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PUBLIC-PRIVATE SECTOR PAY GAPS OVER THE BUSINESS CYCLE

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ABSTRACT

This paper investigates the relationship between business cycles and public-private sector pay gaps. The hypothesis of a counter-cyclical public sector pay premium is examined using Finnish aggregate data from the period of 1977-2008 and micro panel data from the period of 1990-2004. The unconditional aggregate results indicate that the public sector pay premium moves counter-cyclically, which is due to higher economic response of private sector wages. The relationship between labour markets and pay premium, however, disappears when we control for the heterogeneity of individual characteristics.[*]

Keywords: public sector pay, business cycle, wage curve
JEL: J31, J45

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1 Introduction

Studies that examine public-private sector pay gaps have attracted considerable attention from economists over the last three decades (see Disney, 2007, for a survey). These pay gaps are typically analysed using cross-sectional micro data, and results vary from one country to another. The use of a single cross-section, however, is never ideal because it neglects the possibility that pay gaps vary over time and can be dependent on idiosyncratic shocks such as business cycles. Indeed, the role of economic variations on pay gaps is typically ignored, and, excluding Disney and Gosling (1998; 2008) and Bargain and Melly (2008), panel data with a comprehensive period are rarely utilised in sectoral pay gap studies. Panel data allow us to examine this understudied topic: public-private sector wage differentials over the business cycle. Disney *et al*., Bargain *et al*. and Melly (2005) discuss the possible relationship between such pay gaps and changing labour market conditions. They argue that differences in the cyclical responsiveness of the wages between the sectors may cause short-run changes in the public sector pay premium. Earnings in the private sector generally move pro-cyclically. Thus, if the pay structure is less flexible in the public sector and cannot react after an economic boom or a crisis, the public pay premium will vary counter-cyclically. (Melly, 2005). In the same spirit, Sanz-de-Galdeano and Turunen (2006) use individual data from the 1994-2001 waves of the European Community Household panel (ECHP) to explore the wage curve in the euro area. They find that the wage response to unemployment is almost three times higher in the private sector than in the public sector, implying that the public pay premium should behave counter-cyclically. The argument of counter-cyclical pay premium, however, lacks of individual-level empirical tests.

Studies in this field have benefited from macro level evidence. Freeman (1987) examines the economic response of public sector wages and employment and find that variations in the public sector pay premium are due to fluctuations in public wages as much as in private wages. In turn, using aggregate survey data from the Current Population Statistics, Quadrini and Trigari (2007) suggest that private sector wages react more than public sector wages to labor market conditions. Their findings thus support the view that the public sector pay premium behaves counter-cyclically over time. It is worth noticing, that the aggregate macro results should be treated with care, as these studies focus solely on average wage changes. In contrast to macro data, individual-level micro data can explicitly take into account the heterogeneity of individual wage adjustments, which is an important factor for many reasons. For example, Glewwe and Hall (1998) scrutinise individuals' vulnerability to macroeconomic shocks and find that wage adjustments vary between different groups: highly educated individuals and women can adapt more easily to new economic circumstances. Their findings are in line with those of Sanz-de-Galdeano *et al.* (2006), who further discover that younger age is associated with higher wage variability with regional unemployment rates. In a recent study from Finland, Böckerman *et al*. (2007) suggest that job-related characteristics also matter: full-time workers had a lower likelihood of wage cuts in recession years in the early 1990s compared with part-time workers. Declines in wages were also more common in small plants. In short, because the wage response differs not only between sectors but also between groups (i.e., sex, skills, age, firm), there might also be variability among results obtained from aggregate and individual-level data. Our guess is supported by an another study of Böckerman *et al*. (2010), who study the macro and micro level wage rigidity in Finland for the data that span the period 1985-2001. Their findings suggest that there has been macroeconomic flexibility in the Finnish labour market, but the evidence based on individual-level wage change distribution reveals that real wages are, in general, rigid.

The present study adds to the existing literature in two ways. First, to the best of our knowledge, this is the first study to explore the influence of business cycles on public and private sector pay gaps. Second, we provide results from two data sets. We utilise both aggregate macro data for the period of 1977-2008 and individual-level panel data for the period of 1990-2004 in order to test whether the results from the aggregate data change when individual heterogeneity is conditioned out of the analysis. Overall, the period under study is interesting because it covers a deep recession and a recovery period, as well as the ICT boom-recession led by Nokia. The micro data contains 1,024,796 observations over 15 years, and the sample includes 513,017 men and 511,779 women.

The remainder of this paper is organised as follows. Section 2 presents the macro findings of the study. The focus here is to examine the impact of business cycles on sectoral pay gaps. The aggregate wage data are drawn from Statistics Finland. Section 3 presents the wage equations from the micro study and the related results for the entire period and its various phases. Section 4 provides conclusions. The macro results indicate that the public sector wage premium moves counter-cyclically with the overall state of the economy and that this behaviour is due to higher economic response of private sector wages. After controlling for individual heterogeneity, the relationship between labour markets and pay gaps disappears. The only exception is that the local government pay premium was slightly pro-cyclical in the late 1990s for both sexes, but the economic significance of this finding is weak.

2 Macro findings on the cyclical properties of the public pay premium

2.1 Preliminary discussion

Figure 1 depicts the average change in the public pay premium[1] with output rate and change in the unemployment rate using aggregate data from Statistics Finland between 1977 and 2008. In line with the discussion of Disney *et al.* (1998; 2008), Quadrini *et al.* (2007) and Bargain *et al.* (2008), the average change in pay premium (thick line) is approximately counter-cyclical with the state of the economy. The change in the pay premium and the unemployment rate (thin line) tend to co-move in a positive manner, and against the output rate (dotted line). The argument of counter-cyclicality is related to classic *RBC* (Real Business Cycle) models and the wage curve literature (see Abraham and Haltiwanger, 1995, and Nijkamp and Poot, 2005, for comprehensive surveys). These theories suggest that during economic slowdowns, decreasing labour demand adjusts wages downwards, causing a pro-cyclical movement in real wages.

The hypothesis of the counter-cyclical pay gap is justified by two reasons. First, the manufacturing industry is more vulnerable to deteriorating labour market conditions than the service sector (Keane, Moffitt and Runkle, 1988). Thus, the counter-cyclical pay gap is reasonable given the high share of manufacturing in the private sector and the obvious presence of services in the public sector. The second, and probably more important, reason relates to the institutional features of the labour markets in each sector. Typical public sector wage rigidity is seen to stem from both the state's budget-related wage settlements, which must be maintained at a moderate level for reasons of macroeconomic stability, and the increased wage bargaining power of unions. At the same time, typical performance-related pay and bonus systems and lower union bargaining power lead to higher wage flexibility in the private sector. In line with Sanz-de-Galdeano *et al.* (2006), this indicates that public sector wages are more likely to reflect national labour market conditions, unlike private wages, which are likely to reflect local labour market conditions. [2]

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[1] We present the percentage point change in the public sector premium because there was a steady decrease in the pay gap over this period. The total pay premium is calculated as the weighted average of local and central government pay premiums; see Figure A1 in the appendix.

[2] Borjas (1984) presents another theory of why public-private sector pay gap may vary over time. He presents a model of electoral wage cycles that are generated as a result of optimising behaviour on the part of voters, bureaucrats, and the government. Borjas' empirical analysis implies that federal wage rates increase significantly more in election years. However, his theory, although interesting, is not relevant in the present paper.

We contribute to this general discussion by studying the cyclical pattern of pay gaps using three methods. First, following Quadrini *et al*. (2007), we examine the cyclicality of the public pay premium by computing correlations and elasticities. We correlate wages (public and private wages separately) and the public pay premium against output rate and change in the unemployment rate.[3] Additionally, skilled and unskilled workers are segregated by sex to account for potential composition bias as suggested by Abraham *et al.* (1995). Second, we estimate an AR(*p*) (Autoregressive) model with *p* lags to examine the randomness of the pay premium. Finally, we follow Freeman (1987) and test the pay variety between sectors using the variance decomposition model. In all analyses, the overall sample period is 1977-2008, but subsamples 1977-1989 and 1990-2008 are also considered as the micro data used in section 3 begins in 1990.

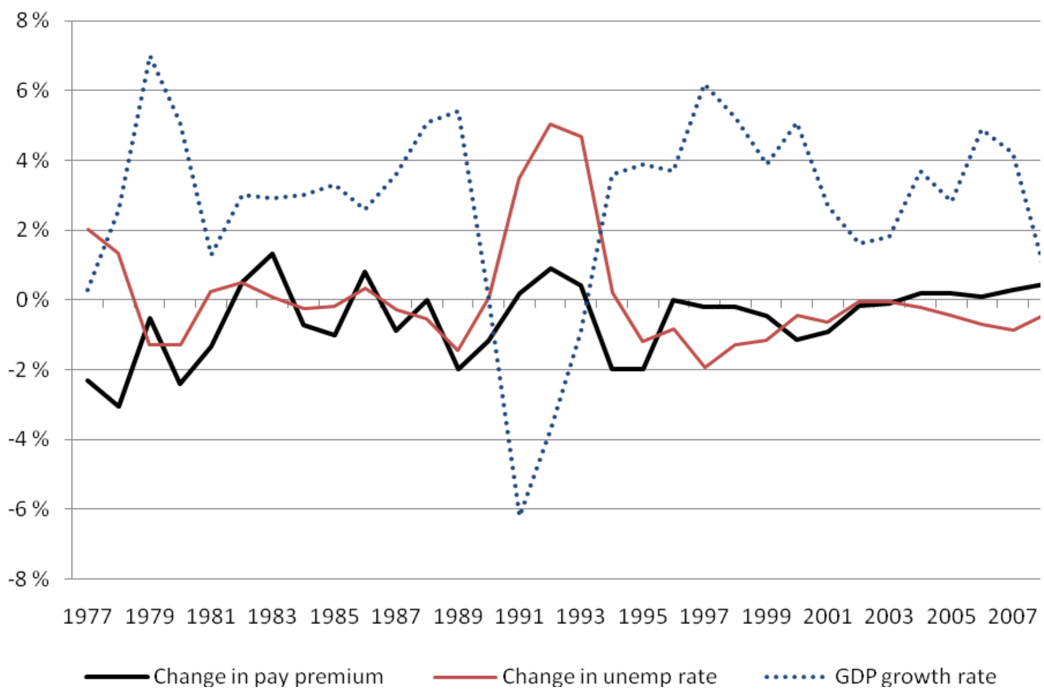

Figure 1. Changes in public sector wage premium and unemployment rate and GDP growth rate from 1977-2008

[3] Elasticities are computed by estimating equation $\ln(y_t) = \alpha + \beta \ln(x_t) + \varepsilon_t$ using the ordinary least square method (OLS). Here, we use the absolute unemployment rate and GDP in euros because changes can take negative values and are unspecified for logarithms. These calculations were also applied to the local and central sectors, but the results were consistent; therefore, to save space, the total public sector was considered.

2.2. Results from the macro analysis

The Table 1 presents the correlations and elasticities for the aggregate data, and the Table 2 presents the correlations for skilled and unskilled individuals by sex.[4] The calculations are made using raw data and seasonally adjusted time series, which are detrended using the Hodrick-Prescott (HP) filter with a smoothing parameter of 6.25. Considering the subsamples, three points emerge from Table 1. First, wages in the private sector respond differently to labour market conditions than wages in the public sector. Private sector wages move pro-cyclically with output, and the correlation varies from 0.38 to 0.60. Public sector wages move less pro-cyclically, with correlations varying from 0.33 to 0.46 across the same periods. The correlations of private sector pay with unemployment varies from -0.47 to -0.72 and in the public sector the corresponding values range between -0.40 and -0.43.[5] This means that average wages negatively respond to an increase in unemployment that supports the findings largely reported elsewhere (see, for example, Nijkamp *et al*., 2005). The elasticities show the same pattern as the correlations.

Second, both the correlations and the elasticities suggest that the public sector pay premium is counter-cyclical. The correlation with output ranges from 0.04 to -0.58, and the corresponding correlation with unemployment ranges from 0.13 to 0.69. Nearly all of the elasticities are statistically significant and have expected signs. These findings are in line with those of Quadrini *et al*. (2007). Third, the cyclical pattern varies across periods. In particular, during the years 1990-2008, both public and private sector wages were less cyclical than in the earlier period. This finding is in line with Böckerman *et al*. (2010), who note that wage rigidity was high during the late 1990s. The public sector pay premium is, in turn, more cyclical in the last period.

The results in Table 2 are comparable to those in Table 1; i.e., private wages react more than public wages to labour market conditions. Considering the results between groups, we do not find any clear differences in wage cyclicality between skilled and unskilled workers or between men and women. This not only turns down the possibility that real wage cuts may be more common for

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[4] Skill groups were segregated by occupation. We also constructed the correlations by education, but the results were comparable. To save space, we do not report the elasticities in the table. The data come from micro data for the years 1990-2004, because wage information by segregated skill groups was not available in the aggregate data.

[5] The correlations for the detrended period from 1990 are of the opposite sign than that predicted by the hypothesis, but fail to reach significance. In particular, the HP-filtered time series may be sensitive to even small changes in the smoothing parameter, and the results should be treated with care: see, for example, Ahumada and Garegnani (1999), who provide a summary of the debate surrounding the use of the HP-filter in practise. A recent suggestion is to set λ equal to between 6 and 7 for annual data: see, for example, Ravn and Uhlig (2002).

men (Glewwe *et al.,* 1998), but also indicates that similar wage adjustment exist among skill -groups. This finding is not surprising, given that in highly unionised country, such as Finland, collective agreements have produced fairly similar real wage increases across different employment groups. This is well in line with Böckerman *et al*. (2007), who find relatively few individual characteristics that have a strong effect on the likelihood of wage cuts across the different segments of labour markets n Finland. The only exception to these similarities is that economic conditions matter slightly more to the wages of unskilled men than to those of skilled men in the private sector. Finally, the response of economic activity to the public pay premium is approximately higher amongst skill men. This finding illustrates the need to control for skill-level factors in earnings equations.

Table 1. Correlations and elasticities of real wages and public sector pay premium with business cycle indicators

	1977–2008		1977–1989		1990–2008	
	Raw data	HP-filtered	Raw data	HP-filtered	Raw data	HP-filtered
Corr(W_{pr}, GDP)	0.03	– 0.06	0.38	0.60*	0.39	– 0.26
Elas($\ln W_{pr}, \ln GDP$)	0.32*	0.18*	0.20*	0.20*	0.39*	0.17
Corr(W_{pu}, GDP)	0.01	– 0.04	0.36	0.46	0.33	– 0.31
Elas($\ln W_{pu}, \ln GDP$)	0.24*	0.05	0.15*	0.13	0.31*	0.02
Corr($W_{pu} / W_{pr}, GDP$)	– 0.07	0.02	– 0.35	0.04	– 0.58*	– 0.00
Elas($\ln W_{pu} / W_{pr}, \ln GDP$)	– 0.07*	– 0.12*	– 0.05*	– 0.07	– 0.08*	– 0.16*
Corr($W_{pr}, \Delta u$)	– 0.20	– 0.26*	– 0.51	– 0.72*	– 0.47*	0.17
Elas($\ln W_{pr}, \ln u$)	0.19*	– 0.04*	– 0.34*	– 0.04*	– 0.09	– 0.04*
Corr($W_{pu}, \Delta u$)	– 0.17	0.00	– 0.43	– 0.41	– 0.40	0.17
Elas($\ln W_{pu}, \ln u$)	0.14*	– 0.02	– 0.25*	– 0.02	– 0.07	– 0.01
Corr($W_{pu} / W_{pr}, \Delta u$)	0.28	0.41*	0.64*	0.13	0.69*	0.64*
Elas($\ln W_{pu} / W_{pr}, \ln u$)	– 0.05*	0.02*	0.09*	0.02	0.01	0.03*

**: statistically significant at least at the 5 % significance level*

Table 2. Correlations by occupation and gender, 1990-2004

	Men				Women			
	Unskilled		Skilled		Unskilled		Skilled	
	Raw data	HP-filtered	Raw data	HP-filtered	Raw data	HP-filtered	Raw data	HP-filtered
Corr(W_{pr}, GDP)	0.64*	0.32	0.49	0.12	0.57*	– 0.08	0.53*	0.03
Corr(W_{pu}, GDP)	0.23	– 0.24	0.30	– 0.31	0.33	– 0.43	0.31	– 0.31
Corr(W_{pu}/W_{pr}, GDP)	– 0.87*	– 0.51	– 0.77*	– 0.68*	– 0.87*	– 0.76*	– 0.73*	– 0.52*
Corr(W_{pr}, Δu)	– 0.64*	– 0.31*	– 0.55*	– 0.26	– 0.59*	– 0.14	– 0.56*	– 0.15
Corr(W_{pu}, Δu)	– 0.37	– 0.07	– 0.41	0.12	– 0.43	0.14	– 0.40	– 0.14
Corr(W_{pu}/W_{pr}, Δu)	0.69*	0.24	0.68*	0.56*	0.64*	0.48	0.68*	0.42

**: statistically significant at least at the 5 % significance level*

The second analysis tests the randomness of the public sector pay premium using a vector autoregression model in the form:

(1) $$\ln y_t = \alpha + \beta_1 \ln y_{t-1} + \beta_2 \ln y_{t-2} + ... + \beta_p \ln y_{t-p} + \delta x_t + \varepsilon_t$$

where y_t is the public sector pay premium, x_t is a vector of exogenous variables and ε_t is assumed to be white noise, that is, $E(\varepsilon_t) = 0$. Equation was estimated with p = 2,…, z *(max)* lags (where z = 5 for the period 1978-1989 and 15 otherwise) to test the robustness of the model. The results for the entire period and from 1990 onwards were consistent; therefore, only results with two lags are reported. The results are presented in Table 3. The upper part of the table shows the results of the basic model with two lags as dependent variables (x_t = 0). The middle and lower parts of the table report the results with one exogenous variable ($x_t = \Delta u$ or $x_t = \text{GDP}$) added to the model. Column 1 shows the results for the entire period, and columns 2 and 3 show corresponding results for the sub-samples.

The results indicate that the public sector pay premium was not entirely random during the periods of 1978-2008 and 1990-2008. The parameter of x_t is positive for unemployment and negative for the growth rate. As expected, these models generate higher explanatory power and smaller AIC indexes. The results accord well with the correlations and elasticities and provide additional support for the counter-cyclical behaviour of the pay premium. The results also indicate and that this behaviour was stronger in the last sub-period.

Table 3. AR(2) results: dependent variable is log of public sector pay premium

	1978–2008	1978–1989	1990–2008
Model 1: AR(2)			
y_{t-1}	1.131*	0.452	1.289*
y_{t-2}	– 0.211	0.136	– 0.372*
R^2	0.95	0.67	0.92
AIC	– 6.438	– 6.072	– 6.841
Model 2: AR(2) with Δu			
y_{t-1}	1.058*	0.460	0.928*
y_{t-2}	– 0.152	0.108	– 0.141
Δu	0.208*	0.380	0.304*
R^2	0.96	0.70	0.96
AIC	– 6.519	– 6.015	– 7.346
Model 3: AR(2) with GDP			
y_{t-1}	1.130*	0.453	1.200*
y_{t-2}	– 0.207	0.138	– 0.367*
GDP	– 0.100*	– 0.043	– 0.161*
R^2	0.96	0.67	0.96
AIC	– 6.471	– 5.910	– 7.310

**: statistically significant at least at the 10 % significance level*

Finally, we address the argument of whether the settlement power of unions is the most important reason for the counter-cyclicality of the pay premium. The Finnish labour market is heavily unionised (the union rate is about 70%), and collective labour contracts are binding for non-union members as well. In short, over 90% of all employees in Finland are covered by collective agreements.[6] Thus, variations in public and private sector wages are likely to be similar. To scrutinize this view more closely, we follow Freeman (1987) and decompose the public pay premium using the variance decomposition model:

$$(2)\quad Var\left[\log\left(\frac{W_{pu}}{W_{pr}}\right)\right] = Var(\log W_{pu}) + Var(\log W_{pr}) - 2Cov(\log W_{pu}, \log W_{pr})$$

[6] There are three main central labour confederations and approximately around 70 trade unions that represent employees in Finland regardless of line of work, type of employment or status in the enterprise. On the employer's side, there is one central confederation for the private sector and three central confederations for the public sector. Industrial relations are regulated by collective agreements, that determine the minimum conditions for the job and establish labour peace. These agreements provide the framework for branch-specific collective agreements, such as possibility to agree about certain issues on local level. In all cases, the employers' associations and trade unions sign collective agreements of their own.

In Equation (2) the term on the left-hand side is the variance of the public sector pay premium. The first two terms on the right-hand side are the variances of public and private sector pay, respectively, and the last term is the covariance. Two approaches are used to examine pay variety. The first approach is the decomposition of real wages, and the second is the decomposition of real wages after removing the HP-filtered trend term. The results are presented in Table 4. The results support the findings reported by Freeman (1987) and our hypothesis of similar variance in pay. The variance decomposition calculated from the raw data indicates that private sector wages fluctuate about 10 percentage points more than public sector wages. After taking the HP-trend into account, differences in pay variability disappear. These variations in the pay premium are more or less due to fluctuations in public wages as much as to fluctuations in private wages.

Table 4. Variance decomposition of public sector pay premium

Period	Total variance	Public pay variance	Private pay variance	Covariance
With trend component				
1977-2008	0.0017	0.0220	0.0369	0.0572
1977-1989	0.0006	0.0052	0.0078	0.0124
1990-2008	0.0006	0.0078	0.0120	0.0192
Without trend component				
1977-2008	0.0000	0.0001	0.0001	0.0002
1977-1989	0.0001	0.0001	0.0001	0.0001
1990-2008	0.0000	0.0001	0.0001	0.0002

Taken together, the aggregate macro results suggest that the pay premium tends to behave counter-cyclically with the overall state of the economy, which is driven by the higher economic response of private wages. The aggregate results may be misleading, however, as these models do not control for any observed characteristics- such as skills. The next section presents the models that control for these characteristics.

3 Micro findings on the cyclical properties of the public pay premium

3.1 Wage equations

Individual-level wage equations are defined in a Mincerian setting complemented by a rich set of individual-, regional- and business environmental-level factors. We control for unobserved individual-level heterogeneity using a fixed effects (FE) model. The dependent variable is the log of annual wages deflated in 2004 euros using the consumer price index. We restricted the analysis to individuals earning more than 12,000 euros per year because the data had only incomplete information for part-time workers. Additionally the wages were truncated at the upper end of earnings distribution because the data reports annual earnings more than around 80,000 at that level.[7]

Two methods are used to analyse the cyclical properties of pay premiums for the micro data. The first analysis follows the idea of the wage curve literature (Blanchflower and Oswald 1994; Nijkamp and Poot, 2005 for a survey). The wage equation with individual fixed effects takes the following form:

$$(3)\quad \log w_{ijrt} = \alpha_i + \theta Pub + \beta \log U_{rt} + \gamma X_{ijrt} + \lambda_t + \delta Pub \log U_{rt} + \phi Pub X_{ijrt} + \lambda_t Pub + \varepsilon_{ijrt}$$

where w_{ijrt} is the annual wage obtained by individual i working in sector j in region r in year t. The regions are categorised into 19 different province - counties. The regional unemployment rate, U_{rt} , is based on the Labour Force Survey. The individual-level fixed effect is denoted by α_i and Pub is the public sector -dummy reflecting the public sector wage effect. The vector of the independent variables is denoted by X_{ijrt} (see the list from Table A1 in the appendix). The time period effect is λ_t , and ε_{ijrt} is a random error term. Previous evidence suggests that returns from the characteristics, such as individual and regional, vary across sectors (see, for example, Adamchik and Bedi 2000; Tansel 2005). Therefore, we allow interactions between the public sector -dummy and other control variables. In order to estimate the effect of unemployment on the public sector pay premium, we interact U_{rt} with the public sector -dummy. The parameters of interest are β and δ. The early theory

[7] Regardless of these constraints, the parameter estimates of most important variables did not change substantially. These wage limitations were chosen based on the parameters of other controls, e.g., education, that were in accordance with the earlier studies on public-private sector wage gaps.

of Harris and Todaro (1970) indicates that the relationship between unemployment and wages (parameter β) is positive due to compensating wage differentials across regions. This finding is in contrast to original study of Blanchflower *et al.* (1994), who argue that this relationship is negative. Based on the findings of wage curve studies (Nijkamp *et al*., 2005) and as presented in the previous section, parameter β should be negative. If we further assume that the public sector pay premium is counter-cyclical, δ should be positive.

The second model used to test the relationship between unemployment and the wage premium sets the individual-level public sector pay premium as the dependent variable in the following manner:

$$(4)\quad \log\left(\frac{w_{pu}}{w_{pr}}\right)_{irt} = \alpha_i + \eta \log U_{rt} + \mu X_{irt} + \lambda_t + \varepsilon_{irt}$$

where α_i, λ_t, X_{irt}, U_{rt} and ε_{irt} are as before. If an individual works in the public sector, w_{pu} is his annual wage, and w_{pr} is his expected annual wage in the private sector, which is estimated using his relevant characteristics (X_{pu}), and their associated private sector returns from these characteristics ($\hat{\gamma}_{pr}$); that is, $E(w_{pr} \mid \hat{\gamma}_{pr} X_{pu})$. If an individual works in the private sector, w_{pr} is his annual wage, and w_{pu} is his expected annual wage in the public sector, which is estimated in the same manner as before: $E(w_{pu} \mid \hat{\gamma}_{pu} X_{pr})$. The parameter of interest is η, which is hypothesised to be positive.

3.2. Data and results

The analysis is based on micro data from Statistics Finland for the period of 1990-2004. These data comprise a comprehensive set of information on individual characteristics and the region where the work is located. The data includes a 7% random sample of Finnish population in 2001. We test the effect of unemployment on pay gaps for men and women separately. Furthermore, the analysis is confined to full-year and full-time wage earners between 18 and 64 years old, who were not self-employed or living in Åland. The data are unbalanced panel data including 1,024,796 wage observations from 513,017 males and 511,779 females from 19 regions over a period of 15 years. The results obtained from Equations (3) and (4) are shown in Tables 5 and 6. The tables present the results obtained from the basic ordinary least squares (OLS) and regional fixed-effects (FE) models.[8] The total public sector was divided into central and local sectors to examine the effect of unemployment on pay gaps in more detail.[9] The upper parts of the tables present the results for the total public sector, whereas the middle and lower parts of the tables present the corresponding results for the central and local government sectors, respectively. The standard errors are clustered by province -county.

The regional FE results indicate that workers earn a positive premium of 6% in the public sector. In the central sector, this premium is zero, and in the local sector it is about 10% for both sexes. The OLS results vary considerably in these respects, but as reported by Bargain *et al*. (2007), the FE procedure is likely to control for endogenous selection and produces estimates that are much closer to zero. Considering the wage curve estimates, the relationship between wages and unemployment is negative. The OLS results yield an estimated coefficient of about -0.03, whereas the regional FE -model yields a slightly lower coefficient of -0.02. The results are robust across gender and different sectors. The slopes of the wage curve are smaller than the original specification of Blanchflower *et al*. (1994), who reported far now familiar slope of -0.10. Our results are comparable with Pekkarinen (2001), who used Finnish panel data from the metal industry for the years 1991-1995 and found that the slope of the wage curve is -0.04.

The results indicate no clear evidence that unemployment affects the pay premium. The regional FE estimates, which are probably the closest comparison to the estimates of Blanchflower *et al*. (1994), vary from positive to negative but fail to reach significance across gender and sectors. The only exception is that the estimated parameter is statistically significant for women at the local-private sector level. This parameter is -0.016 in Table 5 and -0.008 in Table 6, indicating that a 10% increase in the unemployment rate decreases the local government pay premium by about 0.10-0.20%. Given that this result is negative, it is of the incorrect sign according to the hypothesis, implying that local government wages respond more than private sector wages to labour market conditions. The economic significance of this finding, however, is weak.

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[8] The wage equations were also estimated by random effects (RE) model, but the Hausman statistics were high, indicating that individual effects correlate with the regressors. In order to save space, we do not report all variables in the model. Complete results are available from the author upon request. Overall, the returns are well-defined, have expected signs, and are in accordance with the findings of studies examining public-private sector pay gaps.

[9] The biggest personnel groups employed the State's on-budget entities are defense services personnel and those employed by universities. The local government sector provides basic public services- such as education, health and social services.

Table 5. OLS and FE- estimation results for men and women: dependent variable is log of annual earnings (t-statistics in parenthesis)

	Men		Women	
	OLS	Regional FE	OLS	Regional FE
Total public sector				
Pub	– 0.020 (– 0.51)	0.061 (3.38)	0.180 (8.94)	0.064 (5.45)
$\log U_{rt}$	– 0.031 (– 3.92)	– 0.022 (– 3.22)	– 0.027 (– 4.43)	– 0.015 (– 3.75)
$Pub * \log U_{rt}$	– 0.001 (– 0.12)	– 0.001 (– 0.06)	– 0.004 (– 0.46)	– 0.012 (– 1.84)
R^2	0.47	0.37	0.49	0.34
N	513,017		511,779	
	OLS	Regional FE	OLS	Regional FE
Central government				
Pub	– 0.169 (– 4.43)	0.014 (0.39)	0.008 (0.30)	– 0.028 (– 1.15)
$\log U_{rt}$	– 0.031 (– 3.99)	– 0.021 (– 3.14)	– 0.028 (– 4.32)	– 0.015 (– 3.83)
$Pub * \log U_{rt}$	0.017 (1.24)	0.017 (1.69)	0.012 (0.87)	0.004 (0.42)
R^2	0.46	0.38	0.48	0.36
N	451,212		314,442	
	OLS	Regional FE	OLS	Regional FE
Local government				
Pub	0.143 (2.12)	0.133 (4.68)	0.234 (8.15)	0.080 (5.34)
$\log U_{rt}$	– 0.031 (– 4.03)	– 0.022 (– 3.22)	– 0.027 (– 4.38)	– 0.015 (– 3.45)
$Pub * \log U_{rt}$	– 0.023 (– 1.46)	– 0.020 (– 1.56)	– 0.007 (– 0.27)	– 0.016 (– 2.13)
R^2	0.46	0.36	0.48	0.34
N	451,990		458,245	

It is possible that coefficients vary over time. Therefore, we add interaction terms between year dummies and the unemployment rate (and their interactions with the public sector -dummy) to Equation (3). The regional FE results that appear in Table A2 in the appendix provide a more detailed picture than that provided by the pooled regression model. The findings suggest that the wage curve was not entirely stable over the period evaluated. The relationship between unemployment and wages was negative and basically statistically significant for early recession years in 1990-1991 and again during the small slump in the 2000s across gender and sectors, the slopes of the wage curve averaging –0.04 for men and –0.02 for women. Thus, a cautious interpretation supports the theory that men are more vulnerable to economic shocks (Glewwe *et al*. 1998). Our findings from the 1990s are in line with Böckerman *et al*. (2010), who stated that wage rigidity was at a high level after the recession of the mid- 1990s. Our results from the 1990s also support the discussion of Albaek *et al*. (2000), who found no evidence of a wage curve (nor of a Phillips curve) in the Nordic countries. Their results are consistent with a theoretical model in which central bargaining agents determine a national wage increment, whereas local bargaining agents determine wage drift. Generally speaking, our results indicate, in the same spirit as Böckerman *et al*. (2010), that in years of stable labour markets, unions prevent real wages from falling but they can be accepted during recession.

Our results regarding the cyclicality of pay premiums are in line with the results obtained from the pooled regression models. In particular, all of the pay premiums (total public, central government and local government) are largely unaffected by regional unemployment rates. These results indicate that, regardless of whether the response is high or low, wages in the private sector are as responsive to local unemployment rates as wages in the public sector. One exception emerges: the local government pay premium was pro-cyclical in the late 1990s for both sexes (years 1998-1999 for men and 1996-1999 for women), and the estimated parameter was about -0.04 for men and -0.02 for women. These results indicate that a 10% increase in the unemployment rate decreased the local government pay premium by about 0.40% (0.20%) for men (women). Consequently, the total pay premium moved in same manner as the local pay premium for women because a higher share of women works in the local sector rather than in the central sector.

Table 6 OLS and FE- estimation results for men and women: dependent variable is log of annual public sector pay premium (t-statistics in parenthesis)

	Men		Women	
	OLS	Regional FE	OLS	Regional FE
Total public premium				
$\log U_{rt}$	0.013 (1.88)	0.005 (0.97)	– 0.002 (– 0.37)	– 0.007 (– 1.77)
R^2	0.17	0.08	0.24	0.07
N	513,017		511,779	
	OLS	Regional FE	OLS	Regional FE
Central gov. premium				
$\log U_{rt}$	0.018 (2.48)	0.009 (1.67)	0.014 (2.19)	0.006 (1.41)
R^2	0.22	0.11	0.15	0.08
N	451,212		314,442	
	OLS	Regional FE	OLS	Regional FE
Local gov. premium				
$\log U_{rt}$	0.017 (2.40)	0.008 (1.50)	– 0.000 (– 0.07)	– 0.008 (– 2.10)
R^2	0.17	0.13	0.27	0.34
N	451,990		458,245	

Taken together, our micro results suggest that the existence of a wage curve is weak in Finland and that the cyclical behaviour of the public pay premium does not adhere to prior expectations of counter-cyclicality. These results are not in line with the findings of Sanz-de-Galdeano *et al*. (2006) who reported that private wages have three times the response of public wages to unemployment in the euro area, implying that the public pay premium is strongly counter-cyclical. Our results are understandable considering the typical wage rigidity in a highly unionised country such as Finland.

4. Conclusions

This paper investigated the relationship between business cycles and public-private sector pay gaps. The hypothesis of a counter-cyclical pay premium was examined using Finnish aggregate data over the period of 1977-2008 and micro panel data over the period of 1990-2004. The aggregate analysis began by comparing the effects of labour market conditions to public and private sector wages. All of the macro findings, which were scrutinised by different statistical methods, indicated a clear positive relationship between the public pay premium and economic slowdowns. This cyclical pattern was driven by the higher economic response of private compared to public wages.

In the micro analysis, two different wage-setting models were nested in earnings equations and the public sector was divided into central and local government sectors. The micro results suggested that aggregate results should be treated with considerable care. In particular, after controlling for individual heterogeneity, the relationships between pay premiums and labour market conditions disappeared. The estimated regional FE parameters varied from negative to positive but were not statistically or economically different from zero.

References

Abraham, K., and J. Haltiwanger. 1995. "Real wages and the business cycle."*Journal of Economic Literature* 33, 1215-1264.

Adamchik, V. and A, Bedi. 2000. "Wage Differentials in the Public and the Private Sectors: Evidence from an Economy in Transition." *Labor Economics* 7, 203-224.

Ahumada, H. and M.L. Garegnani. 1999. "Hodrick Prescott Filters in Practice," *Central Bank of Turkey* Working Paper.

Albæk, K., Asplund, R., Barth, E., Blomskog, S., Guômundsson, B. R., Karlsson, V. and E. S. Madsen. 2000. "Dimensions of the wage-unemployment relationship in the Nordic countries: Wage flexibility without wage curves." *Research in Labor Economics* 19, 345-381.

Bargain, O., and B. Melly. 2008. "Public sector pay gap in France: New evidence using panel data." IZA discussion paper, no. 3427.

Blanchflower, D.G, and A.J. Oswald. 1994. The wage curve. Cambridge, Massachusetts: The MIT Press.

Borjas, G. 1984 "Electoral cycles and the earnings of federal bureaucrats." *Economic Inquiry* 22, 447-459.

Böckerman, P., Laaksonen, S. and J. Vainiomäki. 2007. "Who bears the burden of wage cuts? Evidence from Finland during the 1990s." *International Journal of Manpower* 28, 100-121.

Böckerman, P., Laaksonen, S. and J. Vainiomäki. 2010. "Micro and macro level wage rigidity: Lessons from Finland." *Finnish Economic Papers* 23, 27-42.

Disney, R. 2007. "Public-private sector differentials around the world: Methods and evidence."Mimeo, University of Nottingham, School of Economics.

Disney, R., and A. Gosling. 1998. "Does it pay to work in the public sector?" *Fiscal Studies* 19, 347–374.

Disney, R., and A. Gosling. 2008. "Changing public sector wage differentials in the UK." The Institute for Fiscal Studies paper.

Freeman, R. 1987. "How do public sector wages and employment respond to economic conditions?" In *Public sector payrolls*, Wise, D. University of Chicago Press, 183-214.

Glewwe, P., and G. Hall. 1998. "Are some groups more vulnerable to macroeconomic shocks than others? Hypothesis tests based on panel data from Peru." *Journal of Development Economics* 56, 181-206.

Harris, J.R., and M.P. Todaro. 1970. "Migration, unemployment and development: A two-sector analysis." *American Economic Review* 60, 126–142.

Keane, M., Moffitt, R., and D. Runkle. 1988. "Real wages over the business cycle: Estimating the impact of heterogeneity with micro data." *Journal of Political Economy* 96, 1232-1267.

Melly, B. 2005. "Public-private sector wage differentials in Germany: Evidence from quantile regression." *Empirical Economics* 30, 505-520.

Nijkamp, P. and J. Poot. 2005. The last word on the wage curve? *Journal of Economic Surveys* 19(3), 421-450.

Pekkarinen, T. 2001. The wage curve: Evidence from the Finnish metal industry panel data. *Finnish Economic Papers* 14(1), 51-60.

Quadrini, V., and A. Trigari. 2007. "Public employment and the business cycle." *Scandinavian Journal of Economics* 109, 723-742.

Ravn, M., and H. Uhlig. 2002. "On adjusting the Hodrick-Prescott filter for the frequency of observations." *The Review of Economics and Statistics,* 84, 371–380.

Sanz-de-Galdeano, A. and J. Turunen. 2006. "The euro area wage curve." *Economics Letters* 92, 93-98.

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

Appendix

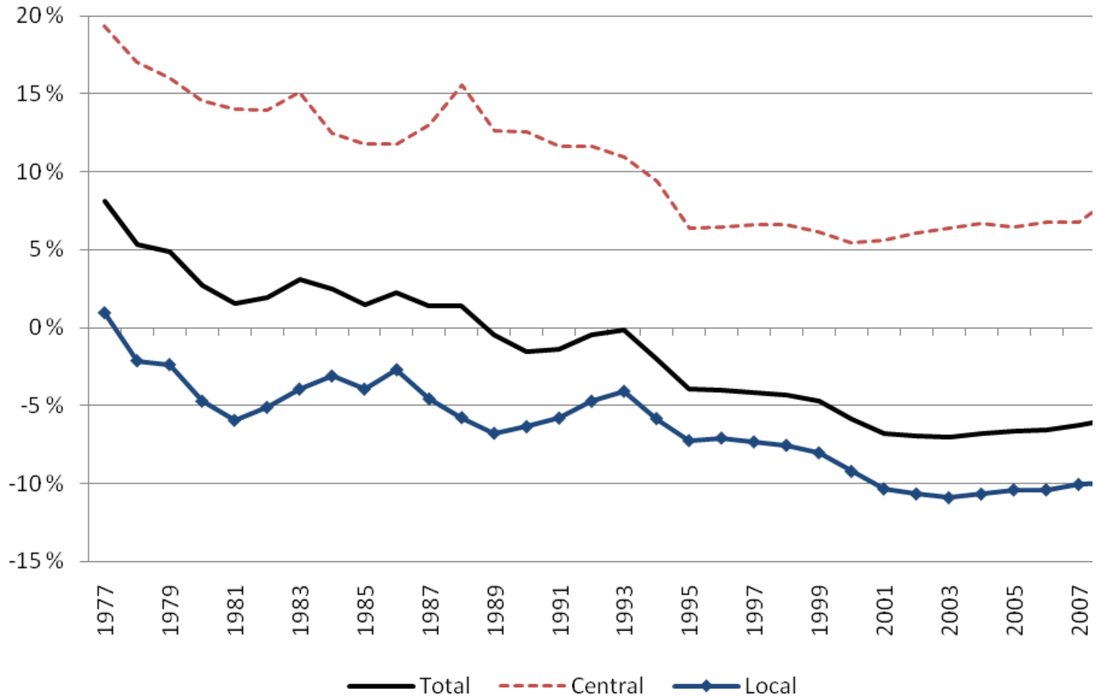

Figure A1. Central government and private sector pay gap, local government and private sector pay gap and total public-private sector pay gap in 1977-2008.

Table A1. Variable description

Variable	Description
ln (wage)	Annual earnings/euros
Business cycle indicators	
$\log U_{rt}$	Logarithm of unemployment rate
$Pub^* \log U_{rt}$	Interaction between logarithm of unemployment rate with public dummy
Individual characteristics	
Pub	Public sector dummy: 1 if public, 0 if private
Exper	Potential work experience, calculated as age minus age at graduation
Exper_sqr	Potential work experience squared
Tenure	Work experience in current job
Married	Individual is married or cohabitates
Children_3	Individual has child/children under 4 years of age
Children_18	Individual has child/children under 18 years of age
Finnish	Native language of Finnish
Swedish	Native language of Swedish
Non-native	Native language other than Finnish or Swedish
Education, 5 levels	Primary, secondary, lowest-level, lower-level and highest-level
Field of education, 10 levels	General, teaching, humanities, business, natural sciences, technical, agriculture and forestry, health and social, services and others
Occupation, 9 levels	Managerial, professional, technical, clerks, sales and care, craft, operative and others (armed force, agriculture and fishery workers)
Business environmental factors	
Industry, 9 levels	Agriculture and forestry, manufacturing, construction, sales and hotel and restaurant, transportation, real estate and finance, education, health and others
R&D intensity, 8 levels	1-4.9, 5-9.9, 10-49.9, 50-99.9, 100-499.9, 500-999.9 and over 1,000
Share of primary production, 4 levels	0-9.9 %, 10-19.9 %, 20-29.9 % and over 30 %
Share of refinement, 4 levels	10-19.9 %, 20-29.9 %, 30-39.9 % and over 40 %
Share of services, 6 levels	30-39.9 %, 40-49.9 %, 50-59.9 %, 60-69.9 %, 70-79.9 %, 80-89.9 %
Regional characteristics	
Major province, 4 levels	Southern, Western, Eastern and Northern Finland
Sub-region, 6 levels	Metropolitan, university centre, regional centre, industrial centre, rural area and countryside
Province county, 19 levels	Uusimaa, Itä-Uusimaa, Varsinais-Suomi, Satakunta, Kanta-Häme, Pirkanmaa, Päijät-Häme, Kymenlaakso, South Karelia, Etelä-Savo, Pohjois-Savo, North Karelia, Central Finland, South Ostrobothnia, Ostrobothnia, Central Ostrobothnia, North Ostrobothnia, Kainuu and Lapland
Population	Population in sub-region
Year dummies	1990, …, 2004

Table A2. Wage curves and unemployment effects on total public, central and local sector wageremiums for men and women in the period of 1990-2004. FE results.

	Results for men						Results for women					
	Total public sector and private sector		Central government and private sector		Local government and private sector		Total public sector and private sector		Central government and private sector		Local government and private sector	
	$\log U_{rt}$	Pub* $\log U_{rt}$	$\log U_{rt}$	Pub* $\log U_{rt}$	$\log U_{rt}$	Pub* $\log U_{rt}$	$\log U_{rt}$	Pub* $\log U_{rt}$	$\log U_{rt}$	Pub* $\log U_{rt}$	$\log U_{rt}$	Pub* $\log U_{rt}$
1990	-0.036*	0.019	-0.036*	0.024*	-0.036*	0.007	-0.017*	-0.005	-0.017*	0.005	-0.016*	-0.008
1991	-0.051*	0.037	-0.051*	0.030	-0.050*	0.043	-0.010	0.006	-0.011	-0.006	-0.009	0.007
1992	-0.028	0.013	-0.030	-0.017	-0.027	0.051	0.012	-0.009	0.011	-0.035	0.013	-0.003
1993	-0.055	0.020	-0.055	-0.010	-0.054	0.045	-0.014	0.008	-0.015	-0.017	-0.013	0.023
1994	-0.027	0.033	-0.028	0.020	-0.026	0.038	0.003	0.009	0.002	-0.006	0.003	0.019
1995	-0.006	0.009	-0.007	0.012	-0.005	-0.002	0.005	-0.016	0.005	0.007	0.004	-0.024
1996	-0.007	0.010	-0.008	-0.003	-0.007	0.018	0.008	-0.022*	0.007	0.008	0.008	-0.031*
1997	-0.014	0.006	-0.014	0.014	-0.014	-0.001	0.000	-0.020*	0.001	-0.005	0.000	-0.023*
1998	0.010	-0.030	0.010	-0.017	0.009	-0.046*	0.009	-0.022*	0.008	-0.023	0.009	-0.023*
1999	-0.004	-0.022	-0.003	-0.014	-0.004	-0.032*	0.005	-0.017*	0.005	-0.019	0.005	-0.017*
2000	-0.011	-0.016	-0.010	-0.004	-0.011	-0.028	-0.007	-0.013	-0.007	-0.007	-0.006	-0.015
2001	-0.015	-0.009	-0.015	-0.001	-0.015	-0.018	-0.017*	-0.007	-0.017*	-0.003	-0.016*	-0.008
2002	-0.024*	-0.003	-0.023*	0.001	-0.024*	-0.008	-0.017*	-0.017	-0.017*	-0.015	-0.016*	-0.018
2003	-0.022	-0.012	-0.022	-0.030	-0.021	-0.008	-0.023*	-0.003	-0.023*	-0.026*	-0.022*	0.003
2004	-0.034*	-0.001	-0.034*	-0.013	-0.032*	-0.013	-0.031*	-0.000	-0.031*	-0.020	-0.029*	0.005
R^2	0.37		0.38		0.37		0.34		0.36		0.34	

*: statistically significant at least at the 5 % significance level