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# Is There a Glass Ceiling over Europe?
# Exploring the Gender Pay Gap across the Wages Distribution

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## ABSTRACT

Using harmonised data from the European Union Household Panel, we analyse gender pay gaps by sector across the wages distribution for eleven countries. We find that the mean gender pay gap in the raw data typically hides large variations in the gap across the wages distribution. We use quantile regression techniques to control for the effects of individual and job characteristics at different points of the distribution, and calculate the part of the gap attributable to differing returns between men and women. We find that, first, gender pay gaps are typically bigger at the top of the wage distribution, a finding that is consistent with the existence of glass ceilings. Second, for some countries gender pay gaps are also bigger at the bottom of the wage distribution, a finding that is consistent with sticky floors. Third, the gender pay gap is typically higher at the top than the bottom end of the wage distribution, suggesting that glass ceilings are more prevalent than sticky floors. Fourth, the gender pay gap differs significantly across the public and the private sector wages distribution for each of our EU countries.



*Keywords:* glass ceilings, sticky floors, quantile regression, public sector, gender pay gaps.

*JEL Classification:* J16, J31, J7

## 1. INTRODUCTION

While the mean gender wage gap has been extensively studied in the labour economics literature, only relatively recently has attention shifted to investigating the degree to which the gender gap might vary across the wages distribution and why. Albrecht, Bjorklund and Vroman (2003) use 1998 data for Sweden and show that the gender wage gap is increasing throughout the wage distribution and accelerating at the top, and they interpret this as evidence of a glass ceiling in Sweden. de la Rica, Dolado and Llorens (2005) undertake a similar analysis using 1999 data for Spain. They stratify their sample by education group and find that the gender wage gap is expanding over the wage distribution only for the group with college/tertiary education. For less educated groups, the gender wage gap is wider at the bottom than the top. Thus in Spain for the more educated there is a glass ceiling while for the less educated there is not. Using a different decomposition methodology in the quantile regressions framework and Spanish data for 1995, del Rio, Gradin and Canto (2005) obtain similar results to de la Rica *et. al.*

The purpose of our paper is to investigate these issues further in order to see if the glass ceiling phenomenon is prevalent across pre-enlargement Europe. Using harmonised data from the European Union Household Panel, we analyse gender pay gaps across the wages distribution for eleven countries utilizing the quantile regression (QR) framework. We investigate the extent to which gender affects the location, scale and shape of the conditional wage distribution, and whether or not these patterns differ across the public and private sectors.

We first chart the gender pay gap using raw data and then compare the raw gender gaps with estimates which control for men's and women's attributes using the QR framework. This enables us to answer the question of how much of the observed gender pay gaps are attributable to differing returns. Unlike ordinary least squares

(OLS), QR methods allow for the possibility that characteristics may have different returns at different points of the distribution. We find that, for some of our countries in both the public and private sectors, the gender wage gap is typically wider at the top and occasionally also wider at the bottom of the wage distribution. Following Albrecht et al (2003), we interpret the gender wage gap at the top of the wage distribution as a *glass ceiling*. At the bottom of the wage distribution, for some of our EU countries, we also find that the gender pay gap widens significantly. We define this phenomenon as a *sticky floor.*[1] We find that differences in returns account for a large part of the variation in the gender pay gap across the wages distribution. In Section 4 of the paper we discuss various hypotheses that could explain the empirical findings.

## 2. THE DATA, VARIABLES AND RAW GENDER WAGE GAP

Our data are from the European Community Household Panel (ECHP), a large-scale survey conducted annually from 1994 to 2001. The ECHP was specifically designed to be harmonised at the input stage: in most countries a standard questionnaire was used, with harmonised definitions and sampling criteria. Although a standardised questionnaire does not overcome the nuances of interpretation and meaning between different languages, the harmonised format greatly facilitates cross-country comparisons. We include in our analysis the eleven European countries listed in Table 1. We omit Greece and Portugal from our estimation owing to apparent gaps in the training data and because of the smaller estimating sub-samples with usable information. The ECHP data for Britain and Germany were adapted from their existing national household surveys,

[1] Booth, Francesconi and Frank (2003) first defined a *sticky floor* as the situation arising where otherwise identical men and women might be appointed to the same pay scale or rank, but the women are appointed at the bottom and men further up the scale. Such a strategy can evade some discrimination laws, since the appointment rank is the same. Here we use the term more generally to describe the situation where the gender pay gap widens at the bottom of the wages distribution, as will be further explained below.

while the other countries used the full harmonised questionnaire. Sample sizes are reported in column [5] of Appendix Table A.1.

The education, industry and occupation variables are all coded according to standard, internationally comparable definitions. Education levels are defined according to UNESCO's International Standard Classification of Education (ISCED). ISCED was intended for education policy analysis and was designed to be invariant to differences in national education systems.[2] The ECHP distinguishes between education completed to the lower secondary stage (ISCED 0-2), upper secondary education (ISCED 3) and post-secondary or tertiary education (ISCED 5-7). The data on industrial sector are categorised according to the European Union's Classification of Economic Activities in the European Community (NACE), while occupation is defined using the International Standard Classification of Occupation (ISCO-88). The Data Appendix lists the occupation and industry groups.

We initially estimated the gender pay gap separately for waves 2 and 8, in order to chart any changes that might have occurred between 1995 and 2001. Since there was little difference between the two sets of estimates, in our main model we estimate the gender gap over the entire sample of waves 2 to 8 inclusive,[3] pooling all the waves and also including wave dummies as explanatory variables in addition to the usual set of exogenous variables. For the pooled sample we do not require individuals to be present in all waves or in consecutive waves. We therefore have new entrants across waves, and

[2] For details, see http://www.unesco.org/education/information/nfsunesco/doc/isced_1997.htm

[3] We omitted wave 1 because first, it does not contain information about whether or not the respondent's employment contract was fixed term / casual. If temporary contract coverage varies between men and women, temporary contracts could be an important determinant of the gender wage gap. Second, the deflator used (the EU harmonised index of consumer prices, from Eurostat) is only available from wave 2. Also note that Austria did not join the ECHP until wave 2 and that Finland did not join until wave 3 (following its accession to the EU in 1995). Thus, we have seven waves of data for all countries except Finland, for which we have 6 waves.

we lose some individuals through attrition. Thus we have a changing composition of individuals. As reported in the final column of Table A.1, respondents are typically present in the panel for 4 waves. As we discuss below, we account for multiple observations on the same individuals in the calculation of the standard errors.

Because we wish to avoid conflating issues to do with gender and early educational enrolments, we exclude from our analysis individuals under the age of 22 years, and paid apprentices and those on special employment-related training schemes (who account for less than 1% of the sampled age group). Amongst older workers there may also be differential withdrawal from the labour force, depending, for example, on how early retirement schemes operate. We therefore exclude workers of 55 years and over. For each country, our estimating sub-samples – stratified by gender – comprise full-time and part-time public and private sector employees who are: (i) between the ages of 22-54 years inclusive; (ii) working at least 15 hours per week; (iii) not employed in agriculture; and (iv) with valid observations on all the variables used in the wage equations. The restriction of working at least 15 hours per week was necessary because of the nature of the ECHP data, where – in the first two waves – we were unable to distinguish individuals regularly working fewer than 15 hours from those out-of-the labour force. In addition, for those working fewer than 15 hours, the ECHP across all waves provides no information on firm size, public/private sector or tenure. Thus our estimating sub-samples will under-represent low-hours part-timers.[4]

[4] For most countries, low-hours part-timers represent only a tiny fraction of workers. Exceptions are Britain (6.4% of the sub-sample), Denmark (3.2%), the Netherlands (9.8%) and Ireland (4.0%). In all other countries the proportion of low-hours part-timers is under 3%.

The dependent variable is the log of the average hourly wage, including overtime payments, in the respondent's main job, deflated to 2001 prices.[5] The deflators are the European Union's harmonised indices of consumer prices (HICP; see *Eurostat Yearbook 2003*). The ECHP provide a rich set of controls, which are listed in the notes under Table 2. Unfortunately, the ECHP does not collect any information on either union status or union coverage, and so we are unable to control for this in our estimation. The data do not contain information on labour market experience, but we do include tenure (6 categories) and a binary indicator denoting whether the individual has had a spell of unemployment since 1989, which should capture some of the variation in workers' labour market attachment.

Throughout, we estimate our models for three sub-samples of data: a combined sample comprising both public and private sector workers, and then two disaggregated sub-samples, comprising public and private sector workers respectively. In the remainder of this section, we discuss the estimates of the raw gender wage gap for all three samples and then briefly present the methodology used to estimate the gender wage gap.

Table 1 reports estimates of the raw gender wage gap by country. The raw gap for the combined sample appears in Panel A (this combines public and private sector workers), for public sector workers in Panel B, and for private sector workers in Panel C.

Column [1] of Table 1 indicates the male percentage of the various sub-samples by country. From Panel A, we see that men form the majority of the workforce in all countries except Finland. Britain and Denmark have a very similar gender composition, at 50.5% and 50.8% respectively. Spain has the highest male proportion, at 62.2% of

[5] The log wage was calculated from the ECHP variables as log (wage) = log (PI211MG * (12/52) / PE005A) = log (normal gross monthly earnings from main job including overtime * (12/52) / hours in main job including overtime). No specific information is provided on overtime hours and premia.

employees. The Netherlands is a close second, at 59.7%, followed by Italy at 59.3%. The mean raw gender gap is presented in Column [2]. Inspection of Columns [3] to [7] reveals that in three countries – Ireland, Italy and Spain – the raw gender gap is decreasing as we move from the $10^{th}$ to the $90^{th}$ percentiles. These raw gaps are also illustrated in Figure 1. In contrast, there is a striking increase of 15-16 percentage points as we shift from the $10^{th}$ to the $90^{th}$ percentiles in Finland and from the $50^{th}$ to the $90^{th}$ percentiles in Denmark. For Britain, while the raw gender wage gap is rather large (its mean is 24.6%), it is relatively constant across the distribution.

This simple comparison suggests there is considerable heterogeneity across our EU countries. It also shows that measuring the gender pay gap at the mean of each distribution (that is, comparing an 'average' woman with an 'average' man) can produce a misleadingly simple picture of how men's and women's wages differ. This mean gap can hide larger or smaller gaps between high-paid men and women, or between low-paid men and women.[6]

Next consider the raw gaps for the public sector, presented in Panel B. We were interested in stratifying our sample by sector because institutions in the public and private sector are typically very different. In the public sector, organisations are largely

[6] Overall wage inequality differs substantially across countries. In our data, the countries with the most compressed raw log hourly wage distributions (public and private sectors combined) are Denmark followed by Italy, the Netherlands, Finland and Belgium, and then Austria. The country with the most unequal wages distribution is Ireland, followed by Spain, Britain and France and Germany. The $90^{th}$-$10^{th}$ percentile differentials of the raw log wage distributions are: Austria 0.94 log points; Belgium 0.90 log points; Britain 1.20 log points; Denmark 0.72 log points; Finland 0.90 log points; France 1.13 log points; Germany 1.01 log points; Ireland 1.32 log points; Italy 0.88 log points; Netherlands 0.89 log points; and Spain 1.30 log points. Although calculated from our samples of prime-aged workers, these figures are reasonably close to the 90-10 log wage differentials reported by Blau and Kahn (1996), whose sample included 4 of the countries considered here, and in OECD (1996). Both these studies used different data to those used here.

non-profit and thus isolated from the rigours of the market economy. Thus, in principle, they could more easily follow "tastes for discrimination" in their wage-setting behaviour. However, they are also subject to government objectives and policies. The European Union countries have adopted strong positions in favour of equal opportunities and it is likely that these might be more enforced in the public sector. We tested to see if this is a valid separation by utilizing simple OLS pooling tests, which in every country rejected joint equality of the public-private sector coefficients.

As Column [1] in Panel B shows, the public sector has a majority female workforce in seven of our eleven countries. Only in Austria, Ireland, Italy and Spain are men in the majority in the public sector, and even in these countries, the majority is slim (the highest proportion of men is 52.7% in Spain). In the private sector, on the other hand (see Panel C), men predominate across all countries, and in six countries they account for over 60% of the private sector workforce.

The raw wage gap measured at the mean (Column [2] Table 1) is generally higher in the private sector than in the public sector. While the raw average gender wage gap in the public sector is in excess of 20% in Britain, Finland and the Netherlands, in Belgium, Italy and Spain it is under 10%, and indeed in Italy it is found to be insignificantly different from zero. In contrast, in the private sector, the raw average gender gap exceeds 13% in all countries and in Britain and Austria, it is found to be close to 30%. In France, Germany, Ireland, the Netherlands and Spain the gap is around or over 20%. How does the raw gender wage gap vary across the unconditional distribution? In the public sector, Italy is the only country where the raw gender gap is found to be insignificant in all parts of the distribution except at the top (see Column [7]), where it is still very much smaller (at about 5%) than other countries. In Finland and the Netherlands, the raw gap increases monotonically as we move up the

unconditional wage distributions, and in Belgium, Denmark and Germany, the gap is also higher toward the top of the distribution. In Ireland and Spain, the gap moves in the opposite direction. In Britain, the raw gap is remarkably similar at about 20% across different parts of the distribution. These raw gaps by sector are also illustrated in Figure 2.

We find similar patterns in the private sector too (the raw gaps for the private sector are presented in Panel C of Table 1). Britain exhibits a similar wage gap along the distribution. The gender gap increases moving up the wage distribution in Finland and Netherlands, and is also higher toward the top in Belgium, Denmark, France and Ireland. In contrast to what is found in the public sector in Italy, the wage gap is now significantly different from zero and is U-shaped. We find a similar pattern in Germany.

In summary, we find that in both the public and the private sectors there is a tendency in some countries for the gender wage gap to be higher at the top of the wage distribution relative to the middle parts of the distribution, hinting at a possible 'glass-ceiling' effect. However, the gender wage gap is also wider at the bottom end too for public sector workers in six countries (Austria, Britain, Denmark, France and Spain), and for private sector workers in four countries (France, Germany, Italy and Spain). This hints at a 'sticky floor' effect for some countries. But these are only raw gender gaps. In order to find out how much of the observed raw wage gap can be explained by the differences in the returns to various characteristics, we next turn to the quantile regression results.

## 3. WAGE GAP ESTIMATES FROM QUANTILE REGRESSIONS

### (a) The Econometric Model

There is now an extensive literature that estimates gender pay gaps using a decomposition of the linear regression framework first introduced by Blinder (1973) and

Oaxaca (1973). In this framework, log-linear wage regressions are estimated using the male and female sub-samples and then the differences in the coefficient estimates, multiplied by a set of characteristics, is attributed to the wage differential for an individual with that particular characteristic. Here, we deviate from this common practice by looking at the effects of gender and other covariates on different *quantiles* of the log wage distribution.[7] The effects of covariates on the location, scale and shape of the conditional wage distribution can be easily estimated using a quantile regression (QR) framework. This is a major advantage compared to the linear or least squares regression model, which yields only the effects on the location - the conditional mean of the distribution. Since the QR framework allows the characteristics to have different returns at different quantiles, at each point of the distribution it can control more fully for differences between men and women's wages that are attributable to their characteristics.

Following Buchinsky (1998), we specify the θth ($0<\theta<1$)[8] conditional quantile of the log wage ($w$) distribution for the $i$-th individual ($i=1,..,N$) in wave t ($t=1,..,T_i$) as

$$\text{Quant}_\theta(w_{it}|\mathbf{x}_{it}) = \alpha(\theta) + \mathbf{x}_{it}'\boldsymbol{\beta}(\theta) \qquad (1)$$

implying

$$w_{it} = \alpha(\theta) + \mathbf{x}_{it}'\boldsymbol{\beta}(\theta) + \varepsilon_{\theta it} \qquad (2)$$

with $\text{Quant}_\theta(\varepsilon_{\theta it}|\mathbf{x}_{it}) = 0$.

For each sector, we estimate this model for men and women separately. Note that, if the underlying model were truly a location model - in the sense that the changes in explanatory variables caused only a change in the location of the distribution of $w$ and

[7] The linear conditional quantile regression model was first introduced by Koenker and Bassett (1978). For a recent survey of these models, see Buchinsky (1998).

[8] θ=0.5 refers to the Median.

not in the shape of the distribution - then all the slope coefficients would be the same for all θ.[9] We use Stata 8 to estimate the coefficients of our QR model.

Below, we detail the method we have used to calculate the gender gap at the θth quantile due to differing returns adjusted for characteristics. That is the gap measured as the difference in pay which women would face at the θth quantile if their distribution of characteristics were the same as that of men.[10]

## (b) Estimation Strategy and the Decomposition Method

As noted above, we initially estimate the models separately by gender and country, and thus have 22 sets of estimations for each specification (Table 2 samples). Then we disaggregate by sector, and estimate the models separately by gender, sector and country, yielding 44 sets of estimations for each specification (Table 4 sub-samples). In the interests of space, and given the focus of our paper, we do not provide the complete set of estimates for each country. Instead we move straight to the calculations of the gender wage gap obtained from the QR model. Full details of all estimated effects for each country can be obtained from the authors on request. The calculations enable us to see whether or not there is a glass-ceiling effect over Europe and to determine if there is also a sticky floor.

All models include the full set of other controls given at the bottom of Tables 2 and 4 (including wave dummies). Table 2 and Figure 1 show the results from the wage gap calculations obtained from the pooled model, excluding controls for occupation and industry but including a dummy variable for private sector. Table 4 and Figure 2 (Figure

[9] Quantile regression models are more general than simple linear regression model allowing for heteroskedastic errors, since the QR model allows for more general dependence of the distribution of *w* (the dependent variable) on the **x**s instead of just the mean and the variance of the conditional mean alone.

[10] We also calculated the gap using women's characteristics as the reference. The results were very similar.

3) illustrate the results disaggregated by sector, where occupation and industry are omitted (included).

We now provide more details of our calculations of the wage gaps. First, we estimated the quantile regressions for each gender (and by sector where necessary). Then we calculated the predicted wage at different parts of the wages distributions by gender (and sector). The wage gap in which we are interested measures the effect of different returns to men and women when *men's* characteristics are used in the counterfactual calculations. A positive wage gap implies that the returns to men's characteristics are higher than those of women, and a negative gap implies the reverse. Instead of using average characteristics of the male sample to calculate the counterfactuals, we follow the bootstrap procedure suggested by Machado and Mata (2000) and use the distribution of men's characteristics to calculate the decompositions directly at particular quantiles of interest.[11] The procedure involves estimating marginal density of wages that are consistent with the estimated conditional densities given by (2) and the hypothesised distribution of characteristics. In practical terms, this was carried out as follows:

Step 1: Generate a random sample of size $n$= 5000 from a uniform distribution U[0,1]: $\theta_1, \ldots, \theta_n$. This will give a series of numbers telling us which quantiles are to be estimated.

Step 2: For each $\theta$ from step 1, estimate the coefficients $\beta_m(\theta)$ and $\beta_f(\theta)$ in equation (2) using the male dataset and female dataset respectively.

Step 3: Randomly draw 5000 males (with replacement) and use their characteristics to predict the wages using the estimated coefficients ($\beta_m(\theta)$ and $\beta_f(\theta)$) from Step 2,

[11] A similar procedure was used by Albrecht *et. al* (2003) and de la Rica *et. al.* (2005). Machado and Mata (2005) Section 2.4 provides a detailed discussion of various methodologies that have been used in the calculations of counterfactual densities.

generating two sets of predicted wages covering the whole distribution. Note, because the block-bootstrapping procedure is used to account for clustering at the individual level, there are more than 5000 observations in practice (see footnote 13). This enables us to calculate the marginal distribution of wages of men and the counterfactual marginal distribution for women if the distribution of their characteristics was the same as that of men's characteristics, and the returns which are consistent with the estimated conditional distributions.

Step 4: Using the distributions calculated in Step 3, we estimate the wage gaps as the difference between the predicted wage at each quantile using the newly generated wage distribution for males and the counterfactual distribution for females.

Although we realise that individuals might self select into particular sector/industry/occupation, addressing the issue of self selection is beyond the scope of this dataset. However, in order to see how the results change, we first present the results from the estimation that pools the sectors. We then separately estimate the wage gaps for each sector with and without the industry and occupational controls.

## (c) Estimates for the Combined Sample (Public and Private Sectors)

The wage gap estimates obtained following the method just described are reported in Table 2, together with the percentage of raw gap that is explained by different returns.[12] To facilitate comparison with the usual procedure, we report - in the first column of Table 2 - the gender wage gap estimated from ordinary least squares (OLS) using average male characteristics. In Figure 1, we present the estimated gender wage gap for each quantile of the log wage distribution along with the 95% confidence band around

[12] The controls included in the equations are listed under Table 2. As well as human capital variables and job characteristics, they include year dummies to allow for cyclical effects on the gender wage gap at each quantile. Unfortunately, the ECHP contains no information about individual union membership or coverage by collective bargaining.

these estimates.[13] Superimposed on the plots is a dotted horizontal line representing the wage gaps estimated from the mean regressions.

The first interesting point to note from this table – and from Figure 2 – is that all the estimated gender wage gaps from the model are positive. Thus, in all countries, even assuming that men and women have identical distributions of characteristics, there is a gender pay gap across the wages distribution (due to differing returns). Notice also that these estimates are all significantly different from zero at the 1% or less significance level.

To facilitate comparison, we summarise in Table 3 the results from the QR model estimates. We first define the existence of glass ceiling if the 90$^{th}$ percentile wage gap is higher than the estimated wage gaps in other parts of the wage distribution by at least 2 percentage points. The sticky floor phenomenon is defined to exist if the 10$^{th}$ percentile wage gap is higher than the 25$^{th}$ percentile wage gap by at least 2 percentage points. These are summarised in columns [1] and [5]. Table 3 shows that there is a glass ceiling in five countries: Denmark, Finland, France, Italy and the Netherlands. Alternative definitions of a glass ceiling produce similar conclusions. Thus, if a wage comparison is made between the 90$^{th}$ and the 75$^{th}$ quantiles, Germany is additionally also found to have a glass ceiling. Britain is brought into this set of countries exhibiting a glass ceiling, if we define the existence in terms of a 90-50 difference. Note also that the estimated wage gap is found to increase in Finland and the Netherlands all along the wage distribution. In contrast, the estimated wage gap decreases as one moves up the wage distribution in Spain.

[13] Bootstrap sample of size 200 was used for the calculation of the standard errors. The sampling procedure used in the calculation also used block-sampling method to account for clustering at the individual level because of the panel nature of the dataset (Fitzenberger, 1998).

There is also some evidence of sticky floors, but in only three countries using the 10-25 difference – Austria, France and Italy– where women at the bottom ($10^{th}$ percentile) are found to be more disadvantaged relative to those at the $25^{th}$ percentile. In general, the wage gap at the mean is found to provide a very incomplete picture of the differing returns faced by women and men at various points of the wages distribution.

The proportion of the observed raw wage gap that is explained by the differences in returns to characteristics is shown in the square parentheses for each country in Table 2. A value greater than 100% implies that women have characteristics that compensate them for any "discrimination" – defined here as different returns to the same characteristics – that they face in the labour market. For example, in four countries – Finland, France, Italy and Spain – women typically have better characteristics than men. The same is also true for Irish women earning in the top parts of the distribution, and for Belgian women in the bottom parts of the distribution. Next we turn to the estimates obtained from the disaggregated sub-samples, where public and private workers are examined separately.

+The wage gap estimates obtained from the separate public and private sector sub-samples are reported in Table 4, together with the percentage of the raw gap that is attributable to differing returns.[14] To facilitate comparison with the usual procedure, we report in the first column the gender wage gap estimated from ordinary least squares (OLS) using average male characteristics. In Figures 2 and 3, we present the estimated gender wage gap for each quantile of the log wage distribution along with the 95% confidence band around these estimates for the models without and with the industry and

[14] See footnote 12.

occupational controls.[15] Superimposed on the plots is a dotted horizontal line representing the wage gaps estimated from the mean regressions. The left hand side of Table 4 presents the results without industrial and occupational controls and we focus on these in our discussion.

As for the pooled model, this table – and Figures 2 and 3 – show that all the estimated gender wage gaps are positive, both in the public and the private sector. Thus, in all countries, even if women had the same distribution of characteristics as men, they would still receive lower pay across the wages distribution. All the gaps are significantly different from zero at the 1% or less significance level. With the exception of Finland and the Netherlands, the estimated wage gaps are also generally higher in the private sector compared to the public sector. The Finnish OLS public sector gender gap is 25% as compared with 21% in the private sector. And from the 25$^{th}$ percentile upwards, the Finnish public sector gender gap exceeds that of the private sector. In the Netherlands, the OLS public sector gap is 13-14% in both sectors, with a similar increasing gap across the wages distribution.

We next discuss in more detail how the wage gap varies across the wages distribution. To facilitate comparisons, we summarise in Table 5 the results from the QR model estimates reported in Table 4 using the same definitions as before (see Table 3). We focus on the models excluding the industry and occupation dummies. First, consider the public sector estimates, shown in the top panel of Table 4. There are eight countries – Austria, Belgium, Britain, Denmark, Finland, France, Italy and the Netherlands – where the gender wage gap is highest at the 90$^{th}$ percentile of the wage distribution compared to other parts of the distribution, pointing to a widespread glass ceiling effect across Europe. Following our precise definition of the glass ceiling – that the 90$^{th}$

[15] See footnote 13.

percentile wage gap is higher than the estimated wage gaps in other parts of the wage distribution by at least 2 percentage points – Finland drops out of the set. However, it joins this group of countries when the glass ceiling is defined by the 90-50 differential (column [3]), and Germany also has a glass ceiling according to this definition. Across the countries, the highest wage gap at the 90$^{th}$ percentile is found in Finland, where it increases from about 15% at the 10$^{th}$ percentile to about 32% at the 90$^{th}$ percentile. The estimated wage gap is found to increase monotonically in Italy and the Netherlands too as we move along the wage distribution, although the increase is not as dramatic as in Finland.

There is also some evidence of sticky floors. Using our earlier definition of a sticky floor as the situation where the 10$^{th}$ percentile wage gap is higher than the 25$^{th}$ percentile wage gap by at least 2 percentage points, we find that in three countries – Austria, France and Ireland – women at the bottom (10$^{th}$ percentile) are more disadvantaged relative to those at the 25$^{th}$ percentile. In general Belgium, Denmark, Germany and Spain are countries with relatively low wage gaps. Once again, the wage gap at the mean is found to provide a very incomplete picture of the differing returns faced by women and men at various points of the wages distribution.

Second, consider the private sector estimates, shown in the bottom panel of Table 4 and also summarised in the bottom panel of Table 5. In contrast to the public sector, the private sector exhibits very large wage gaps. Britain and Spain have a fixed gap of about 21-24% along the wage distribution. A glass ceiling effect is found in six of the eleven countries: Belgium, Denmark, Finland, France, Italy and the Netherlands. There is some evidence of sticky floors, but only in Austria, France, Germany and Italy, where the gap at the 10$^{th}$ percentile is about 2-3 percentage points higher than at the 25$^{th}$ percentile.

We next turn to the proportion of the observed raw wage gap that is explained by the differences in returns to characteristics, shown in the square parentheses for each country in Table 4. In the public sector in five countries – Belgium, France, Ireland, Italy and Spain – women typically have better characteristics than men. The same is also true for Austrian and Finnish women earning in the top parts of the distribution.[16] In the private sector, Finland and Italy are the only countries where women have better characteristics than men in all parts of the distribution to compensate for the different returns that they would face in the labour market for the same characteristics as men.

The estimates just discussed exclude controls for occupation and industry. We have focussed on these results because of the possibility that industry and occupation are endogenous. If, rather than being exogenous, industry and occupation are partly a choice made after labour market entry, then they should not be included in a counterfactual simulation which involves exchanging women's characteristics for men's. Estimates which do include endogenous industry and occupation should be interpreted as 'accounting' for the gender wage gap rather than explaining it causally. For comparison with our main results, the right hand side of Table 4 presents estimates including occupation and industry. They are also pictured in Figure 3, and the right-hand panel of Table 5 summarises the pattern of glass ceilings and sticky floors according to the various definitions. Table 5 shows that using occupation and industry to try to account for the gender wage gap does not greatly change the previous conclusions that glass ceilings are widespread, especially in the public sector, and that some countries also have sticky floors. There are some notable exceptions to this: with the inclusion of industry and occupation, the glass ceilings in Belgium and Finland disappear. This could

[16] The very large values in, for example, the public sector in Italy merit comment. They arise because there is essentially no gap in the raw data (Table 1, panel B), but a large gap when characteristics are controlled for, resulting in a high percentage figure due to differing returns.

indicate that the glass ceilings in these countries primarily reflect occupational or industrial segregation, but we do not push this interpretation too far given the possible endogeneity issues.

## 4. DISCUSSION AND CONCLUSIONS

### 4.1 The European institutional setting

Our observed gender pay gaps showed that even if the distribution of characteristics were the same across gender, men and women received different returns across the wages distribution. We now speculate as to why the observed gender pay gaps in Europe are: (i) in some countries, larger at the top of the wages distribution (*glass ceilings*); and (ii) in some countries larger at the bottom of the wages distribution (*sticky floors*).

Gender-specific policies - such as equal opportunities and anti-discrimination laws, parental leave provisions and the availability of child care – are likely to affect gender wage gaps, both mean gaps and gaps across the wages distribution. Gender wage gaps are also likely to be influenced by wage setting institutions that do not directly impinge on gender, such as those governing collective bargaining and minimum wages. Cross-country differences in such policies and institutions across the eleven European Union countries for which we have data may well contribute to observed variations in gender wage gaps. While clearly with just eleven observations we cannot hope to provide a conclusive test of the impact of different institutions on the gender pay gap, we are able to provide some interesting correlations between summary measures of various important institutions and our observed gender pay gaps. In what follows we use our estimated gaps for the combined samples (in which public and private sector workers were pooled). We do this because all of our summary measures of various institutions are only available country-wide and not disaggregated by sector.

## 4.2 Gender-specific policies

First we consider how gender-specific policies might affect pay. Discrimination in the European Union is prohibited on grounds of gender, race (including nationality and citizenship) and - in Northern Ireland only - religion.[17] Nonetheless, although discrimination may be proscribed by legislation, whether or not it is still practised may depend on the effectiveness of its implementation and the willingness of individuals to take breaches to the courts. To the extent that only the more articulate and better educated are willing to take legal action against breaches of the law, we might expect the impact of these policies to work against glass ceilings as defined above.

Parental leave provisions and state-provision of child care for under-school age children vary considerably across countries (OECD, 2001; Jaumotte, 2003).[18] These are likely to influence the behaviour of men and women differently and hence affect gender wage gaps. Blau and Kahn (2003) note that the expected impact of these policies is unclear a priori. On the one hand, women who are *not* subject to parental leave provisions might give up - or lose - their jobs on having a child, and may re-enter subsequently at lower level jobs providing shorter hours and lower pay. And women who *do* have access to parental leave might have higher relative earnings through the fact that these policies preserve their ties with the firm and thereby increase incentives to invest in specific human capital. This will lead to a correlation between parental leave policies and higher female pay. We will term this the positive effect of parental leave

[17] In light of the European Framework Directive, categories covered by anti-discrimination legislation were extended in 2003 to include religion and sexual orientation, and will be extended in 2006 to include the additional categories of age and disability.

[18] Specific paternity leave entitlements are still relatively uncommon and where they are found are typically of short duration (OECD, 2001:p.145). Of our 11 countries, Spain, the Netherlands, Belgium and France have 3 days or less, while Denmark has 14 days.

policies. But on the other hand, generous leave policies could increase women's time out of workforce for childbearing, thus exacerbating the average gender pay gap for that group. This is the potentially negative effect of parental leave policies.

Empirical research tends to find a positive effect of short leaves on women's wages but a negative effect for long leaves (Ruhm, 1998; Waldfogel, 1998). But why should these leave policies affect gender wage gaps across the wages distribution? We might expect a priori that women at the bottom might be less attached to the workforce, and so the positive impact of leave policies increasing women's attachment to firms might dominate the negative effect outlined above. But ultimately it is an empirical question as to what effect dominates - and in which countries.

What is the extent of statutory parental leave policies in the EU countries for which we have data? According to the OECD (2001: Table 4.7), the countries with the highest total duration of maternity/childcare leave (weeks) are Finland, Spain, France and Germany, followed by Austria. The lowest are found in the UK, followed by Ireland. There is also some evidence of extra-statutory provision of similar family-friendly arrangements by firms. According to the OECD (2001:147) and Evans (2001), the highest coverage of extra-statutory provisions are in Austria and West Germany, followed by Italy, Greece, Spain. The Nordic countries plus Ireland and UK are the worst performers here.[19]

[19] Evans (2001) identifies four main types of family-friendly arrangements by firms: Leave from work for family reasons; changes to work arrangements for family reasons; practical help with childcare and eldercare; and the provision of training and information. OECD (2001) summarizes these extra-statutory provision along 2 dimensions: average % of women employees reporting extra family leave, and % women employees reporting provision/subsidies for child day care. The Netherlands has especially high levels of firm-provided day-care relative to amount of extra-statutory leave.

We now consider formal childcare policies. These are likely to have a positive effect on women's wages (since they are likely to increase women's attachment to firms, thereby increasing incentives to make specific skills investments). They may also encourage women back to work earlier than might otherwise be possible. We would therefore expect them to reduce the gender pay gap, ceteris paribus. According to the OECD (2001), the countries with the largest proportions of children under 3 using formal childcare are Denmark at 64%, followed by Ireland at 38%, Britain at 34%, France at 29% and Finland at 22%. Four countries have fewer than 7% of the under-3s using formal childcare - Italy, the Netherlands, Spain and Austria.

Figure 4 presents three scatter plots illustrating the cross-country correlation between the OECD (2001) work-family reconciliation index and (a) sticky floors defined as the 10-50 pay difference; (b) glass ceilings defined as the 90-50 pay difference; and (c) the mean gender pay gap. The OECD work-family reconciliation index is the sum of indicators for the coverage of the under-3s in formal childcare, maternity leave, flexi-time, voluntary part-time and one half of the extra-statutory leave by firms indicator (see OECD, 2001; p152). The plots show that, across countries, the work-family index is negatively correlated with sticky floors and positively correlated with glass-ceilings. Thus countries with more "generous" work-family policies have a lower wage gap at the bottom of the wages distribution and a wider gap at the top. For example, Denmark and the Netherlands have the most liberal work-family policies and they have a big pay gap at the top and a small pay gap at the bottom of the wages distribution.

We noted above that family-friendly policies could be a double-edged sword. On the one hand they might raise women's relative earnings by preserving their ties with the firm, thereby increasing incentives to invest in specific human capital and leading to

higher female pay. But on the other hand, family-friendly policies could increase women's time out of workforce for childbearing, thus widening the average gender pay gap for that group. Our scatter-plot in Figure 4(b) – showing that the gender pay gap is higher at the top of the wages distribution in countries with generous family-friendly policies - suggests that the negative effect dominates at the top of the distribution in our sample of eleven European countries.

What about women at the bottom of the wages distribution? Our scatter-plot in Figure 4(a) - showing that the gender pay gap is lower at the bottom of the wages distribution in countries with generous family-friendly policies - suggests that the positive effect dominates at the bottom of the distribution. Since women towards the bottom of the distribution might typically be less attached to the workforce, generous family-friendly policies might increase their attachment to firms. Certainly with our data this positive effect seems to dominate the negative effect outlined above.

Albrecht *et al* (2003: 172), charted the extent - in a QR framework - of the Swedish glass ceiling and speculated as to its causes. They also found that gender differences in returns are the primary factor. They rejected the notion of a 'taste-based explanation …[whereby] Swedish women prefer to work in family-friendly but low-wage jobs', on the grounds that gender differences arise from differences in rewards even after controlling for occupation. Instead they hypothesised that a more likely candidate explanation is the 'work environment faced by Swedish women' especially 'the Swedish parental leave policy and the daycare system', which provide strong incentives to participate but not to commit strongly to a career.

This is an interesting conjecture and one that is supported by our results for Denmark.[20] But the fact that we find the same glass ceiling effect across some other EU

[20] See Pylkkänen and Smith (2004) for a detailed analysis of the impact of family-friendly policies on women's parental leave behaviour in Sweden and Denmark.

countries, with their very different parental leave policies and daycare systems, suggests that this cannot be the primary explanation. For example Italy has low levels of 'work-family reconciliation policies' – and it too exhibits a glass ceiling.

A second reason put forward by Albrecht et al (2003) for the Swedish glass ceiling phenomenon is the relatively high wages at the bottom of the wage distribution making it 'very difficult for career-oriented women to hire household help or help with child care', especially for the very young children under 12 months who cannot be admitted into daycare. For this reason, women might be found in less-demanding jobs and thus fall substantially behind men towards the top of the distribution. Thus cross-country evidence should show a negative correlation between the magnitude of the glass ceiling and the dispersion of the wages distribution. This relationship is illustrated in Figure 5(b) for our sample of eleven countries, where we have measured wage dispersion by the $90^{th}$-$10^{th}$ percentile differential of log wages in the full sample of workers in each country. There is indeed a negative correlation that is consistent with this hypothesis.

### 4.3 Pay-bargaining Institutions

Next we consider pay-bargaining institutions that may not directly impinge on gender. While collective bargaining institutions, and the degree of coordination and centralization of wage bargaining, might not have direct gender effects, they could well have significant indirect effects. For example, trade unions may be less likely to represent the interests of their female electorate - who may be perceived as having a marginal attachment to the workforce – than of the male electorate (Booth and Francesconi, 2003). In addition, collective bargaining and associated institutions affect the wage structure in general. To the extent that the wages distribution is compressed, they may thus impinge indirectly on women's wages and through this mechanism affect

the gender pay gap. Figure 5 suggests that this may indeed be the case. For those countries with greater wage dispersion (such as Britain, Ireland and Spain), the gender pay gap is widest at the bottom of the distribution and lowest at the top of the distribution.

Countries with higher levels of unionisation and more centralized or coordinated bargaining tend to have lowest wage dispersion (Blau and Kahn, 1992, 1996, 2003; Boeri, Brugiavini and Calmfors, 2001). Centralized bargaining – and more coordinated bargaining - results in lower wage dispersion, and is thus likely to lower the gender pay gap ceteris paribus – perhaps especially at the bottom of the wages distribution. Moreover, in all the countries for which we have data, the female wage lies below the male across the entire wages distribution. Hence centralized pay bargaining systems that raise the minimum level of pay regardless of gender are also likely to lower the gender pay gap ceteris paribus.

Although we can group our countries by both the extent of union density and of union coverage, we choose to focus only on coverage.[21] Countries in which coverage is at least 75% of the workforce are Austria, Germany, Belgium, the Netherlands, and France (Boeri et al, 2001: p92). Countries with the highest levels of coordination of bargaining – both of unions and employers – are Austria and Norway, followed by Germany and Finland. The least coordinated are the UK and Ireland.

Figure 6(a) reveals a positive correlation between the magnitude of the sticky floor and union coverage, while Figure 6(b) reveals a negative correlation between the magnitude of the glass ceiling and union coverage. This is consistent with unions

[21] The extent of union recognition or coverage is a better measure of union power than union density, as argued in Booth (1995). In addition, the degree of coordination between unions, and and unions and employers, can also be crucial, as well as the degree of centralization of bargaining. See Boeri et al (2001) for a discussion and for detailed tables indicating the variation of these measures across the EU.

representing the interests of females towards the top of the wages distribution but not towards the bottom, since the gender pay gap is higher at the bottom of the distribution and lower at the top in countries with high union coverage.

Statutory minimum wages compress the bottom of pay distribution, and so are likely to reduce gap between men and women at the bottom (Dolado et al, 1996). Institutional pay compression – whether through unions or through minimum wages - may distort skills investment incentives. However, a recent literature suggests that, in the presence of labour market imperfections inducing wage compression, firms may be willing to finance work-related training (see inter alia Stevens, 1994; Acemoglu and Pischke, 199, 2003; Arulampalam et al, 2004). If pay returns are reduced by pay compression, women have less incentive to stay in workforce when engaged in childrearing. Conversely, high wages floors might increase the likelihood women stay in workforce, because of the higher opportunity cost of time out, and they might therefore have higher levels of work experience and skills acquisition. Whether these effects on the gender pay gap vary across the wages distribution is ultimately an empirical issue. Certainly Figures 5 (a) and (b) show that countries with low wage dispersion have lower gender pay gaps at the bottom of the wages distribution and higher pay gaps at the top. This correlation is consistent with the hypothesis that women in countries with low pay dispersion are more likely to stay attached to firms at the bottom of the distribution.

### 4.4 Other factors

Of course other factors are also likely to be at work. Many labour markets are hierarchical, and promotions and appointments procedures can exacerbate gender pay gaps across the pay distribution. While promotions are typically subject to well-defined procedures, especially in larger organisations, exactly *where* in the rank-specific salary scale a successful candidate is appointed can depend on individual negotiation skills or

bargaining power, or employer discretion, in addition to experience. Booth, Francesconi and Frank (2005), using data on promotions from the British Household Panel Survey, show how women do not do as well financially out of promotions as do men, *ceteris paribus*.[22] If promotions procedures favour men rather than women towards the top of the wages distribution, then the gender pay gap might be bigger towards the top. Landers, Rebitzer and Taylor (1996) show, in their study of US law firms, how criteria for promotion like excessively long hours of work can exacerbate gender pay gaps towards the top of the lawyers' wage distribution.

Individuals are frequently appointed at a particular level of the rank of the relevant scale for their occupation or industry and then aim to work their way up the hierarchy. While both promotions and pay are covered by anti-discrimination legislation and equal opportunities policies, there is scope for discretion – or discrimination - about the particular level within a rank to which an individual is appointed. Thus if men are initially appointed at a higher starting salary (a higher rung) within a particular scale, then the gender pay gap might be bigger towards the bottom of the wage distribution - the *sticky floor.* Another hypothesis is that women towards the bottom might have less bargaining power or be more likely to be subject to firms' market power than comparable men, due perhaps to unobservable family commitments or social custom whereby the man's career takes precedence. Although we are unable to explore these hypotheses with our data, we mention them here for completeness since they may contribute to our findings.

[22] Blackaby, Booth and Frank (2002), using data on the UK academic economists' labour market, produce further evidence that promotions might exacerbate gender pay inequality.

## 4.5 Conclusions

The analysis in this paper shows that, across our sample of eleven European Union countries, holding the distribution of characteristics constant, women are still paid less than men. The magnitude of the gaps – which can be attributed to differing returns – varies substantially across the different countries and across the wages distributions. We suggest that the considerable heterogeneity in EU countries' institutions is likely to contribute to these differences, as illustrated by the simple correlations in Figures 4-6.

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**Table 1 - Raw Gender Wage Gap**

| | Males (%) [1] | Mean [2] | 10th Percent [3] | 25th Percent [4] | Median [5] | 75th Percent [6] | 90th Percent [7] |
|---|---|---|---|---|---|---|---|
| **A – POOLED** | | | | | | | |
| **Austria** | 0.580 | 0.234 | 0.268 | 0.236 | 0.210 | 0.194 | 0.201 |
| **Belgium** | 0.538 | 0.100 | 0.100 | 0.100 | 0.074 | 0.080 | 0.150 |
| **Britain** | 0.505 | 0.246 | 0.238 | 0.248 | 0.234 | 0.248 | 0.252 |
| **Denmark** | 0.508 | 0.132 | 0.107 | 0.091 | 0.099 | 0.155 | 0.248 |
| **Finland** | 0.496 | 0.184 | 0.112 | 0.119 | 0.170 | 0.243 | 0.266 |
| **France** | 0.541 | 0.142 | 0.136 | 0.127 | 0.113 | 0.122 | 0.139 |
| **Germany** | 0.570 | 0.204 | 0.230 | 0.189 | 0.178 | 0.206 | 0.227 |
| **Ireland** | 0.551 | 0.201 | 0.253 | 0.233 | 0.209 | 0.166 | 0.129 |
| **Italy** | 0.593 | 0.063 | 0.089 | 0.072 | 0.054 | 0.037 | 0.028 |
| **Netherlands** | 0.597 | 0.183 | 0.151 | 0.146 | 0.155 | 0.196 | 0.232 |
| **Spain** | 0.622 | 0.138 | 0.154 | 0.127 | 0.114 | 0.071 | 0.044 |
| **B – PUBLIC SECTOR** | | | | | | | |
| **Austria** | 51.90 | 0.135 | 0.153 | 0.122 | 0.087 | 0.093 | 0.115 |
| **Belgium** | 47.79 | 0.073 | 0.061 | 0.058 | 0.033 | 0.065 | 0.136 |
| **Britain** | 34.88 | 0.212 | 0.213 | 0.185 | 0.216 | 0.197 | 0.217 |
| **Denmark** | 33.59 | 0.114 | 0.128 | 0.085 | 0.105 | 0.119 | 0.175 |
| **Finland** | 35.04 | 0.259 | 0.164 | 0.196 | 0.260 | 0.316 | 0.307 |
| **France** | 45.06 | 0.116 | 0.112 | 0.095 | 0.110 | 0.128 | 0.139 |
| **Germany** | 43.19 | 0.128 | 0.105 | 0.098 | 0.146 | 0.157 | 0.157 |
| **Ireland** | 52.07 | 0.110 | 0.133 | 0.140 | 0.079 | *0.040* | 0.093 |
| **Italy** | 51.29 | *0.006* | *-0.002* | *0.010* | *0.001* | *-0.021* | 0.046 |
| **Netherlands** | 48.05 | 0.200 | 0.144 | 0.187 | 0.191 | 0.196 | 0.232 |
| **Spain** | 52.65 | 0.054 | 0.083 | 0.068 | 0.058 | *-0.005* | 0.065 |
| **C – PRIVATE SECTOR** | | | | | | | |
| **Austria** | 60.61 | 0.292 | 0.286 | 0.286 | 0.275 | 0.273 | 0.266 |
| **Belgium** | 57.65 | 0.137 | 0.121 | 0.135 | 0.120 | 0.140 | 0.199 |
| **Britain** | 56.43 | 0.306 | 0.269 | 0.304 | 0.309 | 0.326 | 0.311 |
| **Denmark** | 63.63 | 0.134 | 0.104 | 0.115 | 0.091 | 0.167 | 0.240 |
| **Finland** | 59.95 | 0.167 | 0.121 | 0.135 | 0.146 | 0.199 | 0.242 |
| **France** | 58.79 | 0.202 | 0.180 | 0.156 | 0.170 | 0.201 | 0.228 |
| **Germany** | 62.41 | 0.262 | 0.294 | 0.253 | 0.231 | 0.247 | 0.282 |
| **Ireland** | 56.56 | 0.273 | 0.264 | 0.267 | 0.263 | 0.267 | 0.313 |
| **Italy** | 63.83 | 0.153 | 0.145 | 0.111 | 0.130 | 0.146 | 0.194 |
| **Netherlands** | 64.31 | 0.208 | 0.177 | 0.176 | 0.176 | 0.217 | 0.278 |
| **Spain** | 65.39 | 0.230 | 0.252 | 0.206 | 0.205 | 0.244 | 0.207 |

Notes: (i) Raw wage gap is measured as the difference of the log male and log female hourly wage. The log wage was calculated from the ECHP variables as log (wage) = log (PI211MG * (12/52) / PE005A) = log (normal gross monthly earnings from main job including overtime * (12/52) / hours in main job including overtime). It was then deflated to 2001 prices using harmonised indices of consumer prices (HICP) from the *Eurostat Yearbook 2003*. (ii) Except for the coefficients in *italics*, all coefficients are significantly different from zero at 5% level of significance.

## Table 2
### Estimated Wage gap [percentage raw gap explained by different returns] Pooled Model without Industry and Occupational dummies

| | OLS | 10% | 25% | 50% | 75% | 90% |
|---|---|---|---|---|---|---|
| **Austria** | 0.224 [96] | 0.240 [89] | 0.209 [89] | 0.198 [94] | 0.199 [103] | 0.208 [104] |
| **Belgium** | 0.130 [130] | 0.115 [185] | 0.113 [152] | 0.125 [254] | 0.168 [145] | 0.118 [87] |
| **Britain** | 0.186 [92] | 0.211 [89] | 0.217 [87] | 0.223 [95] | 0.226 [91] | 0.236 [94] |
| **Denmark** | 0.124 [94] | 0.089 [84] | 0.080 [89] | 0.102 [104] | 0.154 [100] | 0.210 [85] |
| **Finland** | 0.229 [124] | 0.148 [132] | 0.171 [144] | 0.220 [129] | 0.281 [116] | 0.311 [117] |
| **France** | 0.197 [139] | 0.185 [136] | 0.164 [129] | 0.167 [147] | 0.193 [157] | 0.227 [163] |
| **Germany** | 0.177 [87] | 0.189 [82] | 0.175 [93] | 0.165 [93] | 0.165 [80] | 0.192 [84] |
| **Ireland** | 0.210 [104] | 0.216 [85] | 0.232 [100] | 0.217 [104] | 0.190 [114] | 0.167 [130] |
| **Italy** | 0.159 [253] | 0.163 [184] | 0.146 [203] | 0.136 [254] | 0.137 [368] | 0.180 [635] |
| **Netherlands** | 0.137 [75] | 0.102 [68] | 0.109 [75] | 0.123 [79] | 0.166 [85] | 0.207 [89] |
| **Spain** | 0.193 [140] | 0.220 [143] | 0.209 [164] | 0.186 [163] | 0.177 [249] | 0.167 [381] |

Notes: (i) The model includes dummies for whether training was received in the last year, age, education, tenure, marital status, health status, any experience of unemployment since 1989, part-time status, fixed term and casual contracts, region (where possible), sector and year. Dummies were also included for cases where there were a very large number of missing values. See the Appendix for further details. (ii) All coefficients were significant at 1%.

## Table 3
### Summary of Table 2 Quantile Regression Results – Pooled Model

| | Glass ceiling measured by[(i)]: | | | Sticky floor measured by[(ii)]: | | Estimated Profile of Wage Gap Along distribution | Estimated Range of Wage Gap (%) |
|---|---|---|---|---|---|---|---|
| | 90-all gaps | 90-75 difference | 90-50 difference | 10-50 difference | 10-25 difference | | |
| | **[1]** | **[2]** | **[3]** | **[4]** | **[5]** | **[6]** | **[7]** |
| **Austria** | | | | ✓ | ✓ | | 21-24 |
| **Belgium** | | | | | | | 11-17 |
| **Britain** | | | ✓ | | | | 21-24 |
| **Denmark** | ✓ | ✓ | ✓ | | | | 8-21 |
| **Finland** | ✓ | ✓ | ✓ | | | Increasing | 15-31 |
| **France** | ✓ | ✓ | ✓ | ✓ | ✓ | | 16-23 |
| **Germany** | | ✓ | ✓ | ✓ | | | 18-19 |
| **Ireland** | | | | | | | 17-23 |
| **Italy** | ✓ | ✓ | ✓ | ✓ | ✓ | | 14-18 |
| **Netherlands** | ✓ | ✓ | ✓ | | | Increasing | 10-21 |
| **Spain** | | | | ✓ | | Decreasing | 17-22 |

Notes: (i). Glass ceiling is defined to exist if the 90th percentile wage gap is higher than the reference gaps by at least 2 points. (ii) Sticky floor is defined to exist if the 10th percentile wage gap is higher than the reference wage gap by at least 2 points.

## Table 4 – Estimated Wage gap (and percentage raw gap explained by different returns)

| | Industry and occupation excluded | | | | | | Industry and occupation included | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **OLS** | **10%** | **25%** | **50%** | **75%** | **90%** | **OLS** | **10%** | **25%** | **50%** | **75%** | **90%** |
| | **PUBLIC SECTOR** | | | | | | | | | | | |
| **Austria** | 0.136 [100] | 0.114 [75] | 0.080 [65] | 0.085 [97] | 0.103 [111] | 0.139 [120] | 0.163 [120] | 0.173 [113] | 0.119 [98] | 0.118 [136] | 0.124 [134] | 0.146 [126] |
| **Belgium** | 0.105 [143] | 0.080 [130] | 0.066 [114] | 0.078 [240] | 0.100 [154] | 0.157 [116] | 0.103 [141] | 0.114 [185] | 0.088 [152] | 0.083 [254] | 0.094 [145] | 0.118 [87] |
| **Britain** | 0.179 [84] | 0.141 [66] | 0.163 [88] | 0.182 [85] | 0.180 [92] | 0.210 [97] | 0.186 [88] | 0.181 [90] | 0.197 [106] | 0.186 [87] | 0.159 [81] | 0.177 [82] |
| **Denmark** | 0.097 [85] | 0.083 [65] | 0.073 [83] | 0.089 [85] | 0.118 [99] | 0.162 [92] | 0.086 [76] | 0.092 [72] | 0.079 [89] | 0.076 [72] | 0.092 [77] | 0.127 [73] |
| **Finland** | 0.251 [97] | 0.151 [92] | 0.188 [96] | 0.250 [96] | 0.305 [96] | 0.319 [104] | 0.202 [78] | 0.139 [85] | 0.153 [78] | 0.199 [76] | 0.244 [77] | 0.276 [90] |
| **France** | 0.168 [144] | 0.160 [143] | 0.138 [145] | 0.146 [134] | 0.173 [136] | 0.230 [166] | 0.140 [121] | 0.178 [158] | 0.133 [141] | 0.113 [103] | 0.124 [97] | 0.152 [110] |
| **Germany** | 0.094 [73] | 0.062 [59] | 0.060 [61] | 0.088 [60] | 0.117 [75] | 0.119 [76] | 0.151 [118] | 0.150 [142] | 0.137 [139] | 0.139 [95] | 0.127 [81] | 0.104 [66] |
| **Ireland** | 0.163 [148] | 0.184 [138] | 0.154 [110] | 0.148 [188] | 0.128 [319] | 0.119 [127] | 0.199 [180] | 0.202 [152] | 0.188 [134] | 0.188 [239] | 0.145 [363] | 0.144 [154] |
| **Italy** | 0.095 [1579] | 0.060 [-3527] | 0.059 [575] | 0.068 [5246] | 0.108 [-509] | 0.185 [400] | 0.118 [1971] | 0.093 [-5454] | 0.091 [894] | 0.102 [7781] | 0.123 [580] | 0.185 [400] |
| **Netherlands** | 0.135 [67] | 0.104 [73] | 0.122 [65] | 0.138 [73] | 0.151 [77] | 0.183 [79] | 0.128 [64] | 0.098 [68] | 0.115 [61] | 0.123 [65] | 0.135 [69] | 0.170 [73] |
| **Spain** | 0.101 [188] | 0.115 [138] | 0.109 [159] | 0.117 [203] | 0.071 [-1483] | 0.079 [122] | 0.096 [178] | 0.117 [141] | 0.101 [147] | 0.106 [183] | 0.081 [-1685] | 0.082 [128] |
| | **PRIVATE SECTOR** | | | | | | | | | | | |
| **Austria** | 0.236 [81] | 0.249 [87] | 0.222 [78] | 0.212 [77] | 0.213 [78] | 0.226 [85] | 0.285 [98] | 0.299 [105] | 0.279 [98] | 0.272 [99] | 0.258 [94] | 0.233 [88] |
| **Belgium** | 0.126 [92] | 0.100 [83] | 0.117 [86] | 0.120 [100] | 0.133 [95] | 0.163 [82] | 0.165 [120] | 0.197 [164] | 0.193 [143] | 0.165 [137] | 0.147 [105] | 0.155 [78] |
| **Britain** | 0.231 [76] | 0.205 [76] | 0.223 [73] | 0.234 [76] | 0.236 [72] | 0.239 [77] | 0.218 [69] | 0.208 [77] | 0.217 [71] | 0.215 [70] | 0.196 [60] | 0.196 [63] |
| **Denmark** | 0.132 [99] | 0.089 [86] | 0.097 [85] | 0.114 [126] | 0.158 [95] | 0.199 [83] | 0.122 [91] | 0.112 [108] | 0.114 [99] | 0.104 [115] | 0.116 [69] | 0.155 [65] |
| **Finland** | 0.214 [128] | 0.154 [127] | 0.172 [127] | 0.205 [140] | 0.248 [125] | 0.283 [117] | 0.218 [131] | 0.197 [163] | 0.210 [155] | 0.217 [148] | 0.209 [106] | 0.198 [82] |
| **France** | 0.194 [96] | 0.179 [99] | 0.155 [100] | 0.161 [94] | 0.190 [95] | 0.229 [101] | 0.159 [79] | 0.153 [85] | 0.136 [87] | 0.141 [83] | 0.151 [75] | 0.169 [74] |
| **Germany** | 0.181 [69] | 0.209 [71] | 0.185 [73] | 0.167 [72] | 0.164 [66] | 0.189 [67] | 0.196 [75] | 0.207 [70] | 0.200 [79] | 0.201 [87] | 0.200 [81] | 0.212 [75] |
| **Ireland** | 0.236 [86] | 0.201 [76] | 0.228 [85] | 0.246 [94] | 0.254 [95] | 0.251 [80] | 0.224 [82] | 0.172 [65] | 0.215 [81] | 0.242 [92] | 0.256 [96] | 0.252 [80] |
| **Italy** | 0.177 [116] | 0.182 [125] | 0.154 [138] | 0.153 [118] | 0.167 [115] | 0.195 [101] | 0.188 [123] | 0.178 [123] | 0.159 [143] | 0.172 [132] | 0.191 [131] | 0.210 [109] |
| **Netherlands** | 0.134 [64] | 0.099 [56] | 0.107 [61] | 0.115 [65] | 0.164 [75] | 0.213 [77] | 0.151 [73] | 0.149 [84] | 0.142 [80] | 0.139 [79] | 0.157 [72] | 0.190 [69] |
| **Spain** | 0.224 [97] | 0.229 [91] | 0.228 [110] | 0.221 [108] | 0.211 [87] | 0.216 [105] | 0.230 [100] | 0.208 [83] | 0.222 [108] | 0.233 [114] | 0.236 [97] | 0.220 [107] |

Notes: (i) All models include dummies for whether training was received in the last year, age, education, tenure, marital status, health status, any experience of unemployment since 1989, part-time status, fixed term and casual contracts, private sector firm size, region (where possible) and year. Dummies were also included for cases where there were a very large number of missing values. See the Appendix for further details. (ii) All estimated wage gaps are significant at the 1% level.

**Table 5 – Summary of Table 4 Quantile Regression Results**

| | Industry and occupation excluded | | | | | | | Industry and occupation included | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Glass ceiling measured by: | | | Sticky floor measured by: | | Estimated Profile of Wage Gap Along distribution | Estimated Range of Wage Gap (%) | Glass ceiling measured by: | | | Sticky floor measured by: | | Estimated Profile of Wage Gap Along the distribution | Estimated Range of Wage Gap (%) |
| | 90-all gaps[1] | 90-75 diff[2] | 90-50 diff[2] | 10-50 diff[2] | 10-25 diff[2] | | | 90-all gaps[1] | 90-75 diff[2] | 90-50 diff[2] | 10-50 diff[2] | 10-25 diff[2] | | |
| | **[1]** | **[2]** | **[3]** | **[4]** | **[5]** | **[6]** | **[7]** | **[8]** | **[9]** | **[10]** | **[11]** | **[12]** | **[13]** | **[14]** |
| | **PUBLIC SECTOR** | | | | | | | | | | | | | |
| **Austria** | ✓ | ✓ | ✓ | ✓ | ✓ | | 8-14 | | ✓ | ✓ | ✓ | ✓ | | 12-17 |
| **Belgium** | ✓ | ✓ | ✓ | | | | 7-16 | | ✓ | ✓ | ✓ | ✓ | | 8-12 |
| **Britain** | ✓ | ✓ | ✓ | | | | 14-21 | | ✓ | | | | | 16-20 |
| **Denmark** | ✓ | ✓ | ✓ | | | | 7-16 | ✓ | ✓ | ✓ | | | | 8-13 |
| **Finland** | | | ✓ | | | Increasing | 15-32 | ✓ | ✓ | ✓ | | | Increasing | 14-28 |
| **France** | ✓ | ✓ | ✓ | | ✓ | | 14-23 | | ✓ | ✓ | ✓ | ✓ | | 11-18 |
| **Germany** | | | ✓ | | | | 6-12 | | | | | | Decreasing | 10-15 |
| **Ireland** | | | | ✓ | ✓ | | 12-18 | | | | | | Decreasing | 14-20 |
| **Italy** | ✓ | ✓ | ✓ | | | Increasing | 6-19 | ✓ | ✓ | ✓ | | | Increasing | 9-19 |
| **Netherlands** | ✓ | ✓ | ✓ | | | Increasing | 10-18 | ✓ | ✓ | ✓ | | | Increasing | 10-17 |
| **Spain** | | | | | | | 7-12 | | | | | ✓ | | 8-12 |
| | **PRIVATE SECTOR** | | | | | | | | | | | | | |
| **Austria** | | ✓ | ✓ | ✓ | ✓ | | 21-25 | | | | ✓ | ✓ | Decreasing | 23-30 |
| **Belgium** | ✓ | ✓ | ✓ | | | Increasing | 10-16 | | | | ✓ | | | 15-20 |
| **Britain** | | | | | | Increasing | 20-24 | | | | | | | 20-22 |
| **Denmark** | ✓ | ✓ | ✓ | | | Increasing | 9-20 | ✓ | ✓ | ✓ | | | | 10-16 |
| **Finland** | ✓ | ✓ | ✓ | | | Increasing | 15-28 | | | | | | | 20-22 |
| **France** | ✓ | ✓ | ✓ | ✓ | ✓ | | 16-23 | ✓ | ✓ | ✓ | | | | 14-17 |
| **Germany** | | ✓ | ✓ | ✓ | ✓ | | 16-21 | | | | | | | 20-21 |
| **Ireland** | | | | | | | 20-25 | | | | | | | 17-26 |
| **Italy** | ✓ | ✓ | ✓ | ✓ | ✓ | | 15-20 | ✓ | ✓ | ✓ | | ✓ | | 16-21 |
| **Netherlands** | ✓ | ✓ | ✓ | | | Increasing | 10-21 | ✓ | ✓ | ✓ | | | | 14-19 |
| **Spain** | | | | | | | 21-23 | | | | | | | 21-24 |

Notes: (i). Glass ceiling is defined to exist if the 90th percentile wage gap is higher than the reference gaps by at least 2 points. (ii) Sticky floor is defined to exist if the 10th percentile wage gap is higher than the reference wage gap by at least 2 points.

**Figure 1**
**Gender wage gap due to differences in returns evaluated at men's characteristics.**
**Pooled Model - Industry and occupation dummies NOT included**

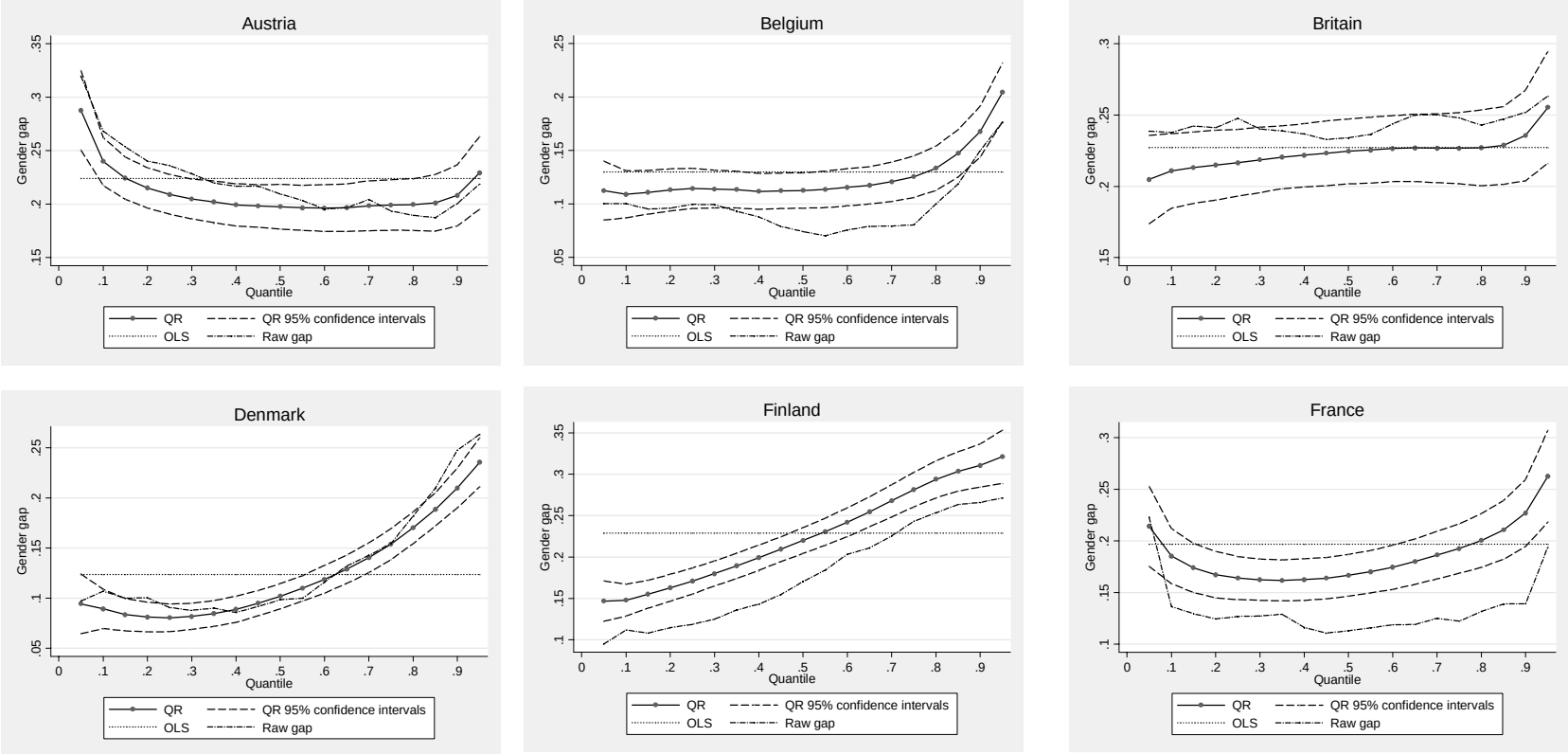
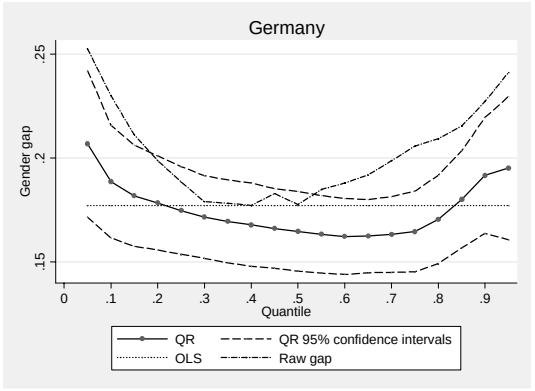
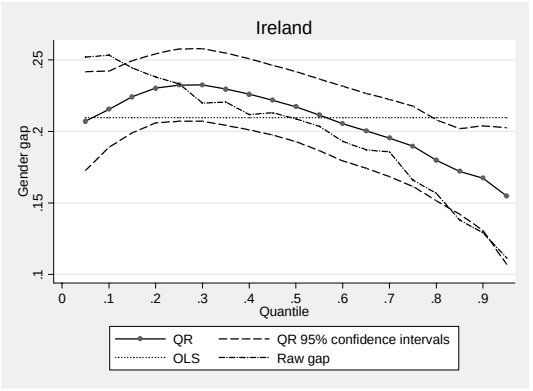
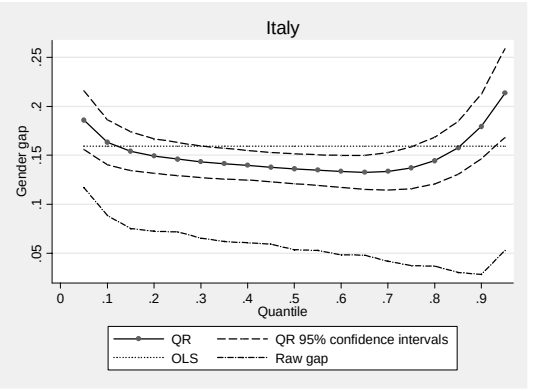
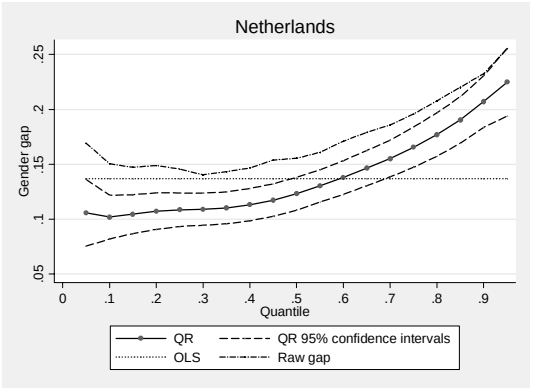



**Figure 1 Continued**


Germany
Gender gap
.15
.2
.25
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
Quantile
QR
QR 95% confidence intervals
OLS
Raw gap


Ireland
Gender gap
.1
.15
.2
.25
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
Quantile
QR
QR 95% confidence intervals
OLS
Raw gap


Italy
Gender gap
.05
.1
.15
.2
.25
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
Quantile
QR
QR 95% confidence intervals
OLS
Raw gap


Netherlands
Gender gap
.05
.1
.15
.2
.25
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
Quantile
QR
QR 95% confidence intervals
OLS
Raw gap

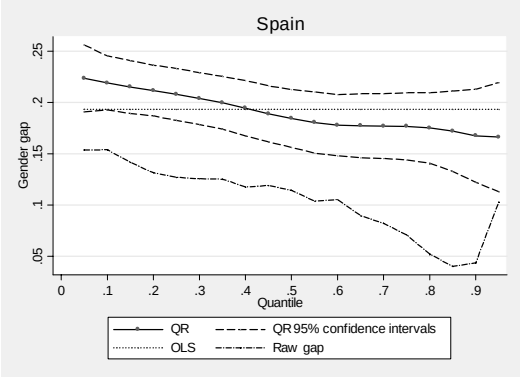

Spain
Gender gap
.05
.1
.15
.2
.25
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
Quantile
QR
QR 95% confidence intervals
OLS
Raw gap

**Figure 2**
**Gender wage gap due to differences in returns evaluated at men's characteristics.**
**Industry and occupation dummies omitted**

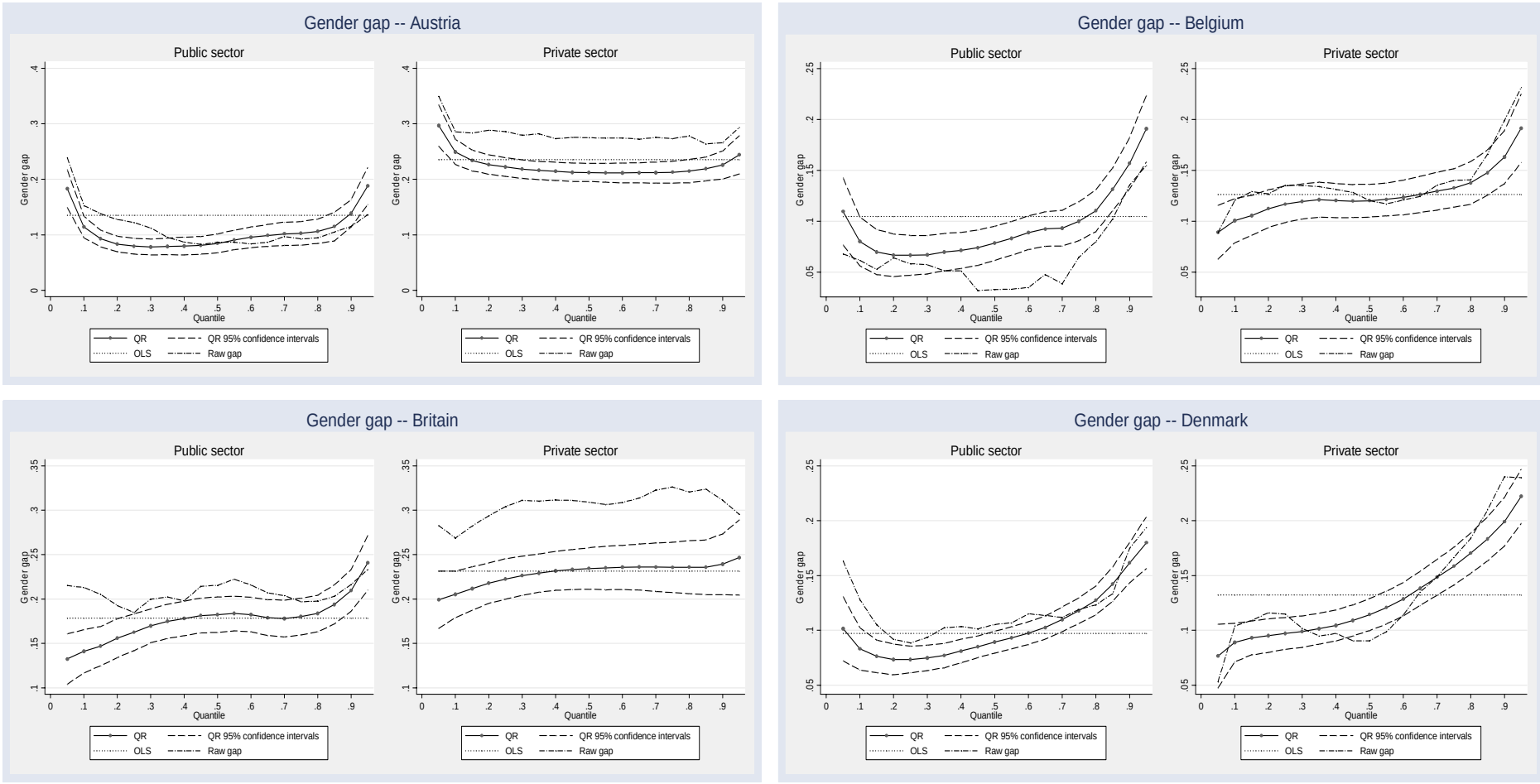
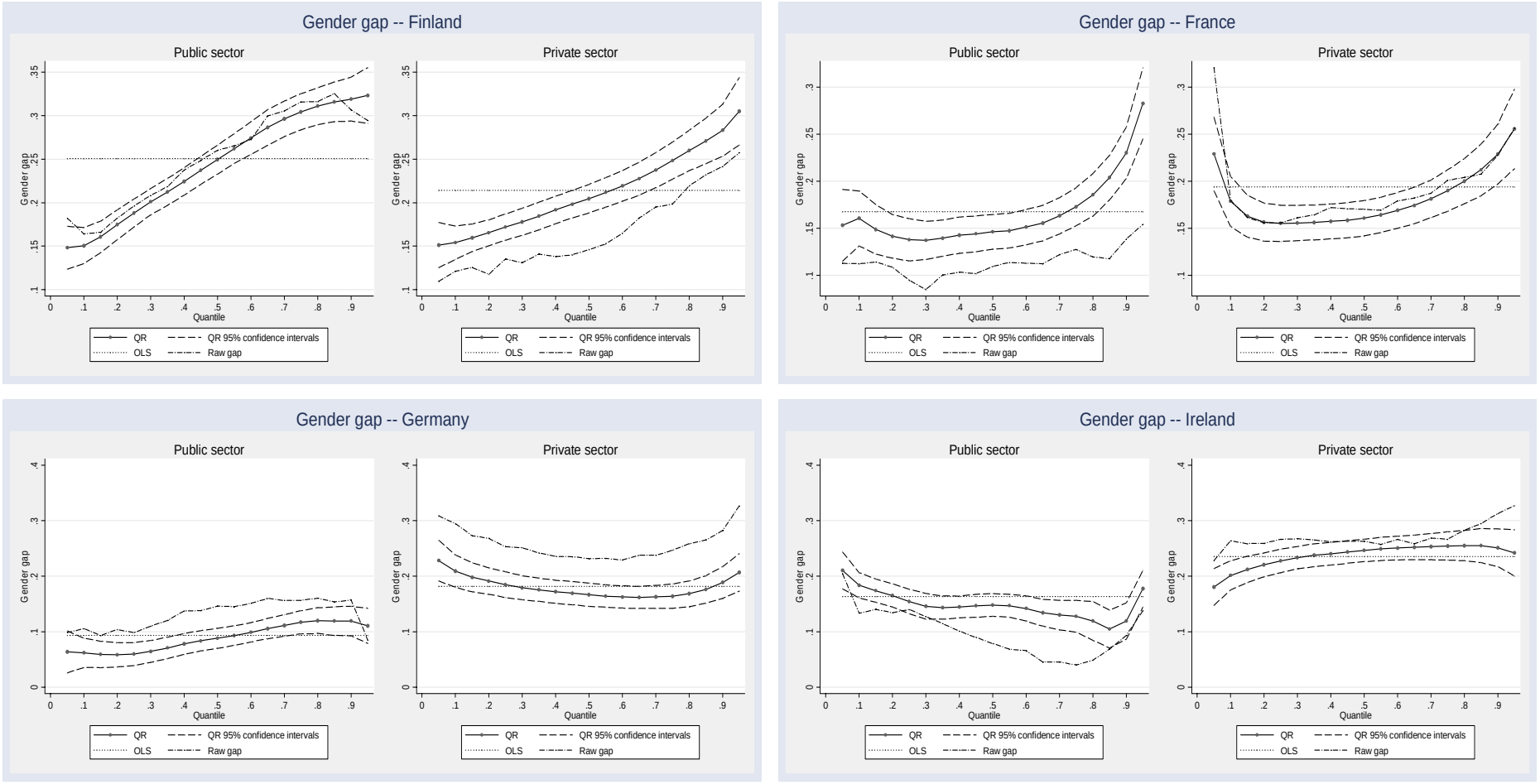
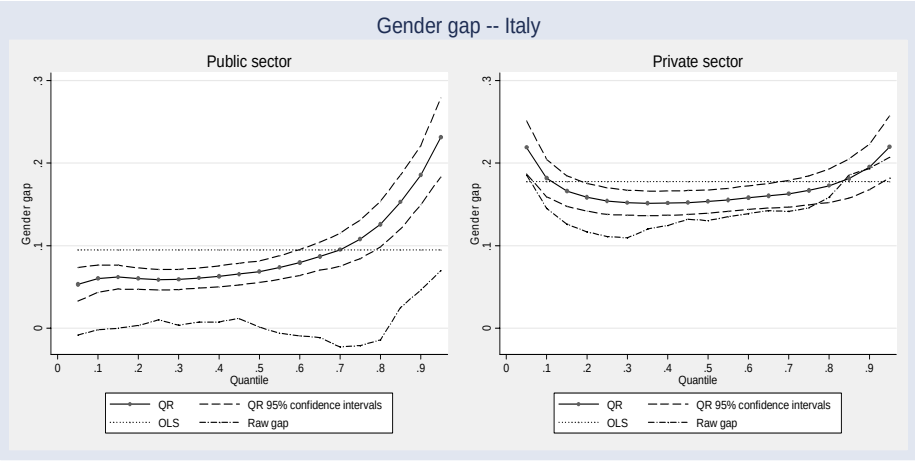
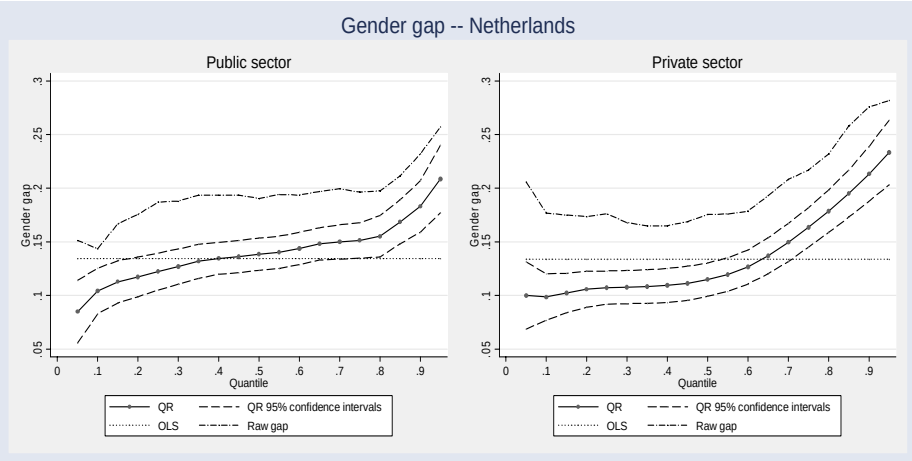


**Figure 2 (continued)**



## Figure 2 (continued)



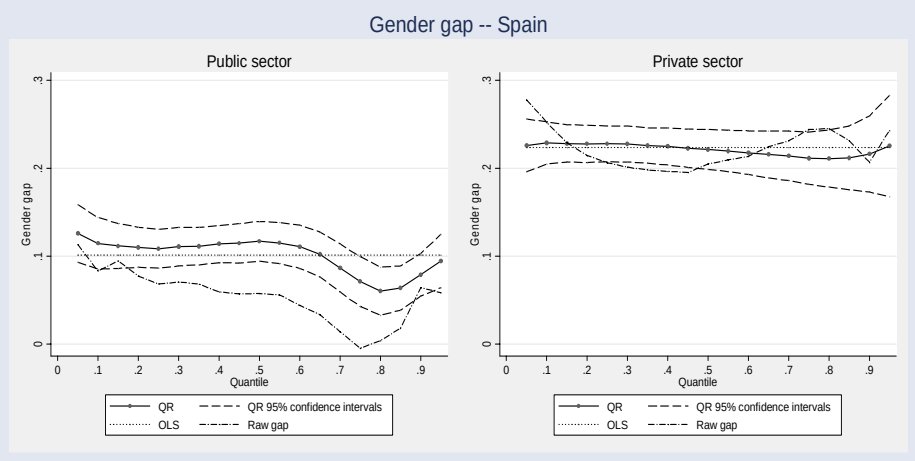
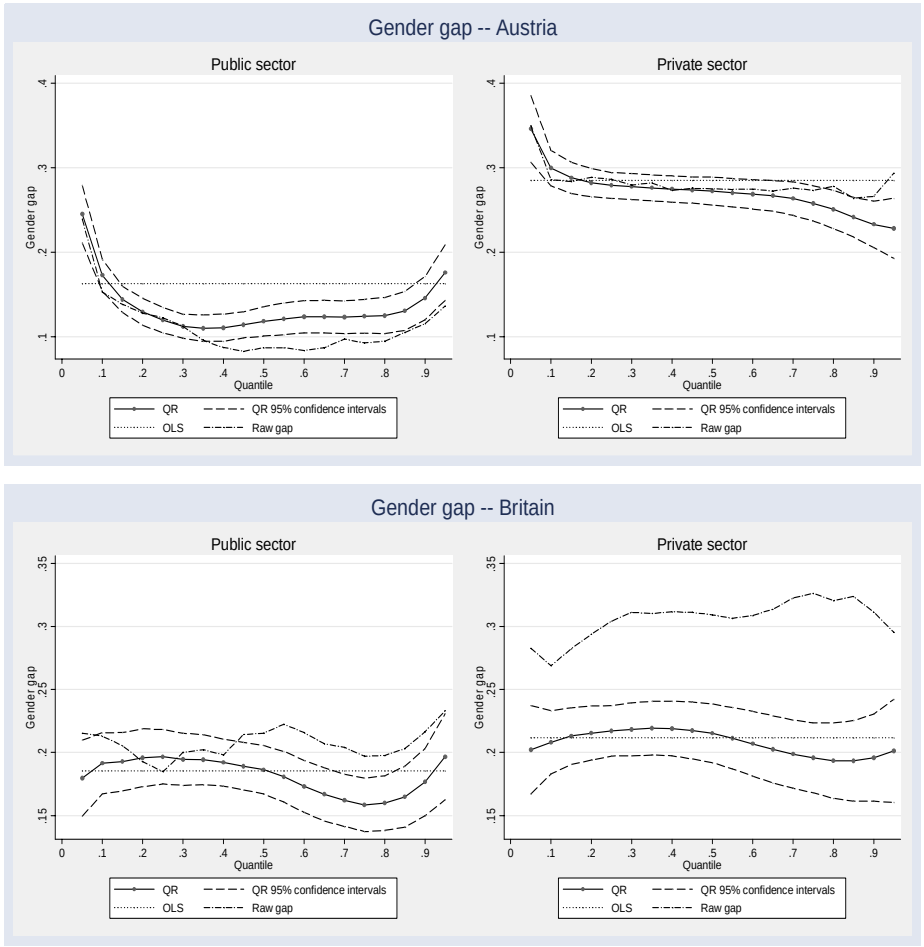



**Figure 3**
**Gender wage gap due to differences in returns evaluated at men's characteristics.**
**Industry and occupation dummies included**



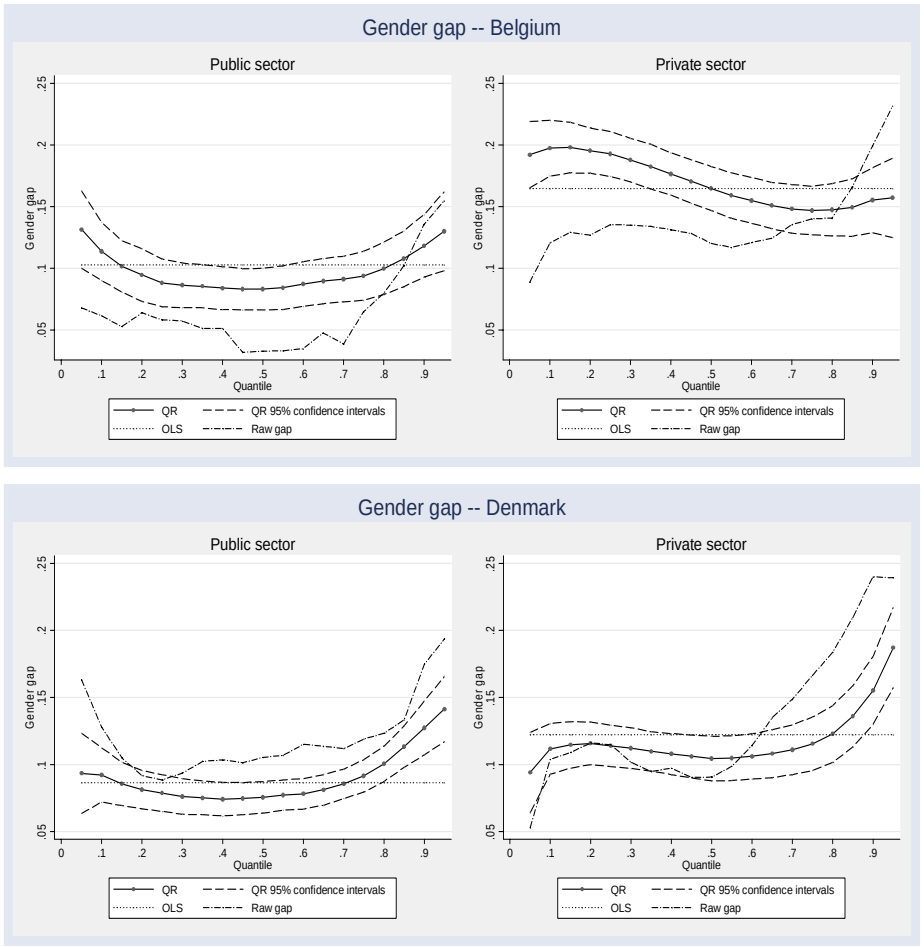
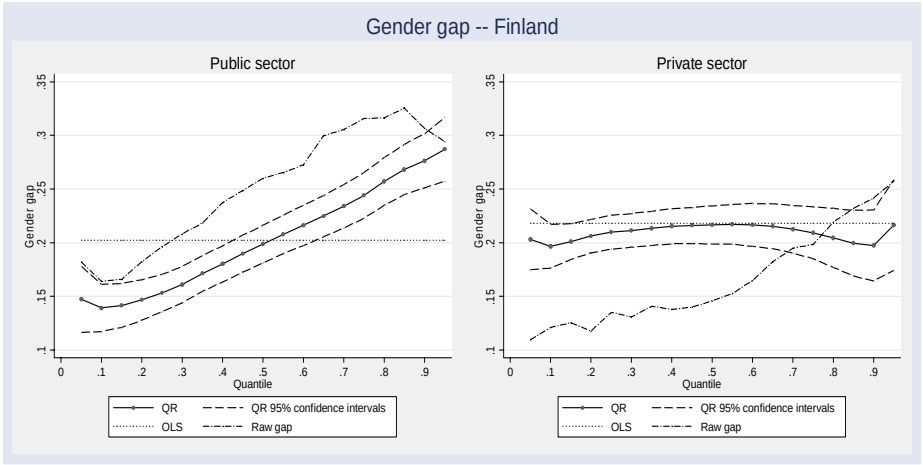
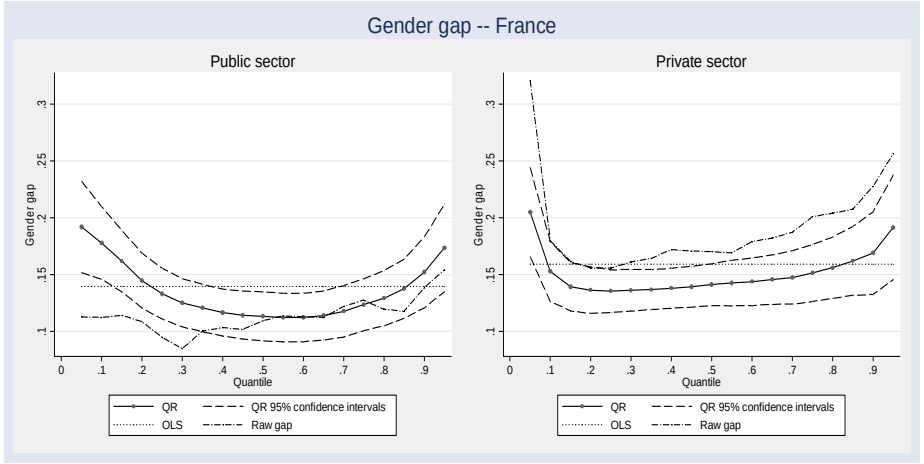
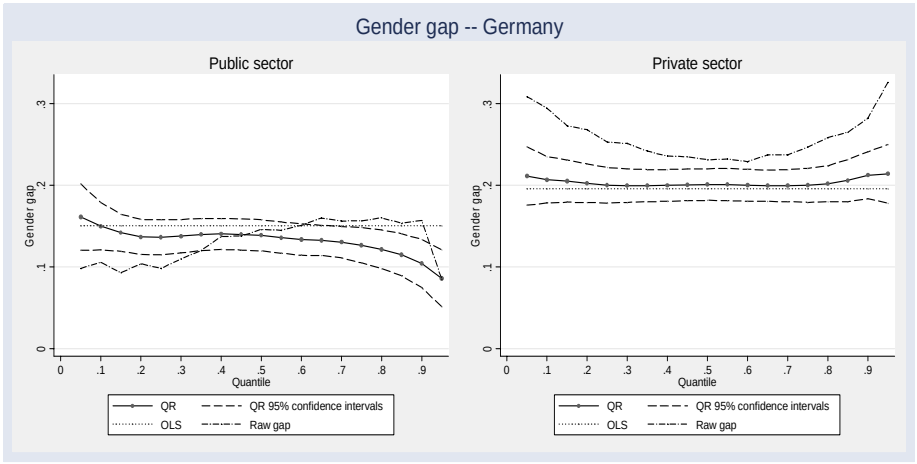



**Figure 3 (continued)**



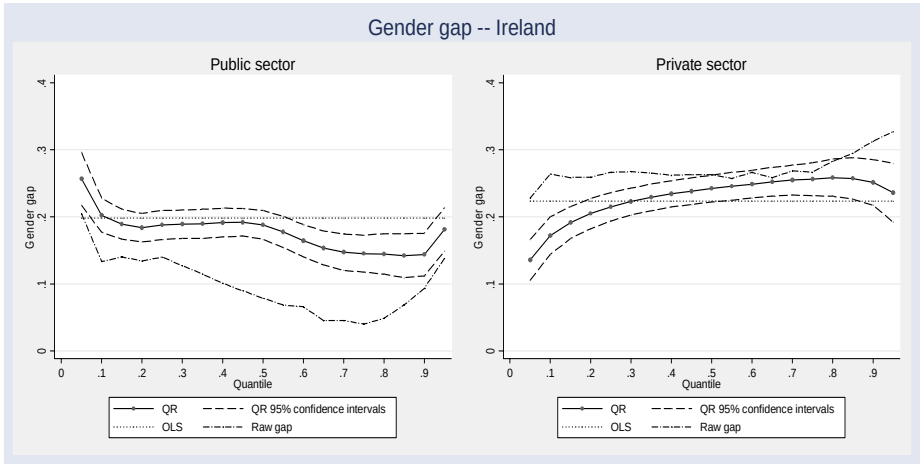
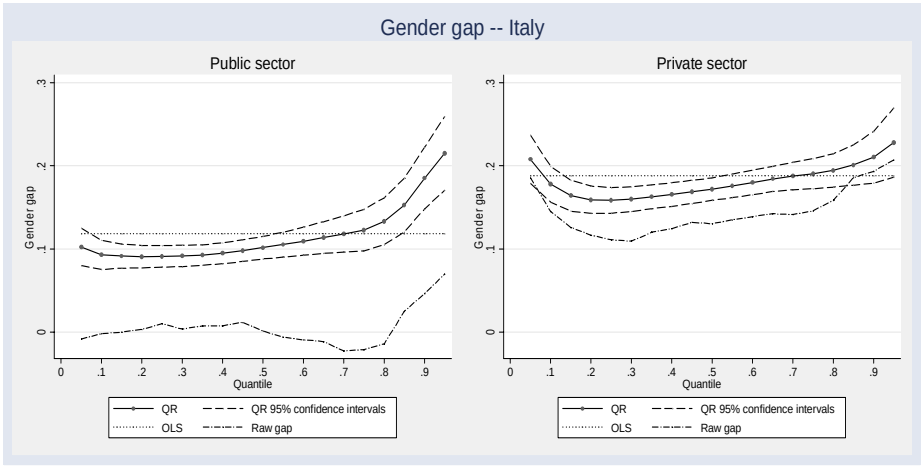
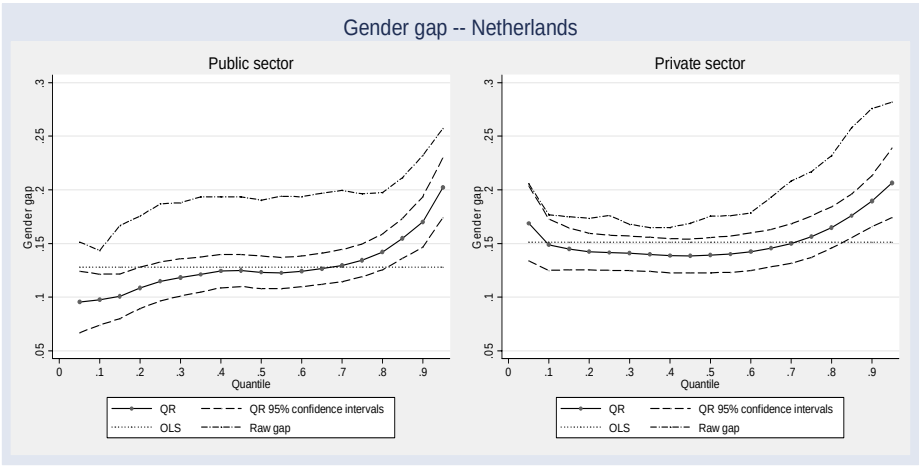



**Figure 3 (continued)**



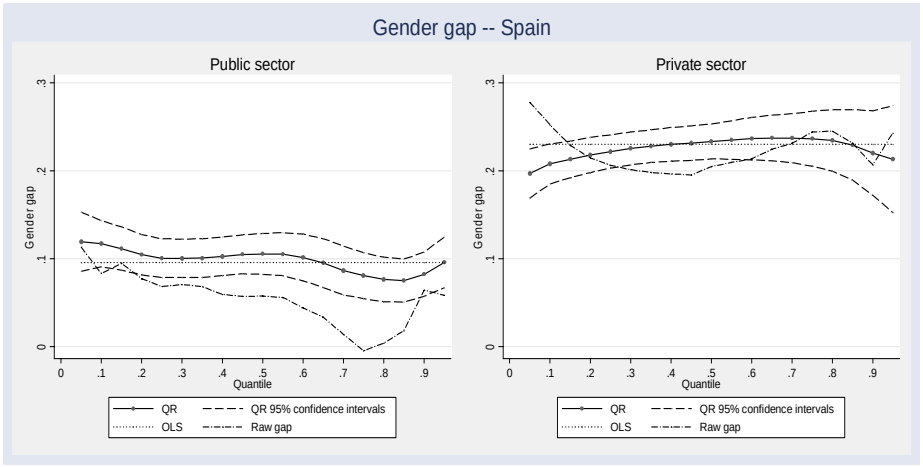



**Figure 4**

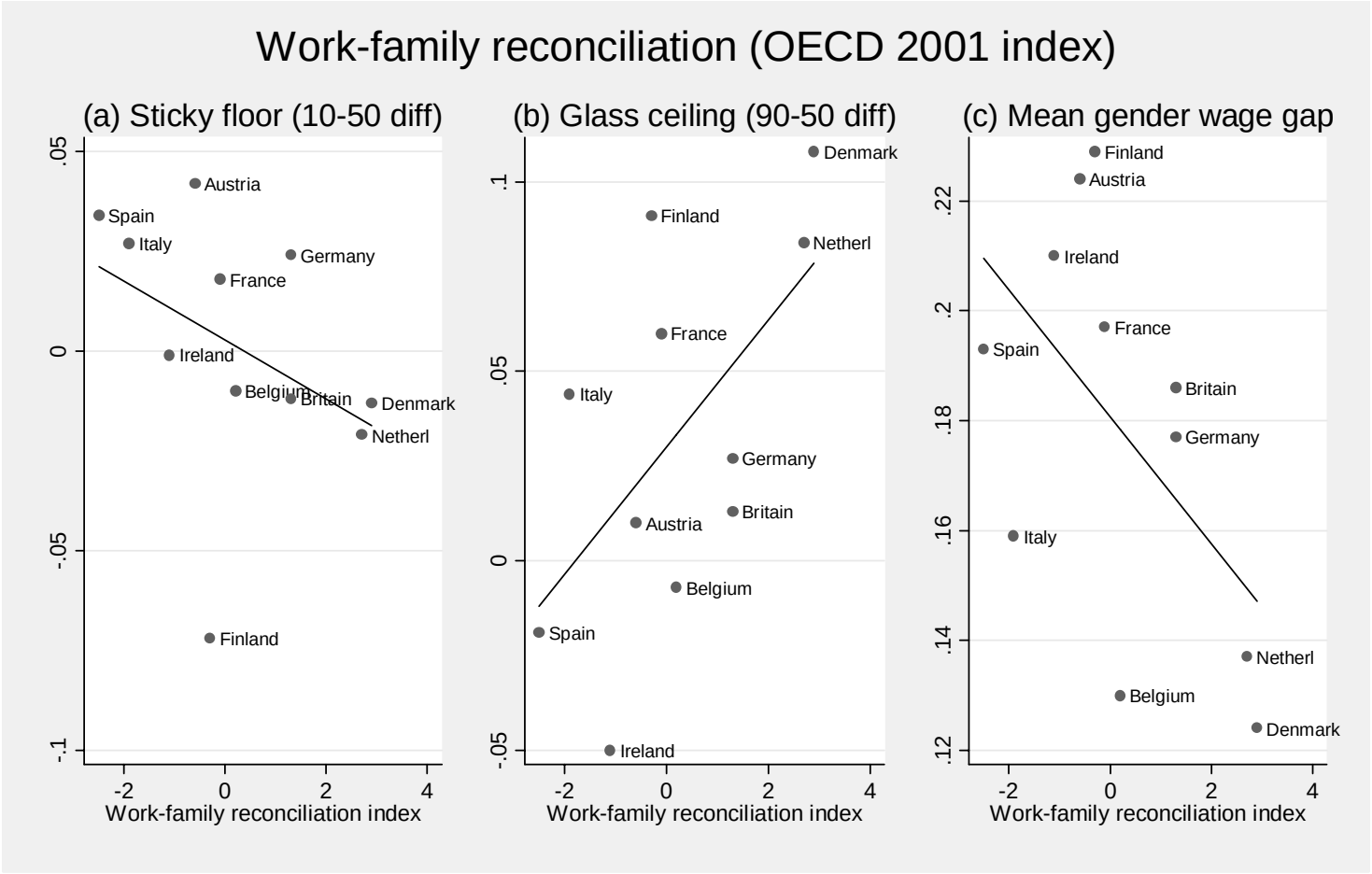

Work-family reconciliation (OECD 2001 index)
(a) Sticky floor (10-50 diff)
(b) Glass ceiling (90-50 diff)
(c) Mean gender wage gap
Austria
Spain
Italy
Germany
France
Ireland
Belgium
Britain
Denmark
Netherl
Finland
Work-family reconciliation index
-2
0
2
4
.05
0
-.05
-.1
.1
.22
.2
.18
.16
.14
.12

**Figure 5**

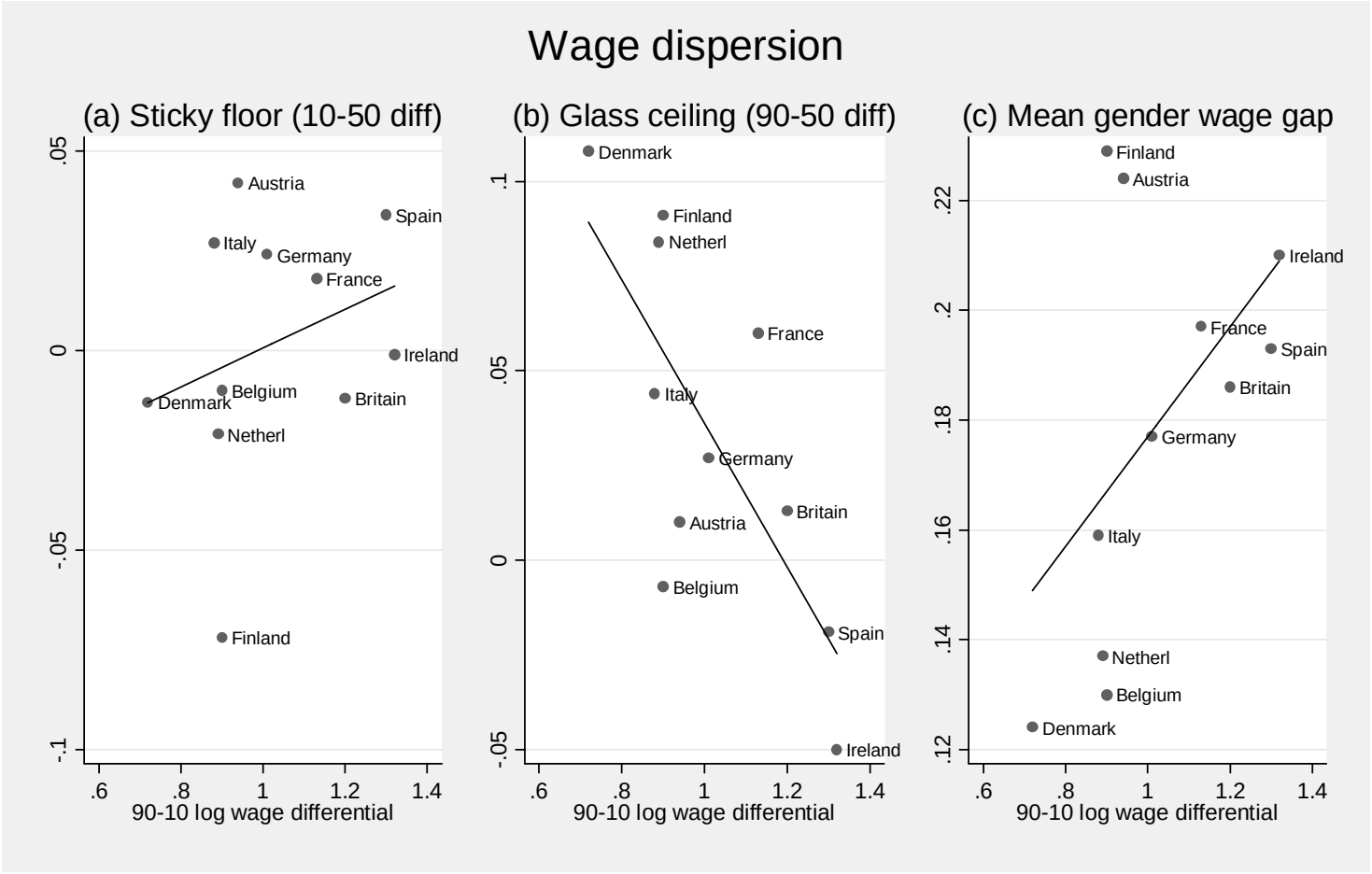
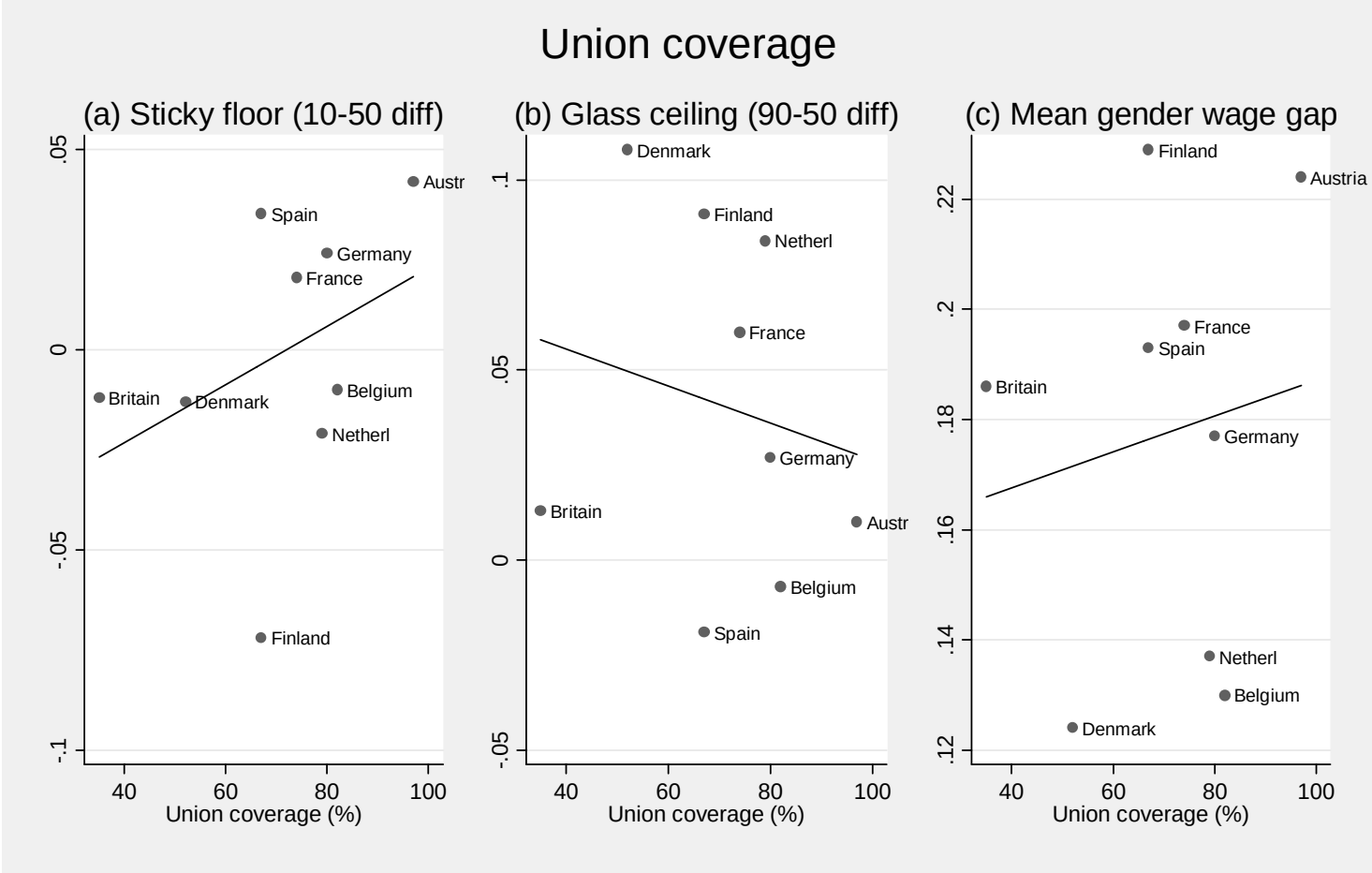

Wage dispersion
(a) Sticky floor (10-50 diff)
(b) Glass ceiling (90-50 diff)
(c) Mean gender wage gap
90-10 log wage differential
Austria
Spain
Italy
Germany
France
Ireland
Belgium
Denmark
Britain
Netherl
Finland

**Figure 6**


Union coverage
(a) Sticky floor (10-50 diff)
(b) Glass ceiling (90-50 diff)
(c) Mean gender wage gap
Austr
Spain
Germany
France
Britain
Denmark
Belgium
Netherl
Finland
Austria
Union coverage (%)
40
60
80
100
.05
0
-.05
-.1
.1
.22
.2
.18
.16
.14
.12

## DATA APPENDIX:

## Selection of Estimating Samples and Sample Sizes

The selection criteria are outlined in the text, and result in sample sizes as given in column [5] of Appendix Table A.1. The pooled, economy-wide models use the combined public and private sector samples for each gender. In the separate private and public sector analyses which include occupation and industry, the various industry and occupation dummies were combined in the following cases: (i) where there were small cell sizes (less than 1% of observations for both sexes); or (ii) where there was strong gender segregation (less than 1% of one sex in a cell).

**For the industry dummies,** the base case in the public sector is administration, and the base case in the private sector is manufacturing. The table below shows how dummies were combined for each sector and country. For the public sector (where industry structure varies substantially across countries), the table lists the dummies combined and those included separately. Note that, when energy is combined with manufacturing, it is simply left in the base case. For the private sector, the table lists only combined dummies. The others are all included separately. The full industry list is: agriculture (all observations dropped), energy, manufacturing, construction, retail, hotels, communications, finance, property, administration, education, social services, other, and missing industry.

**For the occupational dummies**, the base case is unskilled. The most common form of occupational segregation is in the public sector, where there are very few female craft workers or operatives. These categories were combined with service and shop workers (this was preferred to combining them with the unskilled category). The full occupational list is: manager, professional, associate professional, clerical worker, service worker, agricultural worker (all observations dropped), craft worker, operative, unskilled/other, missing occupation.

**Germany:** to account for differences in wage determination between east and west in post-unification Germany, following a pooling test we interacted the following variables with a dummy variable for Eastern Germany: age, education, health status, any experience of unemployment since 1989, fixed term contract, occupation, firm size (private sector) and year.

**Appendix Table A.1 – Sample Selection and Industry/Occupation Definitions**

| ***Country*** [1] | **Sector** [2] | **Industry dummies** [3] | **Occupation dummies** [4] | **Final no. of pooled observations [males, females]** [5] | **Mean waves per individual [males, females]** [6] |
|---|---|---|---|---|---|
| ***Austria*** | Public | Combined: energy, manuf, constr, retail, hotel and finance<br>Separate: comms, property, education, social, other. | Combined: service worker, craft, operative | 2389, 2214 | 4.3, 4.2 |
| | Private | Combined: (1) energy & manuf; (2) admin, educ & social. | | 6469, 4205 | 4.1, 3.6 |
| ***Belgium*** | Public | Combined: energy, manuf, constr, retail & hotel.<br>Separate: comms, finance, property, education, social, other. | Combined: service worker, craft, operative | 2257, 2466 | 4.2, 4.0 |
| | Private | Combined: (1) energy & manuf; (2) admin & educ. | | 4271, 3137 | 3.8, 3.6 |
| ***Britain*** | Public | Combined: energy, manuf, constr, retail, hotel and finance<br>Separate: comms, property, education, social, other. | Combined: service worker, craft, operative | 2099, 3918 | 4.4, 4.1 |
| | Private | Combined: admin and educ. | | 8980, 6934 | 3.8, 3.6 |
| ***Denmark*** | Public | Combined: energy, manuf, constr, retail, hotel and finance<br>Separate: comms, property, education, social, other. | Combined: service worker, craft, operative | 1984, 3922 | 4.1, 4.0 |
| | Private | Combined: (1) energy & manuf; (2) admin, educ & social. | | 5169, 2955 | 4.0, 3.8 |
| ***Finland*** | Public | Combined: energy, constr, retail, hotel and finance<br>Separate: manuf, comms, property, education, social, other. | Combined: service worker, craft, operative | 2240, 4153 | 3.7, 3.5 |
| | Private | Combined: (1) energy & manuf; (2) admin, educ & social. | | 5413, 3616 | 3.3, 3.2 |
| ***France*** | Public | Combined: constr, retail & hotel.<br>Separate: energy, manuf, comms, finance, property, education, social, other. | Combined: service worker, craft, operative | 4114, 5017 | 4.2, 4.1 |
| | Private | Combined: (1) energy & manuf; (2) admin & educ. | | 10309, 7227 | 3.8, 3.6 |

**Appendix Table A.1 Continued – Sample Selection and Industry/Occupation Definitions**

| *Country* | Sector | Industry dummies | Occupation dummies | Final no. of obs [males, females] | Mean waves per individual [males, females] |
|---|---|---|---|---|---|
| ***Germany*** | Public | Combined: energy, manuf, constr, retail, hotel & property<br>Separate: comms, finance, education, social, other. | Combined: service worker, craft, operative | 3572, 4698 | 4.6,4.2 |
| | Private | Combined: (1) energy & manuf; (2) admin, educ & social. | | 13335, 8031 | 4.3, 4.8 |
| ***Ireland*** | Public | Combined: energy, manuf, constr, retail & hotel<br>Separate: comms, finance, property, education, social, other. | Combined: service worker, craft, operative | 2113, 1945 | 3.9, 3.6 |
| | Private | Combined: (1) energy & manuf; (2) admin, educ & social. | | 4684, 3597 | 3.2, 3.0 |
| ***Italy*** | Public | Combined: constr, retail, hotel, finance, property.<br>Separate: energy, manuf, comms, education, social, other. | Combined: (1) manager & professional; (2) service worker, craft & operative | 4638, 4404 | 4.2, 4.5 |
| | Private | Combined: admin, educ & social. | Combined: manager & professional. | 10255, 5812 | 3.7, 3.4 |
| ***Netherlands*** | Public | Combined: energy, manuf, constr, retail, hotel, comms & finance.<br>Separate: property, education, social, other. | Combined: service worker, craft, operative | 3125, 3378 | 4.8, 4.3 |
| | Private | Combined: admin & educ. | | 10491, 5821 | 4.6, 3.9 |
| ***Spain*** | Public | Combined: energy, manuf, constr, retail, hotel & finance.<br>Separate: comms, property, education, social, other. | Combined: (1) manager & professional; (2) service worker, craft & operative | 3155, 2837 | 4.1, 3.9 |
| | Private | Combined: admin, educ & social. | | 11790, 6241 | 3.4, 2.9 |