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Understanding Inter-Industry Wage Structures in the Euro Area

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This paper focuses on the euro area wage structure and its potential determinants from a sectoral viewpoint. Merging information from the OECD Structural Analysis database with data from the EU Labour Force Survey, we construct a cross-country panel of 22 industries in 8 euro area countries for 1991-2002. Data inspection confirms the existence of a fairly stable inter-industry wage structure that is similar across countries. We then apply panel data techniques to identify factors explaining inter-industry wage differentials in the euro area. Both workforce characteristics (*e.g.*, human capital variables) and firm-related characteristics (*e.g.*, capital intensity, productivity) contribute significantly. However, considerable wage heterogeneity across sectors remains. Idiosyncratic sector and country specifics, reflecting different socio-cultural and institutional backgrounds, appear to bear a major role. While our empirical analysis only uses direct evidence from workforce and firm-related characteristics, we also relate remaining heterogeneity to institutional characteristics, based on related literature.

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1. Introduction

According to the Optimal Currency Area theory, a number of criteria need to be fulfilled in order to maximize economic efficiency among countries sharing the same currency. Among these, flexible labour markets are needed to enhance the ability of individual countries to respond to specific circumstances and economic shocks. Wages in particular may need to adapt adequately and adjustments may need to reflect closely regional or sectoral productivity differences.

Hence, understanding sectoral wage differentiation in the euro area is an important issue for policy makers. A number of determining factors of inter-industry wage differentials have been identified in the literature. Our paper extends upon the existing literature by examining the inter-industry wage structure in the euro area between the early 1990s and the early 2000s, using a panel of 22 industries in eight euro area countries. Our approach is consistent with the fact that euro area countries share some common structural features, while also allowing for potential heterogeneity across countries and/or sectors which may be due to different institutional structures, such as wage bargaining systems or degrees of job protection.

The paper is organized as follows.¹ Section 2 briefly reviews theoretical rationales for inter-industry wage differentials and summarises related empirical evidence. Section 3 presents our data and stylised facts for the euro area, as well as the methodology for and the results of our econometric analysis. Section 4 concludes.

2. Inter-industry wage differentials: theory and empirical evidence

Although a textbook competitive labour market model would argue that wages should be the same for equivalent workers working in equivalent jobs, it has long been noted that

1
2 there are substantial differences in wages across industries for workers with similar
3
4 characteristics doing apparently similar jobs (Slichter, 1950). Empirically, substantial wage
5
6 differentials have been found in many countries and they are surprisingly persistent over
7
8 time. A number of arguments have been put forward to explain this phenomenon.
9

10 11 12 **2.1 The theoretical rationale for inter-industry wage differentials**

13
14
15 On the one hand, standard competitive theories argue that wage differentials reflect labour
16
17 productivity differences among the workforce resulting from differences in individual
18
19 human capital endowments (Becker, 1964; Mincer, 1974). Workers' characteristics such as
20
21 educational attainment, professional experience or age are thus crucial to explain
22
23 individual wage levels. As employees working in the same industry may require similar
24
25 skills, these differences may largely translate into industry differences. Alternatively,
26
27 differences in wage levels might also compensate for non-pecuniary aspects of work that
28
29 directly affect a worker's utility, such as available social benefits or an atypical work
30
31 environment (see Purse, 2004).
32
33
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35

36
37 Another explanation put forward by tenants of competitive theories is that wage
38
39 differentials may just reflect a temporary disequilibrium in response to shifts in labour
40
41 demand or supply wherever labour is imperfectly mobile, notably in the short run. In this
42
43 case, inter-industry reallocations are hampered by frictions. Search and matching models
44
45 (see Mortensen and Pissarides, 1999) extend upon the concept of frictions. In case there are
46
47 informational asymmetries and job search is costly, wages fall short of marginal
48
49 productivity. In models with on-the-job search, firms can follow different equilibrium
50
51 strategies: either they pay low wages invoking a high employee turnover or they pay higher
52
53 wages resulting in lower turnover. Again, this may translate to the sectoral level as firms in
54
55 the same industry can be expected to face similar frictions. In summation, competitive
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57
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¹ For an extended version of this article we refer to the discussion paper version, Genre *et al.* (2009).

1 theories imply that in the long-run and beyond temporary frictions, sectoral wage
2 differentials should largely reflect individual differences that translate into sector-specific
3 differences.
4
5
6
7

8
9
10 On the other hand, tenants of new wage determination theories focus on reasons why firms
11 may find it more profitable to pay higher wages than those suggested by the equilibrium
12 level resulting from market forces at play. These models rely on the major assumption that
13 there is imperfect market competition. Consequently, firms would be able to extract rents
14 from their product markets and pay higher wages.
15
16
17
18

19 Rent-sharing may be motivated by a number of reasons. Much attention has been given to
20 “efficiency wage” models that attempt to explain why firms may pay more than the
21 reservation wage to basically select the most efficient workers (Yellen, 1984; Akerlof and
22 Yellen, 1986). Several different versions of the efficiency wage model have been proposed
23 in the literature:²
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25
26
27
28
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32

- 33
34 • According to “turnover models”, firms may wish to pay higher wages to reduce
35 quits and turnover (see Salop, 1979; Stiglitz, 1974, 1985). Higher wage rates make
36 jobs more attractive and workers less likely to switch to other jobs. These models
37 predict that high wage industries are those in which turnover costs are highest.
38
39
40
41
42
- 43 • In “shirking models” (Shapiro and Stiglitz, 1984), firms engage in some monitoring
44 of their employees and fire those workers caught shirking. By paying above market
45 wages, firms decrease the incentive to shirk, as the risk of unemployment makes
46 dismissals costly to the employee. According to these models, high wage industries
47 are those with high monitoring costs or those which bear a relatively high cost of
48 employee shirking.
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² See Groshen (1991) for a survey including a categorisation of different approaches.

- “Adverse selection models” (Stiglitz, 1976; Weiss, 1980; Greenwald, 1986) assume that the average quality of the pool of job applicants increases together with the wage rate. In these models, industries which are more sensitive to labour quality differences or face higher costs of measuring labour quality will offer higher wages in order to raise the average quality of the workforce.
- Finally, so-called “fair wage models” (Akerlof, 1982, 1984; Akerlof and Yellen, 1990), suggest that employees will exert more effort if they think they are paid fairly. These models predict that high wage industries are those where teamwork and workers’ cooperation are particularly important. Along this line of reasoning also, industries with high profits should be those paying higher wages.

From a sectoral perspective, firms within the same industry are likely to face similar product market conditions and hence share similar characteristics that may influence the average wage level and differentiate it from the average wage level in different industries. Specific production technologies or the concentration of large firms which make employees’ productivity more difficult to monitor, may contribute to increasing the average wage level in a specific industry. Other sectoral characteristics, such as the exposure to international competition, are also likely to influence the amount of product market rents and therefore the capability to pay higher wages.

Finally, the actual outcome of rent sharing between employers and employees crucially depends on the relative bargaining power of the involved parties, as well as on institutional settings. The presence of strong and coordinated trade unions is likely to induce higher wages for the represented market segments (Naylor, 2003). Unions are traditionally strong in manufacturing industries and in public sector services, whereas they are less prevalent in private service industries. In “insider-outsider models” (Lindbeck and Snower, 1988), firms may find it more profitable to pay more than competitive wages to insiders in order to avoid strikes or an increase in unionisation, and to maintain industrial peace. Moreover,

1
2 insiders, who have gained firm-specific skills, are more productive than outsiders and thus
3
4 in a better position to claim and obtain higher wages. These models based on bargaining
5
6 power imply that the wage level will depend on a number of different factors: the nature of
7
8 jobs (*e.g.*, the proportion of skilled occupations in an industry), the size of firms (which
9
10 affects employers' ability to replace numerous wage claimers at the same time) and the
11
12 firms' ability to pay (*i.e.*, market power). In addition, labour market institutions such as
13
14 wage setting regimes or legal labour market requirements affect the speed of wage
15
16 adjustments (Blau and Kahn, 1999). Beyond firm or sector specific effects, different
17
18 institutional frameworks should be visible at the country level.
19
20
21
22
23

24 **2.2 Evidence from the empirical literature**

25
26 Empirical evidence shows the existence of substantial and persistent inter-industry wage
27
28 differentials in various countries. Starting with Slichter (1950), a large body of literature
29
30 estimated wage differentials using individual-level data, which allow controlling for a
31
32 number of individual and match-specific determinants of wage differences. In a seminal
33
34 paper, Krueger and Summers (1988) concluded that considerable differences between US
35
36 industries remained even after accounting for observed as well as unobserved individual
37
38 heterogeneity. Katz and Summers (1989) introduced a two-step approach. In a first step,
39
40 they used individual micro data to estimate inter-industry wage differentials net of
41
42 observable individual characteristics. In a second step, they related these estimates to
43
44 industry-specific determinants such as average establishment size or composition of the
45
46 workforce at the two-digit industry level. Their findings also confirm the existence of
47
48 substantial wage differentials across sectors. Abowd *et al.* (1999) used linked employer-
49
50 employee data and controlled for individual as well as firm heterogeneity (both observed
51
52 and unobserved). Again, even though the addition of firm heterogeneity considerably
53
54 reduces inter-industry differentials, sizeable differences in wage levels across sectors
55
56 remain.
57
58
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60

1
2 Industry-level analyses can benefit from internationally comparable data sets and thus
3
4 provide the possibility of cross-country comparisons. There are a few studies which focus
5
6 on cross-country comparisons of inter-industry wage differentials.³ Gittleman and Wolff
7
8 (1993) collect evidence for some OECD countries for different years between 1970 and
9
10 1985. As a main result, they note that the rank order of industry differences remained fairly
11
12 stable over time. Albæk *et al.* (1996) analyse wage differentials in the Nordic countries.
13
14 Their two main conclusions are that dispersion between countries is smaller than the
15
16 dispersion between industries, and that although controlling for individual characteristics
17
18 considerably reduces variability, it leaves the general pattern of differentials unchanged.
19
20 Erdil and Yetkiner (2001) focus on differences in wage structures between industrialized
21
22 and developing countries. Looking at rank correlations, they find rather small differences
23
24 between the two groups of countries. Yet their attempt to regress wage differentials on
25
26 possible determinants uses pooled data without controlling for worker characteristics or
27
28 industry-specific effects. Jean and Nicoletti (2002) examine the impact of product market
29
30 regulation on industry wage premia in European and North American countries. Following
31
32 the two-step approach of Katz and Summers (1989) and using a cross-section of data from
33
34 different OECD databases in 1996, they estimate positive impacts of different measures for
35
36 product market regulation on industry-level wages. However, their approach which
37
38 controls for the impact of human capital variables already at the first stage does not allow
39
40 the authors to investigate additional determinants of wage differences between sectors.
41
42
43
44
45
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49

50 As a first step towards investigating inter-industry wage structures for the euro area as a
51
52 whole, Genre *et al.* (2005) provide descriptive evidence on the magnitude and the
53
54 development of wage differentials since the early 1980s and motivate possible
55
56 determinants by means of bivariate correlation measures. They find substantial differences
57
58
59
60

³ See Dickens and Katz (1987) and Krueger and Summers (1987) for surveys of sector-level studies for single countries.

1
2 in wage levels between various sectors which are largely similar across euro area countries,
3
4 the UK and the US. Moreover, the inter-industry structure in the euro area economy is
5
6 found to be fairly stable throughout the 1980s and 1990s, with only a small increase in
7
8 overall wage dispersion across industries during this period.
9

10 11 12 **3. Empirical Analysis**

13 14 15 **3.1 Data and stylised facts for the euro area**

16
17 Our study extends upon the empirical literature by analyzing inter-industry wage
18
19 differentials for the euro area by means of panel data techniques. Using data from the
20
21 Structural Analysis (STAN) database of the OECD and from the European Union Labour
22
23 Force Survey (LFS), we construct various indicators for a panel of 22 branches of
24
25 economic activity in eight euro area countries between 1991 and 2003 (see the appendix).
26
27 The STAN database allows us to calculate the average wage in sector i in country j at time
28
29 t , w_{ijt} , as the ratio of total compensation to the number of employees. Wage differentials y_{ijt}
30
31 are then defined as the relative deviation of sector i 's wage w_{ijt} from the overall country
32
33 average w_{jt} :
34
35
36
37
38
39

$$40 \quad y_{ijt} \equiv \ln(w_{ijt} / w_{jt}). \quad (1)$$

41
42
43 Descriptive evidence confirms the existence of substantial and persistent differences in
44
45 average wage levels in the various sectors of the euro area. As shown in figure 1, there is a
46
47 great degree of wage dispersion across sectors, with strongly negative wage differentials
48
49 (more than 50% in agriculture, but also quite significant ones in textile industries, hotels
50
51 and restaurants, and in social and personal services) and strongly positive ones (up to
52
53 nearly 50% in utilities and financial intermediation).
54
55
56
57
58

59 **INSERT FIGURE 1 ABOUT HERE**

1
2 While the same overall pattern is visible for all countries, the level of variation differs
3
4 across countries to some degree (figure 2). For example, Portugal shows the most
5
6 pronounced differentials. Moreover, there still exists some degree of relative variation
7
8 across countries. In general, there are higher differences across countries in service sectors
9
10 than in manufacturing, where the wage structure tends to be more similar. This result may
11
12 to some extent be explained by the greater exposure of manufacturing sectors to global
13
14 forces and competition, compared with the relatively more insulated service sectors. In
15
16 addition, the role of the public sector, which would be especially relevant for services, may
17
18 also contribute to heterogeneity across countries.
19
20
21
22
23

24 **INSERT FIGURE 2 ABOUT HERE**

25
26 Changes of inter-industry wage differentials between the years 1991 and 2002 are
27
28 illustrated in figure 3. The average euro area wage structure remained remarkably stable
29
30 over this period and the sectors which paid relatively well at the beginning of the 1990s
31
32 continued to do so in 2002. However, while the overall structure remained nearly
33
34 unchanged, there has been some visible increase in the degree of dispersion over time.
35
36
37

38 **INSERT FIGURE 3 ABOUT HERE**

39
40 Figure 4 displays the evolution of weighted within-country standard deviation of wage
41
42 differentials
43
44

$$\sigma_{jt} \equiv \sqrt{N^{-1} \sum_{i=1}^N g_i y_{ijt}^2}, \quad (2)$$

45
46 where g_i denotes employment weights of sectors i . Increasing dispersion is common to
47
48 most euro area countries with the notable exceptions of Spain, where wage differentials
49
50 tended to narrow, and of Italy and Austria, where the overall wage dispersion did not
51
52 change much between 1991 and 2002. The increase in average euro area wage dispersion
53
54 during the 1990s thus appears to be mainly driven by three of the largest euro area
55
56 countries, namely Germany, France, and The Netherlands.
57
58
59
60

INSERT FIGURE 4 ABOUT HERE

In addition to offering data required to compute wage differentials, the STAN database also allows for the construction of important indicators such as export intensity and import penetration ratios, apparent labour productivity, or capital intensity. Moreover, we merge the STAN data with information from the European Union Labour Force Survey (LFS) provided by Eurostat. In particular, the LFS offers sectoral indicators regarding the structural composition of the workforce (see the appendix for details).

3.2 Estimation approach

In order to disentangle possible determinants of the euro area wage structure and to derive conditional inter-industry differences, we take advantage of the panel nature of the data. Using data for sectors $i=1, \dots, N$ in countries $j=1, \dots, J$ at time (years) $t=1, \dots, T$, we consider the basic error components wage regression

$$\ln(w_{ijt} / P_{jt}) = X_{ijt} \beta + u_{ijt}, \quad (3)$$

where $\ln(w_{ijt} / P_{jt})$ denotes log real wages; X is a vector of observed covariates and β is a coefficient vector to be estimated. The set of covariates X includes workforce (or employee) characteristics as well as firm (or employer) characteristics. More precisely, employee-related variables include information on age and skill structure of the workforce⁴, on its composition in terms of occupations, on the share of employees working part-time⁵, the share of female employees⁶, the share of temporary employment⁷, the degree of self-employment,⁸ and on average hours worked per week. Employer-related characteristics include variables such as real capital intensity and apparent labour

⁴ See Becker (1964) and Mincer (1974) for the traditional human capital argument.

⁵ The extent of part-time work has been rising over the past decades (OECD, 2006), and hourly wages have been proven to be lower for part-timers compared with full-timers (OECD, 1999).

⁶ The existence of gender wage gaps has been extensively documented in the literature (see Altonji and Blank, 1999).

⁷ Ceteris paribus, workers with temporary contracts receive lower wages than those with permanent contracts (Booth *et al.*, 2002).

productivity⁹, firm size¹⁰ and the exposition to foreign trade measured by import penetration ratios and export orientation¹¹. The error term u_{ijt} contains country-specific effects μ_j , industry-fixed effects μ_i , time effects μ_t , and an idiosyncratic term ε_{ijt} :

$$u_{ijt} = \mu_t + \mu_j + \mu_i + \varepsilon_{ijt}. \quad (4)$$

The set of time effects μ_t takes account of euro area-wide business cycle effects in a flexible way. The country and sector-specific effects, μ_j and μ_i , capture general economic conditions or socio-cultural and institutional backgrounds—such as the extent of unionisation or the degree of centralisation and coordination of collective bargaining.¹² In appendix B of the working paper version (Genre *et al.*, 2009) we show that the full set of sector effects μ_i , which yields the conditional inter-industry structure net of all observed impacts, can be estimated by means of orthogonalised weighted industry dummies. The conditional inter-industry wage structure can then be compared with unconditional wage differentials y_{ijt} .

An alternative specification of (4) would include sector and country time trends:

$$u_{ijt} = \delta_j t + \delta_i t + \mu_j + \mu_i + \varepsilon_{ijt}. \quad (5)$$

The country-by-sector dimensioning of the data provides a large cross-section, but there is only a limited number of periods available (at maximum 12 years). Moreover, the

⁸ See Hamilton (2000) for wage effects of self-employment.

⁹ See Abowd *et al.* (1999) on productivity differences. Blanchflower *et al.* (1996) note that wage increases follow preceding movements in profits.

¹⁰ See Brown and Medoff (1989) and Oi and Idson (1999) for employer-size wage effects.

¹¹ See Johnson and Stafford (1999) and IMF (2006) for the impact of international trade and globalization on industry-level price and wage formation. Both import and export variables are available for manufacturing industries only.

¹² See the synopses in Aidt and Tzannatos (2002), Flanagan (1999), OECD (1997, 2004), and Rowthorn (1992).

descriptive analysis above revealed rather little variation of the industry structure across time. Estimation thus relies on fixed-T asymptotics.

Under standard assumptions, pooled OLS (POLS) estimation of (3) provides consistent results. However, as evidence on the persistence of wage differences suggests, some autocorrelation is likely to be present and thus needs to be accounted for. One option to do so is to compute robust standard errors (Newey and West, 1987). A more efficient alternative, however, is to run panel GLS estimation that uses the autocorrelation structure for weighting. Finally, a third approach would be to add lagged log wages $\ln(w_{ijt-1} / P_{jt-1})$ to the regression, yielding the dynamic panel

$$\ln(w_{ijt} / P_{jt}) = \ln(w_{ijt-1} / P_{jt-1})\gamma + X_{ijt}\beta + u_{ijt}. \quad (6)$$

Consistency of POLS then hinges on the prerequisite that ε_{ijt} exhibits no first-order autocorrelation.

A more complex specification of the error term allows for an interaction of country and sector-specific unobserved effects μ_{ij} :

$$u_{ijt} = \mu_t + \mu_{ij} + \varepsilon_{ijt}. \quad (7)$$

In this case, first differencing (FD) or quasi-differencing (estimation with fixed effects, FE) of our basic specification would remove the time-invariant μ_{ij} . Country and sector effects in the differenced equation would then correspond to country and sector trends in specification (5). In case of the dynamic specification (6), results from FE or FD estimations would be biased (Nickell, 1981). However, consistency can be achieved by using the generalized methods of moments (GMM) estimation following Anderson and Hsiao (1982) and Arellano and Bond (1991).

3.3 Results

Table 1 summarises our main results, based on panel GLS estimations of equation (3), including time, country, and industry-specific effects and allowing for first-order autocorrelation. Specification (A) includes workforce characteristics only. The estimated determinants are in line with a priori expectations.¹³ In particular, a high share of young or low-skilled employees in an industry *ceteris paribus* comes along with lower real wages, while industries with a high share of older employees pay higher wages. Moreover, significantly lower wages are paid in sectors with high shares of women or part-timers.

INSERT TABLE 1 ABOUT HERE

Specification (B) exclusively focuses on firm characteristics. This substantially limits the number of available observations, since some of the variables are only available for manufacturing industries. Again, the results are broadly in line with a priori expectations. In particular, high apparent labour productivity brings about significantly higher wages. Since apparent productivity is defined as the ratio of real value added to the number of employees, it does not only measure labour productivity but also gives an indication on the size of rents which can be distributed between workers and capital owners. Consequently, the estimated coefficient would be in line with a positive direct effect of labour productivity as well as with the argument of profit sharing. Capital intensity also enters positively and significantly. High capital intensity, reflecting, for example, the use of specialised machinery, increases workers' productivity and thus leads to a higher average wage. Moreover, capital-intensive industries are likely to be characterised by a high degree of firm concentration and are thus most likely to extract product market rents. Again in line with the literature, larger firms, and in particular those with more than 50 employees, pay higher wages than smaller ones. Finally, although export orientation turns out insignificant

1
2 in this specification, the import penetration ratio of an industry shows a significant and
3
4 positive coefficient—firms which are more internationally integrated are more likely to
5
6 extract gains from trade, which can then be distributed between employers and employees.
7
8

9
10 Specification (C) brings together all workforce and firms characteristics. Interestingly, the
11
12 partial effects of most workforce characteristics become insignificant. This finding could
13
14 be due to two effects. First, the sample must cover manufacturing industries only and
15
16 exhibits less variation in sector specifics, as compared to the full sample. Second, the
17
18 extent of collinearity between workers' and firms' characteristics is likely to be larger in
19
20 manufacturing than in the rest of the economy. For example, bigger firms in manufacturing
21
22 may tend to systematically employ more high-skilled workers due to the use of complex
23
24 machineries and equipment in their production technology.
25
26
27

28
29 Hence, our preferred specification (D) contains workforce characteristics and a slightly
30
31 reduced set of firm characteristics, thus circumventing the problem of sample reduction.
32
33 By and large, the joint inclusion of worker and employer characteristics confirms the
34
35 coefficient estimates of specifications (A) and (B), suggesting that multicollinearity is a
36
37 minor issue. Yet some worker characteristics reveal slightly smaller partial effects. For
38
39 example, the coefficient of the share of female employees is lower by 9 percentage points.
40
41 This finding hints towards some selectivity bias in specification (A), in which the effect of
42
43 the omitted firm characteristics is taken up by the workforce variables. In addition, a few
44
45 additional variables are significant in the preferred specification. For example, the share of
46
47 older workers has a significantly positive impact, which would be in line with human
48
49 capital theory or seniority-based remuneration schemes. The share of self-employment in
50
51 an industry now shows a significantly negative coefficient. To the extent that self-
52
53 employed workers are in direct competition with wage-earners, the presence of self-
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55
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¹³ Note that the set of workforce characteristics does not include occupation variables since occupation and skill categories turn out to be highly correlated. The same reasoning applies to average hours worked,

1
2 employed in a sector lowers the bargaining power of employees. In addition, sectors with a
3
4 high share of self-employed are typically labour-intensive. *Ceteris paribus*, this would
5
6 contribute to a lower average wage.
7

8 9 **Sensitivity Checks**

10
11 Sensitivity checks with respect to the specification of the error component and to the
12
13 choice of the estimation strategy are undertaken in tables 2 and 3. Table 2 confirms the
14
15 robustness of our preferred specification. It investigates the sensitivity of the estimated
16
17 coefficients with respect to different specifications of the error term u_{ijt} and different
18
19 sample restrictions. Our preferred specifications reappear in columns (A) and (B) of table
20
21 2. The specification in column (C) uses our preferred set of covariates (as in column B) but
22
23 restricts the sample to manufacturing industries (as in column A). Estimated coefficients
24
25 are rather similar to those of the benchmarks. More specifically, they lie within the range
26
27 spanned by the respective estimates in columns (A) and (B), but most of the worker
28
29 characteristics are insignificant. This result suggests that in fact both the higher degree of
30
31 similarity among the workforce and the larger extent of collinearity between worker and
32
33 firm characteristics inclined by the restriction of the sample contribute to the deviation of
34
35 the full specification from our preferred one.
36
37
38
39
40
41
42

43 44 **INSERT TABLE 2 ABOUT HERE**

45
46 Specifications (D) and (E) include country and sector-specific time trends instead of the
47
48 full sets of country, sector, and year effects. While allowing for differences in unobserved
49
50 effects across countries and across sectors, this approach comes at the price of reduced
51
52 flexibility regarding business cycle effects. The coefficient estimates remain broadly the
53
54 same, but again the impact of some worker characteristics is estimated less precisely. This
55
56 finding supports the understanding that, for example, trends towards skill upgrading or
57
58
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60

which is highly correlated with the part-time indicator.

1
2 increased female labour force participation show different patterns across countries and
3
4 sectors of the economy.
5

6
7 Finally, columns (F) and (G) estimate wage differentials y_{ijt} , rather than log wage
8
9 equations. Just as in the benchmark specifications, unobserved industry effects are
10
11 accounted for, and again the results broadly match those of the benchmark.¹⁴ However, the
12
13 impact of human capital variables is estimated less reliably. Subtracting country-by-time
14
15 averages presumably takes away too much variation and thus renders the estimation of
16
17 coefficients more problematic.
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21
22 Table 3 investigates the sensitivity of our results according to different estimation
23
24 techniques. Compared with the results of the GLS benchmark reported in column (A),
25
26 POLS estimates in column (B) show the same sign, but in most cases are larger in absolute
27
28 value. We consider these results less reliable because—even though being consistent—the
29
30 estimation does not take advantage of the autocorrelation structure in the data. Column (C)
31
32 reports POLS estimates using the lagged endogenous variable as a regressor. Again the
33
34 (short-run) *ceteris paribus* effects are of the same sign as the benchmark coefficients, but
35
36 the large persistency parameter renders most of them insignificant. Moreover, as the
37
38 persistency parameter does not provide additional information regarding the economic
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40 determinants of wage differences, the approach is judged inferior to the benchmark
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42 specification.
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49 50 **INSERT TABLE 3 ABOUT HERE**

51
52 The last three specifications in table 3 allow for interactions of country and sector-specific
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54 unobserved effects as defined in equation (7). These fixed effects are removed by means of
55
56 FD (column D), FE (column E), or GMM estimation following Arellano and Bond (1991,
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58 column F). The effects of worker characteristics turn out to be insignificant in all three
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¹⁴ Only the coefficient of the share of low-skilled workers changes its sign.

1
2 specifications. Since all three of these regressions remove any between-cell variation, the
3
4 result reflects the small degree of variation in wages over time.
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6

7 **Conditional Inter-Industry Differentials**

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10 The benchmark specification in column (D) of table 1 thus remains our preferred one. This
11
12 specification is estimated using a full set of orthogonalised weighted industry dummies.
13
14 The resulting conditional inter-industry wage structure, illustrating “pure” sector effects, is
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16 compared with the observed wage structure for the euro area in the year 2002 in figure 5.
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19 **INSERT FIGURE 5 HERE**

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21
22 Overall, our model achieves a noticeable reduction in the variability of wage differentials.
23
24 Once the impact of worker and firm characteristics has been taken into consideration, the
25
26 remaining employment-weighted standard deviation in wage levels across sectors is 0.183.
27
28 This corresponds to about two thirds of the standard deviation given by the observed
29
30 differentials (0.240). This result, however, also means that a significant part of sectoral
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32 wage differentials remains after controlling for worker and firm characteristics. In line with
33
34 the results provided by the literature, the general pattern of differentials across sectors
35
36 remains the same. Interestingly, the model captures the euro area wage structure for some
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38 sectors better than for others. For example, the worker and firm variables included in the
39
40 model explain a large part of the positive spike for the utilities sector (12) or of the
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42 negative spike for the textile industry (3). For other sectors, such as agriculture (1), we
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44 detect a higher impact of idiosyncratic industry specifics which are not captured by any of
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46 the observed variables. In some cases unconditional and conditional differentials even have
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48 opposite signs. In these sectors the idiosyncratic industry specifics are overcompensated by
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50 other determinants of the wage structure. In case of the health and social work sector, for
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52 example, the base wage tends to be above average, but the composition of the workforce,
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2 firms' capital intensity, and apparent productivity in this specific sector contribute to the
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4 observed negative differential.¹⁵
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7 8 **4. Conclusion** 9

10 This paper analyses the euro area wage structure from a sectoral point of view. Previous
11 theoretical and empirical studies on inter-industry wage differentials at the country level
12 provide us with a number of possible determinants of observed differences in wages across
13 industrial sectors. Our analysis extends upon this literature by using a large cross-country
14 data set for the euro area as a whole, combining OECD's STAN database with data from
15 the EU Labour Force Survey, and by using panel data estimation techniques.
16
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18 Our results confirm the existence of large and persistent wage differentials across sectors
19 of the euro area economy. Traditional determinants discussed in the literature explain a
20 significant part of these differences, as well as of the slight increase in sectoral wage
21 dispersion during the 1990s. In particular, characteristics of the workforce such as the
22 importance of part-time work, the shares of young, older, and female workers, or the share
23 of self-employment in a sector are relevant variables for explaining differences in average
24 wages across sectors. Firm characteristics such as capital intensity and apparent labour
25 productivity in a sector also have significant impacts. However, while our preferred model
26 captures reasonably well the overall wage structure, it also reveals the non-negligible
27 importance of idiosyncratic factors. Unobservable industry-specific factors may, on
28 occasions, exert pressure on wages that counterbalances and, at times, overcompensate for
29 the influence of traditional observable determinants.
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53 As a first step towards understanding the determinants of the inter-industry wage structure
54 in the euro area, our analysis opens several avenues for further research. For example, a
55 comparison with the US, using a similar dataset, would put the extent and the evolution of
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¹⁵ See the working paper version (Genre *et al.*, 2009) for additional analyses of within-country dispersion.

1 wage differentials in the euro area into perspective. Exploring sectoral differences based on
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4 micro-level data such as the linked employer-employee data provided by the European
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6 Structure of Earnings Survey would be another promising route to follow. This approach
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8 could possibly yield additional insights on those sector-specific factors which have so far
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10 remained unobserved.
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Appendix: Data

We use data from different sources. The Structural Analysis database (STAN) of the Organisation for Economic Co-operation and Development (OECD) provides annual data for OECD countries. It is primarily based on national accounts data and uses data from other sources such as industrial surveys or censuses to estimate missing details. On principle, data are available for the period 1970–2003. Due to missing data, however, we restrict our sample to the years 1991–2002. The euro area aggregation used in this paper consists of the eight countries Germany, Spain, France, Italy, The Netherlands, Austria, Portugal, and Finland, which together cover more than 90% of the euro area in terms of GDP. Only insufficient data were available for Belgium, Greece, Ireland, and Luxemburg. Table A.1 in the discussion paper version (Genre *et al.* 2009) displays our classification of 22 industries as well as respective weights based on employment shares in the euro area. Definitions of variables taken or calculated from STAN are as follows:

- *Compensation of employees* comprises wages and salaries of employees paid by producers as well as supplements such as contributions to social security, private pensions, health insurance, life insurance and similar schemes.
- The *number of employees* includes all persons in employment, disregarding self-employed and unpaid family workers. In case of missing values for the number of employees in single sectors and years, numbers were backcast based on growth rates of corresponding employment numbers which include self-employed.
- *Export intensity* and *import penetration* are calculated as the respective ratios of exports or imports to total output (available for manufacturing industries only).
- *Apparent productivity* is measured by real value added (base year 2000) per employee.
- *Capital intensity* is calculated as real gross fixed capital formation (base year 2000) per employee.

Eurostat further supplied cell-level information from the European Union Labour Force Survey (LFS). The LFS is a quarterly¹⁶ household survey administered by the national statistical institutes of European Union (EU) and Candidate Countries in accordance with International Labour Organisation (ILO) guidelines. The EU LFS micro data collection

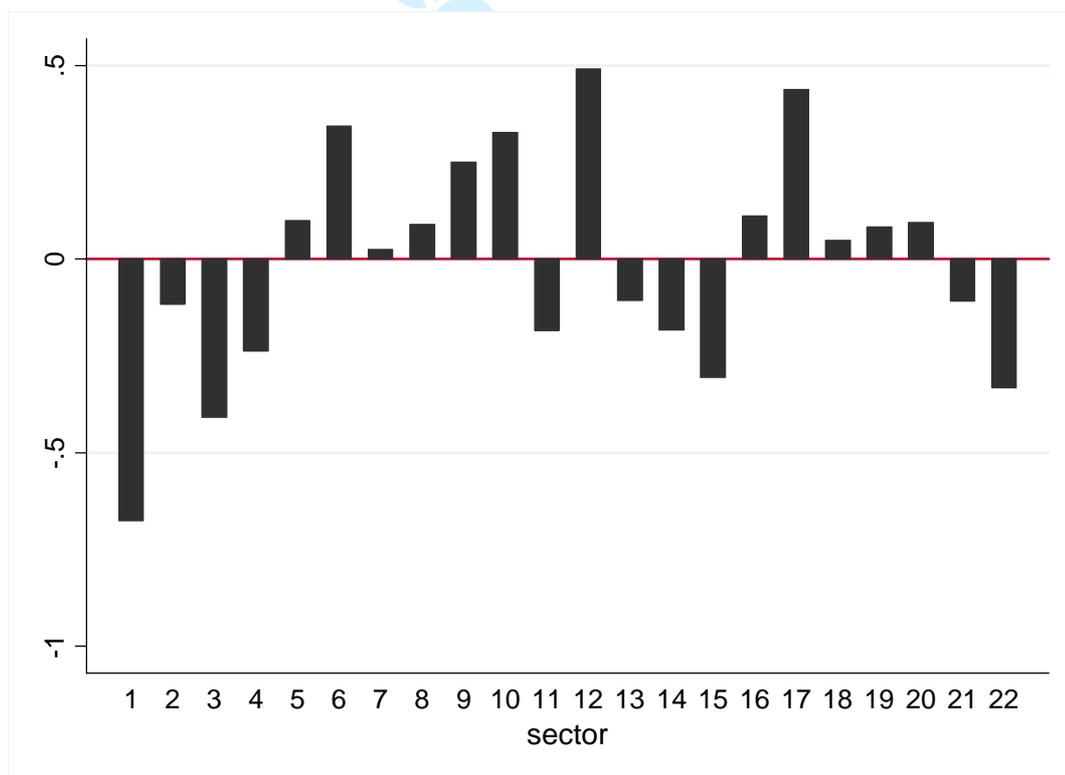
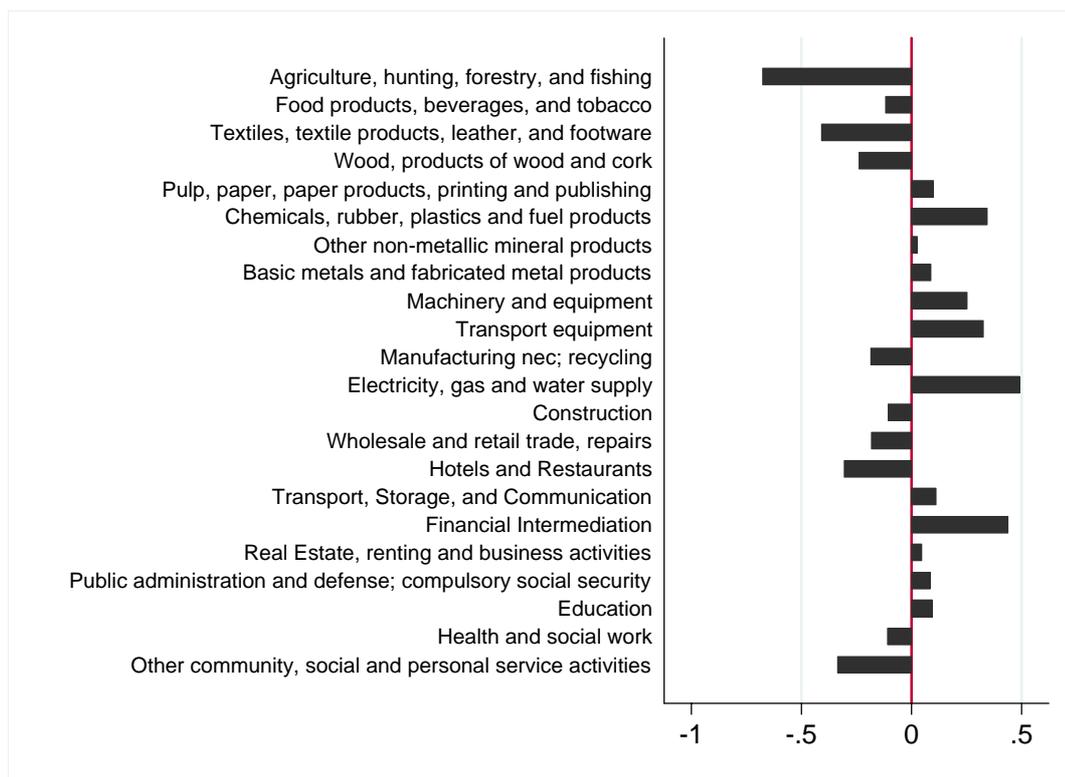
¹⁶ Data have traditionally been reported for one reference quarter per year. Between 1996 and 2005 the LFS has gone through a transition towards a continuous quarterly survey. We chose the second quarter as reference when multiple quarters were available.

1
2 started in 1983, but as the survey has not been mandatory until the early 1990's, data are
3 mainly available from 1993 onwards only. However, several country-series start in later
4 years only, as observations with inconsistencies between the LFS waves had to be
5 excluded. The definition of variables taken from LFS statistics is as follows:
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- The *number of employees* includes all persons in employment, disregarding self-employed and family workers. It is broken down by several dimensions, including three *age groups* (below 25 years, 25–54 years, and above 55 years); three *skill classes* in accordance with the International Standard Classification of Education (ISCED: low-skilled workers with at most a lower secondary degree, medium-skilled with an upper secondary degree, and high-skilled employees holding a tertiary degree); three *occupation groups* in accordance with the International Standard of Occupations, ISCO (management and professional workers ISCO 1-2, base category ISCO 3-8, elementary occupations ISCO 9); *gender* (share of female employees); the share of *part-time* employees; and the share of employees holding a *temporary work* contract.
 - The extent of *self-employment* is captured by the ratio of self-employed to the number of employees.
 - *Establishment size* reports the shares of employees in four size brackets (up to 10 employees, 11–19, 20–49, and 50 or more employees).
 - *Hours worked* are defined as the average number of hours usually worked per week.

Finally, we calculate country-specific price deflators using harmonized indices of consumer prices (HICP, base year 2000) provided by Eurostat.

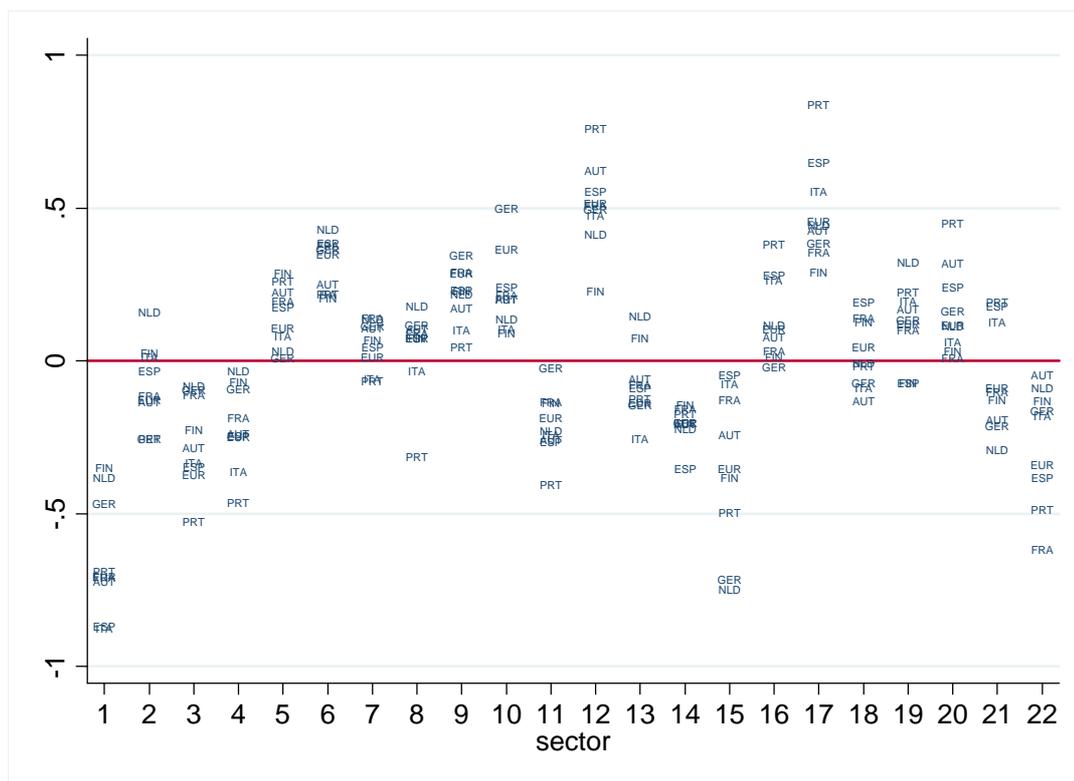
Figure 1: Inter-industry wage differentials in the euro area, average 1991-2002



Deviations of industry wages from euro area average.

Data source: OECD STAN.

Figure 2: Inter-industry wage differentials across euro area countries, 2002



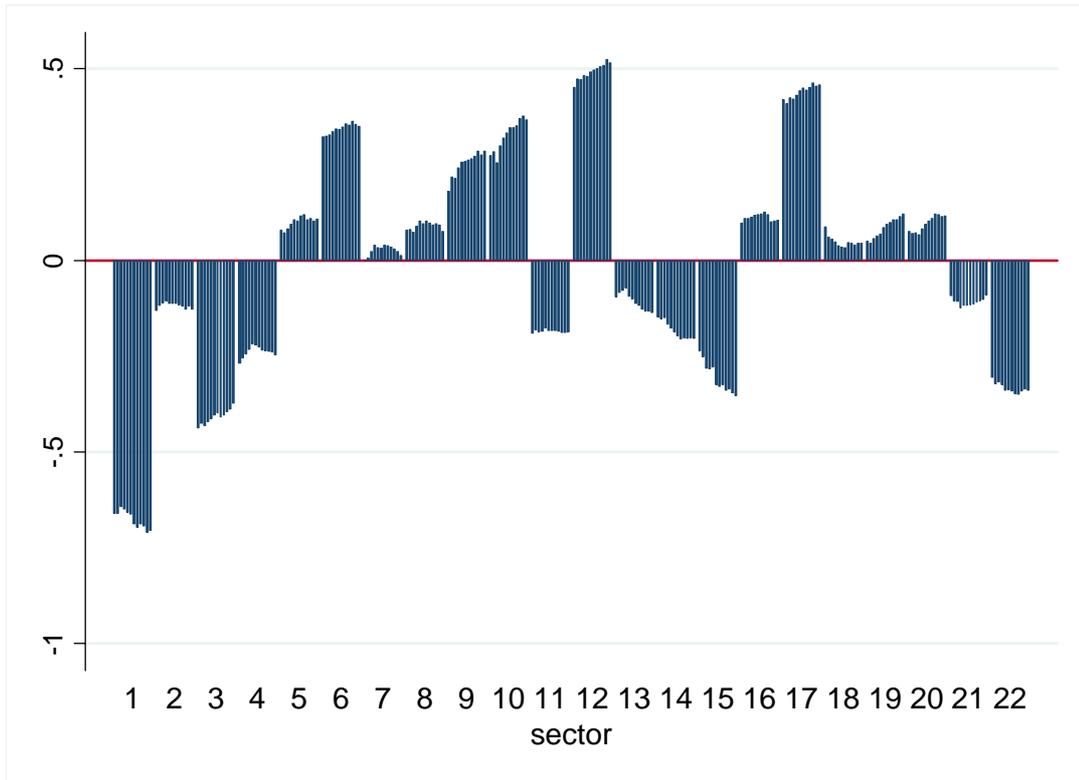
Deviations of industry wages from country averages.
Data source: OECD STAN.

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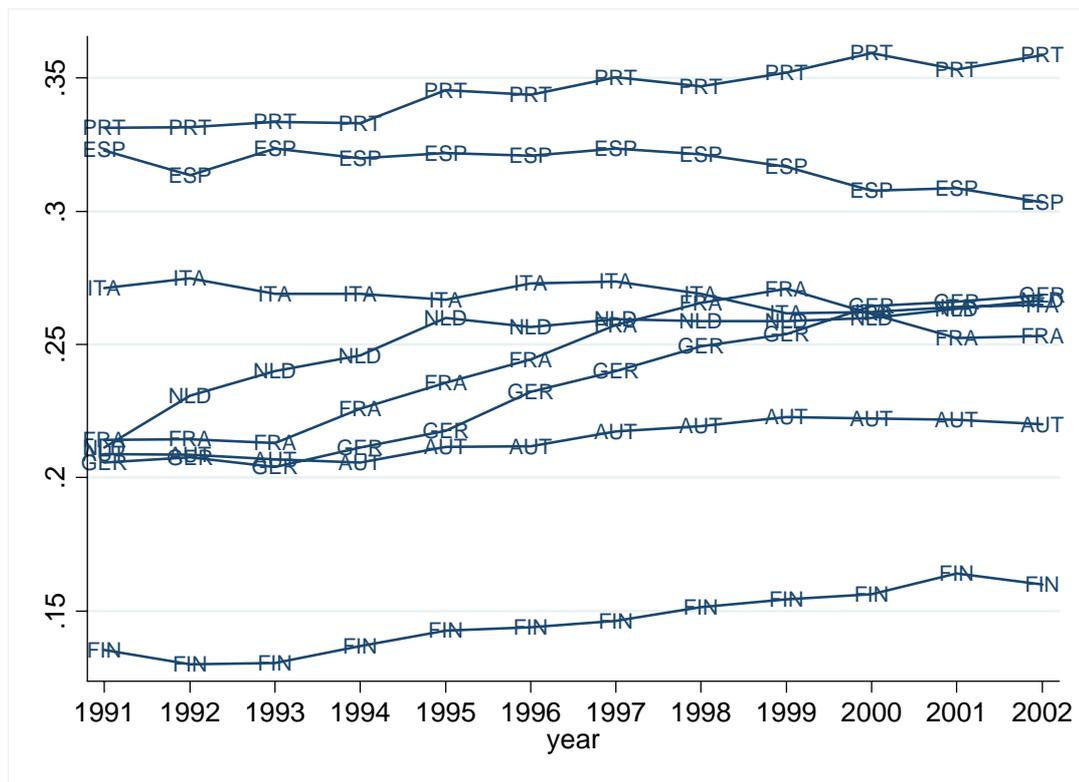
Figure 3: Inter-industry wage differentials across time (1991-2002), euro area



Deviations of industry wages from euro area average.
Data source: OECD STAN.

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Figure 4: Evolution of inter-industry wage dispersion within euro area countries



Weighted standard deviation of wage differentials.

Data source: OECD STAN.

Table 1: Preferred specifications: Panel GLS

	(A)	(B)	(C)	(D)
	ln(W/P)	ln(W/P)	ln(W/P)	ln(W/P)
SHAREYOUNG	-0.130*** (0.046)		-0.025 (0.062)	-0.084** (0.041)
SHAREOLD	0.109* (0.065)		0.049 (0.087)	0.117** (0.059)
SHARELOWSKILL	-0.127*** (0.035)		-0.084 (0.051)	-0.095*** (0.031)
SHAREHIGHSKILL	0.029 (0.044)		-0.104 (0.065)	-0.032 (0.039)
SHAREPARTTIME	-0.368*** (0.050)		-0.117 (0.073)	-0.259*** (0.044)
SHARETEMP	0.033 (0.041)		0.015 (0.056)	-0.005 (0.037)
SHAREFEMALE	-0.159*** (0.038)		-0.039 (0.052)	-0.073** (0.034)
SHARESELF	-0.012 (0.010)		-0.032*** (0.009)	-0.045*** (0.009)
LOGCAPINT		0.029*** (0.007)	0.048*** (0.009)	0.025*** (0.006)
LOGPROD		0.225*** (0.018)	0.220*** (0.020)	0.260*** (0.013)
SHARESIZE19		0.071 (0.061)	0.139* (0.073)	
SHARESIZE49		0.037 (0.049)	0.116** (0.059)	
SHARESIZE50+		0.063* (0.036)	0.119*** (0.042)	
EXPINT		-0.033 (0.028)	-0.072** (0.028)	
IMPPEN		0.060*** (0.022)	0.052** (0.022)	
Observations	1613	769	656	1543
RHO	0.86	0.79	0.73	0.86

Estimation by panel GLS, allowing for first-order autocorrelation (RHO).

All specifications additionally include country, sector, and year specific effects.

Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 2: Sensitivity analyses I: Different covariates, sample restriction

	(A)	(B)	(C)	(D)	(E)	(F)	(G)
	LOG(W/P)	LOG(W/P)	LOG(W/P)	LOG(W/P)	LOG(W/P)	Y	Y
SHAREYOUNG	-0.025 (0.062)	-0.084** (0.041)	-0.031 (0.046)	-0.005 (0.066)	-0.047 (0.040)	0.047 (0.052)	-0.022 (0.037)
SHAREOLD	0.049 (0.087)	0.117** (0.059)	0.078 (0.065)	0.069 (0.091)	0.085 (0.057)	0.054 (0.067)	0.091* (0.051)
SHARELOWSKILL	-0.084 (0.051)	-0.095*** (0.031)	0.014 (0.039)	-0.127** (0.052)	-0.113*** (0.030)	-0.015 (0.028)	0.034* (0.021)
SHAREHIGHSKILL	-0.104 (0.065)	-0.032 (0.039)	-0.082* (0.049)	-0.096 (0.066)	-0.014 (0.038)	0.063 (0.046)	0.106*** (0.031)
SHAREPARTTIME	-0.117 (0.073)	-0.259*** (0.044)	-0.078 (0.058)	-0.130* (0.076)	-0.277*** (0.043)	0.013 (0.054)	-0.160*** (0.032)
SHARETEMP	0.015 (0.056)	-0.005 (0.037)	-0.069 (0.044)	-0.067 (0.057)	-0.081** (0.035)	-0.003 (0.041)	-0.004 (0.029)
SHAREFEMALE	-0.039 (0.052)	-0.073** (0.034)	0.003 (0.039)	-0.031 (0.053)	-0.053 (0.033)	-0.049 (0.041)	-0.097*** (0.030)
SHARESELF	-0.032*** (0.009)	-0.045*** (0.009)	-0.026*** (0.008)	-0.040*** (0.009)	-0.053*** (0.008)	-0.015* (0.009)	-0.021** (0.009)
LOGCAPINT	0.048*** (0.009)	0.025*** (0.006)	0.033*** (0.006)	0.051*** (0.009)	0.029*** (0.005)	0.017** (0.007)	0.014*** (0.005)
LOGPROD	0.220*** (0.020)	0.260*** (0.013)	0.225*** (0.016)	0.234*** (0.020)	0.280*** (0.013)	0.134*** (0.017)	0.161*** (0.011)
SHARESIZE19	0.139* (0.073)			0.158** (0.075)		0.117** (0.059)	
SHARESIZE49	0.116** (0.059)			0.119** (0.060)		-0.006 (0.048)	
SHARESIZE50+	0.119*** (0.042)			0.138*** (0.042)		0.153*** (0.032)	
EXPINT	-0.072** (0.028)			-0.069** (0.028)		-0.044 (0.028)	
IMPPEN	0.052** (0.022)			0.050** (0.021)		0.058** (0.023)	
COUNTRY EFFECTS	yes	yes	yes				
SECTOR EFFECTS	yes	yes	yes			yes	yes
YEAR EFFECTS	yes	yes	yes				
COUNTRY TRENDS				yes	yes		
SECTOR TRENDS				yes	yes		
Observations	656	1543	906	656	1543	656	1541
RHO	0.73	0.86	0.83	0.69	0.86	0.84	0.89

Estimation by panel GLS, allowing for first-order autocorrelation (RHO).

Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 3: Sensitivity analyses II: Different estimation strategies

	(A)	(B)	(C)	(D)	(E)	(F)
	(GLS)	(POLS)	(POLS_Lag)	(FD)	(FE)	(GMM)
	LOG(W/P)	LOG(W/P)	LOG(W/P)	LOG(W/P)	LOG(W/P)	LOG(W/P)
SHAREYOUNG	-0.084** (0.041)	-0.390*** (0.103)	0.004 (0.016)	0.058** (0.029)	0.029 (0.029)	0.018 (0.021)
SHAREOLD	0.117** (0.059)	0.342** (0.158)	0.006 (0.037)	0.005 (0.043)	0.050 (0.039)	0.022 (0.026)
SHARELOWSKILL	-0.095*** (0.031)	-0.404*** (0.059)	-0.027** (0.011)	0.040* (0.023)	0.027 (0.024)	0.015 (0.018)
SHAREHIGHSKILL	-0.032 (0.039)	-0.057 (0.079)	0.002 (0.012)	0.007 (0.027)	0.028 (0.028)	-0.017 (0.024)
SHAREPARTTIME	-0.259*** (0.044)	-0.311*** (0.070)	-0.020* (0.011)	-0.034 (0.035)	-0.057 (0.037)	-0.036 (0.025)
SHARETEMP	-0.005 (0.037)	-0.031 (0.081)	0.005 (0.012)	-0.015 (0.026)	-0.013 (0.026)	0.024 (0.021)
SHAREFEMALE	-0.073** (0.034)	-0.290*** (0.068)	-0.004 (0.011)	-0.004 (0.030)	-0.001 (0.024)	0.006 (0.021)
SHARESELF	-0.045*** (0.009)	-0.094*** (0.016)	-0.006*** (0.002)	-0.017* (0.009)	-0.010 (0.009)	-0.030*** (0.006)
LOGCAPINT	0.025*** (0.006)	0.045*** (0.013)	0.007*** (0.003)	0.023*** (0.005)	0.020*** (0.004)	0.021*** (0.003)
LOGPROD	0.260*** (0.013)	0.311*** (0.022)	0.010*** (0.003)	0.138*** (0.018)	0.138*** (0.015)	0.088*** (0.010)
LOGW/P(-1)			0.966*** (0.006)			0.655*** (0.025)
Observations	1543	1545	1523	1345	1372	1323

Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

(GLS) Estimation by panel GLS, allowing for first-order autocorrelation.

Additional controls: country, sector, and year effects.

(POLS) Estimation by pooled OLS, standard errors allowing for heteroscedasticity and first-order autocorrelation.

Additional controls: country, sector, and year effects.

(POLS_Lag) Estimation by pooled OLS, standard errors allowing for heteroscedasticity.

Additional controls: country, sector, and year effects. Test for autocorrelation: p-value = 0.951.

(FD) Estimation in first differences, standard errors allowing for heteroscedasticity.

Additional controls: country and sector effects. Test for autocorrelation: p-value = 0.403.

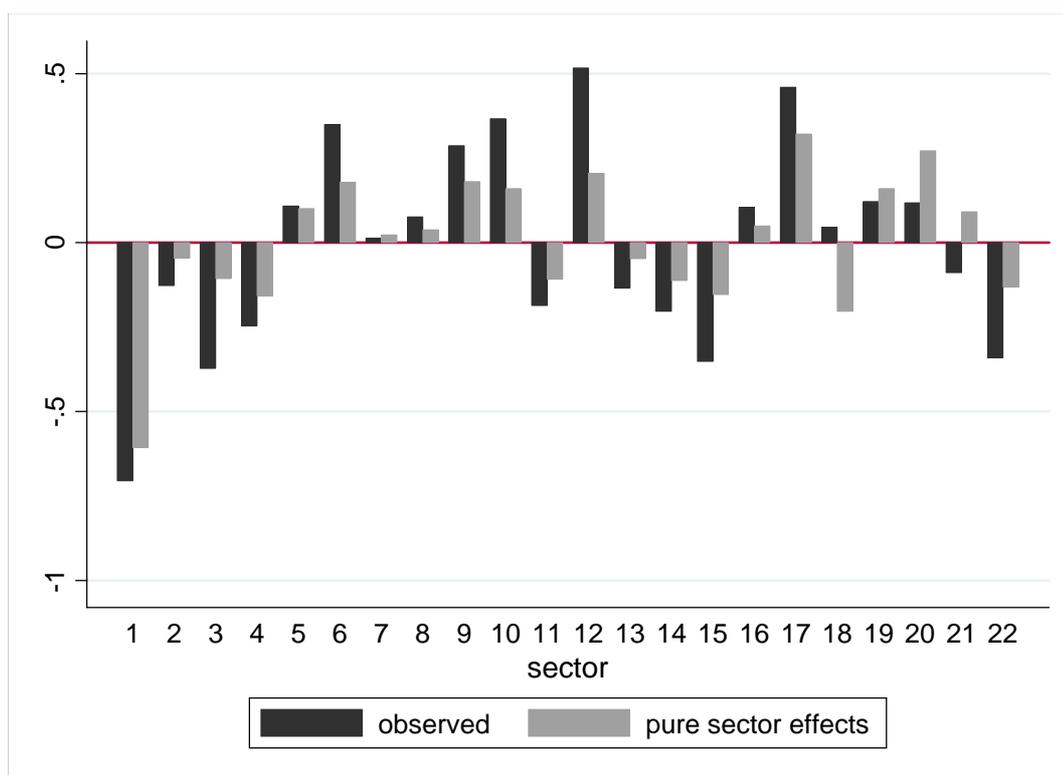
(FE) Estimation with (sector X country) fixed effects, allowing for first-order autocorrelation.

Additional controls: year effects.

(GMM) Estimation by two-stage GMM, instrumentation a la Arellano/Bond (1991).

Additional controls: year effects. Test for second-order autocorrelation: p-value 0.506.

Figure 5: Pure sector effects versus observed inter-industry wage differentials, euro area 2002



Observed: Deviations of industry wages from euro area average.

Pure sector effects: Weighted orthogonalised industry effects based on specification (D) of table 1.