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Public-private sector pay gaps by industry, quantile and gender

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ABSTRACT

This study examines public-private sector wage gaps using unbalanced panel data from Finland for the years 1995-2004. We nest different wage-setting models in an earnings equation to study the existence of pay gaps by industry, gender and at different points of the earnings distribution. The results suggest that aggregate analyses conceal considerable differences in sectoral wage gaps. In particular, our results imply that *(i)* public sector premium is positive in transportation and negative in real estate, *(ii)* public sector employees are better off in the lower quantiles, *(iii)* variations in pay gaps are lower among women, and *(iv)* different components of pay gaps vary over time.*

(JEL: J31, J45)

Keywords: public-private wag gap, selection, decomposition, quantile, gender

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1. Introduction

Wage differentials between workers in the public and private sectors have attracted a considerable amount of empirical research over the last three decades. A cursory literature search finds over 30 empirical studies on the theme, covering all major OECD countries. The main focus of the research has been on how workers' characteristics and the rewards attributable to these characteristics differ across working sectors. A literature review shows that empirical findings vary from one country to another. In some countries (mostly in developed countries) the wage gap is positive, that is, public sector workers earn more than workers in the private sector, and it is mainly related to workers' characteristics. In some countries (mostly in developing or countries in transition), the results are the opposite; the wage gap is negative, and it is mainly due to better rewards offered to the workers of the private sector. In short, almost all possible combinations exist and are reported.

There are four main findings that emerge from the existing empirical literature and are worth emphasising. First, workers in the public sector tend to earn a premium over workers in the private sector. This result is likely to hold whether conditional or unconditional wages are studied (e.g., Kanellopoulos 1997; García-Pérez and Jimeno 2005). Second, women are more likely to be overpaid in the public sector than men (e.g., Kanellopoulos 1997; Mueller 1998; Heitmueller 2004). This implicitly, at least partly, reflects unequal wage opportunities in private sector labour markets for women. Third, quantile regression results suggest that public sector workers are better off at lower parts of the earnings distribution (Papapetrou 2006; Lucifora and Meurs 2006). This may reflect behaviour where workers prefer the public sector at the early stage of their working career, whereas the employment shift from the public to the private sector increases at higher skill levels (Borjas 2003). Fourth, wages seems to be more sensitive to economic upturns and downturns in the private sector, thus leading the public sector pay premium to move counter-cyclically over time (Quadrini and Trigari 2007).

The existing empirical literature shares several common features. These include the use of micro data (typically data from an OECD country), the use of a similar set of control variables (human capital and regional variables), the treatment of unobservable factors (use of a selection equation), and decomposition methods (a type of Oaxaca decomposition). All these studies have, of course, certain specific features and different points of departures; see Disney (2007) for a survey. Two

issues that have received only a limited amount of attention relate to the possible differences between aggregate and industry-level gaps and the possible bias arising from the use of cross-sectional data. Excluding García-Pérez *et al*. (2005), wage gaps are not examined by using industry data. This is a clear shortcoming, as rewards from individual characteristics may vary not only across working sectors and wage distributions but also by industry. Second, excluding studies by Disney and Gosling (1998; 2008), Melly (2005) and Bargain and Melly (2008), wage differentials are typically analysed by using a single cross-section. The use of one data point is never ideal, as wage differentials across working sectors may reflect idiosyncratic shocks of that particular period.

This study contributes to this general discussion on public-private sector wage gaps by analysing data from an OECD country from three encompassing dimensions, namely, between groups (using aggregate and industry data and comparing sexes), within groups (using quantile methods to examine differences along the wage distributions), and over time (using pooled cross-section data). To the best of our knowledge, this is the first study that provides empirical evidence about the existence and degree of sectoral pay gaps from so many levels. To conduct the analysis, we use an employee-based survey that contains a rich set of variables on workers' characteristics and work residence. The data are unbalanced panel data for 1995-2004 (Finnish Labour Force Survey), containing information on 243,809 male and 219,050 female workers. The data allow us to estimate selectivity corrected wage equations (Heckman 1979) separately for the public and the private sector and for men and women by using both mean and quantile regression methods.

The rest of this paper is organised as follows. Section II describes the econometric framework. Wage equations for public and private sector workers are estimated, and wage premiums are scrutinised using the decomposition methodology of Neuman and Oaxaca (2004). Data description and selectivity corrected estimates, reported in Section III, suggest that the aggregate-level analyses conceal considerable industry, distributional, and gender-level differentials in wage gaps. In particular, our findings support the prevailing notion that public sector workers are better off at the lower parts of the earnings distribution. This makes it harder for the public sector to attract high-skilled workers. Other findings are related to between-group differences in wage gaps, where the industry-level differences are substantial, and that the pay gaps are lower amongst female workers. Finally, Section IV concludes.

2. Empirical models

We estimate separate wage equations for public and private sector workers by gender and account for possible selection bias by using the methods of Heckman (1979).[1] The wage equation is expressed as:

$$(1)\quad \ln w_{ijt} = \alpha_i + \beta X_{ijt} + \theta\lambda_{ijt} + dt + \varepsilon_{ijt},$$

in which w_{ijt} is the annual wage obtained by individual i working in industry j in year t. X_{ijt} is a vector of independent characteristics.[2] $\theta\lambda_{ijt}$ refers to the selection correction term, which is calculated by a probit model for a public sector choice; see econometrics in appendix A. *dt* denotes the impact of years and finally, ε_{ijt} is a random error term.

The findings that the pay gaps may differ at different parts of the earnings equation (see Papapetrou (2006), and Lucifora *et al*. (2006)) is accounted for by applying quantile regression methods. Estimation by mean regression presumes that the marginal effects of independent variables on pay are constant over the earnings distribution. A quantile regression method, in turn, measures the pay effect of certain variable at different points of the earnings distribution. It is less restrictive and more sensitive to outliers of the dependent variable than mean regression, allowing more complex examination on returns from exogenous variables. In addition, the quantile regression may be more efficient than mean regression with non-Gaussian errors; see Koenker and Basset (1978) and Buchinsky (1998). The model can be written as

$$(2)\quad \ln w_{ijt} = \beta_\theta X_{ijt} + \varepsilon_{\theta ijt} \quad , \quad Quant_\theta(\ln w_{ijt} \mid X_{ijt}) = \beta_\theta X_{ijt} \ ,$$

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[1] In modeling the choice of the working sector, we follow the example of Kanellopoulos (1997), Dustmann and van Soest, (1998), Lassibille (1998), Prescott and Wandschneider (1999), Christofides and Pashardes (2002) and Tansel (2005).

[2] We control for potential work experience, tenure, education, field of education, marital status, native language, presence of children and occupation as individual factors. The occupation is reported in 1995, 2000 and 2004, and missing information is imputed. We also bring regional and business environmental factors into the earnings equation assuming that sub-region, province, industry and R&D-intensity reflect the average productivity of firms in an area.

in which X_{ijt} is the vector of explanatory variables discussed above, including constant and selection correction terms and year dummies. $Quant_{\theta}(\ln w_{ijt} \mid X_{ijt})$ denotes the θth conditional quantile of wage given variable vector X. We use 0.10^{th}, 0.50^{th} and 0.90^{th} quantiles as θ in the regression analysis.

Finally, we scrutinise wage premiums using Neuman and Oaxaca (2004). Similar to earlier literature, we decompose the difference in observed mean log wages between the public sector (*pu*) and the private sector (*pr*) as follows:

$$\ln \overline{w}^{\theta}_{pu} - \ln \overline{w}^{\theta}_{pr} = (\overline{X}_{pu} - \overline{X}_{pr})^{\theta} \hat{\beta}^{\theta}_{pr} + \overline{X}^{\theta}_{pu} (\hat{\beta}_{pu} - \hat{\beta}_{pr})^{\theta} + (\hat{\theta}^{\theta}_{pu} \hat{\lambda}_{pu} - \hat{\theta}^{\theta}_{pr} \hat{\lambda}_{pr}) + (\hat{\alpha}_{pu} - \hat{\alpha}_{pr})^{\theta} \quad (3)$$

The first term on the right-hand side of the equation captures differences in the individual's characteristics (endowments or explained part), weighted by the parameters from the model for the private sector *pr.* The second term measures the gap that is due to differences in the parameters (treatment or unexplained part), weighted by the means of the public sector workers *pu*. The third term captures the part of the total pay gap due to selectivity.[3] The last term captures the difference between the estimated constant terms, which is added to the unexplained part of the total observed pay gap. θ denotes the quantile that is used. For equation (1), it is one, and for equation (2), it is 0.1, 0.5 and 0.9, respectively.

[3] The effect of the selection term on wages is fused into both explained and unexplained parts of the total pay gap. We separate it into its own component in the aggregate analysis. In the quantile regression analysis, in turn, we concentrate solely on parts that are due to differences in characteristics and returns.

3. Empirical results

3.1 Data preliminaries

We base our empirical analysis on micro panel data from Statistics Finland for a post-recession period of 1995-2004. The data is a seven per cent random sample of the whole population in 2001 and reports a comprehensive set of information on both individuals' characteristics and the region of their employment. The analysis is confined to those who were full-year wage earners between 18 and 64 years old, and who were not self-employed or living in Åland. The data are unbalanced panel data including 462,859 wage observations from 243,809 males and 219,050 females over a period of 10 years.

The empirical analysis focuses on the whole sample and for two industries where the representation of workers in both sectors is sufficient for a robust analysis. The industries are real estate and transportation. Figures 1 and 2 show the average public-private sector pay gaps with 95 per cent confidence intervals over the sample. There are two findings that are of special interest. First, contrary to the aggregate pay gap, which is around zero for both sexes, industry-level differentials are both substantial and vary across gender, being less evident for women. The pay gap is positive in transportation (around +12 per cent for males and +5 per cent for females, the latter having a wider confidence interval) and negative in real estate (around -15 for males and -12 for females). This finding alone stresses the need for an industry-level analysis of wage gaps. Second, pay gaps are in all cases relatively stable over the whole period. However, this does not rule out the possibility that there have been changes in sectoral premiums, as the observed stability may simply reflect changes in observed (and unobserved) characteristics or changes with regard to these characteristics.

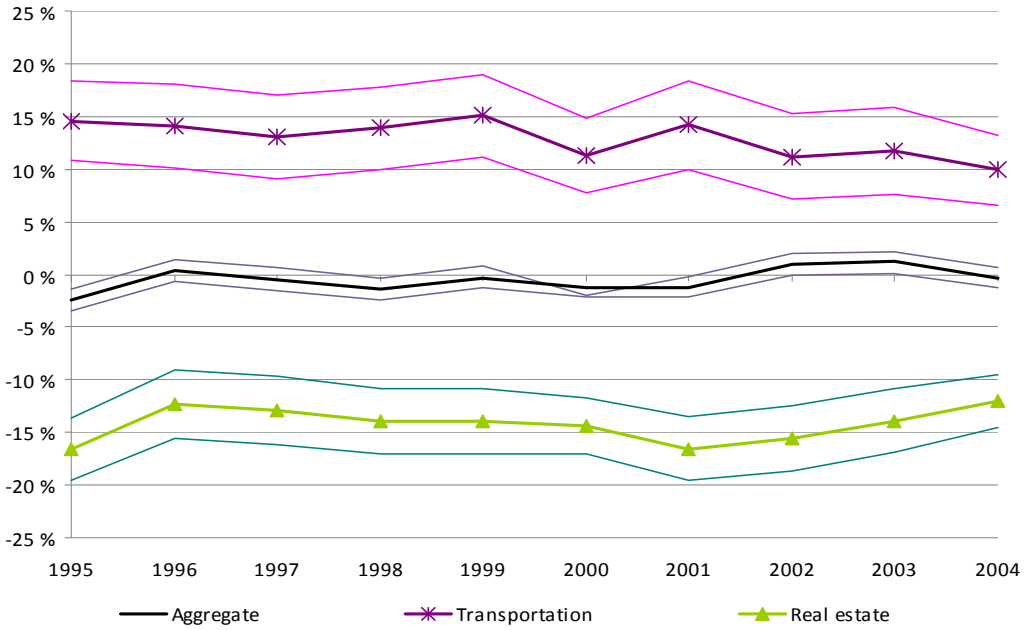

Figure 1: Public-private sector pay gaps for men, with 95 % confidence intervals

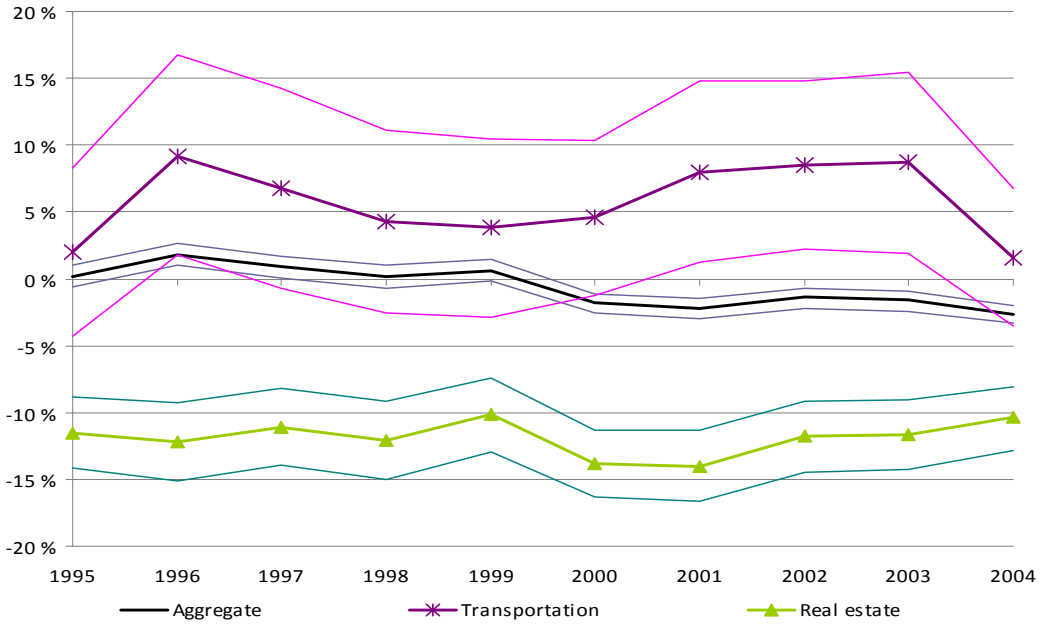

Figure 2: Public-private sector pay gaps for women, with 95 % confidence intervals

Table 1 illustrates the data in two ways. First, it reports the means of two primary human capital variables (age and education). In accordance with the earlier public-private sector pay gap literature, public sector workers are older and, in general, more educated than private sector workers; see, for example, Kanellopoulos (1997), Christofides *et al*. (2002) and Tansel (2005). Second, Table 1 depicts public-private sector pay gaps at different points of the earnings percentiles. The data indicate that public sector pay premiums for both sexes tend to be highest (positive) at the 10th percentile and lowest (negative) at the 90th percentile. This aggregate results shows up firmly in real estate where the pay gap is slightly positive at the 10th percentile for both sexes (+1 per cent for men and +3 per cent for women) and highly negative at the 90th percentile (-21 and -14, respectively). These numbers illustrate in a very simple manner the need to account for differences in personal attributes across the working sector as well to allow for differences along the wage distribution in analysing public-private wage gaps.

Table 1: Variable means (age and education) and public-private wage gaps at 10th and 90th percentiles

	Age	Primary	Secondary	Tertiary	Wage gap, 10th Percentiles	Wage gap, 90th Percentiles
Aggregate						
Males, public	41	0.12	0.36	0.52		
Males, private	38	0.19	0.50	0.31	-3.0	-2.0
Females, public	42	0.09	0.40	0.51		
Females, private	39	0.19	0.39	0.42	10.0	-10.0
Transportation						
Males, public	42	0.25	0.50	0.25		
Males, private	39	0.32	0.51	0.17	13.0	19.0
Females, public	41	0.14	0.35	0.51		
Females, private	39	0.19	0.39	0.42	7.0	7.0
Real estate						
Males, public	43	0.14	0.30	0.56		
Males, private	38	0.09	0.29	0.62	1.0	-21.0
Females, public	43	0.14	0.36	0.50		
Females, private	40	0.15	0.29	0.56	3.0	-14.0

3.2 Aggregate and industry wage equations

We report selectivity-corrected results for men and women in Tables 2 and 3.[4] Both tables have the same structure: column 1 depicts results for the aggregate data, and columns 2 to 3 depict results for real estate and transportation, respectively. The dependent variable (annual earnings) is deflated in 2004 euros using the consumer price index. The data are truncated at the upper end of the earnings distribution, as reported annual earnings are capped at 72,000 (years 1995-2000) and 96,000 euros (years 2001-2004).

The aggregate wage equations perform well, the explanatory power of the model varying from 0.44 (private sector, males) to 0.55 (public sector, women). The selection terms are statistically significant. The term is negative in the public sector wage equations and positive in the private sector wage equations. This implies that average pay is lower (higher) for the public (private) sector workers who are non-randomly selected into the public (private) sector. Overall, the individual parameter estimates are well defined and have the expected signs. The returns from experience and qualifications (education and occupation), for example, fall well in line with previous Finnish findings, including Asplund (1997), Korkeamäki (1999), Uusitalo (1999) and Maczulskij (2008). Below, we shortly discuss the main results and compare them to recent international evidence.

The returns from work experience are higher for men working at the public sector compared to the private sector. For women, the result is the opposite. In line with Prescott *et al.* (1999), we find that the return from tenure is lower in the public sector for both sexes. This is probably due to higher share of temporary employment in the public sector. Similar to earlier literature, we find that married men earn more than unmarried men and that the presence of children increases men's wages significantly in both sectors. Amongst women, the effects are negative and of the same magnitude across the sectors. This contrasts with intuition that public sector is a good employer for protected groups; see Bellante and Link (1981) and Blank (1985) for early evidence. Swedish-speaking employees suffer a small penalty of 1-2 per cent across sectors and gender except for men

[4] The results from the probit model for public sector choice are available on request from the authors. We use individual's age and parent's socioeconomic status as exclusion restriction variables, as suggested by Dustmann *et al.* (1998); see the definition in Appendix A. Similarly, we do not report all the parameter estimates of the wage equations; the importance of unreported controls is given by F-statistics in the lower part of the Tables.

in the public sector. For non-native employees, the statistical significance is weak. This result contrasts with that of Prescott *et al*. (1999), who find that in Canada, non-native and French-speaking men suffer from a penalty of a few per cent in both sectors.

The returns to education are higher in absolute terms in the private sector than in the public sector for women. For men, the public sector returns exceed those of the private sector for the two highest levels of education. The former result is in line with those for Spain (Lassibille 1998) and Turkey (Tansel 2005), whereas the latter result is in accordance with Christofides *et al*. (2002), who found that the public sector pays higher returns from the highest level of education. The returns from occupations are all lower in the public sector for both men and women. This resembles Kanellopoulos (1997), who reports similar results for Greece. The aggregate wage equations show that regional and industry variables affect pay. Industry affiliation, for example, bears considerable importance in both sectors and for both sexes; see the F-test results in the lower part of the Tables.

The industry-level wage equations fit the data well, with the adjusted R2 varying from 0.40 (private sector's transportation) to 0.68 (public sector's real estate). Returns from experience are positive and of the same magnitude in all industries. Tenure, in turn, yields the highest returns in real estate in the public sector. This applies to both sexes. The returns from being married and having children are all positive for men across industries and sectors. The corresponding results for women are comparable with the aggregate data. Being a non-native highly decreases men's wages in real estate in both sectors, with the penalty being about 30 per cent. Swedish-speaking women are better off in the public sector, whereas non-native public sector women suffer a negative pay premium in real estate.

Estimates of the returns to education show variation across the industries. In the real estate, returns to education in the public sector are, in absolute terms, 25-30 per cent lower than in the private sector. This applies to both for men and women. In transportation, in turn, returns are higher in the public sector. For men, the advantage is 25 per cent, and for women, it is 5-12 per cent. In line with the aggregate wage equations, managerial and professional occupations enjoy considerable premiums. In transportation, the private sector premium exceeds that of the public sector. Overall, the premiums from occupation are lower among public sector workers and are consistent with the results from the aggregate data. The results also suggest that regional attributes are important for pay. This applies to both industries and gender; see the F-test results.

Table 2: Selectivity corrected estimates for whole data and for two industries, men

Specification	Whole data		Real estate		Transportation	
ln(month pay)	Public	Private	Public	Private	Public	Private
Experience	0.018*	0.013*	0.016*	0.018*	0.016*	0.017*
Experience squared.	-0.031*	-0.027*	-0.030*	-0.031*	-0.033*	-0.029*
Tenure	0.006*	0.009*	0.009*	0.007*	0.006*	0.005*
Married	0.05*	0.03*	0.05*	0.04*	0.05*	0.02*
Child_under18	0.03*	0.03*	0.00	0.04*	0.00	0.04*
Language						
Swedish	0.00	-0.02*	0.02*	0.02	0.02	0.01
Non-native	-0.02	-0.05	-0.29*	-0.34*	-0.07	-0.02
Education						
Secondary	0.15*	0.09*	0.10*	0.13*	0.22*	0.07*
Lowest level	0.26*	0.16*	0.22*	0.23*	0.30*	0.18*
Lower-degree level	0.42*	0.25*	0.31*	0.31*	0.46*	0.23*
Higher-degree level	0.55*	0.37*	0.42*	0.44*	0.55*	0.34*
Occupation						
Managerial	0.21*	0.36*	0.41*	0.39*	0.37*	0.37*
Professional	0.19*	0.23*	0.20*	0.24*	0.06*	0.26*
Technical	0.11*	0.15*	0.05*	0.14*	0.25*	0.18*
Clerk	-0.08*	-0.02*	-0.03*	0.00	-0.02	-0.06*
Sales & care	0.11*	-0.03*	0.19*	-0.10*	0.12*	0.12*
Operative	0.03*	0.04*	-0.02	-0.04*	-0.01	-0.02*
Other	-0.07*	-0.07*	-0.06*	-0.09*	-0.09*	-0.05*
Constant	9.78*	9.77*	9.63*	9.64*	9.68*	9.74*
$\theta\lambda_i$	-0.077*	0.101*	-0.108*	0.013	-0.110	0.174*
R-squared	0.55	0.44	0.65	0.49	0.55	0.40
Number of obs.	53,333	190,476	7,577	24,342	2,655	23,200
Field of educ. dropped F(n1, n2)	211.8*	59.6*	32.8*	38.9*	45.2*	11.7*
Industry dropped F(n1,n2)	294.7*	564.5*	-	-	-	-
R&D dropped F(n1,n2)	7.1*	77.7*	12.1*	8.3*	3.1*	7.2*
Province dropped F(n1,n2)	37.0*	150.4*	6.4*	9.9*	14.8*	13.6*
Sub-region dropped F(n1,n2)	7.6*	394.6*	5.6*	4.9*	3.3*	16.3*

Notes: * denotes statistical significance at least at the 5 % level. Reference categories are: no child/children, Finnish, primary education, technology, craft, transportation, south, metropolitan area and R&D2. NA= no observations. n1 = 9 for field of education, 8 for industry, 7 for R&D, 5 for sub-region and 3 for province. Column 1: F(n1, n2); n2 = 53,271 for the public sector and 190,414 for the private sector. Columns 2-3: F(n1, n2); 2,601 (public) and 23,146 (private) for transportation, and n2 = 7,523 (public) and 24,288 (private) for real estate

Table 3: Selectivity corrected estimates for whole data and for two industries, women

Specification	Whole data		Real estate		Transportation	
ln(month pay)	Public	Private	Public	Private	Public	Private
Experience	0.009*	0.014*	0.009*	0.015*	0.018*	0.016*
Experience squared.	-0.014*	-0.030*	-0.017*	-0.028*	-0.034*	-0.034*
Tenure	0.004*	0.007*	0.015*	0.007*	0.003	0.009*
Married	-0.02*	-0.01*	-0.00	-0.00	-0.03	-0.02*
Child_under18	-0.01*	-0.01*	-0.00	0.00	-0.00	0.01*
Language						
Swedish	-0.01*	-0.02*	0.03*	-0.01	0.11	-0.01
Non-native	-0.03	-0.01	-0.17*	-0.09	Na	Na
Education						
Secondary	0.09*	0.11*	0.08*	0.12*	0.11	0.10*
Lowest level	0.18*	0.19*	0.17*	0.20*	0.19*	0.19*
Lower-degree level	0.25*	0.29*	0.26*	0.33*	0.32*	0.25*
Higher-degree level	0.49*	0.44*	0.34*	0.45*	0.48*	0.39*
Occupation						
Managerial	0.24*	0.32*	0.25*	0.34*	0.22*	0.37*
Professional	0.11*	0.22*	-0.02	0.21*	Dropped	0.14*
Technical	-0.01	0.10*	-0.22*	0.05*	-0.06	0.10*
Clerk	-0.07*	0.01*	-0.18*	-0.00	-0.19*	-0.02
Sales & care	-0.06*	-0.05*	-0.08*	-0.05	-0.09	0.11*
Operative	-0.11*	0.01*	-0.33*	-0.09*	-0.14*	-0.10*
Other	-0.13*	-0.09*	-0.30*	-0.21*	-0.22*	-0.08*
Constant	9.91*	9.65*	10.00*	9.61*	9.55*	9.59*
$\theta\lambda_i$	-0.074*	0.030*	-0.14*	0.021	-0.055	0.267*
R-squared	0.55	0.49	0.68	0.53	0.64	0.44
Number of obs.	108,552	110,499	7,432	24,293	876	9,507
Field of educ. dropped F(n1, n2)	1012.6*	156.6*	16.9*	52.5*	12.2*	15.2*
Industry dropped F(n1,n2)	119.8*	294.0*	-	-	-	-
R&D dropped F(n1,n2)	7.7*	79.4*	6.3*	20.2*	3.1*	6.1*
Province dropped F(n1,n2)	71.6*	51.8*	14.9*	6.6*	0.36	5.1*
Sub-region dropped F(n1,n2)	39.4*	45.8*	9.2*	8.0*	3.0*	2.9*

Notes: * denotes statistical significance at least at the 5 % level. Reference categories are: no child/children, Finnish, primary education, technology, craft, transportation, south, metropolitan area and R&D2. NA= no observations. n1 = 9 for field of education, 8 for industry, 7 for R&D, 5 for sub-region and 3 for province. Column 1: F(n1, n2); n2 = 108,490 for the public sector and 110,437 for the private sector. Columns 2-3: F(n1, n2); n2 = 825 (public) and 9,454 (private) for transportation, and n2 = 7,378 (public) and 24,239 (private) for real estate

3.3 Aggregate and industry decompositions

Tables 4 and 5 report the decompositions' results. Table 4 divides the total gap (column 1) into two parts: differences in observable characteristics (column 2) and differences in returns from these characteristics (column 3).[5] For men, the pay gap that can be related to the differences in characteristics is negative both at the aggregate data and in real estate (-13.0 and -9.5 per cent, respectively). In transportation, the effect of characteristics is positive (+4.8). The results for women are qualitative and quantitatively similar to those of men.

For men, the pay gap that is due to differences in returns to characteristics is positive, being 12.2 per cent in aggregate data and 7.8 per cent in transportation. In real estate, the effect is, in turn, negative (-5.4). This implies that employees are, in general, better rewarded in the public sector but also that there are considerable differences across industries. Again, the basic results are similar for women. Public sector women earn higher returns in transportation (+5.2) but lower returns in real estate (-3.3). On aggregate, the premium is 8.5 per cent. In particular, the pay gaps that remain unexplained are lower for women.

Table 5 sheds further light on the role of observable characteristics in the wage gaps. The main finding is that the aggregate results are generally similar to males and females. Employees in the public sector are better educated (the effect is +5.5 for males and +3.1 for females) and work in better-paid occupations (+5.1 for males and +1.9 for females). On the other hand, they have less work experience (-6.2 and -4.4) and are employed in industries that generally pay less (-15.0 for males and -9.1 for females).[6] The results indicate that the explained positive wage premium in transportation is mainly due to observable differences in the typical level of education (males +4.3) or occupation (females +3.5). In real estate, the situation is reversed; negative wage premium in this industry owes to the lower skills of the public sector employees. The tenure effect is particularly strong for women (-4.7).

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[5] The unexplained gap represented by each individual component is arbitrary, as the sign and magnitude of the estimate depend on the reference dummy used. Following Oaxaca and Ransom (1999), we report the total unexplained gap and focus on differences in returns across the aggregate and industry data as well as across genders.

[6] Overall, the results agree with recent international findings that stress the role of individual attributes in explaining public-private pay differentials; Kanellopoulos (1997), Papapetrou (2006), Christofides *et al.* (2002), Lucifora *et al.* (2006), and Chatterji and Mumford (2007) for results for Finland, Greece, Cyprus, France, Italy and the UK, respectively. It is also interesting to compare these results to those of Korkeamäki (1999). He uses pooled micro data from Finland for the years 1987-1994 and finds only small industry effects but reports similar results for personal characteristics; that is, public sector workers are more skilled in terms of education and occupation.

Table 4: Decomposed public-private sector wage differentials, Oaxaca decompositions

	Total	Due to characteristics	Due to returns
Aggregate			
Males	-0.8	-13.0*	12.2*
Females	-0.9	-9.4*	8.5*
Transportation			
Males	12.6	4.8*	7.8*
Females	6.1	0.9	5.2*
Real estate			
Males	-14.9	-9.5*	-5.4*
Females	-11.9	-8.6*	-3.3*

Note: *-sign represents the statistical significance at least at the 5 % level

Table 5: Total pay gaps due to characteristics, detailed analysis for men and women

	Aggregate	Transportation	Real estate
Tenure and work experience			
Males	-6.2	0.3	0.1
Females	-4.4	-1.1	-4.7
Education			
Males	5.5	1.9	-1.0
Females	3.1	3.5	1.8
Occupation			
Males	5.1	4.3	-3.2
Females	1.9	0.7	-1.1
Industry			
Males	-15.0	-	-
Females	-9.1	-	-
Other			
Males	-0.8	1.3	-5.0
Females	-0.1	1.6	-4.0
Selection term			
Males	-1.6	-3.0	-0.4
Females	-0.8	-3.8	-0.6

Notes: Other-group includes field of education, marital status, presence of children, native language, R&D intensity, province, sub-region and year dummies.

Finally, we examined the robustness of the decomposition results by splitting the data into three sub-periods (1995-1998, 1999-2001 and 2002-2004) and comparing estimates of wage gap components over the periods. Table 6 summarises our main findings. Three points are worth noting here. First, although the total wage gaps were relatively stable, their underlying components

(observed and unobserved) exhibit variation over the chosen time periods. The average change between the chosen intervals is close to 2.5 percentage points. Certain substantial estimate changes (transportation industry, women, around 8 percentage points) between the periods are alarming. These findings suggest that decomposition calculations may be sensitive to small changes in the data. Second, changes in the total gap or its components exhibit no coherent pattern across gender or industries. For example, average changes in estimates for males are smaller during the first period ($\Delta(t_2 - t_1)$) than the second period ($\Delta(t_3 - t_2)$), whereas the reverse is true for females. As another example, higher public returns in transportation decreased amongst men and increased amongst women over the time periods. Third, average pay gaps are not influenced by the business cycle. In particular, the ICT boom and a small reduction of it in the turn of the century should have brought positive values for the first period and negative values for the second period.

Table 6: Differentials (percentage points) in decomposition analysis across time

	Men		Women	
	$\Delta(t_2 - t_1)$	$\Delta(t_3 - t_2)$	$\Delta(t_2 - t_1)$	$\Delta(t_3 - t_2)$
Aggregate	0.0	1.5	-2.5	-0.7
Due to characteristics	1.6	-1.5	-2.8	-1.8
Due to returns	-1.6	*3.0*	0.3	1.1
Transportation	-0.7	-2.2	*-0.1*	0.1
Due to characteristics	1.1	3.5	*-8.3*	-2.3
Due to returns	-1.8	-5.7	*8.2*	2.4
Real estate	-1.2	1.4	*-1.6*	1.7
Due to characteristics	0.5	1.1	*2.3*	0.7
Due to returns	-1.7	0.3	*-3.9*	1.0

Notes: Periods are the following: t_1 = 1995-1998, t_3 = 1999-2001 and t_3 = 2002-2004.

3.4 Quantile analysis and decompositions

Figures 3 and 4 show the decompositions based on the estimated quantile regressions. The upper parts of the figures report the total pay gaps for the aggregate data and for two industries. As before, we treat men and women separately. The middle parts of these figures illustrate the parts of the total pay gaps that are due to differences in individuals' characteristics, and the lower parts of the figures report the parts of the total pay gaps that are due to differences in returns to these characteristics.

The quantile regression results sharpen the picture from the analysis obtained from the mean regression analysis. The first main finding is that the public sector employees are better off at the lower parts of the wage distribution and worse off at upper end of the wage distribution; see the upper part of Figures 3 and 4. These results accords with those of Mueller (1998), Blackaby, Murphy and O'Leary (1999), Lucifora *et al.* (2006) and Papapetrou (2006). In the case of the aggregate data, the public-private sector pay gap is positive at the 0.10^{th} quantile, close to zero at the median and negative at the 0.90^{th} quantile. The industry results show same general pattern. The positive public-private sector pay gap in transportation declines steadily after the 0.10^{th} quantile. In real estate, the negative pay gap is, in turn, smallest at the lower parts of the wage distribution and largest at the highest parts of the wage distribution. The same patterns observed at the aggregate and industry data apply to both sexes.

For the aggregate data, the role of observable characteristics varies across quantiles and gender; see the middle part of Figures 3 and 4. Differences in the wage gap related to the characteristics are largest at the highest quantiles, with the effect being more profound for females. In real estate and in transportation, the parts of the pay gaps that can be explained by the differences in characteristics, in turn, show less variation across quantiles as well as genders: differences amongst the highest and lowest deciles by gender remain between 2-5 percentage points.

The part of the pay gaps that remains unexplained vary considerably between quantiles in all but one case: for the aggregate data, the public sector pay advantage for men is centred at 10-14 per cent. In all other cases, the variation is more visible. For women, the public sector pay advantage for the aggregate data is 4-15 per cent, being highest at the 0.90^{th} quantile. In transportation, the public sector premiums are highest at the lowest quantiles (+15 for males and +11 for females) and the lowest at the highest quantiles (+5 for males and +1 for females). The same holds also in real estate, where the public sector advantages are positive at the 0.10^{th} quantiles (+12 for males and +6 for females) and negative at the 0.90^{th} quantiles (-16 for males and -12 for females).

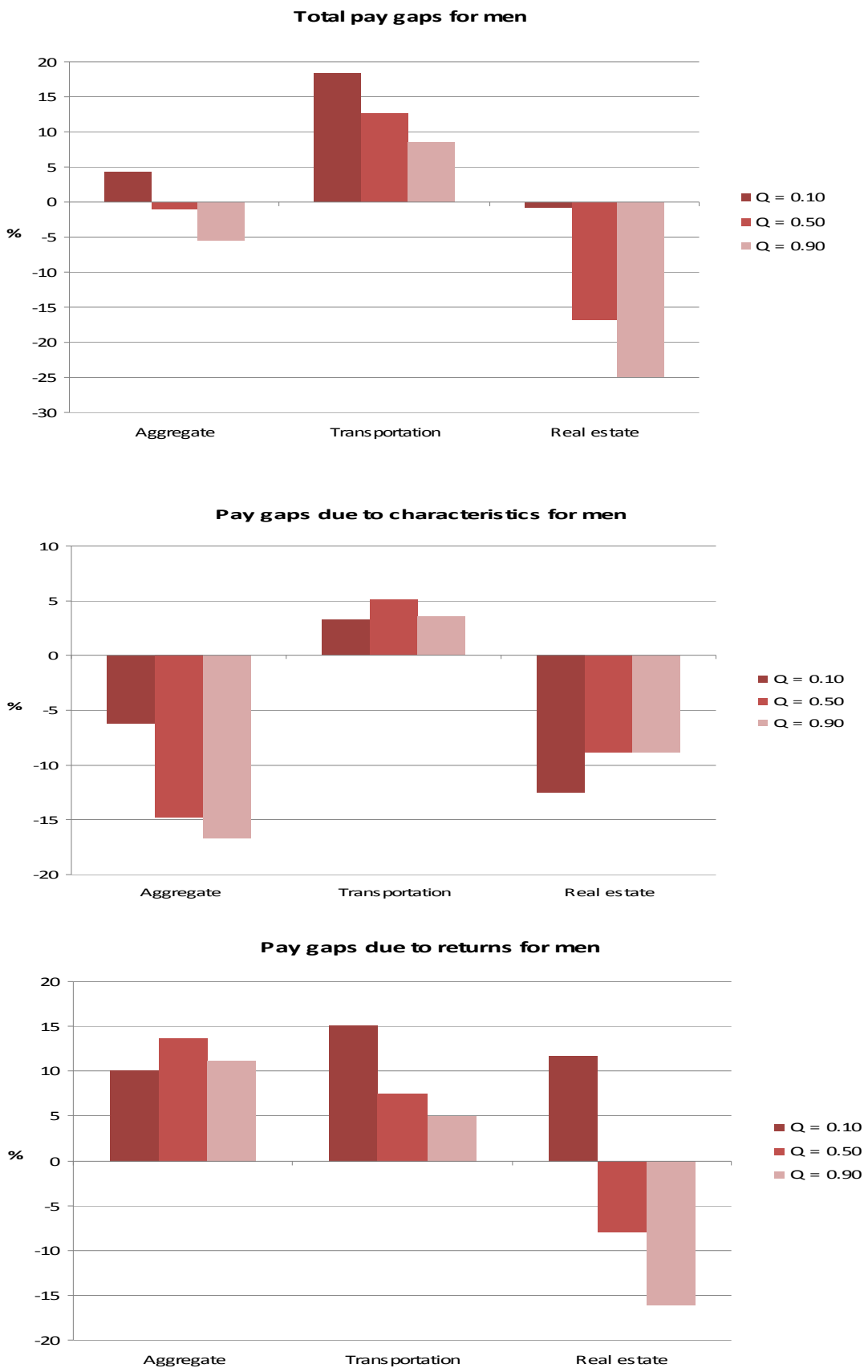

Figure 3: Decomposition analysis for men in different quantiles

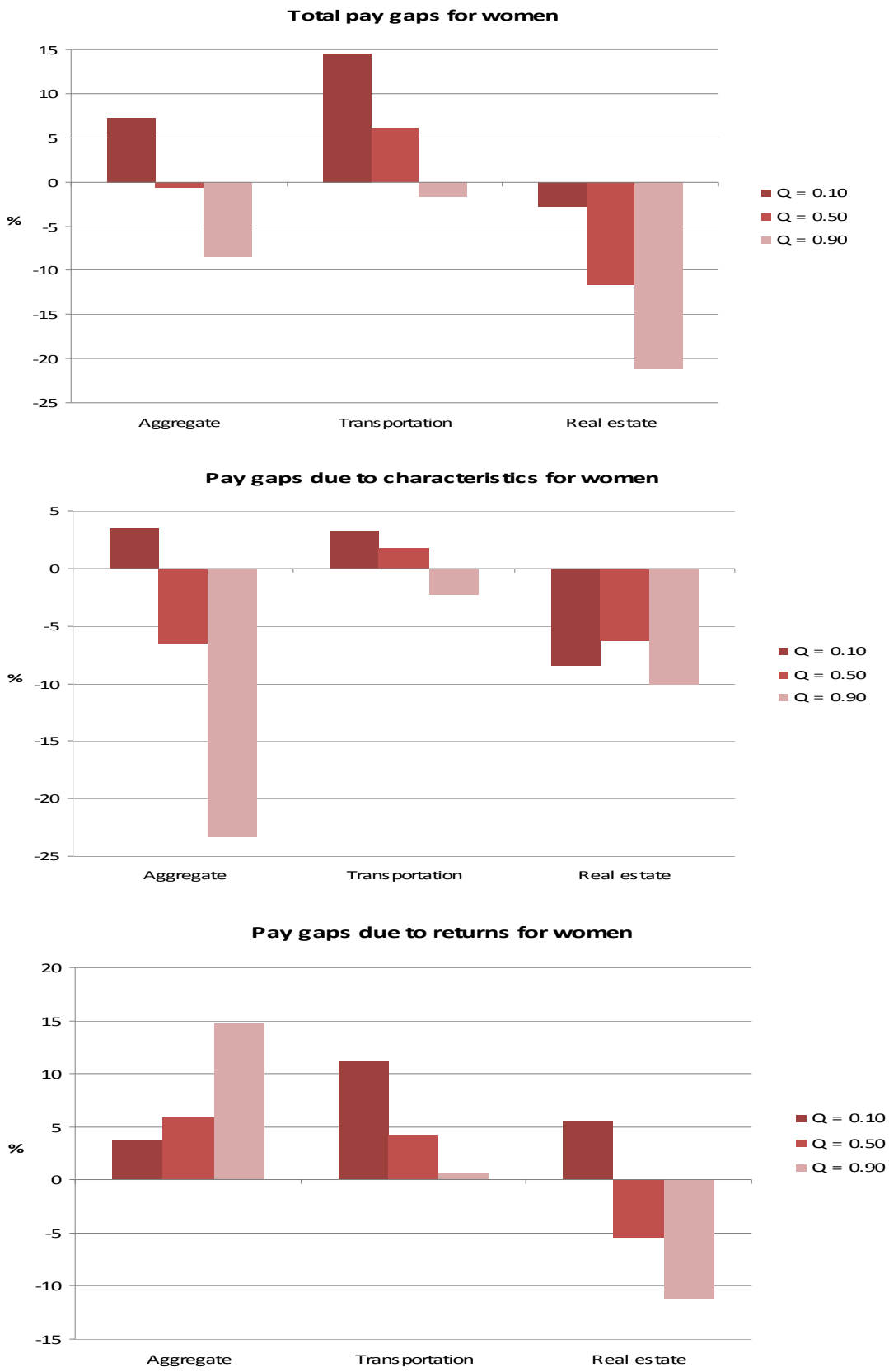

Figure 4: Decomposition analysis for women in different quantiles

4. Conclusions

This study analyses public and private sector pay using unbalanced panel data for the period 1995-2004. We estimate both mean and quantile wage equations for the whole sample and two industries. Men and women are treated separately. The data show that unconditional aggregate wage gaps for both sexes are small but vary considerable across the industries. For men, the pay gap is negative in real estate, -15 per cent. In transportation, the pay gap is positive, with men working in the private sector earning 13 per cent less than their counterparts in the public sector. The pay gaps are lower amongst females, averaging -12 per cent in real estate and +6 per cent in transportation. The results also suggest that pay gaps have been stable over the period 1995-2004. The specification that shows the individual's position in the wage distribution suggests that the public sector's pay premiums are higher at lower parts of the earnings distribution across sex and industries.

The decomposition analyses of conditional wage gaps, which generally follow the same pattern compared to unconditional wage gaps, suggest that aggregate analyses are likely to conceal considerable differences in public-private sector wage gaps. The aggregate results indicate that observable characteristics are, in general, better in the private sector for both sexes, with the industry affiliation representing a notable part in this respect. The returns from the characteristics are, in turn, higher in the public sector. For men, the pay premium is 12 per cent, and for women, it is somewhat lower, at 9 per cent. These lower pay gaps for women do not agree with other international findings from industrialised countries. This probably reflects enhanced economic opportunities that private sector female workers have gained over the past decades in Finland.

The industry-level results vary in many aspects. In real estate, the negative pay gaps are almost evenly accounted for by the differences in employees' characteristics and rewards from these characteristics. The gap that remains unexplained is minus five per cent for men and minus three per cent for women. In transportation, the positive pay gap is related to difference in returns to characteristics, especially for women, with the positive pay gaps being eight and five per cent for men and women, respectively.

We scrutinised the pay gap changes over time by splitting the sample between three sub-sample periods. The results indicate that the average pay gaps are not significantly affected by business cycles but that the underlying components related to these gaps vary over time, across industries, and by sex. In particular, substantial changes in transportation exist; the public sector pay advantage has decreased steadily amongst men, whereas the reverse is true amongst women. Our findings indicate that decomposition calculations may be sensitive even to small changes in the data and that the results of decomposition analyses, which typically rely only on one cross-section, should be treated with considerable care. Finally, our quantile regression results support the prevailing notion that workers in the public sector are better off at the lower parts of the earnings distribution. This implicitly explains why it is generally harder for the public sector to attract and retain high-skilled workers only by means of a wage policy.

References

Asplund, R. (1997). Private vs. Public Sector Returns to Human Capital in Finland. ETLA Discussion Papers No. 607.

Bellante, D., and A. Link (1981). "Are Public Sector Workers more Risk Averse than Private Sector Workers?" *Industrial and Labor Relations Review* 34, 408-412.

Blackaby, D., Murphy, P., and N. O'Leary (1999). "The Payment of Public Sector Workers in the UK; Reconciliation with North American Findings." *Economics Letters* 65, 239-243.

Blank, R. (1985). "An Analysis of Workers' Choice Between Employment in the Public and Private Sectors." *Industrial and Labor Relations Review* 38, 211-234.

Borjas, G. (2003). "The Wage Structure and the Sorting of Workers into the Public Sector". In *For the People: Can We Fix Public Service?* 29-54. Eds. J. D. Donahue and J. S. Nye. Brookings Institution Press.

Buchinsky, M. (1998). "Recent Advances in Quantile Regression Models." *Journal of Human Resources* 33 (1), 88-126.

Chatterji, M., and K. Mumford (2007). Public-Private Sector Wage Gaps for British Full-Time Male Employees: Across Occupations and Workplaces. Mimeo, University of Dundee, Department of Economic Studies.

Christofides, L., and P. Pashardes (2002). "Self/Paid-Employment, Public/Private Sector Selection, and Wage Differentials." *Labour Economics* 9, 737-762.

Disney, R., and A. Gosling (1998). "Does it Pay to Work in the Public Sector?" *Fiscal Studies* 19, 347-374.

Disney, R. (2007). Public-Private Sector Differentials Around the World: Methods and Evidence. Mimeo, University of Nottingham, School of Economics.

Dustmann, C., and A. van Soest (1998). "Public and Private Sector Wages of Male Workers in Germany." *European Economic Review* 42, 1417-1441.

García-Pérez, I., and J. Jimeno (2005). Public Sector Wage Gaps in Spanish Regions. Spanish Bank Working Papers No. 0526.

Heckman, J. (1979). "Sample Selection Bias as a Specification Error." *Econometrica* 47, 153-161.

Heitmueller, A. (2006). "Public-Private Sector Pay Differentials in a Developed Scotland". *Journal of Applied Economics* 9(2), 295-323.

Kanellopoulos, C. (1997). "Public-Private Wage Differentials in Greece." *Applied Economics* 29, 1023-1032.

Koenker, R., and G. Basset (1978). "Regression Quantiles." *Econometrica* 46, 33-50.

Korkeamäki, O. (1999). Yksityisen ja julkisen sektorin palkkoihin vaikuttavat tekijät. Ekonometrinen tutkimus 1987–1994. VATT Discussion Papers No. 57.

Lassibille, G. (1998). "Wage Gaps Between the Public and Private Sectors in Spain." *Economics of Education Review* 17, 83-92.

Lucifora, C., and D. Meurs (2006). "The Public Sector Pay Gap in France, Great Britain and Italy." *Review of Income and Wealth* 52, 43-59.

Maczulskij, T. (2008). Public-Private Wage Differentials for Males: Evidence from Finland. Mimeo, University of Jyväskylä, School of Business and Economics.

Mueller, R. (1998). "Public-Private Wage Differentials in Canada: Evidence from Quantile Regressions." *Economics Letters* 60, 229-235.

Neuman, S., and R. Oaxaca (2004). "Wage Decompositions with Selectivity-Corrected Wage Equations: A Methodological Note." *Journal of Economic Inequality* 2, 3-10.

Papapetrou, E. (2006). "The Unequal Distribution of the Public-Private Sector Wage Gap in Greece: Evidence from Quantile Regression." *Applied Economics Letters* 13, 205-210.

Prescott, D., and B. Wandschneider (1999). "Public/Private Wage Differentials in Canada-Evidence from the 1991 and 1982 Surveys of Consumer Finance." *Applied Economics* 31, 723-731.

Quadrini, V, and A. Trigari. (2007). "Public Employment and the Business Cycle". *Scandinavian Journal of Economics* 109, 723-742.

Tansel, A. (2005). "Public-Private Employment Choice, Wage Differentials, and Gender in Turkey." *Economic Development & Cultural Change* 53, 453-477.

Uusitalo, R. (1999). "Return to Education in Finland." *Labour Economics* 6, 569-580.

Appendix A

To correct selection bias, we use a probit model for public sector participation as follows:

$$I_{ijt}^{*} = \gamma Z_{ijt} + \upsilon_{ijt} \quad (1)$$

$$I_{ijt} = 1 \quad \text{if } I_{ijt}^{*} \geq 0 \quad \text{(public sector)} \quad (2)$$

$$I_{ijt} = 0 \quad \text{otherwise,}$$

where I_{ijt}^{*} is an unobserved variable that reflects the utility of an individual working in the public sector, I_{ijt} is a binary variable that takes the value one if the individual works in the public sector and zero otherwise. Z_{ijt} is a vector of explanatory characteristics that determines sector participation decision. Vector X_{ijt} is a strict sub-set of Z_{ijt}, and we also have to include at least one variable in Z_{ijt} that is not also in X_{ijt} (exclusion restriction variable). υ_{ijt} is an error term. Furthermore, υ_{ijt} and ε_{ijt} from the wage equation are i.i.d error terms that follow a bivariate normal distribution $(0, 0, \delta_{\varepsilon_j}, \delta_{\upsilon_j}, \rho_j)$. Following the literature and the prevailing notation, we express the probability of public sector attainment as

$$\text{Prob}(I_{ijt}^{*} > 0) = \text{Prob}(\upsilon_{ijt} > -\gamma Z_{ijt}) = \Phi(\gamma Z_{ijt}), \quad (3)$$

and correspondingly for the private sector. In the previous equation, $\Phi(\gamma Z_{ijt})$ is the cumulative distribution function of the standard normal distribution. Summing up, the expected wage for individual *i* in the public sector can be estimated as follows:

$$E(\ln w_{ijt} \mid I_{ijt}^{*} \geq 0) = \beta X_{ijt} + E(\varepsilon_{ijt} \mid \upsilon_{ijt} > -\gamma Z_{ijt}) = \beta X_{ijt} + \theta \lambda_{ijt}, \quad (4)$$

where $\theta = \rho \delta_{\varepsilon}$, $\lambda_{ijt} = \Phi(\gamma Z_{ijt})' \phi(\gamma Z_{ijt})$ and $\phi(\cdot)$ is the standard normal density function. Taking the error term into account, we obtain the Heckman's selectivity corrected wage equation for the public sector:

$$\ln W_{ijt} \mid I_{ijt}^{*} \geq 0 = \beta X_{ijt} + \theta \lambda_{ijt} + \varepsilon_{ijt}, \quad (5)$$

and similarly for the private sector.