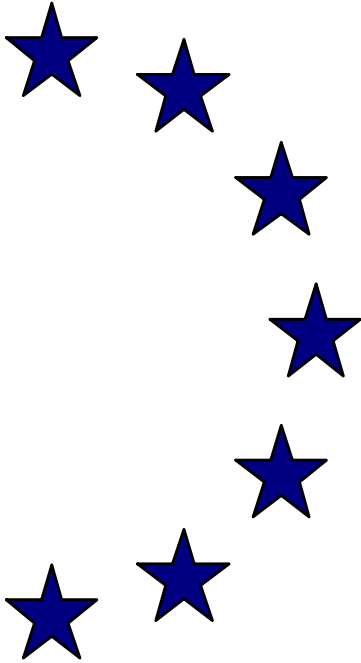


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**Wage compression and employment  
in Europe: First evidence from the  
structure of earnings survey 2002**

by

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# **WAGE COMPRESSION AND EMPLOYMENT IN EUROPE: FIRST EVIDENCE FROM THE STRUCTURE OF EARNINGS SURVEY 2002**

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## ***Abstract***

This paper aims at examining wage compression in Europe using the publicly available data on wages drawn from the Structure of Earnings Survey 2002. By wage compression, it is meant here that the difference in productivity across workers or firms is only partly reflected by the difference in wages. The paper specifically considers the existence of wage compression both across occupations and levels of education by means of cross-sectional econometric analysis. Looking at wage compression across occupations, robust evidence gives some support to the conventional view that there is a compressed wage distribution in Europe. While the estimated wage compression is even higher across the levels of education and is seen in a majority of industries, the evidence appears much less robust than that obtained across occupations. Wage compression seems to be higher in the euro area and EU15 than in the New Member States and the two Acceding Countries, which is in line with their more flexible wage bargaining setting. Likewise, wage compression mainly occurs in continental and southern countries, whilst no compression is detected in Anglo-Saxon countries and mixed evidence is found in Northern European countries. Moreover, the compression of wages is not uniform across wage levels, which is consistent with the stylised fact that there is more wage compression at the lower end of the earning distribution. Compared with the counterfactual where relative wages mirror relative productivity, wage compression would induce some job losses for low-skilled people. However, this paper does not provide conclusive empirical evidence on whether wage dispersion has a negative impact on total employment.

*Key words:* Wage structure, wage differentials by skills, demand for labour, European Union.

*JEL classification:* J23, J31.

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## Summary of the main findings

The purpose of this paper is to examine wage compression in Europe using the publicly released data on wages drawn from the Structure of Earnings Survey 2002 (SES 2002). Although the information is only available in terms of group-specific averages and not in the form of individual data, one advantage of the SES 2002 is to allow one to control for the composition of the workforce when examining wage dispersion. “Wage compression” is here defined as the lower difference in wages across workers or firms compared with the difference in productivity. This can be understood in a static way considering the level of relative wage and relative productivity, but also in a dynamic way as the ability of relative wages to swiftly respond to shocks affecting relative productivity.

The paper first looks at the relation across European countries between the total employment rate and a measure of wage dispersion along a number of dimensions by means of graphical analysis. However, the results of graphical analysis are more than unclear, partly because of its inability to control for country-specific effects. Bivariate graphical analysis indeed reasons *other things being equal*, while numerous other factors should play a great role in explaining the total employment rate. These might also suggest that wage compression would mainly affect the relative employment performance of some worker types rather than the overall employment rate. This strongly supports the need to carry out in-depth econometric analysis going beyond simple cross-country correlations.

The paper then considers the existence of wage compression both across occupations and across educational attainments for Europe as a whole (EU25 plus the two acceding countries and Norway). Given the cross-sectional and “snapshot” nature of SES data, the paper only investigates the “static” dimension of wage compression. As relative marginal productivity cannot be observed across occupations or levels of education directly, the methodology is based on the derivation of a labour demand model, which is estimated by means of cross-sectional econometric analysis.

Looking at wage compression across occupations, the econometric analysis gives some support to the conventional view that there is a compressed wage distribution in Europe. The evidence appears fairly robust and is confirmed by numerous econometric estimations. In particular, the existence of wage compression is also broadly seen when the estimation is carried out for each occupation separately so as to allow the degree of substitution between labour and capital to differ across occupations. Although some caution should be called for regarding the estimated magnitude of wage compression, the compression coefficient would be around one fifth/one fourth, meaning that relative wages in logarithm are reduced by at most one quarter compared with what the productivity level should allow.

As far as the wage structure by level of education is concerned, the empirical findings broadly confirm that the wage distribution is compressed in Europe. The estimated coefficient of compression is even higher than that computed across occupations. However, it should be emphasised that the evidence appears much less robust across educational attainments than across occupations: the findings with respect to the levels of education are in particular very sensitive to the inclusion of dummies and to the choice of the educational base used to compute relative wages. This is most likely due to the fact that educational

attainment is too coarse a measure to capture the various levels of professional skills. Furthermore the level of education attained refers to the personal skills of the worker rather than the set of skills actually required for the job currently occupied, which is indeed the most relevant variable regarding wage determination. Indeed, the phenomenon of over-qualification in some European countries might blur the overall picture.

The pattern of educational wage compression is shared by a majority of industries: manufacturing; construction; wholesale and retail trade; hotels and restaurants; transport, storage and communication; real estate, renting and business activities and, to a lower extent, mining and quarrying. Conversely, no clear sign of wage compression emerges from electricity, gas and water supply, financial intermediation, public administration and defence; education, health and social work.

Overall, wage compression by both occupation and education seems to be higher in the euro area and EU15 than in the New Member States and the two Acceding Countries, which is in line with their more flexible wage bargaining setting. Within the EU15, wage compression mainly occurs in continental and southern countries, whilst no compression is detected in Anglo-Saxon countries, which confirms the stylised facts often reported on these groups of countries. However, mixed evidence is found for Northern European countries, where the econometric analysis points to compressed wage structure across education levels but not across occupations.

Notably, the compression of wages is not uniform across wage levels: there is more wage compression at the lower end of the earning distribution, which is consistent with the conventional view. This suggests that, compared with the counterfactual where relative wages mirror relative productivity, compression of wage distribution would induce some job losses for low-skilled people. The idea that wage compression mostly has a bearing on relative employment performance of some disadvantaged groups could very tentatively explain the lack of obvious (static) relationship between wage dispersion and the total employment rate across countries.

## 1. Introduction

Wage moderation in the euro area appears to have been a crucial element of macroeconomic stability in recent years and may partly explain the resilience of employment in the face of the economic slowdown. However, there is still a long way to go towards achieving Lisbon employment targets in Europe. Consideration should also then be given to the microeconomic structure of wages, which may also affect the macroeconomic performances. Indeed, there has been growing interest amongst researchers and policy makers in the labour market institutions, which are considered as a key factor influencing employment performance and wage determination in Europe (e.g. Nunziata, 2005). Wage distribution could be one of the channels through which some institutions, particularly those shaping the wage setting, impact labour market performances (Bertola and Rogerson, 1997). Moreover, a problem often mentioned about the European Union labour markets is the relatively low employment rate seen in specific groups, such as youth, women, older workers and the low skilled, while the prime-age employment rate is much higher and broadly similar to that of the US (Dolado et al., 2001). This is often attributed to the compressed wage structure in Europe.

Statistically, the dispersion of wage distribution is often claimed to be much lower in Europe than in the United States (Bertola, Blau and Kahn 2001). In economic terms, “wage compression” means the difference in wages across workers or firms in Europe that does not reflect the (wider) difference in productivity. This mismatch can be understood in a static way comparing the level of relative wage and relative productivity, but also in a dynamic way as the ability of relative wages to swiftly respond to shocks affecting relative productivity. According to many authors, the lack of wage dispersion in Europe might cause under-employment in disadvantaged groups which are more vulnerable to long-term exclusion. Therefore, it is important to ensure that wage-bargaining systems allow wages to reflect productivity, taking into account productivity differences across skills and local labour-market conditions.

The recent release of the results of the Structure of Earnings Survey for 2002 (SES2002) by Eurostat sheds light on the wage structure in Europe. As well as yielding a snapshot of the overall wage structure with inter-percentile gaps, the survey provides useful information on average hourly and monthly wages across a number of relevant dimensions: educational attainment, sectors, occupation, firm size, gender or age group. Although the data recently disseminated by Eurostat remain fairly aggregated and expressed as average hourly wages, this information can be adjusted for the composition of the workforce in terms of skills, occupations and sectors, which differs from country to country. Freeman and Schettkat (2001a) emphasised the importance of such compositional effects, when showing that the compression of wages in Germany compared with those in the US partly comes from the compression of skill distribution in Germany. Moreover, the information on hourly wages is more relevant than that on monthly wages to study wage dispersion in Europe, since it is not distorted by the number of hours worked and in particular the impact of overtime and part-time, which vary a lot across European countries.

Based on the recent results of the SES 2002, the paper identifies the existence of employment-detrimental wage compression in Europe using a *labour demand setting*. The methodology has two characteristics: the estimates of wage compression are model-based; the focus of the study is the EU25 plus the acceding countries.

The rest of the paper is structured as follows. Section 2 briefly surveys the literature on the causes and effects of wage compression. Section 3 examines the relationship across European countries between aggregate employment rate and a measure of wage dispersion computed along a number of dimensions by means of graphical analysis. Section 4 sets out the theoretical framework. Section 5 presents the data and the econometric methodology. Section 6 presents and discusses the econometric results. This section looks at the existence of wage compression both across *occupations* and across *educational attainments*. Section 7 concludes.

## **2. Origins and effects of wage compression: a literature survey**

The economic literature has been very fertile in explaining the wage compression and in understanding the relationship between wage dispersion and employment.

Economic theory offers two non-mutually-exclusive types of explanation for the existence of wage compression.

- The first one explains wage compression as being caused by exogenous labour market institutions such as minimum wages (which affect the lower end of wage distributions), trade-unions, central bargaining framework, governmental extension of collective agreements or any institution which contributes to raise the reservation wage, such as generous unemployment benefits. Koeniger et al. (2005) investigate the importance of labour market institutions such as unemployment insurance, unions, firing regulation and minimum wages for the evolution of wage inequality across countries. Their estimates for 11 OECD countries suggest that labour market institutions can account for a large part of the change in wage inequality across countries after controlling for time and country effects.
- The second type of explanation identifies endogenous causes for wage compression. For instance, Booth and Zoega (2002) provide micro-foundations for wage compression by modelling wage-setting in an imperfectly competitive labour market with heterogeneous workers and firms<sup>1</sup>. In their model, wage compression arises quite naturally in market economies and does not depend on the existence of ad-hoc institutional structures such as minimum wages and unions. Using a Nash Bargaining framework with on-the-job search, Shimer (2004) concludes that there can be wage

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<sup>1</sup> Some firms hire higher ability workers who *collectively* perform better and this *collective ability* determines the intra-firm level of task complexity. Because of the finite number of higher ability workers, firms able to do the most complex tasks constitute a “narrow market” where they have a monopsony power. As a result, wages are compressed within firms, so that low-ability workers are paid more, relative to their talent, than high-ability workers.

dispersion in equilibrium even if all workers and firms are homogeneous. If firms are heterogeneous, more productive firms pay higher wages and workers switch employers whenever they encounter a more productive job. Ample empirical evidence gives support to the endogenous determination of wages, suggesting that employers pay different wages to similar workers, which potentially allows wages to deviate from productivity in some cases. Krueger and Summers (1988) show that, after controlling for personal characteristics, some US industries pay wages up to 20% above and below the average wage. Similarly, taking a descriptive and macro approach at the euro area level, Genre, Momferatou and Mourre (2005) show that workers' characteristics fail to fully explain wage differentials across industries, which are partly linked to firms' characteristics, such as corporate size and capital intensity. Two explanations are put forward in the literature: either employers pursue different wage policies or high-wage firms attract more able workers. Empirical studies by Abowd et al. (1999) and Abowd and Kramarz (2000a, 2000b), based on the analysis of matched employer-worker data for both the U.S. and France, conclude that the two are equally important as explanations of inter-industry differentials and that wage policy differences account for 70% of the size differentials.

Besides its origin, the second critical issue covered by the economic literature is the impact of wage compression on employment or more generally on labour market performance.

- A first vein of research looks at the impact of minimum wages on employment. Although many economists traditionally argue that the effect of a binding minimum wage law is to reduce firms' demand for low skill workers, Rebitzer and Taylor (1995) state that this prediction of worker displacement depends critically on the assumption that the productivity of employees is not dependent upon the wage. They find that in an efficiency wage model, a minimum wage may increase the level of employment in low wage jobs. More generally, such a result reflects either the case of an efficiency wage model with a large number of employers (Manning, 1995, Rebitzer and Taylor 1995) or that of labour demand under monopsony (Burdett and Mortensen 1998). While recent empirical studies fail to reach a consensus on the issue of the employment effects of minimum wages (Neumark and Wascher 2000 and Card and Krueger 2000), Strobl and Walsh (2002) argue that, in a more general and realistic employment contract where not only a wage but also a set of working conditions are specified, an employment subsidy is a more effective way of improving welfare than minimum wages.
- A second strand of research focuses on the general impact of wage compression or wage inequality on employment. For instance, Bertola, Blau and Kahn (2001) show that, controlling for country- and time-specific effects, high employment is associated with high levels of wage inequality. They suggest that US relative unemployment of most disadvantaged groups fell in recent years in part because the more flexible labour market institutions prevailing in the US allow economic shocks to affect real and relative wages to a greater degree than in other OECD countries. In another paper, Bertola, Blau and Kahn (2002) find that greater wage compression



caused by a high degree of involvement of unions in wage-setting would lead to relatively lower employment rates for young and older individuals than for the prime-aged (particularly for prime-age men), given the labour demand elasticities for these different groups<sup>2</sup>. They also find evidence that the wage compression induced by higher unionisation raises the unemployment rate of young men and prime-age women compared to prime-age men. Lindquist (2005) shows that, when labour markets are competitive, even low degrees of wage compression lead to large welfare losses, because wage compression brings about costly unemployment among low-skilled workers<sup>3</sup>. Overall, these analyses are mainly based on the theory that employment is mainly determined by firms' labour demand. Therefore, restraining real wage growth results in more employment.

However and as already mentioned in the case of minimum wages, the relevance of the usual labour-demand side story on the negative effect of wage compression should somewhat be qualified. In other models of employment determination at the micro level, such as efficient bargaining or employer monopsony models, wage increases may possibly induce employment growth (Card and Krueger 2000). For instance, compression in wage distribution may have a positive impact on firm-sponsored general training. Acemoglu and Pischke (1999) find that when labour market frictions and institutions compress the structure of wages, firms are encouraged to invest in the general skills of their employees, as the distortion in the wage structure turn "technologically general" skills into "specific" skills. On an empirical ground, Freeman and Schettkat (2001b) highlight that the differing dispersion of wages is not a major contributor to differences in overall employment rates between the US and Germany, although they acknowledge that *changes* (and not level) in relative employment are related to *changes* in relative wages, raising the possibility of some substitution behaviour. The job problem in Germany may be due to a general lack in overall demand for labour rather than an insufficient relative labour demand affecting the low skilled in particular. In a recent study carrying out a descriptive analysis comparing employment structure in Europe and the US, the European Commission (2004) finds no clear graphical evidence in support of the view that differences in employment structure are mainly due to a more compressed wage structure in the EU.

### **3. Data and graphical analysis**

#### **3.1 Data**

The Structure of Earnings Survey (SES) for 2002 is the first issue of a four-yearly survey which gives detailed and comparable information at the European level on the earning distribution and the relationship

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<sup>2</sup> The wage compression, seen empirically, might result from the fact that, in maximising workers' rent, trade unions negotiate the largest wage premium for groups with very elastic labour supply such as women (reflecting their high opportunity cost of employment, i.e. home production and child care).

<sup>3</sup> The effect of wage compression on the supply of skilled labour, however, is fairly small, since the disincentive effect of lower wages for the high skilled is largely offset by a lower opportunity cost of schooling owing to higher unemployment.

between the level of remuneration, individual characteristics of employees and those of their employer<sup>4</sup>. The survey reports gross wages only. It does not cover all labour costs and in particular excludes employers' social security contributions and other non-wage labour costs<sup>5</sup>. Therefore, this study focuses on wage compression and not on labour cost compression, which can be somewhat different given the potentially strong effect of the tax system in Europe. The reference year is the calendar year 2002. The statistical units of the survey are both local units belonging to enterprises with 10 or more employees and employees having at least one working day paid by the employer at a full rate during October 2002. For more details, see annex.

Individual data is not yet available to researchers for legal reasons. The data released to them and to the public are aggregated in the form of group-average along different dimensions. In this study, we use two samples of the survey, both reporting information on average gross *hourly* wages (excluding overtime payments) and the number of employees. The first provides data broken down by occupation, firm size, gender and country, while the second consists of data disaggregated by level of education, industry, gender and country. In order to fully exploit the cross-sectional information of SES data, we use all the country data available: the paper not only covers the EU25 countries (excluding Portugal, Greece and Malta) but also includes the two acceding countries (AC2), i.e. Bulgaria and Romania. Norway, whose economy is fairly close to that of several EU15 countries, has also been added in the sample in order to increase the efficiency of the estimations<sup>6</sup>.

Chart 1 shows the variation of hourly wages across education attainments. The average hourly wage of people with tertiary education is 84% higher in the EU25 than that of people with lower secondary education or less. Chart 2 illustrates that wage dispersion is even more acute across occupations. The average hourly wage of legislators, senior official and top managers is 2.3 times as high as that of elementary occupations. A natural question would be what the "optimal" degree of wage dispersions could be.

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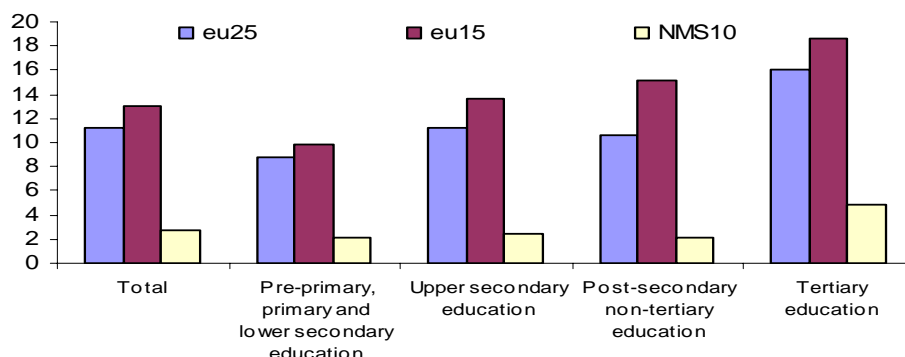
<sup>4</sup> A first Structure of Earnings Survey was conducted in 1995. However, it has a lower geographical coverage and was not fully comparable with the subsequent surveys, which are to be carried out under new regulations aiming at providing more accurate and harmonized data on earnings in EU Member States.

<sup>5</sup> Gross hourly wages (referred to as gross hourly earnings in the survey) are the remuneration in cash paid to the employee directly and regularly by the employer at the time of each pay period, before deductions of any tax and social security contributions payable by employee and withheld by the employer.

<sup>6</sup> Data for Portugal, Greece and Malta were not available when the database was compiled and the bulk of the current study was carried out. At the date of the publication, data were not available for Malta yet. Likewise, it should be noted that the decomposition of earnings by education level and sector for the UK was not posted in the Eurostat website when the current study was started.

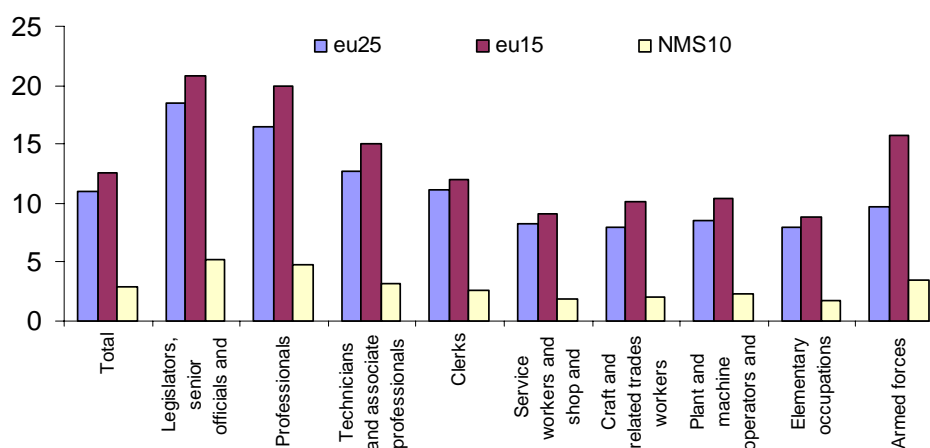
**Chart 1. Hourly wage by educational attainment**

*(Mean hourly earnings in euros, corrected for gender composition)*



**Chart 2. Hourly wage by occupation**

*(Mean hourly earnings in euros, corrected for gender composition)*



### ***3.2 Employment rate and wage dispersion across countries: a graphical analysis***

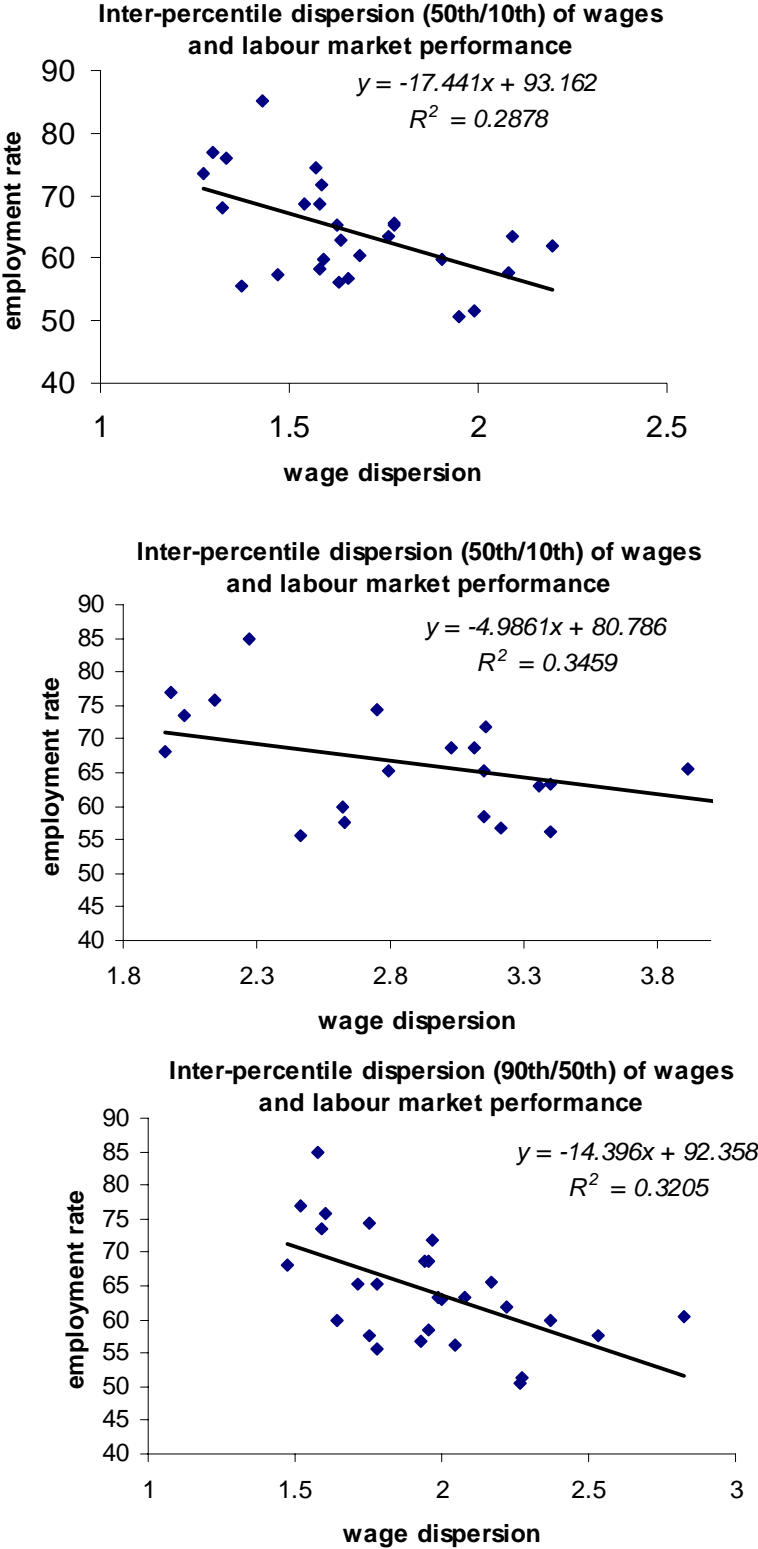
This section aims at collecting initial evidence of any simple relationship between employment performance and wage dispersion by means of graphical analysis. Wage dispersion is computed as the coefficient of variation of nominal earnings<sup>7</sup> along a series of dimensions such as occupation and level of education. Similar types of graphical analysis can for instance be found in Coelli et al. (1994).

The graphical analysis comparing country-specific employment rates and the level of wage dispersion turns out to be inconclusive. When considering the inter-percentile range of wage distribution (see chart 3), a negative relationship appears. However, this negative correlation might be partly optical and related to the composition of workforce by skills: if a country manages to integrate a lot of low-skilled people

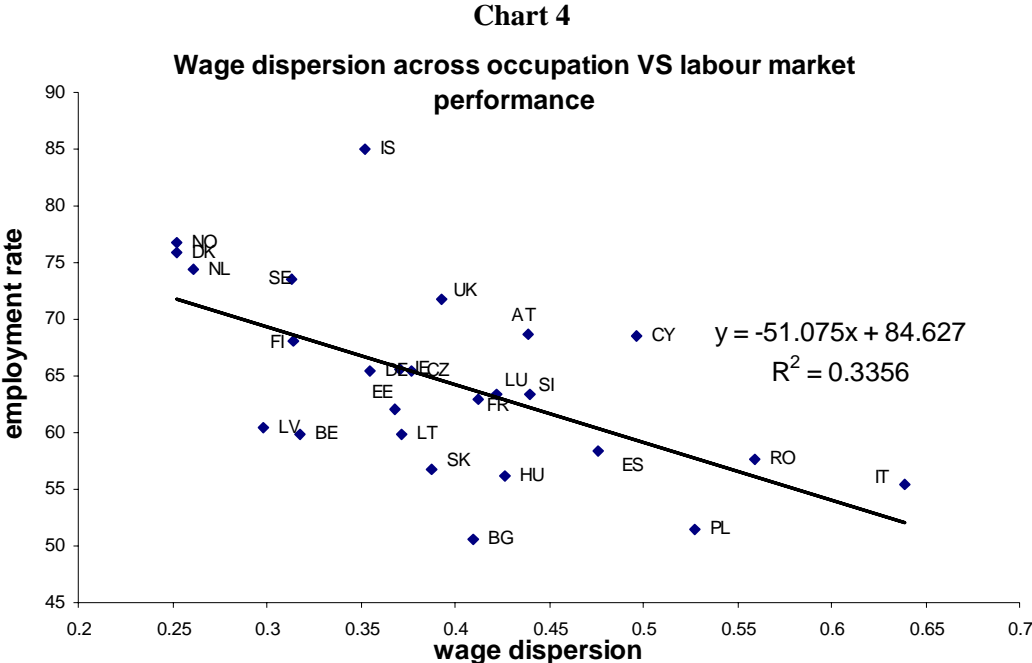
<sup>7</sup> This measure of wage dispersion is corrected for the gender composition of employment, given the huge difference in Europe in female participation and the existence of a high gender pay gap in some European countries.

into its labour market thanks to well-designed policies, this could influence the overall wage structure by reducing the range between the 10<sup>th</sup> and 50<sup>th</sup> percentiles for instance. The role of skill compression on wage dispersion was clearly highlighted by Freeman and Schettkat (2001a).

**Chart 3. Employment performance and inter-percentile range in wage distribution**

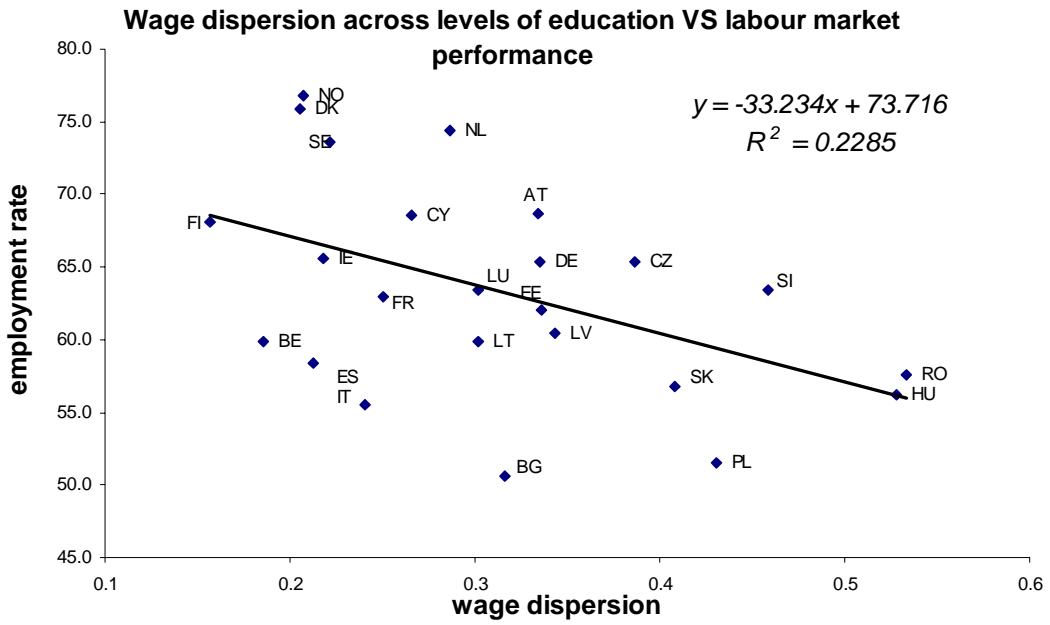


The SES 2002 helps circumvent this difficulty by providing useful information on the composition of wages by occupation, educational attainment and sector. However, the negative correlation between the employment rate and wage dispersion still holds. As regards occupations, there is a negative albeit fairly loose relationship (chart 4). Although a negative relationship is still depicted when considering wage dispersion by level of education, the R<sup>2</sup> becomes lower (chart 5). Moreover, looking at the relationship between relative wage (as a percentage of average wages) and the share in total employment, a negative correlation emerges in a low-pay sector such as hotel and restaurant and a positive one in a high-pay sector such as financial intermediation, suggesting that wage dispersion might benefit some specific sectors (chart 6). However, the low R<sup>2</sup> attached to these relationships remains very low, which hampers strong interpretation. Overall, one should refrain from inferring any clear-cut relationship between wage dispersion and overall employment performance.



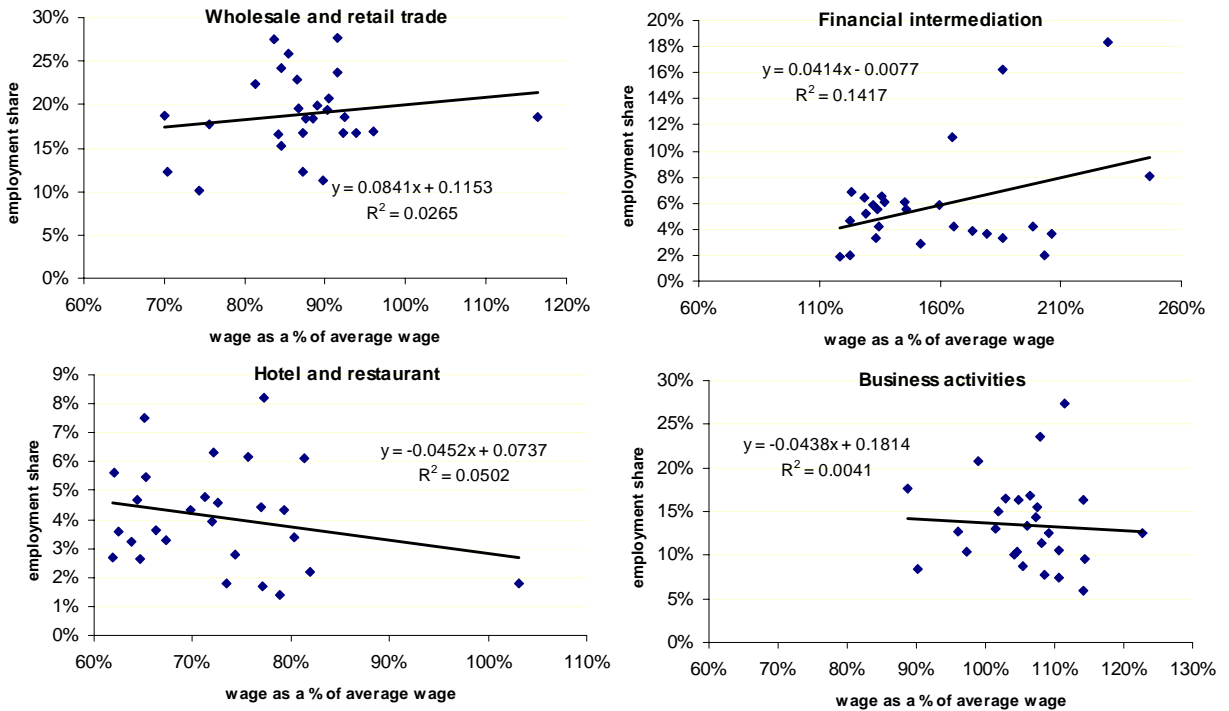
*Note: Wage dispersion is measured by the coefficient of variation, which is calculated as the ratio of standard deviation to mean value.*

**Chart 5**



Note: Wage dispersion is measured by the coefficient of variation, which is calculated as the ratio of standard deviation to mean value.

**Chart 6. Relative wage and share in total employment by sectors**



As mentioned in another paper (Bertola, Blau and Kahn 2001), these unclear findings would illustrate that the graphical analysis generally fails to control for country-specific effects, which can be very strong<sup>8</sup>. The country dimension is all the more important because the macroeconomic and employment

<sup>8</sup> The lack of clear evidence coming from graphical analysis can be emphasised further when noting that there is surprisingly no cross-country correlation between wage dispersion by level of education, sector and occupation.

performance may partly be shaped by the type of social model prevailing in a particular country (Frederiksen et al., 2005). Therefore, a more thorough econometric analysis is required to go beyond simple cross-country correlations. Moreover, even if *no* real impact of wage dispersion existed on *overall* employment performance, this would not mean at all that there is no effect of *relative* wages on *relative* employment performance. A similar case emerges in the literature with the impact of Employment Protection Legislation (EPL). While there is no consensus on the long-term effect of EPL on total employment level, there is sound evidence that it affects the relative employment situation of specific groups, improving that of the prime-age people and worsening that of youth, female and older workers (Bertola, Blau and Kahn 2001, Jimeno and Rodriguez-Palenzuela 2002).

#### 4. Theoretical framework: a simple labour-demand model

In order to identify the degree of wage compression in Europe, we need to develop a simple model, which relates wages to the relative employment by using a standard labour demand framework. The idea is to examine whether the (absolute value of) wage coefficient in the relative employment equation is higher than that in the employment equation. If so, there is evidence of wage compression.

We first consider a CES production function with two production factors and constant returns to scale, as proposed by Arrow et al. (1961):

$$Y_i = \left[ \alpha (a_i L_i)^{\frac{\sigma-1}{\sigma}} + (1-\alpha) K_i^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}}$$

with  $Y$  standing for output,  $L$  for labour,  $K$  for capital,  $a$  for labour-enhancing technical progress<sup>9</sup>,  $\alpha$  for the labour-intensity of the method of production and  $\sigma$  for the elasticity of substitution between effective labour ( $aL$ ) and capital. The subscript  $i$  represents a specific type of workers or firms (sector, age bracket, skill level, occupation, gender, contract type, etc). Assuming that firms do not necessarily operate in a perfectly competitive environment, the first order condition of firm's profit maximisation leads to equate the marginal labour productivity to the mark-up adjusted real compensation per employee  $\mu_i(w/p)$  with  $\mu$  being the mark-up over costs in the case of imperfect competition<sup>10</sup>. This gives the following expression:

$$\mu_i \frac{w_i}{p_i} = \frac{\partial Y_i}{\partial L_i} = \alpha a_i^{\frac{\sigma-1}{\sigma}} L_i^{-\frac{1}{\sigma}} Y_i^{\frac{1}{\sigma}} \quad (1)$$

After rearranging and writing in logarithms, we end up with a standard employment equation:

$$\log L_i = \log Y_i - \sigma \log(w/p)_i - (1-\sigma) \log a_i + \sigma \log(\alpha/\mu) \quad (2)$$

<sup>9</sup>  $a$  represents the labour efficiency. It can also be seen as the degree of *labour-augmenting* technical progress (i.e. Harrod-neutral technical progress).

<sup>10</sup> The SES 2002 data dealt with in this study cover gross wages, which exclude non-wage labour costs (mainly employers' social security contributions). However, we can arguably suppose that within a given country, the share of non-wage costs in total labour costs is not substantially different along the wage distribution. In any case, this study focuses on wage compression and not on labour costs compression, which can be even higher given the effect of the tax system.

The employment level depends on total output, real wages and labour-augmenting technical progress (i.e. Harrod-neutral technical progress). The elasticity of employment to real labour costs equals minus one times the elasticity of substitution between labour and capital. The latter is conventionally assumed to lie between zero and unity, which reflects the imperfect substitution between production factors. This implies that the elasticity of employment to real labour costs is negative and lower than 1 in absolute value and that the coefficient of labour-augmenting technical progress is negative as well. This assumption is only called into question when the production factors are complements instead of substitutes, which is not plausible as shown by some studies (e.g. Bentolila and Saint-Paul, 2003).

If we consider two different types of workers or firms  $i$  and  $o$  with  $o$  serving as a base, the relative mark-up adjusted wage can be written from (1) as a function of relative marginal return of labour:

$$\frac{\mu_i}{\mu_o} \left( \frac{w_i}{p_i} / \frac{w_o}{p_o} \right) = \left( \frac{\partial Y_i}{\partial L_i} / \frac{\partial Y_o}{\partial L_o} \right) \quad (3)$$

Allowing for wage compression would mean that relative wage is lower than relative productivity. So, with wage compression coefficient  $c$  lower than 1, expression (3) can be rewritten in logarithm as:

$$\log \left( \frac{\mu_i}{\mu_o} \cdot \frac{w_i}{p_i} / \frac{w_o}{p_o} \right) = (1-c) \log \left( \frac{\partial Y_i}{\partial L_i} / \frac{\partial Y_o}{\partial L_o} \right) = (1-c) \log \left( \frac{\alpha_i}{\alpha_o} \left( \frac{a_i}{a_o} \right)^{\frac{\sigma-1}{\sigma}} \left( \frac{L_i}{L_o} \right)^{-\frac{1}{\sigma}} \left( \frac{Y_i}{Y_o} \right)^{\frac{1}{\sigma}} \right) \quad (4)$$

If  $c$  equals 1, this expression comes down to (3) expressed in logarithm. If  $c$  ranges between 0 and 1, there is wage compression. Conversely, if  $c$  is negative, the elasticity of relative wages to relative marginal product of labour becomes higher than unity: there is a stretched wage distribution.

After rearranging (4), we obtain the relative employment equation:

$$\log L_i - \log L_o = -\frac{\sigma}{1-c} (\log w_i - \log w_o) + \gamma_{i0} \quad (5)$$

where:

$$\gamma_{i0} = \log Y_i - \log Y_o + \frac{\sigma}{1-c} (\log p_i - \log p_o) + (\sigma-1) (\log a_i - \log a_o) + \sigma (\log \alpha_i - \log \alpha_o) - \frac{\sigma}{1-c} (\log \mu_i - \log \mu_o)$$

or more simply:  $\gamma_{i0} = \log Y_i - \log Y_o$  if we assume that  $p$ ,  $a$ ,  $\alpha$  and  $\mu$  are constant across the types of workers/firms considered<sup>11</sup>. In this setting, the higher the wage compression, the lower the relative employment rate. If there is no wage compression, the coefficient of relative wage equals the elasticity of substitution<sup>12</sup>.

The coefficient of compression cannot be estimated directly as it cannot be disentangled from the elasticity of substitution in (5). It can, however, be calculated indirectly by comparing the results of the

<sup>11</sup> If the elasticity of substitution is equal to unity, the production function becomes a Cobb-Douglas function and relative employment rate takes the following form:  $\log L_i - \log L_o = -1/(1-c) [\log(w/p)_i - \log(w/p)_o] + \gamma_{i0}$

<sup>12</sup> In this setting, real labour cost elasticity gives a measure of the elasticity of substitution  $\sigma$ . In economic terms, this parameter means that a growth of 1% in the relative cost of labour to capital will lead to a growth of  $\sigma\%$  in the ratio of capital to labour.



labour demand equation (2) and the relative employment equation (5). If the wage coefficient of the employment equation (2) and that of the relative employment equation (5) are denoted by W1 (i.e.  $-\sigma$ ) and W2 (i.e.  $-\sigma/(1-c)$ ) respectively, the coefficient of compression is equal to  $1-W1/W2$ .

Equation (5) also shows that data on relative productivity or relative output are *not* needed to compute  $c$ . It suffices to estimate the wage coefficients in (2) and (5), as the output produced by each group  $i$  and more broadly  $\gamma_{i0}$  are captured by group-specific fixed effects. This is extremely important as either relative productivity or relative output is very difficult to measure. In particular, there is no available data on any of these in the SES 2002.

However, we have made the strong assumption in (2) that the elasticity of substitutions between labour and capital is the same across the different groups of workers/firms considered. It is a convenient way to identify wage compression. We implicitly suppose that any difference in the elasticity of employment to wages across groups is explained by wage compression. While this could be reasonable across education levels, this might however be quite debatable across occupations or sectors, where the elasticity of substitution may vary owing to the use of different production methods. If we relax this hypothesis, expression (5) becomes (assuming for simplicity that  $p$ ,  $a$ ,  $\alpha$  and  $\mu$  are constant across the groups considered):

$$\log L_i - \log L_0 = -\frac{\sigma_i}{1-c}(\log w_i - \log w_0) - \frac{(\sigma_i - \sigma_0)}{1-c} \log w_0 + \gamma_{i0} \quad (6)$$

This means that the way to identify wage compression  $c$  remains broadly unchanged, as relative employment can still be written as a function of the coefficient of wage compression, the elasticity of substitution and relative wages. The condition to get unbiased estimate of  $c$  is that equations (2) and (6) should be estimated separately for each group  $i$  rather than over the full population.

The estimated value of  $c$  can also be used to estimate the potential loss in total employment induced by wage compression, as derived in equation (7).

$$L = \sum_{i=0}^I L_i = L_0 + \sum_{i=1}^I e^{\log L_i} = L_0 + \sum_{i=1}^I e^{\left[ -\frac{\sigma}{1-c}(\log w_i - \log w_0) + \log L_0 + \gamma_{i0} \right]} = L_0 + L_0 \sum_{i=1}^I \left( \frac{w_i}{w_0} \right)^{-\frac{\sigma}{1-c}} e^{\gamma_{i0}} \quad (7)$$

From a labour-demand perspective, the higher the coefficient of compression  $c$ , the lower the total employment. Properly speaking, this net employment loss is not an empirical estimate but rather a labour-demand-based *theoretical* effect calculated *other things being equal*. Consequently, this computation should be taken with great caution and for illustrative purposes only. Indeed, other (offsetting or aggravating) effects of wage compression on total employment can also be at play in real life. For example, a compressed wage structure might increase the work effort of those with low productivity (according to the efficiency wage theory) and increase the participation of the low-skilled. Conversely, if we consider wages of the low-skilled as given, wage compression may translate into the reduction of the wages of the highly skilled, bringing about a reduction of their work effort and possibly a cut in the

participation rate of educated females. Wage compression might also encourage the development of black economy and reduce the quality of official employment statistics.

## 5. Econometric strategy

Two equations are estimated: an employment equation and a relative employment equation. They are run according to different techniques (OLS with dummies, simple OLS, fixed-effects, random effects). For fixed effects and random effects estimations, we arrange our data as a “panel” of groups of employees (horizontal dimension) across countries (vertical dimension). The main technique used is OLS with dummies taking into account heterogeneity in the sample.

The *employment equation* corresponds to the standard labour demand equation (2). It uses the *level* of employment (in logarithm) as the dependent variable and also includes GDP level and labour costs. Thus, the following general specification is estimated, where  $E$  denotes employment,  $Y$  real GDP and  $w$  nominal hourly wage rate (weighted average of gross hourly earnings of all individuals included in the group considered, excluding overtime payment), the  $i$ ,  $o$ ,  $s$  and  $g$  are country-, occupation-, corporate-size- and gender-dummy indices,  $Y$  an output variable (country GDP/value-added) and  $X_k$   $k$  additional exogenous variables used as controls (e.g. output gap and labour market institutions) in some ancillary equations so as to test the robustness of the main results.  $\varepsilon$  is the residual and the equation is:

$$\ln E_{o i s g} = \alpha_o + \alpha_i + \alpha_s + \alpha_g - \beta \ln w_{o i s g} + \gamma \ln Y_i + \sum_{k=1}^K \mu_k X_{ki} + \varepsilon_{o i s g}$$

Then we estimate a *relative employment equation*, similar to equation (5) where  $oB$  denotes the occupation chosen as a base for the computation of relative employment and relative nominal wages. For convenience, the notations presented above are again taken below but with an apostrophe to signal that this is a symmetric but different specification. The estimated equation is<sup>13</sup>:

$$\ln \left( \frac{E_{o i s g}}{E_{oB i s g}} \right) = \alpha_o' + \alpha_i' + \alpha_s' + \alpha_g' - \beta' \ln \left( \frac{w_{o i s g}}{w_{oB i s g}} \right) + \gamma' \ln Y_i + \sum_{k=1}^K \mu_k' X_{ki} + \varepsilon'_{o i s g}$$

From there and as derived in section 4, the coefficient of compression can easily be computed as:

$$c = 1 - \frac{\beta}{\beta'}$$

However, if  $\beta$  has a positive sign (which does not comply with the theory) or if  $c$  is above 1 or below -1, the result for  $c$  becomes suspicious and would be considered as insignificant. As shown earlier, positive  $c$  points to the existence of wage compression, while a negative  $c$  points to the existence of wage extension.

<sup>13</sup> The variable  $\ln Y_i$  is not absolutely necessary as it could be included in the country dummies. However, it is directly derived from the equation (5). It is indeed interesting to specifically control for the “economic size” of countries or sectors (in the specification with education levels and sectors). Moreover, it is important to set up an identical form for both equations (relative employment equation and employment equation) in order to make the results as comparable as possible. In any case the results are not altered by the inclusion of this variable.

The two equations will also be estimated with a different version of the SES aggregated database, where occupation and corporate size are replaced by educational attainment and sector, while gender and country are still among the dimensions used in the sample.

As a robustness check, we also run the employment and relative employment equation on each occupation  $o$  (and alternatively on each sector and each level of education) in order to take due account of the fact that the coefficient of compression and the coefficient of substitution between labour and capital may significantly vary across occupations. This comes down to estimating equation (2) and (6) described in section 4.

$$\forall o \neq oB, \begin{cases} \ln E_{o i s g} = \alpha_i + \alpha_s + \alpha_g - \beta_o \ln w_{o i s g} + \gamma \ln Y_i + \sum_{k=1}^K \mu_k X_{ki} + \varepsilon_{o i s g} \\ \ln \left( \frac{E_{o i s g}}{E_{oB i s g}} \right) = \alpha_i' + \alpha_s' + \alpha_g' - \beta_o' \ln \left( \frac{w_{o i s g}}{w_{oB i s g}} \right) + \gamma' \ln Y_i + \sum_{k=1}^K \mu_k' X_{ki} + \varepsilon'_{o i s g} \\ c_o = 1 - \frac{\beta_o}{\beta_o'} \end{cases}$$

While possible pooling bias could be removed through group-specific estimations, the flip side of this is that the estimation would be much less efficient due to the much lower number of observations used. This is the reason for running both pooled estimation and group-specific estimation in this paper.

## 6. Econometric results

### 6.1 Wage compression across occupations

The empirical findings on the wage structure by occupation confirm the conventional view that there is a compressed wage distribution in Europe. The evidence appears robust and is confirmed by the numerous econometric estimations carried out in this paper. However, there is more uncertainty surrounding the exact magnitude of this compression as the estimated coefficients vary significantly across the samples and specifications used. Overall, the compression coefficient is around one fifth/one fourth<sup>14</sup>, meaning that relative wages (in logarithm) are reduced by at most one quarter, compared with what the productivity level should allow. The existence of wage compression in Europe means that the structure of wages might be responsible for some job loss compared with a counterfactual characterised by productivity-based wage dispersion.

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<sup>14</sup> This is the simple average of the estimates shown in table 1 and 2 for the whole sample.

**Table 1: overall results for EU25 +AC2 (base: legislators and managers)**

<b>Relative employment equation in log (deviation from legislators and managers' wage and employment)</b>				
	OLS with dummies	OLS	Random effect	Fixed effect
	relative employment	relative employment	relative employment	relative employment
Relative wage	-0.628 (5.65)***	-0.569 (8.12)***	-0.875 (9.53)***	-0.897 (9.82)***
GDP	0.212 (4.38)***	0.078 (4.53)***	-0.037 (1.83)*	0.189 (4.86)***
Observations	1970	1970	1970	1970
R-squared	0.47	0.04	0.47	0.46

<b>Standard employment equation in log</b>				
	OLS with dummies	OLS	Random effect	Fixed effect
	employment	employment	employment	employment
Wage	-0.458 (3.10)***	-0.469 (17.55)***	-0.836 (6.55)***	-0.878 (6.89)***
GDP	1.135 (22.33)***	1.004 (53.30)***	0.829 (28.89)***	1.111 (26.25)***
Observations	1970	1970	1970	1970
R-squared	0.76	0.59	0.76	0.80

*Absolute value of z statistics in parentheses*

*\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%*

<b>Estimated coefficient of compression</b>				
	OLS with dummies	OLS	Random effect	Fixed effect
Relative employment equation	27%	18%	4%	2%

Table 1 shows the results for the whole population using various econometric techniques: OLS with dummies<sup>15</sup>, simple OLS, fixed effects model and random effects model. Wage compression can technically be seen through the elasticity of relative employment to relative wages, which is lower in absolute value than the elasticity of employment to wages. From a technical point of view, OLS with dummies ‘a priori’ seems to be the soundest approach, as it does not need to care about what should be the second “panel” dimension (i.e. the country in random effects and fixed effects estimations) and permits to correct for all the heterogeneity inherent in each dimension considered (firm size, occupation, gender and countries). It provides an estimate value of 27%, which is higher than the other estimates. Moreover, OLS regressions of the employment equation with dummies provide estimated elasticities of employment to labour costs of around -0.4, which is in line with time-series and panel estimates available for the euro area as a whole (e.g. Mourre, 2004) and the main EU15 countries (Van der Horst, 2003)<sup>16</sup>.

<sup>15</sup> The dummies capture the various dimensions at stake (i.e. firm size, occupation, gender and countries).

<sup>16</sup> While Mourre found the elasticity of employment to real labour costs ranging from -0.35 (pooled-time series) to -0.41 (euro area equation with break) and -0.55 (euro area equation without break), Van der Horst got consistent country elasticities of -0.12 for France, -0.48 for Germany, -0.33 for the Netherlands, -0.27 for Spain and -0.67 for the United Kingdom.

Table 2 suggests that wage compression is higher in EU25 than in the two acceding countries (Romania and Bulgaria). Within the EU25, the euro area and EU15 seem to experience a higher wage compression than in the New Member States. This is confirmed by evidence concerning the decentralised wage bargaining institutions in the New Member States, where wages are negotiated at the firm level.

**Table 2: wage compression by geographical areas**  
**Relative employment equation in log (deviation from legislators and managers' employment)**

	Total (eu25+ac2) relative employment	euro area relative employment	eu15 relative employment	eu25 relative employment	eu10 relative employment
Relative wage	-0.921 (9.55)***	-1.877 (10.70)***	-1.675 (10.23)***	-1.099 (9.57)***	-1.289 (8.23)***
Observations	1970	725	949	1690	741
R-squared	0.24	0.33	0.29	0.25	0.32

**Employment equation in log**

	total employment	euro area employment	eu15 employment	eu25 employment	eu10 employment
Wage	-0.542 (22.61)***	-0.37 (1.95)*	-0.226 -1.51	-0.534 (16.60)***	-0.896 (14.15)***
Observations	1970	725	949	1690	741
R-squared	0.7	0.66	0.65	0.69	0.72

*Absolute value of t statistics in parentheses*

*\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%*

*Estimated by OLS with GDP, firm size, gender and occupation dummies (but without countries dummies)*

**Estimated coefficient of compression**

	total	euro area	eu15	eu25	eu10
	41%	80%	87%	51%	30%

Looking closer at the EU15, wage dispersion may also be influenced by the type of social model. We will have recourse to the now traditional taxonomy of social protection models in Europe, derived from the seminal sociologic work by Esping-Anderson (1990), which is more and more used to evaluate labour market policy in Europe (e.g. Frederiksen et al., 2005)<sup>17</sup>. As shown by Table 3, there seems to be relatively large wage compression in the continental and southern models (Austria, Belgium, France, Germany, Italy, Luxembourg and Spain), which is in line with the common knowledge regarding the incidence of union or collective bargaining in wage determination and the admittedly rigid wage structure in these countries. Conversely, no significant wage compression emerges from the econometric analysis in the Anglo-Saxon countries (Ireland and the United Kingdom), which is again consistent with the stylised

<sup>17</sup> Esping-Anderson (1990) divides welfare systems into three models: a conservative model (comprising continental and Mediterranean countries), a liberal model (comprising Anglo-Saxon countries) and a social democratic model (including Northern-European countries). Frederiksen et al (2005) derive similar grouping using statistical cluster analysis of the labour market policies in EU countries (such as the partition method and the hierarchic method). An issue here is to know whether a continental model should be distinguished from a Southern European Model. As regards wage distribution, the two sub-models share similar institutional characteristics (importance of union or collective bargaining in wage setting) and a admittedly rigid wage structure. Moreover, pooling the two sub-sets would give rise to more efficient panel estimations and would solve the problem of some borderline countries (France, Belgium) whose exact position appears less clear.

facts often reported on these countries (e.g. relatively high wage dispersion, weak trade unions, decentralised wage bargaining, large share of low-paid jobs). More surprisingly, the analysis does not point to any significant wage compression in the Northern European countries (Denmark, Finland, the Netherlands and Sweden), which are often said to have highly compressed wage distribution, ensured by powerful and “consensual” trade unions and very centralised and wide-ranging wage bargaining. This could be due to a shortcoming of the methodology, as the results appear fairly sensitive to the country grouping chosen. However, looking further, this might capture a real phenomenon. The definition of wage compression used in this paper is not a statistical one, which just compares the interpercentile range across countries. With such a definition, there would indeed be little doubt that Nordic countries have a compressed wage structure. Conversely, the definition used in this paper looks at the possible gap between relative wage and relative productivity. In this respect, it could well be possible that the compressed wage structure across occupations in the Northern European countries matches a compressed productivity distribution.

**Table 3: wage compression by type of social model in the EU15**  
**Relative employment equation in log (deviation from legislators and managers' employment)**

	eu15	Continental and Southern	Anglo-Saxon	Northern European
	relative employment	relative employment	relative employment	relative employment
Relative wage	-1.675 (10.23)***	-1.417 (6.40)***	0.758 -1.26	0.423 -1.09
Observations	949	474	167	308
R-squared	0.29	0.35	0.52	0.47

**employment equation in log**

	eu15	Continental and Southern	Anglo-Saxon	Northern European
	employment	employment	employment	employment
Wage	-0.226 -1.51	-0.65 (3.53)***	1.224 (1.75)*	1.88 (6.19)***
Observations	949	474	167	308
R-squared	0.65	0.78	0.81	0.59

*Absolute value of t statistics in parentheses*

*\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%*

*Estimated by OLS with GDP, firm size, gender and occupation dummies (but without countries dummies)*

**Estimated coefficient of compression**

	eu15	Continental and Southern	Anglo-Saxon	Northern European
	87%	54%	-61% <sup>o</sup>	-344% <sup>o</sup>

<sup>o</sup>Not significant, as the wage coefficient of the relative employment equation or the employment equation is either not statistically significant or of a positive sign (contrary to the theory).

Table 4 presents estimations of the coefficient of compression for *each occupation*. These allow the coefficient of substitution to vary across occupations, improving the identification of the coefficient of compression. Indeed, in the pooled estimation, the value of wage compression might partly and

mistakenly capture the differences in labour-capital substitution coefficient across occupations. The occupation-specific estimations show that the elasticity of substitution, as estimated in the employment equation, is the highest for professionals and not significantly different from zero for crafts and related trades workers. It is higher for technicians, service workers and shop and market sales workers and elementary occupations than for clerks and plant and machine operators.

Table 4 confirms the widespread idea that wages are more compressed at the lower end of the wage distribution. Indeed, there is no evidence that wages of professionals or technicians are more compressed compared with those of legislators, senior officials and managers, while they are amongst the high paid and high skilled occupations. Conversely, wages for clerks, service workers and shop and market sales workers, craft workers and plant and machine operators and assemblers appear to be quite compressed vis-à-vis those of legislators, senior officials and managers. In particular, plant and machine operators and assemblers, which constitute one of the least paid and skilled occupational groups, turn out to have very high average wages vis-à-vis legislators, senior officials and managers. However, elementary occupations display no clear evidence of compression, which is somewhat puzzling. By and large, this suggests that, compared with the counterfactual where relative wages mirror relative productivity, the compression of wage distribution would induce some job losses for low-skilled people.

**Table 4: Wage compression by occupations for EU25 +AC2 (base: legislators and managers)**

	Total	Professionals	Technicians and associate professionals	Clerks	Service workers and shop and market sales workers	Craft and related trades workers	Plant and machine operators and assemblers	Elementary occupations
	Relative employment	Relative employment	Relative employment	Relative employment	Relative employment	Relative employment	Relative employment	Relative employment
Relative wage	-0.628 (5.65)***	-0.770 (3.90)***	-0.762 (5.25)***	-1.093 (6.60)***	-0.941 (4.25)***	-0.638 (2.84)***	-0.425 (1.54)	-0.735 (3.35)***
Observations	1970	286	286	286	286	275	275	276
R-squared	0.47	0.76	0.88	0.94	0.79	0.75	0.67	0.79
	Employment	Employment	Employment	Employment	Employment	Employment	Employment	Employment
Wage	-0.458 (3.10)***	-1.266 (3.72)***	-0.859 (2.50)**	-0.433 (1.49)	-0.838 (2.65)***	0.035 (0.10)	-0.104 (0.28)	-0.735 (1.92)*
Observations	1970	286	286	286	286	275	275	276
R-squared	0.76	0.89	0.89	0.93	0.87	0.90	0.90	0.88
<b>Coefficient of compression</b>	<b>27%</b>	<b>-64%</b>	<b>-13%</b>	<b>58%</b>	<b>11%</b>	<b>28%°</b>	<b>76%°°</b>	<b>0%</b>

Absolute value of z statistics in parentheses: \* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%

° adjusted by the elasticity of substitutions derived from the whole sample; °° weak significance

Estimated in log with country-specific GDP and country, firm size, gender and occupation dummies.

Robustness checks have been carried out. For instance, controlling for labour market institutions and the cyclical position of the economy, the estimations confirm the existence of wage compression, although of lower magnitude (see Table 5). In general, employment protection legislation negatively affects relative employment, while unemployment trap, low wage trap and output gaps exert a positive effect. Moreover, the coefficient of wage compression has been estimated when choosing other occupational bases than

legislators, senior officials and managers, as shown in Table 6. Although the estimated coefficient of compression appears somewhat sensitive to the choice of the occupational base, the existence of wage compression remains broadly confirmed. However, with low-paid and low-skilled occupations as a base, there is no clear evidence of wage compression except for craft and related trades workers. As in Table 4, this suggests that wage compression is not uniform across occupations and that wage compression applies more to low-skilled occupations<sup>18</sup>.

**Table 5. Robustness check: estimation of occupational wage compression with labour market institutions and output gap.**

*(OLS in log with country, size and occupation dummies)*

	relative employment				employment		
	(1)	(2)	(3)		(1)	(2)	(3)
Relative wage	-0.504 (3.34)***	-0.471 (3.25)***	-0.615 (3.77)***	Wage	-0.467 (2.10)**	-0.35 (1.65)*	-0.566 (2.40)**
GDP	-0.920 (10.04)***	-0.118 (2.83)***	0.883 (11.53)***	GDP	1.123 (11.86)***	1.135 (11.54)***	0.464 (6.22)***
Employment Protection Legislation	0.815 (11.16)***	1.14 (14.66)***	-0.219 (1.65)*	Employment Protection Legislation	-0.539 (6.96)***	-0.445 (4.78)***	0.743 (2.51)**
Union density	-0.009 (1.91)*	0.023 (10.00)***	0.03 (7.46)***	Union density	0.001 (0.25)	-0.002 (-0.56)	-0.017 (3.21)***
Unemployment trap	-0.059 (8.40)***	-0.13 (13.88)***		Unemployment trap	0.033 (4.66)***	0.027 (3.71)***	
Low wage trap for a couple with two children	-0.015 (8.30)***	0.008 (4.52)***		Lower wage trap for a couple with two children	0.005 (2.79)***	0.005 (2.72)***	
Training expenditures			0.073 (4.22)***	Training expenditures			-0.036 (-1.37)
Subsidies to regular employment in the private sector			-0.265 (3.97)***	Subsidies to regular employment in the private sector			0.191 (1.88)*
Low wage trap for a single individual			-0.027 (6.16)***	Low wage trap for a single individual			0.026 (3.18)***
Output gap	-0.419 (5.90)***			Output gap	0.187 (2.39)**		
Constant	15.819 (10.08)***	7.083 (8.19)***	-10.991 (15.35)***	Constant	-6.71 (4.16)***	-6.548 (4.12)***	1.383 (-1.4)
Observations	1201	1285	978	Observations	1201	1285	978
R-squared	0.49	0.49	0.47	R-squared	0.61	0.61	0.6
<i>Absolute value of z statistics in parentheses</i>							
<i>* significant at 10%; ** significant at 5%; *** significant at 1%</i>							
<b>WAGE COMPRESSION</b>	<b>8%</b>	<b>35%</b>	<b>9%</b>				

<sup>18</sup> Indeed, if we suppose that wages are mainly compressed in the low skilled occupations, it is logical that wage compression is more obvious when taking higher skilled occupations as a base, since the number of lower-skilled occupations in the standard taxonomy (ISCO-88) is higher than the higher-skilled occupations (legislators-managers, professionals and technicians).



**Table 6. Robustness check: estimation with different occupational bases for the computation for relative employment and relative wages**

**Relative employment equation in log**

Benchmark occupation in computing relative wage	Legislators, senior officials and managers	Professionals	Technicians and associate professionals	Clerks	Service workers and shop and market sales workers	Craft and related trades workers	Plant and machine operators and assemblers	Elementary occupations
	relative emp	relative emp	relative emp	relative emp	relative emp	relative emp	relative emp	relative emp
relative wage	-0.921 (9.55)***	-1.474 (11.77)***	-0.691 (5.31)***	-0.448 (3.34)***	-0.562 (4.43)***	-1.25 (9.53)***	-0.209 -1.51	-0.386 (3.12)***
GDP	0.071 (4.62)***	0.04 (2.27)**	-0.023 -1.61	-0.2 (13.05)***	0.027 (1.75)*	0.082 (5.34)***	0.026 (1.67)*	-0.033 (2.19)**
Observations	1970	1970	1970	1970	1970	1924	1924	1930
R-squared	0.24	0.14	0.14	0.44	0.3	0.47	0.34	0.14

**Employment equation in log**

Benchmark occupation in computing relative wage	Legislators, senior officials and managers	Professionals	Technicians and associate professionals	Clerks	Service workers and shop and market sales workers	Craft and related trades workers	Plant and machine operators and assemblers	Elementary occupations
	emp	emp	emp	emp	emp	emp	emp	emp
Wage	-0.542 (22.61)***	-0.54 (22.64)***	-0.587 (23.50)***	-0.639 (26.51)***	-0.621 (25.08)***	-0.551 (22.93)***	-0.57 (23.55)***	-0.615 (24.26)***
GDP	1.007 (62.38)***	1.005 (63.03)***	1.006 (60.21)***	0.997 (61.88)***	1.021 (62.06)***	1.01 (63.07)***	1.009 (62.39)***	1.011 (60.24)***
Observations	1970	1970	1970	1970	1970	1981	1981	1980
R-squared	0.7	0.72	0.7	0.71	0.71	0.71	0.71	0.7

Absolute value of t statistics in parentheses

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%

Estimated with occupation, firms' size and gender dummies

**Estimated coefficient of compression with different bases for the computation for relative wages**

Benchmark occupation in computing relative wage	Legislators, senior officials and managers	Professionals	Technicians and associate professionals	Clerks	Service workers and shop and market sales workers	Craft and related trades workers	Plant and machine operators and assemblers	Elementary occupations
	41%	63%	15%	-43%	-10%	56%		-59%

Based on the theoretical model developed earlier, which only takes into account the labour-demand side, a tentative simulation suggests that, *all things being equal*, a wage compression of one quarter might lead to an employment loss that is far from being negligible (of around 8%, as seen in Chart 7). It should be noted that the employment effect is non linear and more specifically convex, as it increases more than proportionally. Indeed, a wage compression coefficient of 10% entails a relative employment loss of 3%, whilst a compression coefficient of 50% is associated with a relative employment loss of 22%. However and as clearly spelled out in section 4, this estimate is subject to many caveats and should be seen as merely illustrating the potentially negative effect of wage compression coming from the labour-demand side. It cannot be interpreted as the effect of wage compression on total employment observed empirically.

**Chart 7. Illustrative labour-demand-based theoretical impact of wage compression on total employment for EU25 +AC2**



## 6.2 Wage compression across educational attainments

As far as the wage structure by level of education is concerned, the empirical findings broadly confirm that the distribution of wages is compressed in Europe. However, unlike the wage compression across occupations, evidence appears very sensitive to the inclusion of dummies. If education dummies and country dummies are added, the coefficient of compression becomes insignificant, in the sense that the underlying coefficient of either the relative employment equation or the employment equation turns insignificant or positive, which is difficult to reconcile with the economic theory. An explanation might be that wage differentials are very similar across educational groups and sectors within the same country, which would mean that using country dummies artificially removes part of the explanatory power contained in the wage variable. The most plausible explanation would, however, be that the variable “educational attainment” (referring to four levels of education only) is too coarse to capture the various levels of professional skills. Moreover, the level of education attained refers to the potential skills of the worker rather than the skills actually required for the job currently occupied, which is the most relevant explanatory variable for the level of wage paid by the employer. In this respect, the phenomenon of over-qualification and of increasing enrolment in higher education in some European countries might blur the overall picture.

OLS with dummies provides an estimated value of wage compression of 47%, as shown in Table 7<sup>19</sup>. However, other econometric techniques such as simple OLS, fixed-effects and random-effects, do not yield conclusive evidence of wage compression.

<sup>19</sup> This estimation method gives a wage elasticity of -0.473, which is broadly consistent with the employment equation estimations across occupations, as presented in the section 6.1.

**Table 7: overall results for EU25 +AC2 (base: those with tertiary education)**

<b>Relative employment equation in log (deviation from tertiary education)</b>				
	OLS with dummies	OLS	Random effect	Fixed effect
	relative employment	relative employment	relative employment	relative employment
Relative wage	-0.892 (5.52)***	-0.526 (3.13)***	-0.325 (2.33)**	-0.264 (1.88)*
Value added	0.15 (4.73)***	0.03 -1.02	0.123 (5.01)***	0.12 (4.92)***
Observations	1193	1193	1193	1193
R-squared	0.18	0.01	0.17	0.02

<b>Employment equation in log</b>				
	OLS with dummies	OLS	Random effect	Fixed effect
	employment	employment	employment	employment
Wage	-0.473 (9.09)***	-0.532 (10.52)***	-0.391 (10.14)***	-0.386 (10.03)***
Value added	0.933 (26.11)***	0.987 (32.56)***	0.898 (34.28)***	0.896 (34.30)***
Observations	1193	1193	1193	1193
R-squared	0.52	0.47	0.52	0.52

*Absolute value of z statistics in parentheses: \* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%. Estimated in log with country-specific GPD and country, firm size, gender and occupation dummies*

<b>Estimated coefficient of compression</b>				
	OLS with dummies	OLS	Random effect	Fixed effect
	47%	-1%	-20%	-47%

**Table 8: wage compression by geographical areas (base: those with tertiary education)**

<b>Relative employment equation in log (deviation from those with tertiary education)</b>					
	Total (eu25+AC2)	euro	eu15	eu25	eu10
	relative employment	relative employment	relative employment	relative employment	relative employment
Relative wage	-0.892 (5.52)***	-3.582 (9.86)***	-3.834 (10.39)***	-1.063 (5.88)***	0.266 (1.22)
Observations	1193	510	615	1079	464
R-squared	0.18	0.27	0.25	0.19	0.34

<b>Employment equation in log</b>					
	total	euro	eu15	eu25	eu10
	employment	employment	employment	employment	employment
Wage	-0.473 (9.09)***	-1.802 (5.65)***	-1.934 (6.61)***	-0.606 (9.78)***	-0.723 (6.39)***
Observations	1193	510	615	1079	464
R-squared	0.52	0.55	0.51	0.54	0.62

*Absolute value of t statistics in parentheses. \* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%. Estimated with GDP, firm size, gender and occupation dummies (but without countries dummies)*

<b>Estimated coefficient of compression</b>					
	total	euro	eu15	eu25	eu10
	47%	50%	50%	43%	372% <sup>o</sup>

<sup>o</sup>Not significant, as the wage coefficient of the relative employment equation is positive and not statistically significant.

**Table 9: wage compression by type of social model (base: those with tertiary education)****Relative employment equation in log (deviation from legislators and managers' employment)**

	eu15 relative employment	Continental and Southern relative employment	Anglo-Saxon relative employment	Northern European relative employment
Relative wage	-3.834 (10.39)***	-3.345 (7.77)***	0.257 -0.32	-5.952 (6.64)***
Observations	615	327	66	222
R-squared	0.25	0.25	0.54	0.27

**Employment equation in log**

	eu15 employment	Continental and Southern employment	Anglo-Saxon employment	Northern European employment
Wage	-1.934 (6.61)***	-1.808 (4.64)***	1.374 -1.27	-3.405 (5.18)***
Observations	615	327	66	222
R-squared	0.51	0.56	0.73	0.44

*Absolute value of t statistics in parentheses*

*\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%*

*Estimated by OLS with GDP, firm size, gender and occupation dummies (but without countries dummies)*

**Estimated coefficient of compression**

	eu15	Continental and Southern	Anglo-Saxon	Northern European
	50%	<b>46%</b>	-435% <sup>o</sup>	<b>43%</b>

<sup>o</sup>Not significant, as the wage coefficient of the relative employment equation or the employment equation is either not statistically significant or of a positive sign (contrary to the theory).

As with occupational wage dispersion, Table 8 suggests that wage compression across educational levels is higher in the EU25 than in the Acceding Countries in the sample. Moreover, the euro area and EU15 seem to witness higher wage compression than in the EU25 as a whole. The coefficient of compression is indeed insignificant in the New Member States, which is in line with their more flexible wage bargaining setting.

Looking closer at the EU15, wage dispersion across education levels may also be influenced by the type of social model. As shown by Table 9, there seems to be significant and relatively large wage compression in the continental and southern model, while no significant wage compression emerges from the econometric analysis in the Anglo-Saxon countries. These results confirm those obtained as regards wage compression across occupations and match the common knowledge on these groups of countries. Conversely, wages also appear compressed across education levels in the Northern European countries, whilst this is not the case across occupations.

Table 10 (in the end of this section) shows that the pattern of wage compression is shared by seven sectors out of eleven: manufacturing; construction; wholesale and retail trade; hotels and restaurants; transport, storage and communication; real estate, renting and business activities and, to a lower extent, mining and

quarrying. Conversely, no clear sign of wage compression emerges from electricity, gas and water supply, financial intermediation, public administration and defence; education, health and social work.

Although Table 11 shows that the diagnosis of wage compression is broadly confirmed when controlling for institutions, Table 12 highlights the lack of robustness of the estimates: they substantially change when opting for other educational bases than tertiary education. Indeed, with lower or medium education levels as a base, there is no clear evidence of wage compression any longer. This may underline that the findings are fragile due to the coarse measure of job-related skills provided by the educational level reached by the employee. It might also confirm that wage compression is not uniform across the levels of education attained by employees.

**Table 11. Robustness check: estimation of educational wage compression with labour market institutions and output gap**

(OLS in log with sector and education level dummies)

	relative employment		employment
Relative wage	-1.437 (5.21)***	Wage	-0.699 (3.71)***
GDP	0.213 (2.35)**	GDP	0.782 (6.88)***
Employment Protection Legislation	0.207 (1.18)	Employment Protection Legislation	0.182 (1.05)
Union density	0.002 (0.37)	Union density	-0.011 (2.24)**
Unemployment trap	-0.027 (2.88)***	Unemployment trap	0.014 (1.38)
Lower wage trap for a couple with two children	0.002 (0.65)	Lower wage trap for a couple with two children	0.003 (1.13)
Output gap	0.051 (0.99)	Output gap	0.175 (2.18)**
Constant	-0.297 (0.33)	Constant	1.917 (1.95)*
Observations	760	Observations	760
<i>R-squared</i>	0.19	<i>R-squared</i>	0.45
<i>Absolute value of z statistics in parentheses</i>			
* significant at 10%; ** significant at 5%; *** significant at 1%			
WAGE COMPRESSION	51%		

**Table 12. Robustness check: estimation with different educational bases for the computation for relative wages**

**Employment equation**

	Pre-primary, primary and lower secondary education - levels 0-2 (ISCED 1997) Relative employment	Upper secondary education - level 3 (ISCED 1997) Relative employment	Post-secondary non-tertiary education - level 4 (ISCED 1997) Relative employment	Tertiary education - levels 5-6 (ISCED 1997) Relative employment
Wage	-0.037 -0.24	0.249 (2.07)**	-0.053 -0.29	-0.891 (5.73)***
Value added	-0.378 (11.13)***	-0.046 -1.61	0.422 (9.84)***	0.171 (5.34)***
Observations	1280	1282	984	1282
R-squared	0.22	0.04	0.13	0.19

**Relative employment equation**

	Pre-primary, primary and lower secondary education - levels 0-2 (ISCED 1997) employment	Upper secondary education - level 3 (ISCED 1997) employment	Post-secondary non-tertiary education - level 4 (ISCED 1997) employment	Tertiary education - levels 5-6 (ISCED 1997) employment
Relative wage	-0.63 (13.53)***	-0.373 (8.48)***	-0.292 (9.20)***	-0.46 (9.83)***
Value added	0.896 (25.94)***	0.905 (26.72)***	0.962 (39.91)***	0.98 (26.93)***
Observations	1284	1282	1432	1282
R-squared	0.52	0.53	0.7	0.51

*Absolute value of t statistics in parentheses*

*\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%*

*Estimated by OLS with gender and sector dummies.*

**Estimated coefficient of compression**

	<b>-1603%°</b>	<b>250%°</b>	<b>-451%°</b>	<b>47%</b>
<i>°Not significant, as the wage coefficient of the relative employment equation or the employment equation is either not statistically significant or of a positive sign (contrary to the theory).</i>				

**Table 10. Wage compression across educational attainments: breakdown by industries (for EU25 +AC2)**

<b>Employment equation in log</b>											
	Mining and quarrying	Manufacturing	Electricity, gas and water supply	Construction	Wholesale and retail trade; repair	Hotels and restaurants	Transport, storage and communication	Financial intermediation	Real estate, renting and business activities	Public administration and defence; compulsory social security	Education; health and social work; social, personal services
	relative emp.	relative emp.	relative emp.	relative emp.	relative emp.	relative emp.	relative emp.	relative emp.	relative emp.	relative emp.	relative emp.
relative wage	-1.121 (2.40)**	-3.630 (5.04)***	-0.777 (1.36)	-1.860 (3.38)***	-1.122 (2.41)**	-0.928 (2.59)**	-1.730 (2.72)***	0.789 (1.57)	-1.571 (3.41)***	0.844 (1.47)	1.001 (2.03)**
Observations	116	120	116	129	124	123	126	123	124	42	50
R-squared	0.13	0.18	0.05	0.13	0.09	0.11	0.08	0.15	0.13	0.09	0.12

Absolute value of t statistics in parentheses

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%

Estimated by OLS with value-added as additional explanatory variable, as well as country, education, sector and gender dummies.

<b>Relative employment equation in log</b>											
	Mining and quarrying	Manufacturing	Electricity, gas and water supply	Construction	Wholesale and retail trade; repairs	Hotels and restaurants	Transport, storage and communication	Financial intermediation	Real estate, renting and business activities	Public administration and defence; compulsory social security	Education; health and social work; social, personal services
	emp.	emp.	emp.	emp.	emp.	emp.	emp.	emp.	emp.	emp.	emp.
Wage	-0.700 (5.18)***	-0.926 (4.41)***	-0.760 (5.88)***	-0.545 (4.05)***	-0.396 (2.67)***	-0.286 (1.79)*	-0.602 (3.57)***	-0.100 (0.50)	-0.497 (3.35)***	0.009 (0.05)	-0.287 (2.47)**
Observations	116	120	116	129	124	123	126	123	124	42	50
R-squared	0.61	0.39	0.64	0.50	0.42	0.37	0.36	0.45	0.48	0.33	0.64

Absolute value of t statistics in parentheses

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%

Estimated by OLS with value-added as additional explanatory variable, as well as country, education, sector and gender dummies.

<b>Estimated coefficient of compression</b>											
	Mining and quarrying	Manufacturing	Electricity, gas and water supply	Construction	Wholesale and retail trade; repairs	Hotels and restaurants	Transport, storage and communication	Financial intermediation	Real estate, renting and business activities	Public administration and defence; compulsory social security	Education; health and social work; social, personal services
	38%	74%	2% <sup>o</sup>	71%	65%	69%	65%	113% <sup>o</sup>	68%	99% <sup>o</sup>	129% <sup>o</sup>

<sup>o</sup>Not significant, as the wage coefficient of the relative employment equation or the employment equation is either not statistically significant or of a positive sign (contrary to the theory).

## 7. Concluding remarks

Looking at wage compression across occupations, the analysis gives some support to the conventional view that there is a compressed wage distribution in Europe. However the evidence appears much less robust across educational attainments than across occupations.

By and large, whatever the dimension considered (education or occupation), wage compression seems to be higher in the euro area and EU15 than in the EU25 and the acceding countries (Bulgaria and Romania). The coefficient of compression is indeed smaller or insignificant in the New Member States, which is in line with their more flexible wage bargaining setting. Including the acceding countries does not much alter the overall results, although wage compression by occupation might be slightly lower in these than in the EU25. Within the EU15, wage compression mainly occurs in continental and southern countries, whilst no compression is detected in Anglo-Saxon countries and mixed evidence is found in Northern European countries. It also seems that compression of wages is not uniform across wage levels, which is fully consistent with the traditional view that wage dispersion is lower at the lower end of the earning distribution.

Another important open issue is to know whether wage compression has any impact on total employment. The evidence drawn from this paper is insufficient to provide any conclusive answer. A simple graphical analysis indicates that no robust and clear relationship emerges across European countries between aggregate employment rate and a standard measure of wage dispersion. The relationship, if any, appears negative, unlike what many economists would have expected. This could simply reflect the fact that graphical analyses generally fail to control for country-specific effects. Conversely, an illustrative simulation, based on a theoretical labour-demand model, would suggest that, *all things being equal*, the wage compression estimated in Europe might lead to a non-negligible employment loss. To sum up, there is no compelling evidence of any strong impact of wage compression on total employment. This could be due to the shortcoming of the data and the methodology used. Alternatively, this might point to the absence of any actual relationship at a macroeconomic level between wage compression and overall employment performance. Such a speculative hypothesis is not incompatible *per se* with the idea that wage compression could mainly (or only) harm particular disadvantaged groups of workers, such as the low skilled. Indeed, wage compression, i.e. the mismatch between relative wages and (greater) relative productivity, is more likely to hit the groups of workers experiencing highest unit labour costs (i.e. highest wages corrected by productivity or, in other words, highest wages per unit of output) and to concomitantly favour those with lowest unit labour costs. Further research with more disaggregated data would be needed to go further in the understanding of the macroeconomic effect of wage compression.



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## ANNEX: Data

### Structure of Earnings Survey (SES) for 2002: quick presentation

The Structure of Earnings Survey (SES) for 2002 is the first of a series of four-yearly surveys to be conducted under the Council Regulation 530/1999 and the Commission Regulation 1916/2000. The objective of this legislation is to provide accurate and harmonized data on earnings distribution in EU Member States and Candidate Countries for policy-making and research purposes. The 2002 SES is aimed at giving detailed and comparable information, at European Union level, on earnings distribution and relationships between the level of remuneration, individual characteristics of employees and those of their employer. Objects of the survey are: characteristics of employer (enterprise, local unit) – number of employees in the local unit, type of ownership, existence and type of collective pay agreement, size of the enterprise; individual characteristics of employees - age, sex, educational level, occupation, length of service, mode of employment (full-time/part-time), working hours per day, working days per week, type of employment contract, annual gross earnings, annual bonuses, annual days of paid holiday leave, monthly gross earnings, earnings related to overtime, earnings related to shift work, employee's compulsory social security contributions and income tax, number of paid monthly hours, and number of paid overtime hours.

The survey is to be carried out once every four years. The reference year is the calendar 2002. For a representative month, October has been approved as being the month that is least affected by absences owing to annual leave or public holidays. The statistical units of the survey are both local units with 1 or more employees belonging to *enterprises* with 10 or more employees and employees with earnings during October 2002, having at least 1 working day paid by the employer at a full rate. For more details on this information, see the Eurostat website.

### Main definitions

**Employees** are all persons who have a direct employment contract with their employer and receive remuneration in cash or in kind for certain quality and quantity of work done, irrespective of the type of work performed, the number of working hours (full or part-time) and the duration of the employment contract (fixed or indefinite). Other categories of workers include:

- apprentices and trainees with an employment contract with the reporting unit.
- seasonal or occasional workers who are working pre-defined hours on a contractual basis with the local unit or the enterprise.
- outworkers, but only if there is an explicit agreement that they are remunerated on the basis of the amount of hours worked.
- employees on maternity leave as long as they receive remuneration from the employer.

Conversely, the following categories of workers are **excluded**: employees, apprentices or trainees without an employment contract with the enterprise/local unit; seasonal or occasional workers who are employed without pre-defined working hours; persons (i.e. unpaid owners or directors or managers) remunerated by way of fees or commission; employees of the observation unit who have been working abroad for more than one year in an affiliated company; the self-employed; family workers and voluntary workers.

**Gross earnings** are the remuneration in cash paid to the employee directly and regularly by the employer at the time of each pay period, before deductions of any tax and social security contributions payable by employee and withheld by the employer.

The following are **not included**: payments paid in this period but relating to other periods, such as advances, or pay for holiday or sickness absence outside reference period; periodic bonuses and gratuities not paid regularly at each pay date; payments for periods of absence paid by the employer at a reduced rate; statutory family allowances; the value of benefits *in kind*; reimbursements or payments for travelling, subsistence etc. or expenses incurred in carrying out the employer's business.

**Hourly earnings** used here are those received for normal working hours, i.e. for the number of hours which the employee is obliged to work in the reference month under the terms of the employment contract, regulation or rules in force in the local unit.

### **Classifications and nomenclatures used**

National Classification of Economic Activities 2001 – fully compliant with the European classification NACE Rev. 1.

National Classification of Occupations – consistent with the International Standard Classification of Occupations ISCO-88 (COM).

Nomenclature of Educational Levels – in compliance with the International Standard Classification of Education ISCED'97.

### **Statistical indicators used**

The following weighted averages are used in this paper: Average gross hourly earnings in October 2002 (overtime excluded). We do not use the **median** of hourly gross earnings. We do not use either monthly or annual data.

### **Comparability with other surveys**

The results from the 2002 Structure of Earnings Survey are not comparable with the average gross earnings data and data on number of employees from other surveys carried out by NSI with the same indicators:

1. Quarterly Survey on Number of Employees, Time Worked, Wages and Salaries and Other Labour Costs
2. Annual Survey on Employed Persons, Wages and Salaries and Other Labour Costs
3. Labour Force Survey