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Intangible capital and wages: An analysis of wage gaps across occupations and genders in Czech Republic, Finland and Norway[1]

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Abstract: This paper compares the effects of intangible capital on wage formation among white-collar manufacturing workers using comparative data from three European countries: the Czech Republic, Finland and Norway. The analysis is undertaken in two steps. First, we explore the wage differentials and the underlying sources for two occupation groups: innovation and non-innovation workers. In a second step, this analysis is broken down by gender. We apply a decomposition method based on unconditional quantile regression techniques to examine the factors underlying the wage gaps observed along the whole wage distribution. The use of comparative cross-country data and a more elaborated wage decomposition method provides important new insights. We find, for example, that although innovation workers earn more than non-innovation workers in all three countries under scrutiny, there is considerable variation across the countries both in the levels and profiles of these wage differentials. Also the sources underlying these wage differentials vary between the countries. The levels and profiles of the gender wage gaps prevailing among innovation and non-innovation workers also reveal conspicuous cross-country differences. However, when it comes to the major sources contributing to these gender wage gaps, the results are strikingly similar across countries: what matters is marked gender differences in the rewards to similar basic human capital characteristics, not gender differences in these endowments.

Keywords: Gender wage gap, decomposition, human capital, intangible capital, manufacturing, quantile regression, wage formation, cross-country comparison

JEL: J16, J31

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JEL-koodit: J16, J31

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1. Introduction

In tandem with developed countries becoming increasingly knowledge-based, researchers have shown growing interest in finding out how much countries actually invest in intangible capital and how important these investments are as determinants of productivity and, ultimately, economic growth. Several studies provide support for intangible capital investments playing a crucial role; for some countries such investments are estimated to account for an even larger share of GDP than investments in tangible capital. Van Ark et al. (2009), for instance, report that investments in intangible capital in the market sector accounted for some 11 per cent of GDP in the US and the UK in 2006, whereas the corresponding GDP-share of investments in tangible capital was 7–8 per cent. There is also ample evidence on intangible capital having boosted both labour productivity growth and GDP growth rates over the past decades (e.g. Corrado et al., 2009; Marrano et al., 2007; Jalava et al., 2007). Marrano et al. (2007), for example, estimate that as much as 20 per cent of UK labour productivity growth in 1995–2005 is explained by intangible capital deepening.

The fact that intangible capital has become one of the key factors behind productivity growth invites one to ask, whether the growing importance of intangibles has affected wage formation as well. Several studies exploring the effect of information and communication technologies (ICT) – an important component of intangible capital – on wage structures have presented evidence that ICT has, indeed, affected wage formation through, *inter alia*, increased returns to education (e.g. Kirby and Riley, 2007). In fact, the so-called skill-biased technological change is one of the most frequently proposed explanations for the increase in wage inequality experienced in many countries over the past decades (e.g. Beaudry and Green, 2005).

An important aspect of the effects of intangible capital on wage formation concerns its potential impact on the gender wage gap. There are several reasons why intangible capital might be of relevance in this context. First, it is a well-known fact that men and women tend to work in different industries, firms, occupations and job tasks (e.g. Meyersson-Milgrom et al., 2001; Korkeamäki and Kyyrä, 2006). Given that industries and firms differ in their investments in intangible capital and, hence, in their occupation structures, the effect of intangible capital on wages might not be gender-neutral. Another plausible channel through which intangible capital might affect the male–female wage gap is gender differences in the accumulation of human capital. Several studies show that women tend to accumulate less human capital than men due to their traditional role of being the main provider of child care within the family

(Waldfogel, 1998; Anderson et al., 2003). Accordingly, intangible capital can be expected to increase the gender wage gap to the extent it boosts the return on human capital.

Despite theoretical justifications for why intangible capital might affect men's and women's wages differently and, hence, influence gender wage differentials, there is surprisingly little research on the topic. One noticeable exception is a fairly recent paper by Moreno-Galbis and Wolff (2008). They analyze the impact of ICT by comparing gender wage gaps among ICT-users and non-ICT-users using survey data from France. Moreno-Galbis and Wolff find that although the general pattern of gender wage gaps is similar for the two worker groups, they nevertheless reveal clear-cut differences when it comes to key sources underlying the observed gender wage gaps. Among ICT-users, the wage advantage of men over women is driven by women's lower returns to human capital related characteristics. Among non-ICT-users, on the other hand, the gender wage gap is only partly due to this 'price-effect' – gender differences in observed characteristics matter as well. In particular, Moreno-Galbis and Wolff find that the male–female wage differentials among non-ICT-users located in the upper part of the wage distribution are explained by the advantage of men over women in their rewards to similar human capital characteristics, whereas the gender wage gaps in the bottom half of the wage distribution are rather explained by gender differences in human capital endowments.

This paper examines the effects of intangible capital on wage formation by comparing wage differentials across occupation groups which, in a second step, are further broken down by gender. The analysis is undertaken by use of comparative data from three European countries: the Czech Republic, Finland and Norway. A comparison of these countries is well-justified on several grounds. First, they reveal clear differences in intangible capital investments. According to data produced within the framework of the INNODRIVE project, the intangibles-to-GDP share was in 2005 some 8 per cent in the Czech Republic, 7.3 per cent in Finland and 4.5 per cent in Norway. The three countries provide an interesting point of comparison also in that they differ in terms of the average size of the overall gender wage gap and also with respect to the institutional background affecting gender equality in the labour market. According to figures for 2007 recently published by Eurofound (2010), the average unadjusted gender gap in hourly wages was some 15 per cent in Norway compared to 20 per cent in Finland and 24 per cent in the Czech Republic. An illustrative example of the institutional differences between the countries relates to family policy.[2] Norway and Finland typically claim top positions in the listings ranking countries on the grounds of the generosity of their family leave policies, while the Czech Republic ranks much lower in this respect (e.g. Mandel and Semyonov, 2003). Norway also counts

[2] For a more detailed discussion about recent developments in gender equality policies in the Czech Republic, Finland and Norway, see e.g. European Commission (2010).

among the countries having taken quite drastic measures in order to narrow gender differences in careers and wages. For example, legislation on gender representation on company boards was introduced in Norway in 2006, enforcing a minimum proportion of both genders on these boards of 40 per cent in all privately-owned public limited companies. No similar policies are in place in Finland or the Czech Republic. Accordingly, comparing patterns of gender wage gaps across these three countries is not only of general interest but also provides a convenient way to test the robustness of our findings. If we can see similar mechanisms behind gender wage differentials in all three countries, then this would suggest that we have identified some 'fundamental' sources of the observed male–female wage gaps and not merely arbitrary factors reflecting, say, the institutional features of a country.

In contrast to previous studies focusing on one single country, our paper provides cross-country evidence on the effect of intangible capital on wages. We also add to the vast literature on gender wage gaps in two major ways (for comprehensive reviews, see e.g. Altonji and Blank, 1999; Blau and Kahn, 2000; Kunze, 2008). First, our paper contributes to the scant present-day evidence on the possible role of intangible capital in explaining wage differentials between men and women. As will become evident later on, we thereby adopt a somewhat broader definition of intangible capital than, for instance, Moreno-Galbis and Wolff (2008). Second, we add to the literature by applying a wage decomposition method based on unconditional quantile regressions developed by Melly (2005a, 2005b, 2006). This method allows us to decompose the observed wage gaps along the whole range of the wage distribution and not merely at the mean, as is the case with the more traditional decomposition methods such as Blinder (1973) and Oaxaca (1973). In view of the recent findings of increasing gender wage differentials when moving up through the wage distribution (e.g. Albrecht et al., 2003; Arulampalam et al., 2007; Napari, 2009), considering the whole wage distribution can be expected to provide important new insights into the mechanisms behind the male–female wage gaps. Indeed, despite their great potential, decomposition methods based on unconditional quantile regression techniques have so far been applied in few gender wage-gap studies (see e.g. Chzhen and Mumford, 2009, and the references therein).

The rest of the paper is organized as follows. The next section provides a brief outline of the decomposition method used. This is followed, in Section 3, by a description of the datasets and a discussion of the descriptive statistics for the three countries under study. Section 4 reports the decomposition results. The paper ends with a summary of our main conclusions.

2. Estimation method

We investigate wage differentials across both occupation groups and genders by implementing a decomposition method based on unconditional quantile regressions.[3] More specifically, our estimation method comprises three distinct steps. First, conditional wage distributions are estimated by use of quantile regression techniques. The second step includes estimation of the corresponding unconditional distributions by integrating the first-step conditional wage distributions over the full range of background characteristics accounted for in the quantile regressions. The final step decomposes the differences in the estimated counterfactual wage distributions across occupation groups and genders into two components: one which captures the contribution of differences in estimated coefficients (i.e. the price effect) and one which measures the contribution of differences in the characteristics considered (i.e. the composition effect). In what follows, we describe each of these three steps in more detail.

Regarding the first step – i.e. the estimation of whole conditional wage distributions using quantile regression techniques – assume, following Koenker and Bassett (1978), that[4]

$$F_{y|x}^{-1}(\tau|x_i) = x_i\beta(\tau), \quad \forall\, \tau \in \left]0,1\right[, \tag{1}$$

where $F_{y|x}^{-1}(\tau \mid x_i)$ is the τ^{th} quantile of the log wage distribution y conditional on a vector of characteristics x_i with (y_i, x_i) representing an independent sample $i = 1,\ldots, N$ drawn from some population. As is shown by Koenker and Bassett (1978), $\beta(\tau)$ in eq. (1) can be estimated, separately for each quantile τ, by

$$\widehat{\beta}(\tau) = \underset{b\in R^K}{\arg\min} \frac{1}{N}\sum_{i=1}^{N}(y_i - x_i b)(\tau - 1(y_i \le x_i b)), \tag{2}$$

where 1(.) is the indicator function. Since the dependent variable is the logarithm of wages, eq. (2) results in a vector of coefficients which can be interpreted as wage effects of the different characteristics at a particular quantile of the conditional wage distributions estimated.

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[3] For a detailed outline of the method used, see e.g. Machado and Mata (2005) and Melly (2005a, 2005b, 2006).

[4] The notation is simplified by suppressing the dependence on the occupation and gender dimension, respectively.

From eq. (1) it is evident that an infinite number of quantile regressions could be estimated, but with large datasets such as those used in this paper, estimation of the whole quantile regression process would become too time consuming. Instead, we estimate a specific number of quantile regressions uniformly distributed over the wage distribution, and assume that the solution only changes at these specific points, not on the interval between the points. This procedure gives a finite number of quantile regression coefficients, $\hat{\beta}(\tau_1),\ldots,\hat{\beta}(\tau_j),\ldots,\hat{\beta}(\tau_J)$.

In the second step, estimates of unconditional quantiles, θ, of the log wage distribution, y, are derived by replacing each conditional estimate $F_{y|x}^{-1}(\tau_j \mid x_i)$ by its consistent estimate $x_i\hat{\beta}(\tau_j)$. Thus, the θ^{th} quantile of the log wage distribution can be estimated by

$$\hat{q}(\hat{\beta},x)=\inf\left\{q:\frac{1}{N}\sum_{i=1}^{N}\sum_{j=1}^{J}(\tau_j-\tau_{j-1})1\!\!1\left(x_i\hat{\beta}(\tau_j)\leq q\right)\geq\theta\right\}, \tag{3}$$

where taking the infimum ensures that the finite sample solution is unique.

In the final step, the procedure for simulating the counterfactual distribution described above is used for decomposing the overall wage gap between occupations and genders along the whole wage distribution into one part capturing the effects of differences in estimated coefficients and another part measuring the contribution of differences in characteristics. If it is assumed that the linear quantile regression model is correctly specified, the residual component in the decomposition of the differences in wage distributions between worker group *m* and worker group *n* vanishes asymptotically, and the resulting decomposition of the overall wage differentials between the two worker groups under scrutiny can be written as[5]

$$\hat{q}(\hat{\beta}^m,x^m)-\hat{q}(\hat{\beta}^n,x^n)=\left(\hat{q}(\hat{\beta}^m,x^m)-\hat{q}(\hat{\beta}^n,x^m)\right)+\left(\hat{q}(\hat{\beta}^n,x^m)-\hat{q}(\hat{\beta}^n,x^n)\right), \tag{4}$$

where the first term on the right-hand side of eq. (4) measures the price effect, that is, the contribution of worker groups *m* and *n* being differently rewarded in the labour market for similar background characteristics. The second term captures the component effect, that is, the contribution of differences in these same characteristics between the two worker groups compared.

[5] As will become evident later on, the effect of the residuals is, indeed, almost persistently negligible, thus indicating the good fit of the models estimated. The only exceptions are the two tails of the wage distribution.

In the subsequent section (Section 4) presenting major results from our analysis, we focus entirely on the decomposition of wage differentials across occupation groups and genders. In other words, we will report results from the final estimation step only. This decomposition of overall wage gaps is undertaken by use of the Stata command *rqdeco* coded by Melly (2006). More precisely, the decomposition results reported in Section 4 are produced by estimating a grid of 100 different quantile regressions distributed uniformly between the two tails of the wage distribution. In order to keep the processing time reasonable, a 50 per cent random sample is drawn from the total datasets available, leaving the sample for each country considered still large enough to produce precise estimation results. But before turning to these results, we present, in the next section, the data used and highlight the wage gaps across occupation groups and genders characterizing the three countries under study.

3. Data and descriptive evidence

We use data from three European countries: the Czech Republic, Finland and Norway. The data for the Czech Republic comes from a national employer survey *The Information System on Average Earnings (ISAE)* directed to for-profit firms. This survey, to which firms are obliged to respond, is conducted on behalf of the Czech Ministry of Labour and Social Affairs, and covers all industries, ownership groups and firm sizes.[6] The Finnish data comes from the administrative records of the member firms of the Confederation of Finnish Industries (EK), which is the central organization of employer associations in Finland. EK collects its data by sending annual surveys to its member firms and, since it is mandatory for the firms to respond to the survey, the non-response bias is practically non-existent. The coverage of the EK database is broad, comprising roughly half of all private-sector employees in Finland. The Norwegian dataset comes from Statistics Norway and covers the whole economy, self-employment excluded. Information on wages and human capital endowments, apart from education, is obtained from the Norwegian Tax Directorate's Register of Wage Sums. Data on education comes from the National Education Database.

Our analysis focuses on white-collar manufacturing workers. For Norway and the Czech Republic, white-collar workers are identified by means of NACE and occupational codes (ISCO-88). For Finland, on the other hand, industrial and occupational codes are not needed for the identification of white-collar workers in manufacturing as data on their part is collected separately by EK. A major reason for restricting our analysis to white-collar manufacturing workers is that the occupational classification of this particular worker group allows a fairly straightforward and systematic allocation of individuals into

[6] More information on the datasets used for the Czech Republic, Finland and Norway is provided in e.g. Jurajda and Paligorova (2009), Napari (2009) and Nilsen et al. (2010), respectively.

two broad occupation groups with respect to intangible capital. In particular, white-collar workers performing either ICT- or R&D-related job tasks, as well as those involved in the production of organizational competencies – i.e. management and marketing – are labelled innovation workers (INNO-workers). All other white-collar workers are classified as non-innovation workers (non-INNO workers).[7]

For all three countries under study we use individual-level data from 2006 confined to those aged 18 to 64. We exclude a minor number of observations with suspiciously low or high wages. The final dataset contains 116,208 white-collar workers for Finland, out of which 34.5 per cent are women. For the Czech Republic we have 189,248 individuals, the female share being 35.8 per cent. Finally, the Norwegian data includes 107,121 white-collar workers, out of which 25.6 per cent are women. Hence, the female share is of a similar magnitude for Finland and the Czech Republic while it is notably lower for Norway. Table 1 presents more detailed country-specific information on the number of observations by occupation group and gender.

The applied wage measure is the total hourly wage.[8] The exact definition of the wage variable varies slightly across the three countries but is, nonetheless, well suited for undertaking cross-country comparisons. In the Finnish data, total hourly wages are calculated by using information on each individual's total monthly earnings (basic monthly wage plus possible bonuses and fringe benefits) and regular weekly working hours. In Norway, total hourly wages are defined as annual earnings divided by normal (contracted) hours for the duration of the job within the year. In the Czech Republic data, finally, total hourly wages are calculated as total quarterly cash compensation and bonuses divided by total hours worked in that quarter.

Table 1 Number of observations by country, occupation group and gender

	Czech Republic		**Finland**		**Norway**	
	Male	**Female**	**Male**	**Female**	**Male**	**Female**
Innovation workers	59507	19552	54073	25664	16509	2452
Non-innovation workers	61920	48269	22070	14401	63235	24925

[7] Compared to, for instance, Moreno-Galbis and Wolff (2008), we adopt a somewhat broader definition of intangible capital. Görzig et al. (2011) provide a detailed discussion of measurement issues related to intangible capital and justify why, apart from ICT and R&D personnel, also those engaged in organizational work should be accounted for when constructing a measure for intangible capital.

[8] Wages are converted into euros using the annual average exchange rates as published by ECB.

Table 2 gives descriptive statistics, separately for the Czech Republic, Finland, and Norway, for the average total hourly wage of white-collar manufacturing workers broken down by occupation group and gender. In all three countries, innovation workers earn, on average, higher hourly wages than non-innovation workers, the average wage gap being largest (1.41) in the Czech Republic and smallest (1.20) in Finland. For Norway, the average wage gap between innovation and non-innovation workers settles quite close to that of Finland, or at 1.26. When it comes to the average gender wage gap and its variation across occupation groups and countries, we see, first of all, that the average gender wage gap is slightly higher among innovation workers than among non-innovation workers in both the Czech Republic and Finland, whereas the opposite holds true for Norway. Table 2 also reveals that the average gender wage gap is smallest in Norway and largest in the Czech Republic, irrespective of the occupation group considered. Finland falls in-between, but seems to settle closer to the Czech Republic than to Norway with respect to average gender wage gaps among white-collar manufacturing workers.

Figure 1 provides a more detailed description of the wage differentials between innovation and non-innovation white-collar workers in manufacturing by presenting the wage gaps along the whole range of the wage distribution. As is evident from the figure, the average wage gap between innovation and non-innovation workers hides, indeed, a lot of variation across the wage distribution. There are marked country differences also in this respect. In Finland, the wage advantage of innovation workers over non-innovation workers increases considerably when moving up through the wage distribution. In the Czech Republic, the wage gap to the favour of innovation workers has a much flatter profile; it is practically constant over most of the wage distribution, only to start increasing towards the top end of the distribution. In Norway, in contrast, the wage gap between the two occupation groups decreases along the wage distribution, with the decline accelerating in the upper half of the wage distribution.

Table 2. Average total hourly wage of white-collar manufacturing workers, 2006, by occupation group, gender and country

	Czech Republic		**Finland**		**Norway**	
	INNO	**non-INNO**	**INNO**	**non-INNO**	**INNO**	**non-INNO**
All	6.39	4.52	20.73	17.21	29.68	23.61
INNO/non-INNO	1.41		1.20		1.26	
Males	6.82	5.03	22.34	18.55	30.00	24.40
Females	5.08	3.86	17.33	15.16	27.50	21.60
Females/Males	0.75	0.77	0.78	0.82	0.92	0.89

Notes: INNO refers to innovation workers and non-INNO to all other white-collar manufacturing workers (see definition in the text). Wages are in euros.

Figure 1. Variation across the wage distribution in the INNO/non-INNO wage ratio

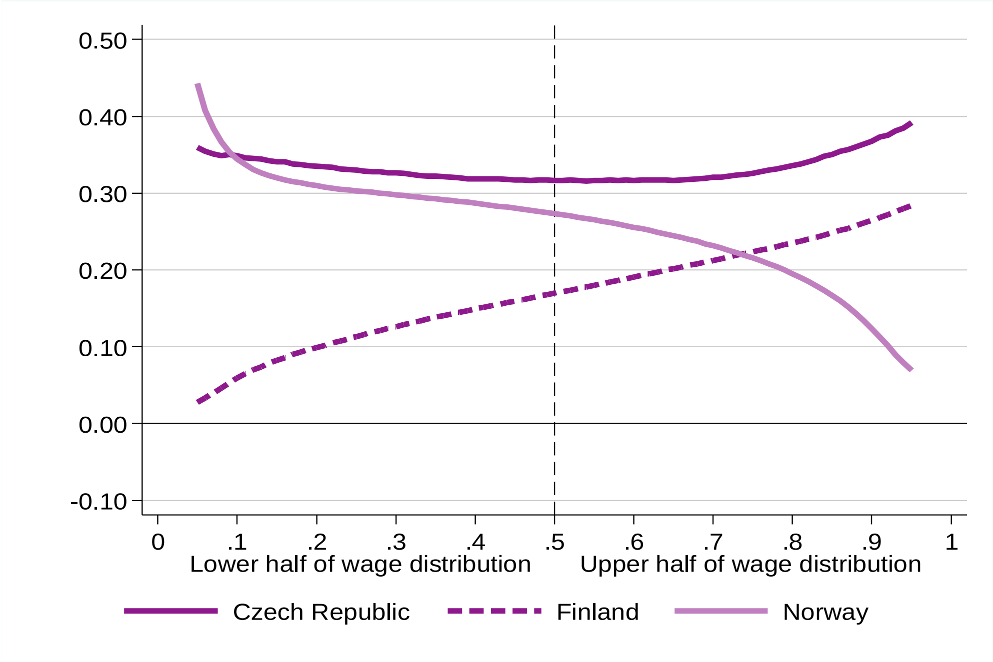


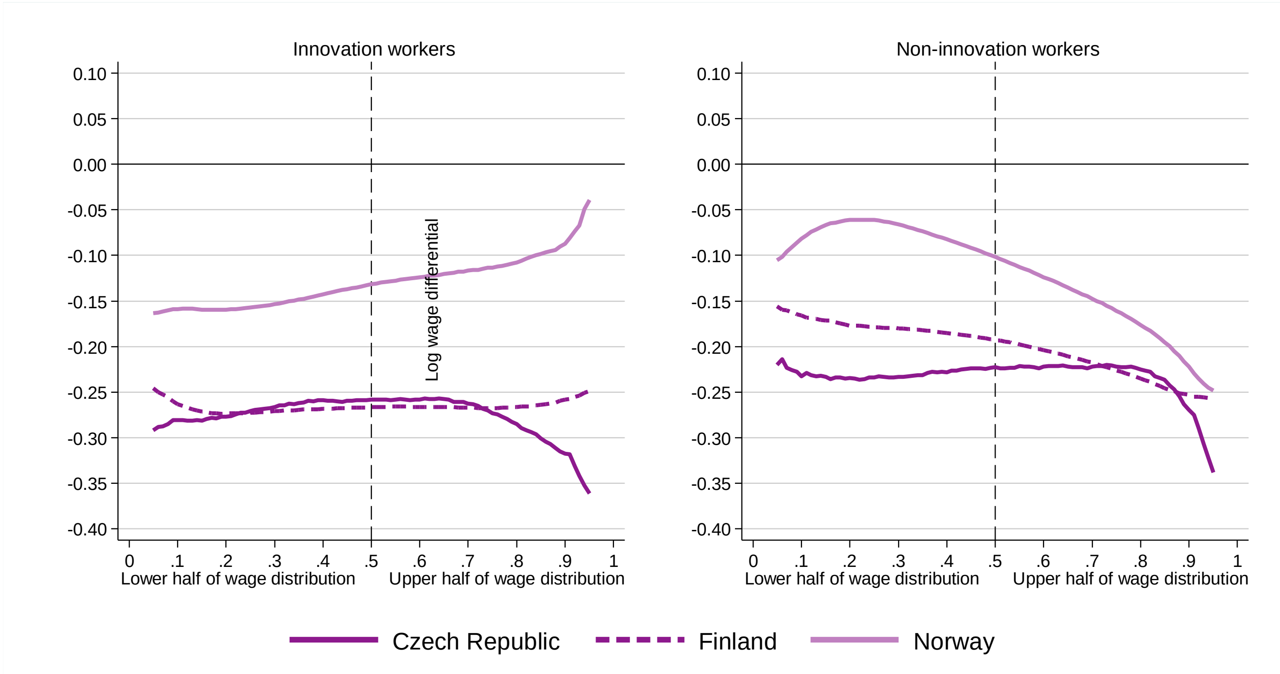
Figure 2 focuses on the gender wage gap at various points of the occupation-specific wage distributions. Several previous studies on gender wage differentials have found that the male–female wage gap is all but constant across the wage distribution (e.g. Albrecht et al., 2003; Arulampalam, 2007). Also our results reveal that there is considerable variation in the gender wage gaps along the wage distribution in all three countries under study. Starting with the results for non-innovation workers, they unravel a clear tendency of increasing gender wage differentials when moving up through the wage distribution. This tendency is most outstanding for Finland and especially for Norway. In Norway, for instance, the gender wage gap varies between 5 and 10 per cent in the lower half of the wage distribution, but is as high as 25 per cent at the top end of the wage distribution. In Finland, the gender wage gap among non-innovation white-collar workers increases steadily towards the upper tail of the wage distribution, where it settles at approximately the same level as in Norway. In the Czech Republic, finally, the gender wage gap among non-innovation white-collar manufacturing workers is more or less constant all the way up to the 80th percentile, but increases substantially after this point. However, these top-end calculations of gender wage gaps suffer from few female observations.

The results are for the most part quite different for innovation workers. In Norway, instead of observing increasing gender wage differentials when moving up through the wage distribution, the profile of the gender wage gap among innovation workers is actually the opposite with much smaller wage gaps observed for the upper half of the wage distribution. In Finland, on the other hand, the gender wage differentials among innovation workers do not vary much across the wage distribution. In contrast to Finland and Norway, the overall pattern of gender wage differentials is in the Czech Republic quite similar for innovation and non-innovation workers; that is, the gender wage gap remains fairly constant, or even decreases somewhat, when moving up through the wage distribution but, suddenly, at some high percentile point starts to increase quite markedly. As already noted, these findings are primarily driven by a small number of female observations at the top end of the wage distribution.

Taken together, Figures 1 and 2 clearly suggest that in order to fully understand the factors behind the wage differentials prevailing between innovation and non-innovation workers, as well as the gender wage gaps existing within these occupation groups, it is of utmost importance to undertake the wage decomposition along the whole range of the wage distribution, not merely at its mean.

Table 3, finally, presents descriptive statistics for the three countries under scrutiny, broken down by occupation group and gender, for the traditional measures of human capital accounted for in the subsequent decomposition analysis: years of schooling, years of potential work experience and seniority (years in current employment relationship).[9] The table shows that in all three countries, innovation

Figure 2. Variation across the wage distribution in the female-over-male wage ratio, 2006, by occupation group and country



[9] For the Czech Republic we do not have information on seniority, though.

workers are, on average, more educated than are non-innovation workers. This difference in average years of schooling is largest for Norway (1.17), slightly lower for the Czech Republic (1.14) and lowest for Finland (1.08). Moreover, the same overall pattern shows up for both men and women. From the table it is also evident that the gender differences in years of schooling are typically small. In the Czech Republic and Finland women are, on average, only slightly less educated than are men, irrespective of the occupation group considered. In Norway, the situation is the opposite.

When the two occupation groups are compared with respect to the accumulated general and employer-specific work experience, non-innovation workers seem to have a clear advantage over innovation workers. Also the differences across genders are more conspicuous. In Norway, women tend to accumulate less general work experience, and they also seem to stay at the same employer for substantially shorter time periods as compared to their male counterparts. This pattern is discernible for both occupation groups, although these particular gender differences are more outstanding among innovation workers than among non-innovation workers. In Finland, the situation is quite different in the sense that women have typically accumulated more general as well as employer-specific work experience than men, the only exception being female non-innovation workers who tend to have slightly shorter careers with their current employer than do male non-innovation workers. Finally, in the Czech Republic male innovation workers have more general experience than their female colleagues, whereas the opposite holds true among non-innovation workers.

Table 3. Descriptive statistics for the measures of human capital used in the analysis, 2006, by occupation group, gender and country

	Czech Republic				Finland				Norway			
	All	Male	Female	Female/ Male	All	Male	Female	Female/ Male	All	Male	Female	Female/ Male
Years of schooling:												
INNO	14.18	14.20	14.10	0.99	14.08	14.30	13.60	0.95	13.39	13.30	14.00	1.05
non-INNO	12.47	12.60	12.30	0.98	13.10	13.20	13.00	0.98	11.51	11.40	11.80	1.04
INNO/non-INNO	1.14	1.13	1.15		1.07	1.08	1.05		1.16	1.17	1.19	
Work experience:												
INNO	21.15	21.60	19.80	0.92	20.23	19.50	21.80	1.12	24.11	24.60	20.80	0.85
non-INNO	23.14	22.40	24.10	1.08	24.21	23.90	24.60	1.03	24.73	24.90	24.30	0.98
INNO/non-INNO	0.91	0.96	0.82		0.84	0.82	0.89		0.97	0.99	0.86	
Seniority:												
INNO	-	-	-	-	10.68	10.20	11.70	1.15	5.85	6.10	4.20	0.69
non-INNO	-	-	-	-	14.16	14.30	13.90	0.97	4.87	5.10	4.30	0.84
INNO/non-INNO	-	-	-	-	0.75	0.71	0.84		1.20	1.20	0.98	

4. Wage decomposition results

Figure 3 presents results from the decomposition of the wage gaps (in log total hourly wages) observed between innovation and non-innovation white-collar manufacturing workers along the whole wage distribution, using the methodology outlined in Section 2.[10] By undertaking the wage decomposition along the whole range of the wage distribution we get information on possible variation in the relative importance of differences in the composition and in the rewarding of basic human capital endowments in explaining the wage differentials prevailing between these two occupation groups at various points of the wage distribution. The figure displays both the composition and the price effect, with their sum equalling the total wage differential between innovation and non-innovation workers.

While both the level and the profile of the wage gaps observed between innovation and non-innovation workers differ substantially between the three countries, so do also the underlying sources of these wage gaps, as is evident from Figure 3. Starting with the Czech Republic, the composition effect is estimated to account for a relatively large part of the total wage gap between the two occupation groups. Furthermore, the importance of the composition effect increases when moving up through the wage distribution, clearly outweighing the price effect among those earning above the median wage. In other words, the wage gap between innovation and non-innovation workers located in the upper half of the wage distribution is primarily driven by differences in basic human capital endowments rather than by differences in the rewarding of these endowments. At the bottom end of the wage distribution, on the other hand, the composition and the price effect are approximately equally important explanatory factors.

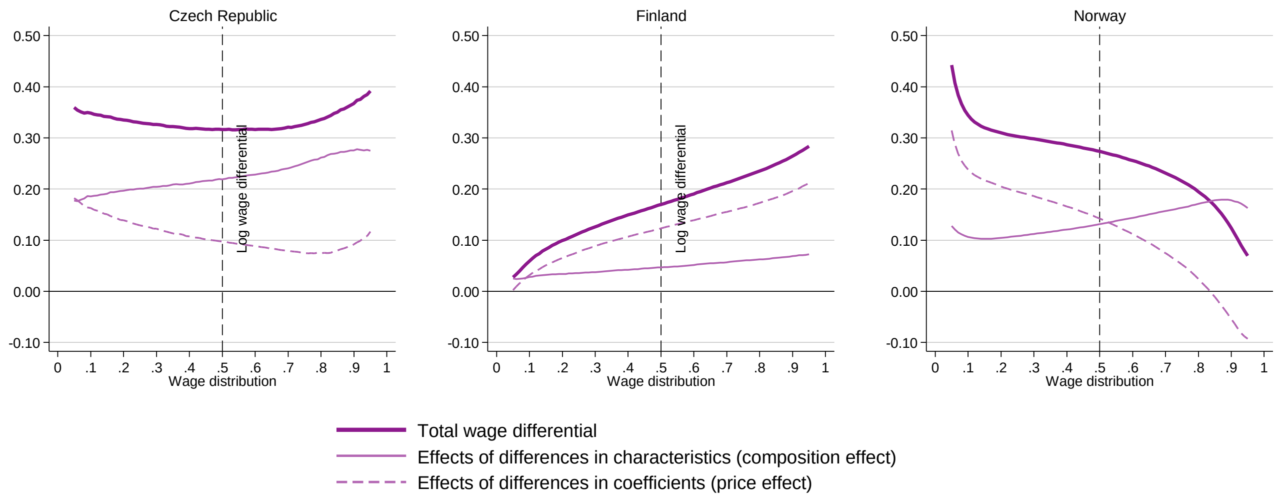
In Finland, the sources underlying the wage gaps observed between innovation and non-innovation workers are very different from those characterizing the Czech Republic. Among Finnish white-collar manufacturing workers, most of the wage differentials prevailing between these two occupation groups are explained by the price effect, that is, by non-innovation workers being less rewarded than innovation workers for similar basic human capital endowments. Indeed, the price effect strongly dominates over the composition effect at all points along the wage distribution despite the fact that the absolute importance of the composition effect increases somewhat when moving up through the wage distribution.

[10] In line with previous studies using the Machado and Mata (2005) or the Melly (2005a, 2005b, 2006) decomposition method, no attempt is made to account for the possible presence of sample selection or endogeneity problems. In the present context, these may arise from including women in the analysis, from confining the analysis to a particular sector (manufacturing) and particular occupation groups and from relying on individual attributes which are likely to involve choices and selections.

In Norway, finally, the overall picture of the factors contributing to the wage gaps observed between innovation and non-innovation workers seems very different compared to the situation in the Czech Republic and Finland. However, a closer look mediates the impression that the Norwegian situation resembles in several respects the situation in the Czech Republic, especially if ignoring the results for Norway in relation to the extreme tails of the wage distribution. More precisely, in the lower end of the wage distribution, the price effect plays a more important role than the composition effect. Broadly speaking, about two-thirds are attributable to the price effect leaving about one-third for the composition effect. The relative importance of the price effect shrinks, however, rapidly when moving up through the wage distribution, whereas the composition effect gains strength. Indeed, at the top end of the wage distribution the wage gap between innovation and non-innovation workers is entirely explained by differences in human capital endowments.

Figures 4 and 5 display the corresponding decomposition results for the gender wage gaps, separately for innovation workers and non-innovation workers. When it comes to the major sources underlying the gender wage gaps, the results for the three countries under study are much more similar compared to the results for the factors explaining the wage differentials observed between the two occupation groups. Focusing first on innovation workers, in all three countries differences in basic human capital endowments between men and women account for only a small part of the total gender wage gap. This suggests that the wage differentials prevailing between male and female white-collar innovation workers

Figure 3. Decomposition of wage gaps between innovation and non-innovation workers, 2006, by country



in manufacturing are mainly driven by women being less rewarded than men for similar human capital endowments. However, while the dominance of the price effect over the composition effect strengthens even further in Finland and Norway when moving up through the wage distribution, the opposite holds true in the Czech Republic.

Turning then to non-innovation workers, it is highly evident from the decomposition results displayed in Figure 5 that the factors contributing most strongly to the gender wage gaps observed within this particular occupation group are the same as for innovation workers. In particular, the wage differentials across genders are almost entirely due to male and female non-innovation workers being differently rewarded for similar basic human capital endowments. In the Czech Republic, the price effect is slightly less important at the top end of the wage distribution than further down the wage scale but, nonetheless, strongly dominant over the composition effect also among the highest-paid. This is similar to what we found for the country's innovation workers. For Finland, the relative importance of the price effect is even more outstanding than in the case of innovation workers. Indeed, the price-effect curve is almost identical to the overall wage-gap curve, implying that the gender wage gaps observed among non-innovation workers are to almost 100 per cent explained by different rewarding of basic human capital endowments. For Norway, finally, the outcome is very similar to what is observed for Finland in the sense that the total wage-gap and price-effect curves are almost identical. However, in Norway the price-effect curve is located below (and not above, as in Finland) the total wage-gap curve. This is due to the fact that, in Norway, the differences in basic human capital endowments between

Figure 4. Decomposition of gender wage gaps, innovation workers, 2006, by country

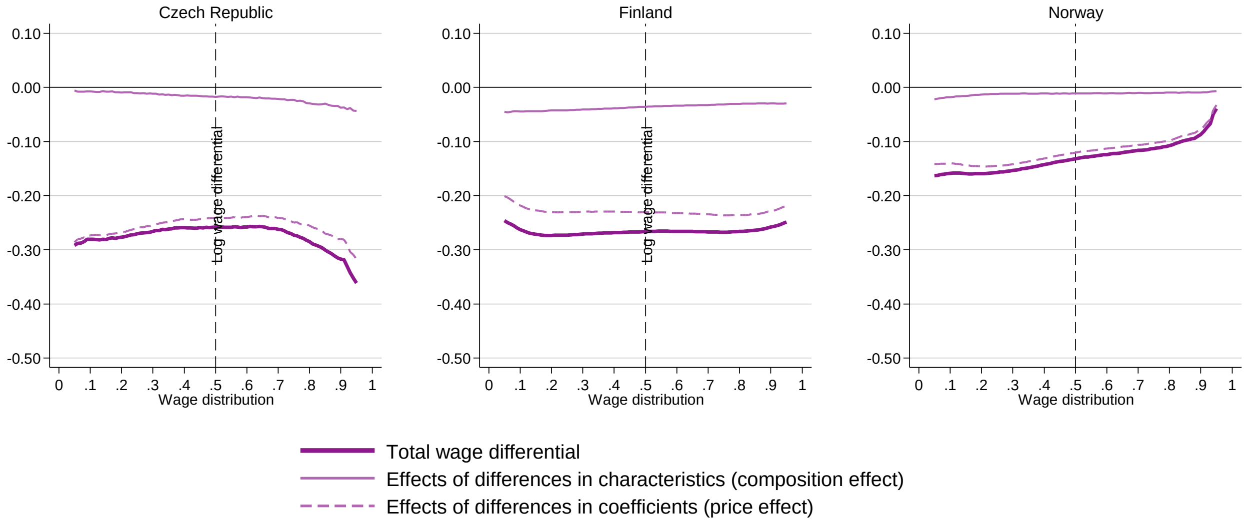
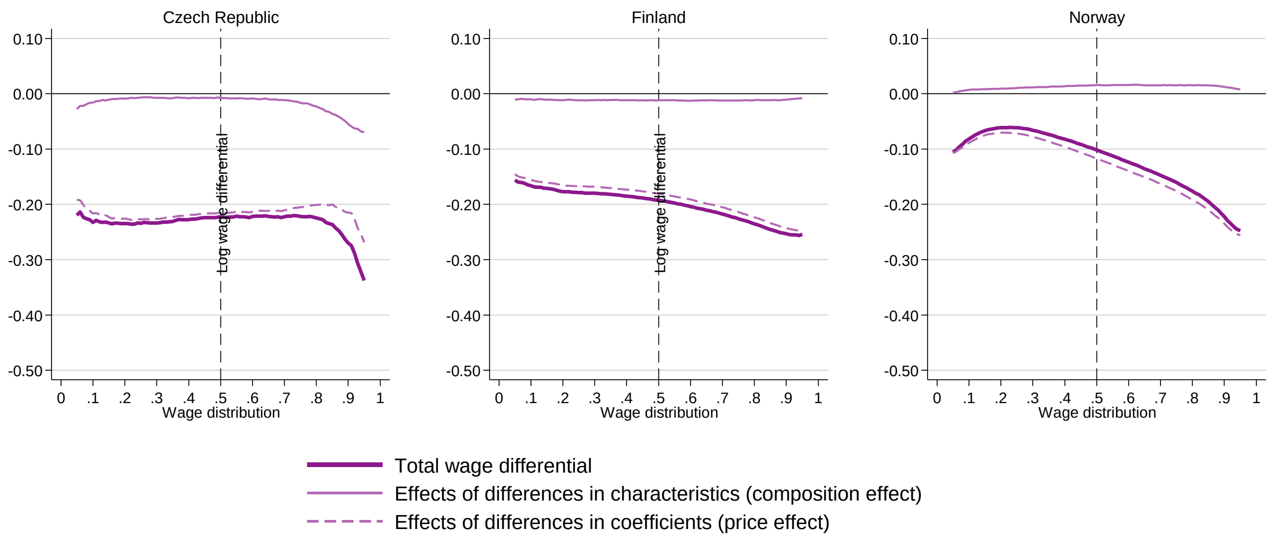


Figure 5. Decomposition of gender wage gaps, non-innovation workers, 2006, by country



male and female non-innovation workers turn out to have a weak positive effect on the gender wage gap. In other words, with no price effect influencing the gender wage gap, women would, in effect, earn more than men.

5. Conclusions

Earlier literature shows that intangible capital has had an important impact on both labour productivity growth and GDP growth rates over the past decades. There is plenty of evidence suggesting that intangible capital has affected wage structures as well. Our paper continues on the line of research investigating the effects of intangible capital on wage formation by comparing the wages of two broad occupation groups among white-collar manufacturing workers. The first occupation group, labelled innovation workers, includes individuals performing ICT- or R&D-related job tasks, as well as individuals involved in the production of organizational competencies – i.e. management and marketing. The second group, non-innovation workers, comprises all other workers. Categorizing workers into these two occupation groups is well justified given the distinctly different role that intangible capital plays in these two occupation groups.

The major contributions of our paper are threefold. First, by using comparative data from three European countries – the Czech Republic, Finland and Norway – we can provide cross-country evidence on the effects of intangible capital on wages. Second, we pay special attention to gender differences in wages within and between the groups of innovation and non-innovation workers, thus adding to the scant present-day evidence on the potential role of intangible capital in explaining wage differentials between men and women. Finally, we explore wage gaps across occupation groups and genders by applying a decomposition method based on unconditional quantile regressions which allows us to investigate the sources underlying these overall wage gaps along the whole range of the wage distribution and not merely at its mean, as in studies relying on more traditional wage decomposition methods.

For all three countries, we find that innovation workers earn, on average, higher wages than do non-innovation workers, the wage gap being largest in the Czech Republic and smallest in Finland. When it comes to male–female wage differentials, we observe that the average gender wage gap is larger among innovation workers than among non-innovation workers in the Czech Republic and Finland, whereas the opposite holds true for Norway. Our results also show that the average gender wage gap is, in both occupation groups, lowest in Norway and highest in the Czech Republic, with Finland falling in-between.

A closer look at wage gaps along the whole range of the wage distribution reveals, though, that these average wage gaps hide a lot of variation across the wage distribution. Furthermore, there are also considerable country differences in this respect. In Finland, the wage gap between innovation workers and non-innovation workers increases substantially when moving up through the wage distribution while in the Czech Republic, these wage gaps reveal a much flatter profile across the wage distribution with only a small increasing trend when approaching the top end of the distribution. In Norway, in contrast, the wage gap between innovation and non-innovation workers decreases along the wage distribution.

Also the size of the gender wage gap varies considerably along the wage distribution. For Finland and Norway, there is a clear tendency of increasing gender wage gaps when moving up through the wage distribution of non-innovation workers, whereas in the Czech Republic the wage gap between male and female non-innovation workers is practically constant across the wage distribution, except for its top end. The results for innovation workers are mostly quite different. In Norway, the profile of the gender wage gaps takes the opposite shape when shifting over to innovation workers. More precisely, instead of observing increasing gender wage gaps along the wage distribution as in the case of non-innovation workers, the gender wage gap among innovation workers is actually much smaller in the upper tail of the wage distribution than further down the wage scale. In Finland, the gender wage gap among innovation workers shows only small variation across the wage distribution, which is to be compared to increasing wage gaps among non-innovation workers. The strongest similarity in gender wage-gap profiles between innovation and non-innovation workers is found for the Czech Republic, where the male–female wage differentials reveal, in both occupation groups, a marked increase when approaching the top end of the wage distribution from having been practically constant hitherto.

The decomposition results indicate that the wage differentials observed between innovation and non-innovation workers in the Czech Republic are first and foremost explained by innovation workers being equipped with more basic human capital than are non-innovation workers. Moreover, the relative importance of the composition effect increases when moving up through the wage distribution. In Finland, on the other hand, the wage gaps observed between these two occupation groups are mainly driven by the price effect; that is, the wage disadvantage of non-innovation workers is down to their weaker rewarding of similar human capital endowments as compared to innovation workers. For Norway, the corresponding decomposition results are less clear-cut, but seem to paint a picture that resembles more the situation in the Czech Republic than in Finland. More precisely, while the price effect dominates the composition effect at the lower end of the wage distribution, the relative importance of the price effect shrinks rapidly when moving up through the wage distribution. Indeed, differences in human capital endowments seem to explain most of the wage differentials between the highest paid innovation and non-innovation workers.

When it comes to the main sources underlying the observed gender wage gaps, our results are remarkably similar for all three countries. In both occupation groups, the wage differentials across genders are driven by women being less rewarded for similar human capital endowments. Despite certain country differences in relation to the relative importance of the price effect at the various points of the wage distribution, the bottom line is that the price effect drives the gender wage gap along the whole range of the wage distribution.

In sum, in all three countries under scrutiny innovation workers earn more than non-innovation workers. However, both the levels and profiles of these wage differentials reveal considerable variation across the three countries, as do also the main sources underlying the observed wage gaps. This variation is likely to reflect differences in the countries' industrial structures and institutional set-ups. Also the levels and profiles of the gender wage gaps observed within these two occupation groups display marked variation. The sources behind these gender wage gaps are, however, strikingly similar across countries and occupation groups. In particular, it is the price effect that matters, not gender differences in basic human capital endowments.

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