− .0148***
	(.0028)	(.0010)	(.0007)	(.0058)	(.0020)	(.0014)
Intercept	.0363***	.0550***	.0690	.0443***	.0682***	.0919***
	(.0047)	(.0018)	(.0012)	(.0061)	(.0027)	(.0019)

Table 14 continued

	2005			2013		
	q10	q50	q90	q10	q50	q90
N	1539	7501	13,498	1167	5836	10,504
Adj R-squared	.0350	.1787	.2249	.0212	.0896	.1808
Root MSE	.0286	.0247	.02308	.0387	.0360	.0329

*Significant at 10%

**Significant at 5%

***Significant at 1%

Standard errors in brackets

Table 15 RIF-regression of Gini on log-wage by quantile. The United Kingdom, 2005 and 2013

	2005			2013		
	q10	q50	q90	q10	q50	q90
Individual characteristics:						
Gender (1 if *male*)	− .0046	.0003	.0017	− .0103**	− .0019	− .0004
	(.0031)	(.0014)	(.0009)	(.0043)	(.0012)	(.0008)
Couple (ref. *married*)						
Never married	.0054	.0060***	.0036	.0050	.0016	− .0001
	(.0042)	(.0015)	(.0010)	(.0048)	(.0014)	(.0009)
Others (*sep div wid*)	.0029	.0008	− .00009	.0023	− .0002	.00006
	(.0048)	(.0019)	(.0013)	(.0056)	(.0018)	(.0013)
Health (1 if *no suffer*)	.0053	.0021	.0023	.0039	.0005	.0001
	(.0041)	(.0017)	(.0012)	(.0035)	(.0011)	(.0008)
Human capital:						
Experience (*years*)	.0007*	− .0007***	− .0006	.0002	− .0004***	− .0004***
	(.0004)	(.0001)	(.0001)	(.0005)	(.0001)	(.0001)
Experience squared (*squared years*)	− .00001*	.00001***	.00001	− 5.27e−06	9.64e−06***	7.07e−06***
	(9.65e−06)	(4.36e−06)	(3.11e−06)	(.00001)	(3.64e−06)	(2.61e−06)
Education (ref: *high*, ISCED: 5;6)						
Medium (ISCED: 3;4)	.0025	.0070***	.0054	− .0102***	.0013	.0012
	(.0032)	(.0014)	(.0009)	(.0039)	(.0012)	(.0008)
Low (ISCED: 1;2)	.0221	.0040	.0074	− .0086	.0022	.0020
	(.0141)	(.0070)	(.0060)	(.0061)	(.0020)	(.0016)
Job characteristics:						
Type of contract (1 if *permanent*)	− .0081***	− .0174***	− .0186	− .0050	− .0046***	− .0035**
	(.0029)	(.0017)	(.0014)	(.0044)	(.0017)	(.0014)

Table 15 continued

	2005			2013		
	q10	q50	q90	q10	q50	q90
Economic status (1 if *full-time*)	.0052	− .0238***	− .0359	.0230***	− .0228***	− .0339***
	(.0042)	(.0013)	(.0010)	(.0049)	(.0012)	(.0009)
Occupation (ref.: *elementary*)						
Corporate managers	− .0133	− .0069**	− .0033	− .0014	− .0050	− .0092***
	(.0101)	(.0035)	(.0019)	(.0116)	(.0031)	(.0021)
Managers of small enterprises	− .0033	− .0062	− .0075	− .0124	− .0043	− .0051**
	(.0140)	(.0053)	(.0035)	(.0182)	(.0046)	(.0025)
Professionals	− .0010	− .0076**	− .0065	.0236**	− .0063**	− .0089***
	(.0120)	(.0038)	(.0021)	(.0113)	(.0027)	(.0016)
Teaching professionals	− .0082	− .0113***	− .0083	− .0132	− .0142***	− .0110***
	(.0100)	(.0040)	(.0024)	(.0129)	(.0035)	(.0020)
Technicians/ass. professionals	.0115	− .0073**	− .0105	.0038	− .0089***	− .0135***
	(.0077)	(.0031)	(.0020)	(.0092)	(.0023)	(.0016)
Clerks	− .0006	− .0104***	− .0113	.0129**	− .0078***	− .0130***
	(.0044)	(.0020)	(.0016)	(.0055)	(.0018)	(.0015)
Service workers	− .0027	− .0005	.0049	.001538	− .00084	− .0002
	(.0037)	(.0021)	(.0017)	(.0042)	(.0017)	(.0015)
Skilled agricultural	− .0202	− .0130	− .0206	− .0072	− .0092	− .0132**
	(.0379)	(.0081)	(.0060)	(.0207)	(.0065)	(.0053)
Machine operator/assemblers	− .0054	− .0099***	− .0118	.0096	− .0063**	− .0130***
	(.0093)	(.0031)	(.0022)	(.0123)	(.0027)	(.0019)
Intercept	.0311***	.0653***	.0855	.0319***	.0596***	.0809***
	(.0069)	(.0032)	(.0024)	(.0081)	(.0029)	(.0022)

Table 15 continued

	2005			2013		
	q10	q50	q90	q10	q50	q90
N	676	3514	6591	821	4068	7317
Adj R-squared	.0088	.1807	.2816	.0358	.1169	.2147
Root MSE	.0342	.0365	.0342	.0474	.0350	.0327

*Significant at 10%

**Significant at 5%

***Significant at 1%

Standard errors in brackets

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