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Product Market Regulation and Wage Premia in Europe and North America: An Empirical Investigation

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PRODUCT MARKET REGULATION AND WAGE PREMIA IN EUROPE AND NORTH AMERICA: AN EMPIRICAL INVESTIGATION

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ABSTRACT/RÉSUMÉ

Product market regulation and wage premia in Europe and North America: an empirical investigation

Using new cross-country data on industry-specific product market regulations, this paper investigates the relationship between wage premia and some of the policy determinants of product market rents. Hourly wage premia in 2-digit manufacturing and non-manufacturing industries are estimated from detailed data on wage earnings in (or around) 1996 by category of worker (age, sex, education and type of contract) in 12 European and North-American countries. The effects of regulation on these wage premia are estimated by panel data regression techniques. We find that product market regulation restricting competition has a significant positive impact on wage premia in both manufacturing and non-manufacturing industries. However, in the latter industries, this effect is offset by a negative effect of legal public monopolies on wage premia. Since public ownership per se shows no relation to premia, we interpret this result as evidence of either a low-productivity trap due to x-inefficiency in heavily regulated industries or the existence of rent-sharing in the form of non-pecuniary rents, such as job stability and/or low worker effort in public monopolies. Our data is unable to discriminate among these two possibilities.

JEL: *J31, L51, C23*

Keywords: *Regulation, competition, wage premia, rent-sharing, panel data*

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Régulation des marchés des biens et rentes salariales en Europe et en Amérique du nord: une analyse empirique

Cette étude utilise une nouvelle base de données internationale concernant les régulations sectorielles pour explorer le lien entre les primes salariales et quelques unes des politiques qui affectent les rentes dans les marchés des produits. Les primes salariales horaires dans plusieurs industries manufacturières et non manufacturières sont estimées à partir de données détaillées sur les salaires par catégories de travailleurs (âge, sexe, éducation et type de contrat) dans 12 pays Européen et de l'Amérique du Nord en (ou aux environs de) 1996. Les effets des régulations sur ces primes salariales sont ensuite estimées en utilisant des méthodes économétriques de panel. Nous trouvons que les régulations qui réduisent la concurrence ont un impact positif et significatif sur les primes salariales dans les industries manufacturières et non manufacturières. Dans ces dernières, toutefois, cet effet est partiellement compensé par un effet négatif et significatif des monopoles publics légaux sur les primes salariales. Étant donné que la propriété publique en soi ne montre aucune relation avec les primes, ce résultat peut signaler soit une "trappe" de basse productivité, due à la présence d'inefficacité X dans les industries très fortement régulées, soit une forme de partage non-pécuniaire des rentes, tel qu'une stabilité accrue du poste de travail et/ou un moindre effort de travail dans les monopoles publics. Nos données ne permettent pas de discriminer entre ces deux hypothèses alternatives.

Classification JEL: J31, L51, C23

Mots-clés: Régulation, concurrence, rentes salariales, partage des rentes, données de panel

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PRODUCT MARKET REGULATION AND WAGE PREMIA IN EUROPE AND NORTH AMERICA: AN EMPIRICAL INVESTIGATION

Sébastien Jean and Giuseppe Nicoletti[1]

I. Introduction

1. There is a large amount of evidence pointing to the existence of significant inter-industry wage differentials in OECD countries (see, for instance, Krueger and Summers, 1988; Gittleman and Wolff, 1993; Haisken-DeNew and Schmidt, 1999). If the labour market was perfectly competitive, wage differentials would reflect only the characteristics of workers (e.g. age, gender, education, skills) and, possibly, working conditions (firm location, health hazards, etc.). In an efficiency-wage setting, earnings differentials are also related to the characteristics of firms (industry affiliation, size, etc.), with firm profits increasing with wages over some range (Krueger and Summers, 1988). But how much do these differentials reflect interindustry differences in competitive pressures and employee bargaining power? If workers and firms bargain over wages, the larger are product market rents and the larger is the share of these rents that are likely to be appropriated by workers (Abowd, 1989; Nickell *et al.*, 1994). Therefore, differences in the degree of product market competition and rent sharing may provide an additional explanation of interindustry wage differentials, giving rise to so-called wage premia.

2. There is abundant evidence of a positive relationship between product market rents (or measures of market power) and wage premia (or workers' bargaining power) (Katz and Summers, 1989; Abowd and Lemieux, 1993; Nickell *et al*., 1994; Abowd and Allain, 1996; Blanchflower *et al*., 1996; Benito, 2000). There is also evidence of a significant impact of trade openness on wage premia both at the single country (Gaston and Trefler, 1994, 1995; Borjas and Ramey, 1995; Pizer, 2000) and cross-country levels (Oliveira-Martins, 1993; Mirza, 2001), though its sign appears to depend on industry and worker characteristics (including union membership).[2] One problem with this evidence is that it is often affected by potential measurement and endogeneity problems: proxies for product market competition are difficult to construct, and most available measures (such as profit per worker, mark-ups or concentration rates) are likely to be determined jointly with the wage outcomes.[3] Moreover, recent research shows that there is no univocal relationship between many of these empirical measures and the degree of product market competition (Boone, 2000).

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1. CEPII and OECD Economics Department, respectively. This paper was written while Sébastien Jean was a consultant in the OECD Economics Department. The authors wish to thank Andrea Bassanini, Ekkehard Ernst, Jørgen Elmeskov, Mike Feiner and John Martin for their comments on previous versions of this paper. Olivier Boylaud and Martine Levasseur provided excellent research assistantship. The views expressed in the paper are personal and do not engage the OECD or its Member countries.

2. Concerning import penetration, for instance, Borjas and Ramey (1995) find a negative impact on wages of low-skilled workers in concentrated industries. Oliveira-Martins (1993) finds a clear negative effect only in fragmented industries producing homogeneous goods, and a positive effect in fragmented industries producing highly differentiated goods. Pizer (2000) finds differential effects on unionised and non-unionised workers. Neary (2001) provides a model of oligopolistic competition rationalising the opposite effects of trade liberalisation on the wages of skilled and unskilled workers.

3. Acknowledging the endogeneity problem, Abowd and Lemieux (1995) use an instrumental variable estimation approach.

3. This paper looks at the empirical relationship between wage premia and product market competition instrumenting the latter with anticompetitive product market regulation. Indeed, regulation is one of the main determinants of product market competition. In potentially-competitive product markets, regulations can curb the intensity of competition among incumbent firms as well as hinder (or prevent) entry of new firms. Restrictions to competition can result from direct hindrances, such as legal barriers to entry or price controls, or more indurectly from administrative burdens, ineffective competition laws and/or widespread public ownership in the business sector. Regulation can also favour competition in certain industries by ensuring that market power in natural monopoly segments is not used abusively and by providing the correct incentives to market participants.

4. Since anticompetitive regulation can create and/or protect product market rents, it is a potentially important determinant of wage premia. Being policy-determined, product market regulation can be assumed to be strictly exogenous to the bargaining outcome and, therefore, represents an appropriate proxy for the influence of product market conditions on it. Moreover, empirical results based on product market regulation also provide for a direct link to policy, which is missing in analyses based on measures of industry concentration or product market rents. Studying the linkage between anti-competitive product market regulations and the wage premia resulting from market and bargaining power has important implications for regulatory policies. For instance, recent research has emphasised the potential positive effects of product market liberalisation for employment (see, for instance, Nickell, 1999, and Blanchard and Giavazzi, 2001). Much of these effects are thought to result from the impact of liberalisation on product and labour market rents.

5. Empirical evidence on the influence of product market regulation on inter-industry wage differentials is scant, especially at the cross-country level. Conceptually, this linkage can be studied in two different but complementary ways. First, premia should be found to be relatively higher in countries and industries in which regulations restrict competition. Second, premia should decrease as anticompetitive regulations in these countries and industries are removed. Taking the second approach, a few studies have concentrated on the effects of liberalisation in specific countries and regulated industries. For instance, the reaction of industry wages to deregulation outside manufacturing in the United States was studied by Hendricks (1977, 1994) and Peoples (1998). Their conclusions were mixed: while competition is often found to lead to decreases in average earnings, in some cases market power is found to be associated with lower pay levels, and increased competitive pressures were found to lead to either no or positive effects on wage premia.

6. This paper follows the first approach. It uses the cross-sectional variation of wages and product market regulations across countries and industries in a single year to explore the long-run effects of anticompetitive regulation on wage premia. To our knowledge, no empirical study to date has focused explicitly on the role of product market regulation using such data.[4] The analysis is aimed at checking whether there is evidence that labour market rents are relatively high where regulation is most restrictive of competition. To this end, we use the two-step estimation methodology of Katz and Summers (1989). We first filter out of interindustry wage differentials the effects due to observed worker and firm characteristics. Then we regress the estimated wage premia on indicators of the restrictions to competition implied by industry-specific regulations, controlling for other country and industry-specific factors that may have a bearing on wage differentials. While other authors have applied this approach to data concerning individual workers in specific industries or countries, we apply it to more aggregate data concerning different categories of workers across both industries and countries.

4. Using a different data set and estimation approach, Nicoletti *et al.* (2001a) looked at the impact of economy-wide product market regulations on wage premia in a cross-section of OECD countries and industries.

7. We find that anticompetitive regulations tend to raise wage premia in all industries. However, in non-manufacturing industries this effect is non-linear, with premia tending to decline as restrictions to market mechanisms become severe. We show that the combination of anticompetitive regulation and public ownership accounts for this non-linearity, possibly suggesting the presence of a low-productivity trap implied by x-inefficiency or the existence of a trade off between pecuniary and non-pecuniary rents (e.g. longer job tenure and/or lower work effort). An alternative interpretation, in terms of a disciplining effect of regulation on rents in public monopolies, is made implausible by the absence of a direct effect of public ownership on wages.

8. The paper is organised as follows. In the next section, we describe a simple model of rent sharing and our estimation approach. Then we describe the data, focusing on our proxies for industry-specific regulation. Finally, we discuss the empirical results. A few conclusive remarks draw policy implications from the analysis and suggest further extensions and refinements.

II. Model specification and estimation approach

9. The basic framework for our estimations is the rent-sharing model proposed by Abowd and Lemieux (1993), in which wages result in partial equilibrium from efficient bargaining between the union and the firm over wages and employment, given an outside option for workers.[5] In this framework, negotiated wages can be shown to be a linear function of the firm's product market rents and workers' reservation wage (i.e. the alternative market wage). The share of rents appropriated by workers is measured by a rent-shifting parameter to be estimated, which depends among other things on workers' bargaining power. Product market rents can be thought of as being composed of two elements: quasi-rents, which are determined by investment in quasi-fixed factors (such as tangible and intangible capital); and "pure" rents, which depend exclusively on the firm's market power. We postulate a linear relationship between these rent elements and a number of industry and country-specific variables, among which we include prominently anticompetitive product market regulations. Instrumenting product market rents by product market regulation helps side-stepping some of the potential errors in variables problems pointed out by Abowd and Lemieux (1993).[6] Our units of observation are wages at the industry level, therefore the basic model specification for wages of the typical worker (ω) negotiated in industry *k* of country *i* is:

$$\omega_{ki} = \alpha + \alpha_i + \beta_k + \gamma * PMR_{ki} + \delta * CNTRL_{ki} + \eta_{ki} \qquad (1)$$

where α_i are country effects that are common across industries, subsuming for instance the going reservation wage in each country; β_k are industry effects that are common across countries, such as technological characteristics; PMR_{ki} are country and industry-specific product market regulations that restrict competition; $CNTRL_{ki}$ are other country and industry-specific factors potentially affecting the negotiated wage, such as measures of production scale and intangible capital or measures of heterogeneity of bargaining power.[7] The parameter γ measures the extent to which pure rents due to effects of anticompetitive regulations are shifted to the negotiated wage.

5. Abowd and Lemieux's model is a version of the "strongly efficient" bargaining model proposed by Brown and Ashenfelter (1986).

6. These problems may arise due to both errors in measuring product market rents and endogeneity of rents to negotiated wages, such as would occur if bargaining was on wages and employment levels were chosen *ex post* by firms (so-called "right to manage" model). Clearly, the possibility of errors in measuring product market regulations remains.

7. For instance, production scale and innovative activity may both provide a measure of quasi-fixed factors, affecting the rents earned by the firm. Innovative activity involves some degree of market power, which is

10. In estimating equation (1) we make two other amendments to Abowd and Lemieux's model. First, we attempt to explicitly model industry effects that are common across countries, replacing the β_k by a set of explanatory variables representing intrinsic characteristics of each industry (economies of scale, competitive structure, skill composition). Second, we include foreign trade variables among the country and industry-specific factors potentially affecting the negotiated wage ($CNTRL_{ki}$). Borjas and Ramey (1995) show that embedding Abowd and Lemieux's rent-sharing model in an open economy in which industries differ in market structure makes wages sensitive to net imports, with the partial equilibrium effects of increased net imports on negotiated wages depending on industry structure. The relative wages of workers in more concentrated industries tend to fall with net imports because the loss in product market rents is higher in these industries than elsewhere.[8] Accordingly, we include among the $CNTRL_{ki}$ also import penetration and export intensity.

11. Equation (1) describes the determination of wages in a given industry under the unrealistic assumption that workers in the industry are homogeneous. In fact, observed industry wages will deviate from this benchmark due to differences in the characteristics of the workforce (*e.g.* demographic and skill composition) across industries. To account for heterogeneity in worker characteristics across industries, we filter their effects out of the observed wage data following the two-step estimation approach of Dickens and Katz (1987) and Katz and Summers (1989). Therefore, we estimate the wage of the typical worker (ω_{ki}) in industry k of country i (relative to the wage in a benchmark industry of country i) regressing, country by country, observed wages (w_{ki}) on industry dummies (θ_k) and other dummies (D_s) reflecting a set of observable characteristics of workers in each industry ($s \in C$):

$$w_{ki}^{s\in C} = \alpha_i + \theta_{ki} + \sum_{s\in C} \alpha_{si} D_s + \varepsilon_{ki} \qquad (2)$$

The estimates of the industry dummies ($\hat{\theta}_{ki}$) provide proxies for the deviations of the wages of the typical workers in each industry from a benchmark (which we define as the average wage in the country). Therefore, $\hat{\theta}_{ki}$ can be interpreted as the industry wage premium and is used as the dependent variable in our basic equation (1), under the assumption that all the effects of different worker characteristics across industries have been eliminated through the first-step estimation.

12. While first-step estimates were made country by country pooling together all industries, the second-step analysis of the determinants of wage premia was performed in a cross section of countries, and separately for manufacturing and non-manufacturing industries. It was therefore possible to account for the wide differences in the characteristics of firms and market environments in these two sets of industries, for instance in terms of trade openness, industry regulation and innovative activity. To this end, two simplifying hypotheses were made: in manufacturing, product market regulation was proxied by tariff and non-tariff barriers, assuming that no other industry-specific regulations restrict domestic competition; in non-manufacturing, no trade variables were included, assuming that in these industries competitive pressures coming from imported products are insignificant.[9]

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needed to recuperate the value of investment in innovation. The size of firms and innovative activity may also be related to wages for other reasons (see Acemoglu and Shimer, 2000; Burdett and Mortensen, 1998).

8. Borjas and Ramey show that these effects carry over in general equilibrium. Moreover, the effect is the same whether the increase in net imports is due to an increase in imports or to a decline in exports of the concentrated industry.

9. No industry-specific data is available on regulatory restrictions to competition in manufacturing, but these are likely to be minor in the set of countries covered by this study. In non-manufacturing industries, significant

III. The data

13. Our dependent variable in first-step estimates is hourly earnings of full-time workers. For each industry, we broke down earnings according to gender, four age groups (15-24 years, 25-34 years, 35-54 years, 55 years and over) and four categories of education (less than upper secondary, upper secondary, non-university tertiary, university). Wages and skills data are from the OECD DEELSA database on employment in services (OECD, 2000).[10] The data concerns 1994 for France, 1996 for Sweden, 1995 for other EU countries, and 1998 for non EU countries. The two-digit (ISIC Rev. 3) industry breakdown includes 21 manufacturing industries and 20 non-manufacturing industries. The full breakdown within the manufacturing sector is available only for the US and for a subset of EU countries.

14. Our main explanatory variables are the indicators of product market regulation. These cover industry-specific regulations restricting market mechanisms (in potentially competitive environments) and international trade. In manufacturing, the industry-specific regulatory indicators cover only tariff and non-tariff barriers to trade (OECD, 1997). The original data are at the 6-digit level of the Harmonised System (HS) classification and refer to 1996.[11] We aggregated them into indicators for two-digit (ISIC Rev. 3) industries using import-weights corresponding to 1998 trade flows across OECD countries as obtained by OECD Foreign Trade Statistics (we used the sum of all imports of OECD countries instead of national imports as weights to avoid endogeneity problems). In EU countries, where common trade policies would imply identical import-weighted trade barriers, we generated sample variation in trade barriers by adjusting the weights to reflect the relative size of industries in each country.[12]

15. Outside manufacturing, the regulatory indicators contain information on market and industry structure and industry-level product market regulations in most of the energy and marketable service industries at the three or four-digit level (a total of 21 ISIC Rev 3 industries and industry aggregates) in the 1996-1998 period. Depending on the industry, they cover barriers to entry, public ownership, price controls, government involvement in business operation, market concentration and vertical integration.[13] In network industries -- such as utilities, post and telecommunications and railways -- the basic data

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competitive pressures can originate from foreign direct investment and the activity of affiliates of foreign firms. Unfortunately, limited industry and country coverage precludes the use of these data in empirical analysis.

10. The primary sources of the data are: the European Structure of Earnings Survey (Eurostat) for EU countries; OECD calculations on the microdata file of the outgoing rotation group of the Current Population Survey for the US; and Structure of Earnings Surveys or Labour Force Surveys for the other countries. Only those categories for which earning data are available are represented. Many possible crossings of the various identifiers are thus absent, mainly because the insufficient number of persons concerned prevents reliable estimate for average earnings. The OECD database also also includes a breakdown into nine occupation categories (the ISCO-88 one-digit classification excluding "armed forces"). Unfortunately, however, this characteristic of workers cannot be crossed with the information about age and education.

11. The original data provide the number of tariff lines for each 6-digit industry (usually one). Tariffs are defined as the *ad valorem* tariff rates applied to the most favoured nation. Conversely, the indicator of non-tariff barriers is a frequency ratio: it corresponds to the proportion of tariff lines to which non-tariff barriers apply.

12. See Nicoletti *et al.*(2001b) for details. The assumption is that identical tariff or non-tariff measures have a different economic impact across EU countries depending on the size of the industry concerned. Import differences across EU countries reflect differences in patterns of preferences or industrial structure and are not the result of trade barriers themselves. In other words, these differences reflect cross-country heterogeneity in the importance of the various sectors.

13. In some industries (such as telecommunications) market structure was used to proxy for the actual implementation of procompetitive reforms.

concerned regulatory and market conditions in different (vertical or horizontal) segments of the industries (e.g. gas production, distribution and supply, or regular and express mail). Cardinal indicators were constructed for each of the regulatory or market dimensions covered by the data, ranking countries according to their friendliness to competition on a scale from least to most restrictive (see Nicoletti *et al.*, 1999, Nicoletti *et al.*, 2001b, and the papers in OECD, 2001a, for an illustration of the methodologies followed). Corresponding cardinal indicators at the two-digit industry level were constructed by weighting the indices for lower-digit industries with average OECD employment shares.[14] Finally, summary indicators of product market regulation by industry were obtained aggregating the cardinal indicators by simple or weighted average, depending on the number and type of regulatory dimensions covered in each industry. Figure 1 provides a synthetic view of how each country included in the sample scores in selected non-manufacturing industries relative to the OECD average regulation level in each industry. Further details about coverage and sources in each of the industries included in the analysis are provided in the Data Annex.

Figure 1. Regulation in non-manufacturing industries

16. It is worth stressing that only regulations that have a potential for curbing competition and hindering market mechanisms -- *where competition and market mechanisms are viable* -- have been included in the regulatory indicators.[15] As a result, regulatory indicators highlight two types of cross-country patterns: i) differences in the stringency of regulatory provisions that exist in all countries, taking for granted the need for some level of regulation to correct for market failures (*e.g.* zoning restrictions for the siting of commercial outlets); and ii) differences due to the presence of specific restrictions to market mechanisms that exist only in certain countries (*e.g.* restrictions to entry in certain potentially competitive markets). Furthermore, the cardinal indicators were rescaled to ensure the comparability of the product market indicators across industries. The aim of this operation was to account for structural differences in industry characteristics, such as differences in minimum efficiency scale or vertical and horizontal relationships.[16] Unavoidably, the construction of the indicators involved a fair amount of discretion, which can potentially affect country rankings and empirical results based on the indicators.

17. Other explanatory variables control for industry and country-specific factors potentially affecting wage negotiation. These include firm size, R&D intensity, union density, import penetration and export intensity. Average firm size was proxied in each industry with the share of total employment of firms with more than 49 employees, estimated using the OECD SME Database. R&D intensity was defined in each industry as the ratio of Business Expenditure in Research and Development (BERD) to output, averaged over the 1993-1997 period. BERD data were generally drawn from the OECD ANBERD database and output data resulted from the harmonisation of different sources (OECD STAN Database - edition 2000, OECD Annual National Accounts Database, OECD Industrial Structure Statistics - ISIS). Industry and

14. Aggregation of segments within each industry was made either by simple average (for vertical segments) or with shares in total sales (for horizontal segments). For instance, indicators for postal services were constructed aggregating indicators for ordinary mail, express mail and parcels using the shares of each of these services in total turnover of the post industry.

15. We focus on differences in regulatory settings across a set of relatively homogeneous countries in terms of economic, institutional and social characteristics. Therefore, differences in the stringency and the scope of regulations should signal differences in the reliance on market mechanisms rather than different stages of development of national institutions.

16. For instance, indicators for barriers to entry in each industry were rescaled using the OECD average of the frequency of barriers to entry in that industry. As a result, indicators of barriers to entry in structurally competitive industries (such as retail distribution) take by construction a lower range of values than indicators of barriers to entry in industries having natural monopoly elements (such as electricity).

country-specific union densities in non-manufacturing industries (in a year between 1994 and 1998) were drawn from Ebbinghaus and Visser (2000) and Booth *at al.* (2000) for European countries and from the OECD DELSA database on employment in services (OECD, 2000) for Canada, Ireland and the USA. Import penetration is defined as the ratio of industry imports to apparent demand, and export intensity is the ratio of industry exports to output; the trade data were drawn from OECD Foreign Trade Statistics.

18. Additional explanatory variables were used to model explicitly industry effects on wages that are common to all countries. We included among these country-independent effects average firm size, reflecting economies of scale; entry rates, representing competitive pressures unrelated to regulation; and the skill composition of the workforce, attempting to catch residual effects of worker heterogeneity unaccounted for in the first-step regressions (which only used information on a country-by-country basis). To use the available information on size, entry and skills efficiently, these country-independent variables were calculated as the estimated coefficients on the corresponding industry dummies in regressions where the dependent variables were average firm size, entry rates and the (log) share of skilled workers (defined as legislators, senior officials, professionals, technicians and associate professionals), and independent variables only included industry and country dummies.[17] Entry rates by industry, country and year were based on the firm-level data covering 9 OECD countries estimated in OECD (2001b). Table 1 shows the resulting estimates of average firm size, entry rates and skills by industry.

Table 1. Characterising industries by average firm size, entry rates and skills

IV. Empirical results

19. This section presents the results of first-step an second-step panel regressions of equations (2) and (1), respectively. In the first step, we obtain estimates of wage premia (country by country) as the fixed industry effects of panel regressions of hourly wages of full-time workers on gender, four age classes and four education levels. In the second step, wage premia are regressed on indicators of product market regulation and other controls using both fixed and random-effects specifications and pooling together all countries. The first-step analysis is carried out on a sample of 12 OECD countries (10 EU countries, Canada and the United States) and 41 two-digit industries in both manufacturing and non-manufacturing sectors.[18] In the second step, the sample size is smaller since indicators of product market regulation for non-manufacturing cover only a subset of industries (see annex).

IV.1 Wage premia estimates

20. To illustrate the overall reliability of our earnings data, Table 2 shows the earning profiles estimated in the first-step regressions (2). The Table presents the coefficient estimates of the gender, age and education dummies as well as (in parenthesis) the shares of each group of workers in total employment that result from our sample. Coefficient estimates for each worker characteristic should be interpreted as the percentage variations relative to the (omitted) benchmark characteristic. For instance, regression results indicate that earnings of female workers are between 11 per cent (Sweden) and 25 per cent (United

17. Estimating average industry size, entry rates and skills by panel regressions made it possible to use all the available information in our unbalanced panels. The size regressions used 413 observations covering 17 countries and 30 industries; the entry regressions used 2572 observations covering 9 countries and 37 industries over the 1978-1998 period; the skill regressions used 482 observations covering 16 countries and 43 industries.

18. Results for Canada should be considered as tentative, given the lack of industry breakdown available in manufacturing.

Kingdom) lower than those of male workers sharing the same age and education. Results for age and education are also generally consistent with standard "Mincerian" equations, with earnings increasing with age and education levels.

Table 2. Estimates of earnings profiles

21. Table 3 shows the estimates of industry wage premia obtained from the same regressions, centred with respect to each country's (employment-weighted) average wage. Wage premia are jointly significant at conventional levels and their individual standard errors are generally low and broadly uniform across industries and countries (with the exception of France where wage premia are less precisely estimated).[19] Consistent with previous findings (Gittleman and Wolff, 1993; OECD, 1996), the cross-industry structure of wage premia is remarkably similar across countries, with correlations with the U.S. structure ranging from 35 per cent in Denmark to 90 per cent in Canada. The highest premia are generally found in the manufacturing of tobacco and petroleum products, in utilities (gas and electricity), in the supply of financial and computer-related services and in air transport. The lowest premia are found in the manufacturing of wearing apparel and leather products, in retail trade and, especially, in hotels and restaurants. On the other hand, the inter-industry dispersion of wage premia is substantial in all countries, with standard deviations ranging from 8 per cent in Sweden to 16 per cent in the United Kingdom and Canada.[20] Wage dispersion has the same magnitude in manufacturing and non-manufacturing industries separately. The estimated wage premia may reflect both efficiency wages and pure rent-sharing deriving from workers' bargaining power in the presence of product market rents.[21] However, only the rent element directly related to market power can be expected to fall with anticompetitive product market regulation.

Table 3. Estimated industry wage premia

IV.2 Regulation and wage premia

22. As an introduction to second-step regressions relating the estimated wage premia to regulation, it is useful to look at the cross-country relationship between the (cross-industry) variances of wage premia and the summary indicators of anticompetitive regulations. To this end, we focus on non-manufacturing industries in which such regulations have the widest variability and summary indicators are available. Figure 2 suggests that, for a subset of the countries included in the sample (most European countries and Canada), a positive correlation exists between the two variances: where anticompetitive regulations vary most, wage differentials also tend to be largest. However, the figure also points out that a few countries (the United States, the United Kingdom and Spain) deviate from this pattern. Aside from differences in industry composition, plausible explanations for these exceptions include the importance of efficiency-wage factors in decentralised bargaining settings (the United States and the United Kingdom) and biases implied by the focus on full-time workers in countries where the share of part-time work is significant in

19. In this paper, the focus is on interindustry differences in wage premia. Comparing relative levels of wage premia in one industry across countries requires an assumption as to which industry can be taken to be the common "competitive" benchmark in which premia are lowest. This line of reasoning is not pursued here.

20. Standard errors were adjusted for sampling error, as in Krueger and Summers (1988). The estimated dispersion of wages in the United States (11 per cent) is broadly consistent with the dispersion found by these authors based on 1984 micro data (14 per cent)

21. In an efficiency-wage perspective, wage premia correspond to the compensation paid by firms for avoiding the costs of monitoring, collecting information, etc. Even conceptually, the distinction between efficiency-wage and rent-sharing elements is difficult. To the extent that rent sharing is a device to avoid the costs of labour unrest, it can also be seen as part of efficiency wages (Krueger and Summers, 1988).

some industries (Spain). More generally, the cross-country patterns highlighted in Figure 2 illustrate the need to control for industry and country-specific factors in panel regressions.

Figure 2. The variance of regulations and wage premia in non-manufacturing industries

23. Second-step panel regressions were run for both manufacturing and non-manufacturing industries. In these regressions, wage premia were weighted by the inverse of their standard error in the first-stage estimation, to control for sampling error and for possible heteroskedasticity. Industries were chosen as the units defining the panel dimension of the fixed-effects model specification, given that premia are defined in relative terms within each country. When modelling explicitly effects that are common to all countries but vary across industries, we estimated both a specification adjusting for clustering in the industry dimension (see Moulton, 1986) and a specification with random effects (dropping the industry dummies). In these regressions, industry effects are captured by the country-independent variables described in the previous section: entry rates accounting for differences in market structure across industries; average firm size accounting for differences in industry structure and technology; and the share of skilled workers accounting for differences in skill composition of the workforce. Moreover, the differential effect of unionisation on wage premia in manufacturing industries with different occupational characteristics (see, Card, 1996) was checked by crossing the skill structure of employees by industry with overall union density.[22]

24. Table 4 summarises the regression results. Standard F-tests rejected the specifications with no industry-specific effects and controlling for them improves the fit of the model in the dimension in which wage premia vary the most. In manufacturing industries, specification tests (RESET and Hausman) suggest that the cluster-adjusted and random-effects model are rejected by the data, while in non-manufacturing regression results are broadly consistent across model specifications. Variables that turned out to be insignificant in all model specifications were omitted from the table. This was the case in the non-manufacturing regressions for industry and country-specific average firm size and the interaction between union density and skills. Average skills were also dropped from the non-manufacturing cluster-adjusted and random-effects regressions because they led to rejection by specification tests while leaving other results broadly unchanged.[23]

25. Several conclusions can be drawn as to the impact of control variables on wage premia. In all industries, structural influences appear to be significant. These include negative effects of entry rates and positive effects of average firm size on wage premia. In manufacturing industries, higher average skills in the industry were also found to be associated with higher premia, while R&D intensity had no effects. On the whole, the regression results suggest that premia are higher in industries characterised by lower entry rates, larger firms and a relatively skilled workforce, the latter two effects possibly reflecting efficiency-wage phenomena.[24] Consistent with previous findings (e.g. Borjas and Ramey, 1995), import penetration has a significant negative effect on wage differentials in manufacturing industries once industry characteristics are controlled for. However, the influence of export intensity is not significant.

Table 4. The effects of anticompetitive regulations on wage premia

26. Both inside and outside manufacturing there appears to be heterogeneity in the bargaining power of workers across industries. In manufacturing, wage premia tend to be higher as the industry share of

22. No cross-country data on union densities are available for manufacturing branches.

23. Full regression results are available from the authors upon request.

24. The positive relationship between wages and firm size, even after controlling for observable worker characteristics and other job attributes, is a common empirical finding (for a review, see Oi and Idson, 1999).

unionised unskilled workers increases. The positive and significant coefficient estimated for the interaction variable suggests that the effect of unionisation on wages is relatively stronger for unskilled workers or, alternatively, that the bargaining power of unions decreases with the share of skilled labour.[25] In non-manufacturing industries, for which industry-specific union densities are available, there is some evidence that wage premia increase with unionisation.

27. We now turn to the effects of regulation on wage premia, which we interpret as capturing the appropriation of pure product market rents by workers. It should be noticed at the outset that, to the extent that firm size, R&D expenditure, imports and union density are themselves affected by regulation, the regressions estimate the effects of regulation on wage premia over and above the indirect effects through these control variables.[26] In manufacturing industries, there is reasonable evidence that trade barriers tend to increase wage premia. In the fixed-effects specification, which fits best the data according to the specification tests, both tariff and non-tariff barriers tend to push up wage differentials. This may reflect the cost advantages and related market power ensured by barriers to domestic producers.[27] Since barriers are also likely to affect directly import penetration, the overall effect of trade barriers on wage premia may be actually underestimated in our regressions. In non-manufacturing industries, the picture is different. Figure 3 (Panel A) plots the first-step estimates of non-manufacturing wage premia against the industry-specific summary indicators of product market regulation, showing the scatter diagram for both industries and countries. There is some evidence of a positive correlation between the two phenomena (the correlation coefficient is 0.3 and is significant at conventional levels), though it is blurred by the relatively high dispersion of wage premia. However, the bivariate evidence is only partly confirmed by the results of panel regressions, which provide a picture of a strong but more complex relationship between wage premia and regulation. Indeed, regression results suggest that the effect of product market regulation on non-manufacturing wage premia is hump-shaped, with decreasing premia observed in tightly-regulated industries. For illustrative purposes, Figure 3 (Panel B) also plots the wage premia predicted by the indicators of industry-specific product market regulations (net of other country and industry-specific effects) against the regulatory indicators themselves.

Figure 3. Wage premia and regulation in non-manufacturing industries: bivariate and multivariate evidence

28. Interestingly, the decreasing part of the hump-shape mostly describes the relationship between regulation and wages in countries/industries that are dominated by public-owned and tightly-regulated incumbents. We can see several possible rationales for this phenomenon. A benign interpretation is that direct control by the state is more successful than arm's length regulation in curbing product market rents and rent-sharing in some industries (*e.g.* utilities). For this to be the case, public ownership per se should have a negative impact on wage premia. An analogous role for regulation (other than public ownership) is hardly conceivable, given that our regulatory indicators are increasing in the degree of restrictions imposed on market mechanisms.[28] A more malevolent explanation, consistent with efficiency wages, is that pervasive anticompetitive regulation increases the possibility of x-inefficiency, leading to both low labour

25. Acemoglu *et al.* (2001) argue that this reduction in bargaining power is related to the wider outside options for skilled workers, which undermines the coalition among skilled and unskilled labour in support of unions.

26. Nicoletti *et al.* (2001b) provide evidence that anticompetitive product market regulations positively affect average firm size and negatively affect R&D intensity. However, the potential bias induced by these indirect effects appears to be negligible in actual estimations and results do not change when these variables are instrumented. Peoples (1998) shows that union density has declined after liberalisation in some non-manufacturing industries.

27. This result is consistent with findings by Nicoletti *et al.* (2001a), obtained using more aggregated data.

28. Thus, price controls that prevent the exercise of market power (such as price caps) actually *decrease* the value of the indicator.

productivity and wages. Under this scenario, regulation per se (other than public ownership) should have a negative impact on wage premia. A related possibility is that it is the combination of public ownership and tight anticompetitive regulation that creates the conditions for regulatory failure and x-inefficiency. Lighter or more arm's length regulatory approaches may lead to a more efficient use of inputs (see Hendricks, 1994). Finally, another related explanation is that by sheltering firms from competition, regulation preserves product market rents that are shared with workers in both pecuniary and non-pecuniary ways.[29] Non-pecuniary rents become more viable as regulation becomes tighter, interfering with all dimensions of business activity (ownership, objectives, input and output choices) such as in many public-owned utilities.[30] In this case as well, it would be the combination of public ownership and tight anticompetitive regulation that should have a negative impact on wage premia.

29. To further explore the potential causes of the non-linear relationship between anticompetitive regulations and non-manufacturing wage premia, in Table 5 we distinguish between the effects of public ownership, the effects of other regulations thwarting market mechanisms (i.e. legal barriers to entry, restrictions to business operation, discretionary price controls) and the interaction between ownership and regulatory restrictions. While these regressions can in principle reject or validate the benign interpretation of the observed hump-shape, they are unable to distinguish between the different malevolent interpretations, chiefly because we have no good proxies for x-inefficient outcomes or non-pecuniary rents. The regression were run on the fixed-effects model specification, excluding the additional effects of union density on workers' bargaining power, in order to maximise the number of available observations.

Table 5. The effects of public monopoly in non-manufacturing industries

30. Regression results show that neither public ownership nor non-linear regulation (other than public ownership) per se can explain the hump-shape estimated in the basic model. The only variables that retain some significance across all model specifications are regulation (other than public ownership), which positively affects wage premia, and its combination with public ownership, which explains the falling part of the hump shape. This suggests that the relationship between wage premia and regulation in non-manufacturing is best explained by the "public monopoly" model, in which wage premia fall as restrictions to competition are coupled with state control of business sector enterprises. This inference finds further support from the results of non-nested tests that oppose the public monopoly model to the basic model estimated in Table 4, in which wage premia depended positively on overall product market regulation (inclusive of public ownership) and negatively on its square.[31] While these findings appear to

29. Non-pecuniary rents can take the form of weak work incentives (*e.g.* lack of monitoring), inefficient utilisation of inputs (*e.g.* labour hoarding) and other business practices that induce firms to operate within the efficiency frontier (so-called X-inefficiency) while increasing the utility of workers.

30. There are many reasons for this phenomenon. For instance, public-owned firms are typically more exposed to political interference and profit maximisation is often overridden by other objectives, which may be consistent with some degree of X-inefficiency (Haskel and Sanchis, 1995); "public service" considerations and strong union participation make high pay levels and pay inequalities less politically acceptable.

31. The tests follow the procedure of Davidson and McKinnon (1981). We first test the null of the "public monopoly" model against the "basic model", in which premia depend on regulation and its square; then we test the null of the "basic model" against the alternative of the "public monopoly" model. In each of these tests, the null is rejected if the t-statistic associated with the predicted value of the alternative model is significant. The results in Table 5 suggest that the predicted value of the "basic model" does not help explain wage premia, while the predicted value of the "monopoly model" does (at the 10 per cent level of significance).

reject the benign interpretation of the hump-shape suggested above, they cannot discriminate between the two alternative malevolent interpretations hinging on x-inefficiency and non-pecuniary rents.[32]

V. Concluding remarks

31. In this paper we applied the two-step methodology pioneered by Katz and Summers (1989) to look at the effects of product market competition on wage premia. Instead of using data on individual workers in a single country, we focused on categories of workers (classified according to observable characteristics) in a cross-section of industries and countries. Market conditions were instrumented by a new set of industry and country-specific indicators of anticompetitive regulations. Our results suggest that restrictions to competition do increase wage premia, as predicted by rent-sharing models. However, the relationship between regulation and rent-sharing is complex, with different regulations, and combinations of them, affecting premia in different ways. Complexities partly depend on the fact that the estimated relationships subsume the effects of regulatory restrictions on both the level of product market rents and the degree of rent sharing. Moreover, the estimated wage premia cannot account for the sharing of non-pecuniary rents, which may be significant in some industries. To better discriminate between alternative hypotheses concerning the effects of regulation on rent-sharing, future research should provide ways to isolate these effects from the effects on overall rents and distinguish between pecuniary and non-pecuniary rents.

32. Our attempts to test the hypothesis of non-pecuniary rents were unsuccessful. Using industry-specific data on average job tenure available in the OECD DELSA Employment in Services database, we tried to check whether job tenure beared any relationship to anticompetitive product market regulation. No such relationship was found, possibly due to the few degrees of freedom available for the panel regressions (once job tenure data were crossed with product market regulation indicators, only around 60 observations remained).

DATA ANNEX

Industry-specific product market regulation in 1998: coverage and sources

Industry	ISIC code Revision 3	Regulatory and market dimensions covered[1]	Industrial segments covered	Countries covered	Main sources[2]
Electricity	401	P, E, PO, MS, VI E, PO, VI	Prod., Trans., Dist.	24-25 21	OECD OECD, EC, PI, WB
Gas manufacture and distribution	402	P, E, PO, MS, VI E, PO, MS, VI	Prod., Trans., Dist.	26 21	OECD, EC, PI, WB
Energy	40	E, PO, VI	Prod., Trans., Dist.	25	OECD, EC, PI, WB
Water works and supply	41	E, PO, VI		23	OECD, EC, PI, WB
Electricity, gas and water	40_41	E, PO, VI		23	OECD, EC, PI, WB
Wholesale trade	50_51	E, PO		25	OECD
Retail trade	52	E, CBO		28	OECD
Restaurant and hotels	55	E		25	OECD
Railways	601	P, E, PO, MS, VI E, PO, MS, VI	Passenger, freight	27 21	OECD, ECMT
Road freight	602	P, E, CBO P, E		27-29 21	OECD OECD, ECMT
Land transport	60	P, E		27	OECD, ECMT
Water transport	61	E, CBO		22	APC
Air transport carriers	62	E, PO, MS E, PO	Passenger	27 21	OECD OECD, EC
Transport	60_62	E		22	OECD, ECMT EC, APC
Supporting services to transport	63	E, PO		21	OECD
Post	641	P, E, PO, VI	Letter, parcel, express	22-26 21	OECD, EC, UPU
Telecoms	642	P, E, PO, MS, VI E, PO, MS	Fixed, mobile	20-29 21	OECD
Communication	64	P, E, PO, MS		26	OECD
Financial institutions	65	E, CBO		23	OECD, APC
Insurance	66	P, E	Life, general, health	12	OECD
Legal services	7411	E, CBO		22	APC
Accounting services	7412	E, CBO		23	APC
Architectural and engineering services	7421	E, CBO		23	APC
Professional business services	74	E, CBO		22	APC

Note 1 :
- P = Price regulation
- E = Barriers to entry
- PO = Public ownership
- CBO = Constraints to business operation
- MS = Market structure
- VI = Vertical integration

Note 2 :
- ECMT = European Conference of Ministers of Transportation
- EC = European Commission
- WB = World Bank
- PI = Privatisation International
- APC = Australian Productivity Commission
- UPU = Universal Postal Union

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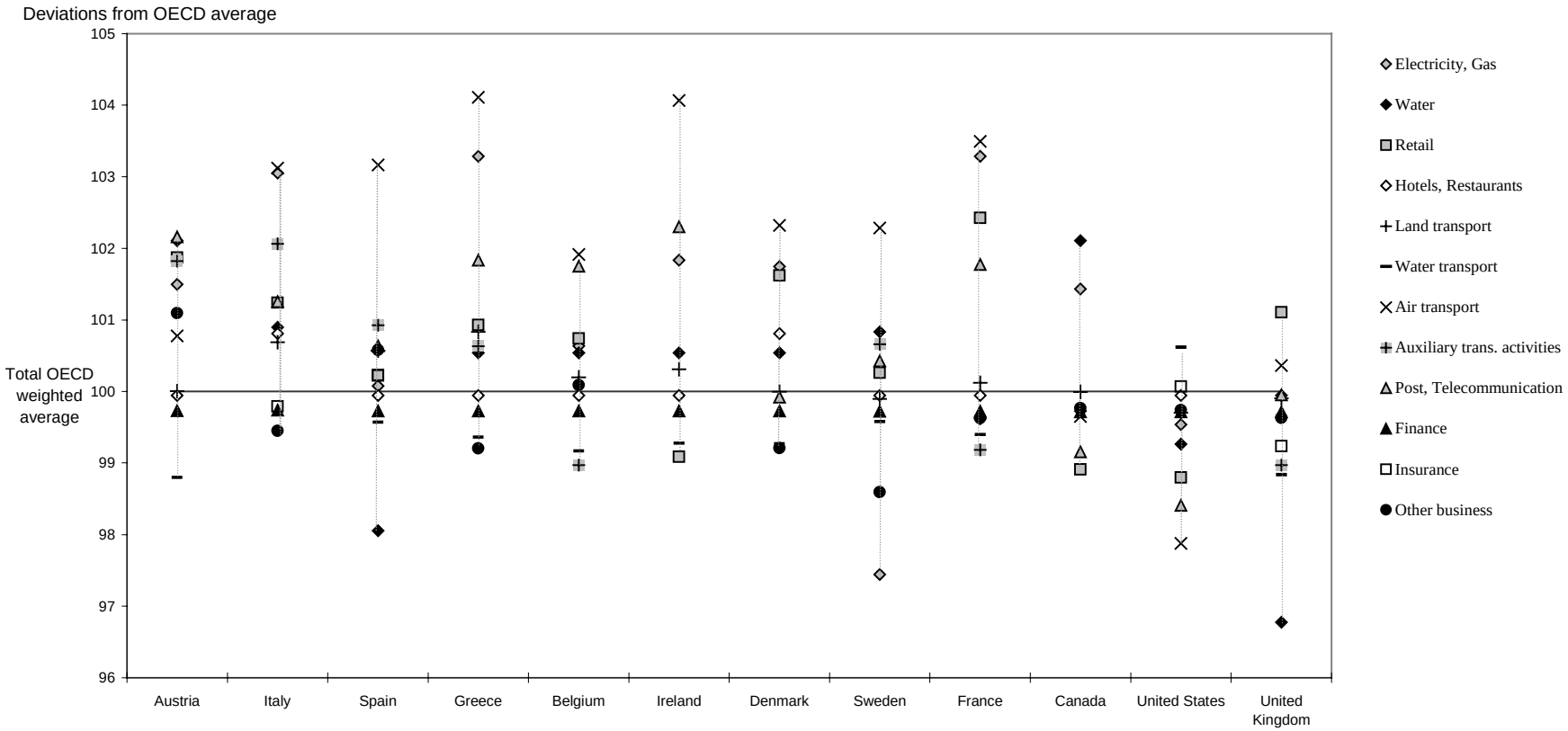
FIGURES AND TABLES

Figure 1. **Regulation in non-manufacturing industries[1], 1998**
(increasingly anticompetitive)



1. Depending on the industry, the indicators cover barriers to entry, price controls, restrictions to business operation, public ownership, market structure and vertical integration. See Data Annex for details.

Source : Nicoletti *et al.,* 2001.

Figure 2. **The variance of regulation and wage premia in non-manufacturing industries**

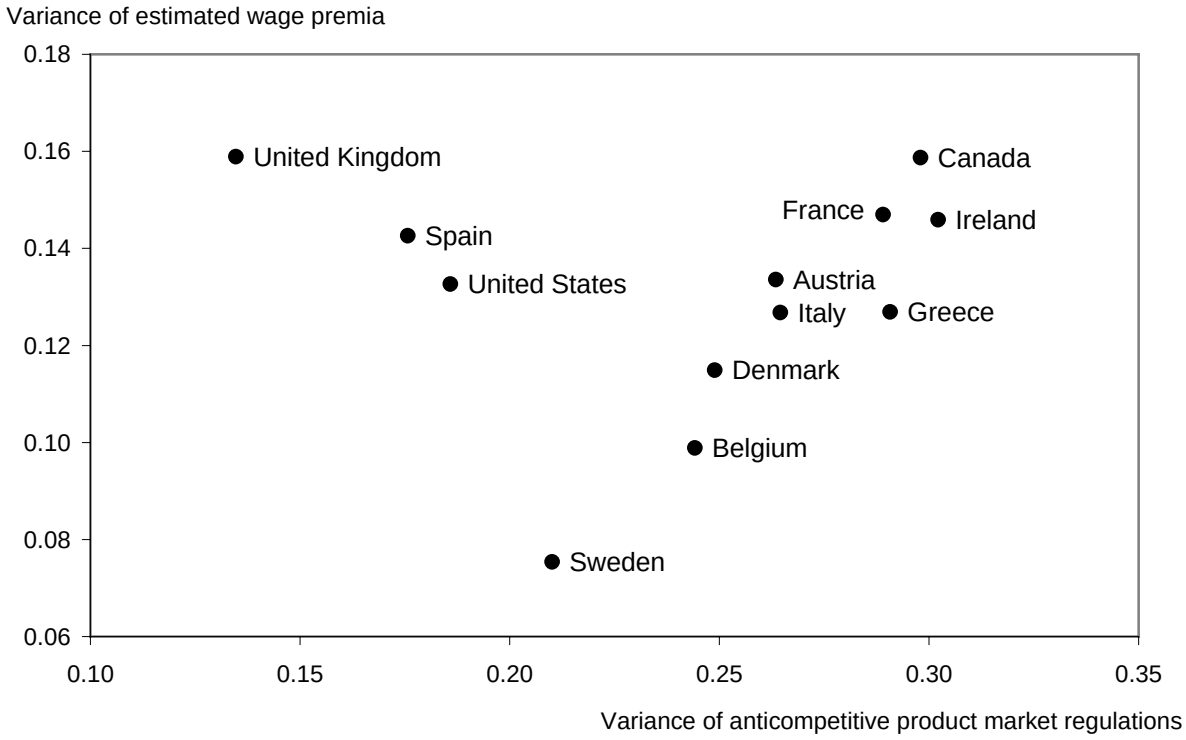
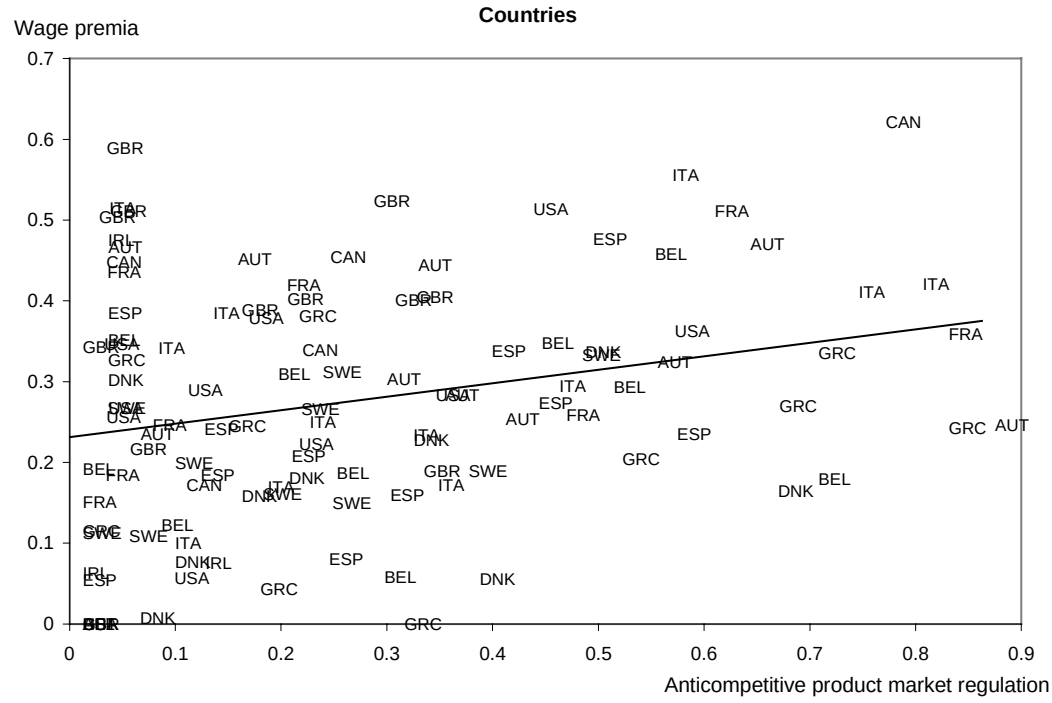
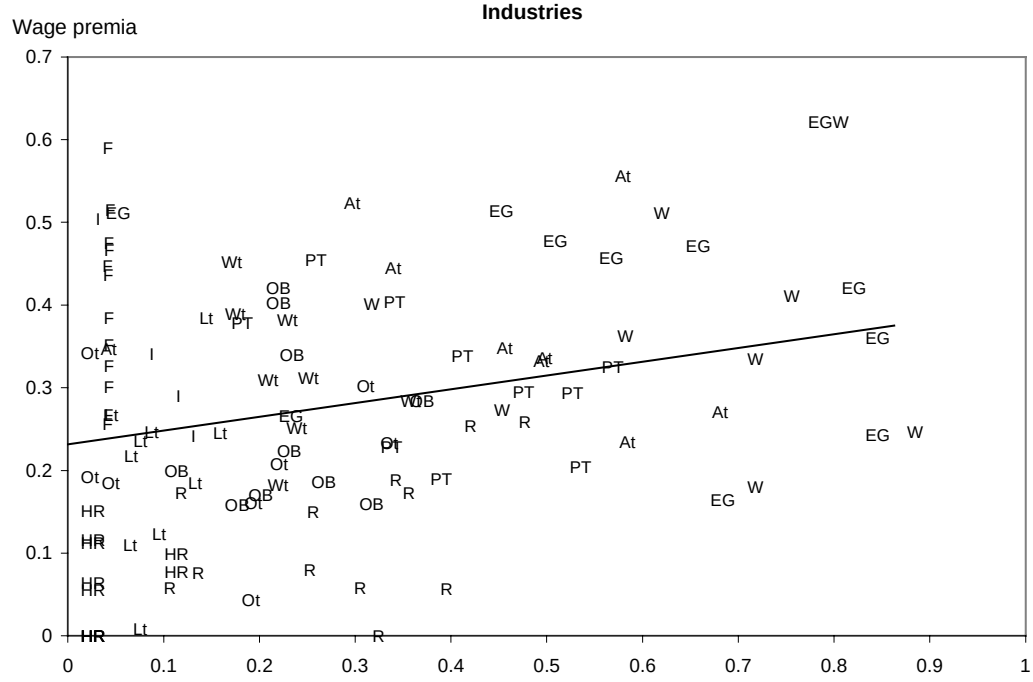


Figure 3. **Wage premia and regulation in non-manufacturing industries: bivariate and multivariate evidence**

A. First-step estimates

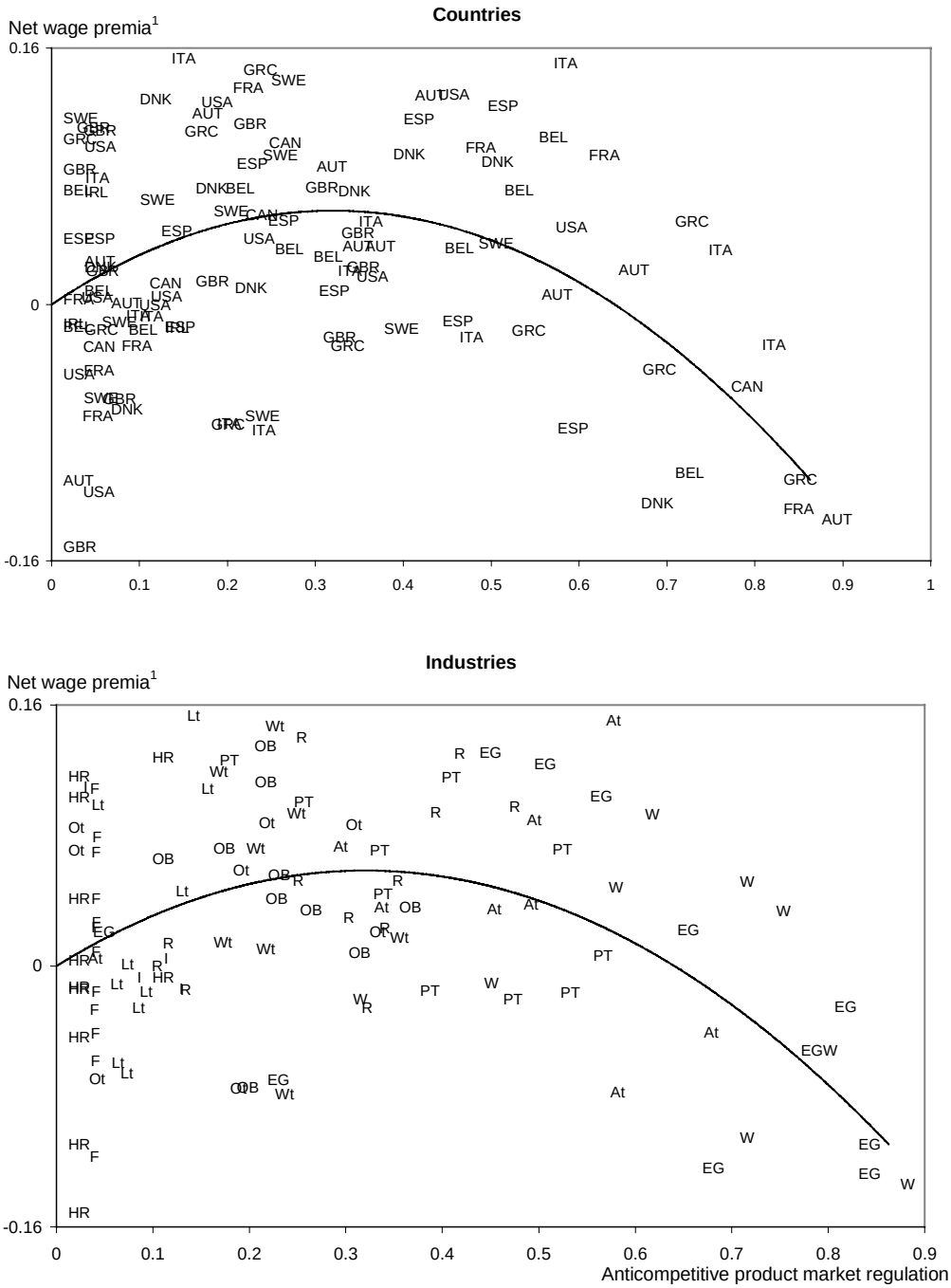




EG:	Electricity, Gas	At:	Air transport
W:	Water	Ot:	Auxiliary trans. activities
R:	Retail trade	PT:	Post, Telecommunications
HR:	Hotels, Restaurants	F:	Financial intermediation
Lt:	Land transport	I:	Insurance
Wt:	Water transport	OB:	Other business activities

Figure 3 . **Wage premia and regulation in non-manufacturing industries bivariate and multivariate evidence** (continued)

B. Net of influences other than regulation



EG:	Electricity, Gas	At:	Air transport
W:	Water	Ot:	Auxiliary trans. activities
R:	Retail trade	PT:	Post, Telecommunications
HR:	Hotels, Restaurants	F:	Financial intermediation
Lt:	Land transport	I:	Insurance
Wt:	Water transport	OB:	Other business activities

1. Net wage premia are the first step estimates of wage premia net of the country and industry fixed effects estimated in Table 4 (column 4).

Table 1. **Characterising industries by average firm size, entry rates and skills** [1]

Average sector characteristics
(per cent)

	Entry rate[2]	**Share of skilled workers in sector employment**	**Share of firms with more than 50 employees**[4]
Sample	*9 OECD countries 1978-1998*	*16 OECD countries from 1994 to 1998* [3]	*17 OECD countries average 1993-1997*
Total manufacturing	9.6	20.1	79.5
Food products and beverages	8.2	12.2	81.1
Tobacco	8.2	16.9	98.9
Textiles	10.6	9.5	76.6
Wearing apparel, dyeing of fur	10.6	5.7	66.0
Dressing of leather, luggage	10.6	4.1	69.3
Wood, except furniture	9.3	7.6	56.8
Pulp, paper and paper products	9.7	11.4	87.6
Publishing, printing	9.7	28.6	70.8
Coke, petroleum products	9.2	38.3	88.6
Chemicals	8.8	33.4	93.0
Rubber and plastics products	9.0	13.7	75.7
Other non-metallic mineral products	8.7	12.8	76.0
Basic metals	8.6	13.9	94.2
Metal products, except machinery and eq.	9.0	11.2	61.8
Machinery and equipment n.e.c.	9.0	18.8	79.2
Office machinery, computers	13.3	53.2	83.5
Electrical machinery n.e.c.	9.5	21.3	84.9
Radio, television and communication eq.	11.4	35.3	88.7
Medical and optical instruments	9.5	32.5	79.5
Motor vehicles	8.1	14.1	93.4
Other transport equipment	10.0	26.7	93.1
Services			
Electricity, Gas, water	7.9	24.7	97.5
Electricity, Gas	7.9	32.3	94.9
Water	7.9	27.3	88.1
Construction	11.4	12.8	55.6
Sale and repair of motor vehicles	10.9	14.4	47.7
Wholesale trade	10.9	30.1	59.7
Retail trade	10.9	16.5	69.8
Hotels and restaurants	14.5	12.2	52.9
Transport	11.3	19.6	77.5
Land transport	11.3	6.2	73.5
Water transport	11.3	28.9	83.0
Air transport	11.3	26.9	89.8
Auxiliary transport activities	11.3	20.8	77.1
Post and telecommunications	17.3	30.1	94.7
Financial intermediation	8.7	40.9	97.9
Insurance and pension funding	9.1	46.4	99.1
Auxiliary financial activities	14.6	41.6	59.5
Real estate activities	12.5	27.2	51.8
Renting of manchinery and eq.	13.7	17.0	60.7
Computer and related activities	19.7	72.1	68.5
Research and development	17.1	71.3	77.2
Other business activities	14.6	38.8	68.8

1. Estimated industry fixed effects in panel regressions of entry data, the share of the large firms and the share of the skilled workers on country and industries dummies.
2. Entry rates for industry branches in which data were missing were assumed to be identical to the entry rates for the aggregates.
3. 1994 for France, 1996 for Sweden, 1995 for other EU countries and 1998 for non-EU countries.
4. In total employment of firms with more than 10 employees.

Table 2. **Estimates of earnings profiles**
Wages and observable workers characteristics

(estimated on a hourly basis for full-time workers)

	Austria	Belgium	Canada	Denmark	France	Greece	Ireland	Italy	Spain	Sweden	United Kingdom	United States
Gender												
Male	-	-	-	-	-	-	-	-	-	-	-	-
	(0.65)	(0.69)	(1.00)	(0.63)	(0.67)	(0.64)	(0.58)	(0.71)	(0.75)	(0.70)	(0.58)	(0.61)
Female	-0.24	-0.16	-0.23	-0.14	-0.21	-0.19	-0.18	-0.17	-0.19	-0.11	-0.25	-0.20
	(0.35)	*(0.31)*	*(0.00)*	*(0.37)*	*(0.33)*	*(0.36)*	*(0.42)*	*(0.29)*	*(0.25)*	*(0.30)*	*(0.42)*	*(0.39)*
Age												
15-24	-	-	-	-	-	-	-	-	-	-	-	-
	(0.16)	*(0.10)*	*(0.00)*	*(0.20)*	*(0.12)*	*(0.11)*	*(0.22)*	*(0.10)*	*(0.09)*	*(0.08)*	*(0.15)*	*(0.17)*
25-34	0.19	0.22	0.38	0.22	0.30	0.21	0.36	0.21	0.33	0.16	0.33	0.22
	(0.32)	*(0.36)*	*(0.00)*	*(0.29)*	*(0.31)*	*(0.34)*	*(0.38)*	*(0.32)*	*(0.32)*	*(0.27)*	*(0.30)*	*(0.26)*
35-54	0.35	0.45	0.52	0.33	0.59	0.48	0.58	0.48	0.62	0.33	0.40	0.35
	(0.47)	*(0.51)*	*(0.00)*	*(0.43)*	*(0.53)*	*(0.48)*	*(0.36)*	*(0.53)*	*(0.50)*	*(0.54)*	*(0.44)*	*(0.46)*
55 and over	0.26	0.54	0.49	0.32	0.77	0.53	0.65	0.45	0.71	0.37	0.28	0.34
	(0.05)	*(0.04)*	*(0.00)*	*(0.08)*	*(0.03)*	*(0.07)*	*(0.04)*	*(0.05)*	*(0.09)*	*(0.11)*	*(0.11)*	*(0.10)*
Education												
Early childhood, primary and lower secondary	-	-	-	-	-	-	-	-	-	-	-	-
	(0.32)	*(0.34)*	*n.a.*	*(0.32)*	*(0.15)*	*(0.42)*	*(0.26)*	*(0.65)*	*(0.61)*	*(0.70)*	*(0.55)*	*(0.14)*
Upper secondary	0.23	0.12	0.16	0.10	0.06	0.08	0.18	0.19	0.23	0.09	0.10	0.23
	(0.66)	*(0.43)*	*n.a.*	*(0.50)*	*(0.60)*	*(0.46)*	*(0.54)*	*(0.29)*	*(0.19)*	*(0.15)*	*(0.30)*	*(0.57)*
Non-university tertiary	n.s.	0.28	0.22	0.20	0.26	0.18	0.35	n.s.	0.21	0.15	0.25	0.31
	(0.00)	*(0.14)*	*n.a.*	*(0.05)*	*(0.13)*	*(0.03)*	*(0.14)*	*(0.00)*	*(0.09)*	*(0.09)*	*(0.06)*	*(0.08)*
University tertiary	0.49	0.44	0.42	0.22	0.62	0.34	0.56	0.21	0.45	0.32	0.40	0.44
	(0.02)	*(0.09)*	*n.a.*	*(0.14)*	*(0.12)*	*(0.09)*	*(0.07)*	*(0.06)*	*(0.11)*	*(0.06)*	*(0.09)*	*(0.22)*
R-squared	0.75	0.91	0.96	0.93	0.90	0.93	0.92	0.88	0.96	0.90	0.95	0.97
R-squared adjusted	0.67	0.88	0.95	0.92	0.87	0.90	0.89	0.85	0.95	0.87	0.94	0.96

Note:
The dependent variable is the fixed effect obtained in the first-stage regression for each age *x* education *x* gender category. These equations are thus estimated with 32 observations for each country.
Data in parentheses are employment shares within each country's sample. They may differ from the actual employment share in the economy, as the sample is not necessarily representative.
n.a. : Not available.

Table 3. **Estimated industry wage premia**[1]

Results of first-step regressions

	Austria	Belgium	Canada	Denmark	France	Greece	Ireland	Italy	Spain	Sweden	United Kingdom	United States
Manufacturing												
Food & Beverages	-0.02	-0.03	-0.01	-0.06	-0.04	0.02	0.02	0.05	0.00	-0.01	-0.06	-0.07
	(0.03)	*(0.03)*	*(0.02)*	*(0.02)*	*(0.06)*	*(0.03)*	*(0.03)*	*(0.04)*	*(0.03)*	*(0.02)*	*(0.03)*	*(0.05)*
Tobacco	0.25	0.12		-0.06		0.27	0.26	-0.13	0.26	-0.07	0.35	0.26
	(0.04)	*(0.04)*		*(0.03)*		*(0.03)*	*(0.09)*	*(0.05)*	*(0.04)*	*(0.04)*	*(0.10)*	*(0.12)*
Textiles	-0.06	-0.13		-0.13	-0.20	-0.02	-0.15	-0.13	-0.13		-0.26	-0.09
	(0.03)	*(0.03)*		*(0.02)*	*(0.08)*	*(0.02)*	*(0.03)*	*(0.06)*	*(0.03)*		*(0.04)*	*(0.07)*
Wearing apparel	-0.21	-0.09		-0.14	-0.28	-0.15	-0.17	-0.23	-0.17	-0.19	-0.26	-0.21
	(0.05)	*(0.03)*		*(0.03)*	*(0.07)*	*(0.03)*	*(0.04)*	*(0.05)*	*(0.03)*	*(0.02)*	*(0.04)*	*(0.06)*
Leather	-0.20	-0.10		-0.15	-0.34	-0.09	-0.30	-0.24	-0.17	-0.09	-0.21	-0.15
	(0.03)	*(0.03)*		*(0.03)*	*(0.10)*	*(0.03)*	*(0.04)*	*(0.07)*	*(0.03)*	*(0.02)*	*(0.05)*	*(0.07)*
Wood	-0.12	-0.13		-0.10	0.38	-0.02	-0.19	-0.18	-0.20	-0.06	-0.15	-0.08
	(0.03)	*(0.03)*		*(0.02)*	*(0.05)*	*(0.04)*	*(0.03)*	*(0.05)*	*(0.02)*	*(0.03)*	*(0.04)*	*(0.05)*
Pulp & Paper	0.00	0.03		-0.02	0.05	0.06	0.04	-0.01	0.08	0.07	0.00	0.08
	(0.03)	*(0.03)*		*(0.02)*	*(0.06)*	*(0.03)*	*(0.02)*	*(0.06)*	*(0.03)*	*(0.03)*	*(0.04)*	*(0.05)*
Printing & Publishing	0.13	0.02		0.12	0.04	0.03	0.15	0.08	0.07	0.03	0.17	-0.03
	(0.04)	*(0.02)*		*(0.02)*	*(0.08)*	*(0.03)*	*(0.03)*	*(0.05)*	*(0.03)*	*(0.02)*	*(0.03)*	*(0.06)*
Coke, Petroleum	0.45	0.20		0.15	0.25	0.39		0.20	0.43	0.11	0.23	0.19
	(0.05)	*(0.04)*		*(0.02)*	*(0.05)*	*(0.05)*		*(0.04)*	*(0.03)*	*(0.03)*	*(0.04)*	*(0.07)*
Chemicals	0.11	0.13		0.06	0.13	0.15	0.11	0.09	0.12	0.08	0.11	0.10
	(0.03)	*(0.02)*		*(0.02)*	*(0.05)*	*(0.03)*	*(0.02)*	*(0.04)*	*(0.02)*	*(0.04)*	*(0.02)*	*(0.05)*
Rubber & Plastics	0.02	0.02		-0.05	-0.09	-0.04		-0.06	0.03	0.01	-0.10	-0.02
	(0.03)	*(0.02)*		*(0.01)*	*(0.05)*	*(0.03)*		*(0.05)*	*(0.03)*	*(0.02)*	*(0.03)*	*(0.05)*
Non-metallic mineral	0.07	-0.01		-0.04	0.00	0.05	-0.03	-0.06	0.04	0.01	-0.12	-0.01
	(0.03)	*(0.02)*		*(0.02)*	*(0.05)*	*(0.02)*	*(0.03)*	*(0.05)*	*(0.02)*	*(0.05)*	*(0.03)*	*(0.06)*
Basic metals	0.07	0.08		-0.07	-0.01	0.09	0.13	-0.03	0.14	0.07	-0.07	0.10
	(0.03)	*(0.02)*		*(0.02)*	*(0.07)*	*(0.03)*	*(0.03)*	*(0.06)*	*(0.03)*	*(0.03)*	*(0.04)*	*(0.06)*
Fabricated metal	0.01	-0.08		-0.09	-0.04	-0.03	-0.09	-0.09	0.04	-0.05	-0.07	-0.02
	(0.03)	*(0.02)*		*(0.02)*	*(0.05)*	*(0.03)*	*(0.02)*	*(0.05)*	*(0.02)*	*(0.03)*	*(0.03)*	*(0.05)*
Machinery & equipment	0.06	-0.07		-0.08	0.00	0.07	-0.06	-0.05	0.11	-0.05	-0.02	0.08
	(0.04)	*(0.02)*		*(0.02)*	*(0.06)*	*(0.03)*	*(0.02)*	*(0.04)*	*(0.03)*	*(0.02)*	*(0.03)*	*(0.05)*
Office machinery	0.15	-0.09		-0.04	0.08		0.00	0.11	0.16	0.03	0.21	0.09
	(0.05)	*(0.04)*		*(0.02)*	*(0.13)*		*(0.03)*	*(0.05)*	*(0.05)*	*(0.05)*	*(0.04)*	*(0.06)*
Electrical machinery	0.15	-0.02		-0.11	-0.04	0.03	-0.02	-0.05	0.07	-0.05	-0.07	0.06
	(0.04)	*(0.02)*		*(0.02)*	*(0.06)*	*(0.03)*	*(0.03)*	*(0.04)*	*(0.02)*	*(0.04)*	*(0.03)*	*(0.05)*
Radio, television	0.13	0.12		-0.12	-0.01	0.05	0.00	0.01	0.09	0.03	-0.01	0.14
	(0.03)	*(0.03)*		*(0.02)*	*(0.06)*	*(0.05)*	*(0.03)*	*(0.05)*	*(0.03)*	*(0.03)*	*(0.03)*	*(0.06)*
Instruments,Watches	0.07	-0.01		0.00	0.03	-0.09	-0.01	-0.05	-0.03	-0.01	-0.03	0.11
	(0.03)	*(0.02)*		*(0.02)*	*(0.07)*	*(0.03)*	*(0.02)*	*(0.05)*	*(0.03)*	*(0.03)*	*(0.03)*	*(0.05)*
Motor vehicles	0.04	0.08		-0.15	-0.14	0.03	-0.13	-0.12	0.15	0.03	0.05	0.20
	(0.03)	*(0.02)*		*(0.02)*	*(0.05)*	*(0.05)*	*(0.04)*	*(0.05)*	*(0.03)*	*(0.03)*	*(0.04)*	*(0.06)*
Other transport equip.	0.01	0.06		-0.07	0.07	0.28	-0.02	0.00	0.14	0.00	0.05	0.21
	(0.03)	*(0.03)*		*(0.02)*	*(0.06)*	*(0.03)*	*(0.05)*	*(0.06)*	*(0.03)*	*(0.04)*	*(0.03)*	*(0.05)*

1. In logarithm, compared to the economywide, employment weighted, average wage.

Table 3. **Estimated industry wage premia**[1] (continued)

Results of first-step regressions

	Austria	Belgium	Canada	Denmark	France	Greece	Ireland	Italy	Spain	Sweden	United Kingdom	United States
Non-manufacturing												
Electricity and Gas	0.17	0.25	0.27[2]	0.01	0.02	0.09		0.18	0.27	0.07	0.21	0.28
	(0.03)	*(0.03)*	*(0.03)*	*(0.02)*	*(0.05)*	*(0.04)*		*(0.04)*	*(0.04)*	*(0.03)*	*(0.03)*	*(0.05)*
Collection, distribution of water	-0.05	-0.03			0.17	0.19		0.17	0.07		0.10	0.13
	(0.04)	*(0.03)*			*(0.05)*	*(0.03)*		*(0.07)*	*(0.03)*		*(0.03)*	*(0.07)*
Construction	0.01	-0.06	0.05	-0.01	0.00			0.00	-0.04	-0.01	-0.03	0.13
	(0.04)	*(0.03)*	*(0.02)*	*(0.02)*	*(0.06)*			*(0.05)*	*(0.02)*	*(0.02)*	*(0.02)*	*(0.05)*
Sale , repair of motor vehicles	-0.07	-0.06		-0.07	-0.06	-0.03	-0.12	-0.10	-0.12	-0.04	-0.14	-0.13
	(0.04)	*(0.02)*		*(0.02)*	*(0.05)*	*(0.03)*	*(0.03)*	*(0.05)*	*(0.03)*	*(0.02)*	*(0.03)*	*(0.06)*
Wholesale trade	0.03	-0.01	-0.03	0.03	0.09	-0.05	0.08	0.01	-0.09	0.04	-0.02	-0.07
	(0.03)	*(0.02)*	*(0.02)*	*(0.02)*	*(0.06)*	*(0.02)*	*(0.03)*	*(0.05)*	*(0.02)*	*(0.03)*	*(0.02)*	*(0.05)*
Retail trade	-0.05	-0.15	-0.17	-0.10	-0.08	-0.15	-0.22	-0.07	-0.12	-0.04	-0.11	-0.18
	(0.04)	*(0.02)*	*(0.02)*	*(0.02)*	*(0.05)*	*(0.03)*	*(0.03)*	*(0.05)*	*(0.03)*	*(0.02)*	*(0.03)*	*(0.05)*
Hotels & Restaurants	-0.30	-0.21	-0.35	-0.08	-0.19	-0.03	-0.23	-0.14	-0.15	-0.08	-0.30	-0.24
	(0.05)	*(0.03)*	*(0.02)*	*(0.02)*	*(0.09)*	*(0.03)*	*(0.02)*	*(0.06)*	*(0.03)*	*(0.03)*	*(0.04)*	*(0.05)*
Land transport	-0.06	-0.08	-0.01	-0.14	-0.10	0.10		0.15	-0.02	-0.08	-0.09	0.03
	(0.04)	*(0.03)*	*(0.02)*	*(0.03)*	*(0.05)*	*(0.02)*		*(0.06)*	*(0.02)*	*(0.04)*	*(0.04)*	*(0.05)*
Water transport	0.15	0.10	0.00	0.03		0.23		0.01	0.32	0.12	0.09	0.05
	(0.06)	*(0.03)*		*(0.02)*		*(0.04)*		*(0.06)*	*(0.08)*	*(0.03)*	*(0.04)*	*(0.09)*
Air transport	0.15	0.14		0.18		0.12		0.32	0.03	0.14	0.22	0.11
	(0.08)	*(0.05)*		*(0.03)*		*(0.04)*		*(0.05)*	*(0.06)*	*(0.06)*	*(0.03)*	*(0.06)*
Auxiliary transport activities	0.00	-0.01		-0.01	-0.16	-0.11		-0.01	0.00	-0.03	0.04	0.01
	(0.04)	*(0.02)*		*(0.02)*	*(0.07)*	*(0.02)*		*(0.04)*	*(0.03)*	*(0.03)*	*(0.03)*	*(0.07)*
Post & Communications	0.02	0.09	0.11	0.08		0.05		0.06	0.13	0.00	0.10	0.14
	(0.05)	*(0.04)*	*(0.02)*	*(0.03)*		*(0.03)*		*(0.05)*	*(0.05)*	*(0.03)*	*(0.03)*	*(0.05)*
Financial intermediation	0.17	0.15	0.10	0.15	0.09	0.18	0.18	0.28	0.18	0.08	0.29	0.02
	(0.04)	*(0.03)*	*(0.03)*	*(0.02)*	*(0.06)*	*(0.03)*	*(0.04)*	*(0.05)*	*(0.04)*	*(0.05)*	*(0.03)*	*(0.05)*
Insurance	0.11	0.08	0.14	0.21	0.03	0.15	0.21	0.10	0.04	0.17	0.20	0.05
	(0.04)	*(0.03)*	*(0.00)*	*(0.02)*	*(0.08)*	*(0.03)*	*(0.04)*	*(0.05)*	*(0.03)*	*(0.04)*	*(0.04)*	*(0.05)*
Auxiliary financial activities	0.19	0.02		0.31	0.19	0.20		0.13	0.23	0.14	0.23	
	(0.05)	*(0.03)*		*(0.04)*	*(0.07)*	*(0.07)*		*(0.06)*	*(0.05)*	*(0.05)*	*(0.04)*	
Real estate	0.07	-0.05	-0.09	-0.06	-0.05			0.09	0.04	-0.03	0.03	-0.03
	(0.04)	*(0.03)*	*(0.04)*	*(0.02)*	*(0.20)*			*(0.09)*	*(0.04)*	*(0.04)*	*(0.03)*	*(0.05)*
Renting of machinery & equipment	-0.04	-0.06		-0.01					-0.12	-0.02	-0.02	-0.17
	(0.03)	*(0.04)*		*(0.04)*					*(0.05)*	*(0.04)*	*(0.04)*	*(0.06)*
Computer	0.21	0.04		0.20	0.28			0.06	0.03	0.12	0.24	0.18
	(0.04)	*(0.02)*		*(0.02)*	*(0.14)*			*(0.05)*	*(0.05)*	*(0.04)*	*(0.04)*	*(0.06)*
Research and development	0.08	0.03		0.16	-0.01			0.06		0.02	0.17	0.14
	(0.06)	*(0.03)*		*(0.02)*	*(0.06)*			*(0.05)*		*(0.04)*	*(0.04)*	*(0.06)*
Other business services	-0.02	-0.02	-0.01	0.01	0.08			-0.07	-0.04	0.01	0.10	-0.01
	(0.03)	*(0.02)*	*(0.02)*	*(0.02)*	*(0.06)*			*(0.04)*	*(0.02)*	*(0.02)*	*(0.03)*	*(0.05)*
Adjusted standard deviation	0.13	0.09	0.16	0.11	0.13	0.12	0.14	0.12	0.14	0.07	0.15	0.11
Correlation with US structure	0.72	0.75	0.90	0.35	0.48	0.70	0.62	0.49	0.78	0.61	0.72	1.00
R-squared	0.87	0.91	0.94	0.85	0.88	0.88	0.93	0.78	0.88	0.84	0.84	0.67
Observations	676	905	337	1128	310	677	431	733	1021	398	1023	1311

1. In logarithm, compared to the economywide, employment weighted, average wage.
2. Electricity, Gas and Water supply

Table 4. **The effects of anticompetitive regulations on wage premia**

Results of panel regressions

Dependent variable : Estimated hourly wage premia for full-time workers

	Manufacturing sector			**Non-manufacturing sector**			
Method	Fixed effects	Cluster adjusted	Random effects	Fixed effects		Cluster adjusted	Random effects
Tariff barriers	0.33 *	0.08	0.19 **				
	(2.51)	*(0.69)*	*(3.19)*				
Non-tariff barriers	0.12 *	-0.01	-0.01				
	(2.43)	*(-0.64)*	*(-0.52)*				
Product market regulation				0.23 *	0.30 *	0.20	0.20 *
				(2.37)	*(2.39)*	*(1.63)*	*(2.14)*
Non-linear effect of regulation[1]				-0.57 **	-0.63 **	-0.55 **	-0.55 **
				(-3.52)	*(-3.64)*	*(-3.28)*	*(-3.01)*
Import penetration rate[2]	-0.03 *	-0.03 **	-0.03 **				
	(2.48)	*(-2.96)*	*(-3.41)*				
Export intensity[2]	0.02	0.00	0.003				
	(1.69)	*(-0.48)*	*(0.32)*				
Union density[2]					0.03	0.03 *	0.03
					(1.52)	*(2.04)*	*(1.95)*
Union density * average share of unskilled workers[3]	0.10 **	0.11 **	0.11 **				
	(5.23)	*(4.47)*	*(5.37)*				
Size[2]	0.05 **	0.07 **	0.06 **				
	(3.67)	*(6.86)*	*(5.80)*				
R&D[2]	0.002						
	(0.33)						
Country-independent variables :							
Average entry rate		-1.7 **	-1.9 **			-0.02 **	-0.02 **
		(-3.26)	*(-3.11)*			*(-2.82)*	*(-4.30)*
Average skill[2]		0.18 **	0.19 **				
		(8.94)	*(10.90)*				
Average size[2]						0.10 **	0.10 **
						(4.72)	*(7.88)*
Industry dummies	Yes	No	No	Yes	Yes	No	No
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
RESET	2.31	5.00 **		0.91	1.67	0.35	
R-squared	0.87	0.78		0.77	0.80	0.68	
F-test on industry dummies	14.8 **			21.4 **	14.9 **		
Cook-Weisberg	0.29			0.03	1.81		
Breusch-Pagan			60.7 **				21.0 **
Hausman			92.6 **				1.07
Observations	206	206	206	112	84	84	84
Countries	11	11	11	12	10	10	10

Note: All equations includes a constant. *, ** denote significance at the 5% and 1% level, respectively.
T-statistics in parentheses. Samples are adjusted for outliers.
All variables in logs except regulation, tariff barriers, non-tariff barriers and entry rates.

1. Defined as the product of the industry-specific product market regulation indicators and their deviations from their industry means.
2. In logarithm.
3. Product of the average union density in manufacturing for the country, by the (country-independent) average share of unskilled workers (see Table 1).

Table 5. **The effects of public monopoly in non-manufacturing industries**
Results of fixed-effects panel regressions

Dependent variable : Estimated hourly wage premia for full-time workers

	Basic model	Unrestricted model	Testing public ownership per se	Testing regulation per se	Public monopoly	Non-nested tests	
						Public monopoly model vs basic model	Basic model vs public monopoly model
Product market regulation	0.23 *						0.04
	(2.37)						*(0.26)*
Non-linear effect of regulation	-0.57 **						-0.09
	(-3.52)						*(-0.29)*
Regulation (net of public ownership)		0.19	0.19 **	0.19	0.19 *	0.16	
		(1.58)	*(2.74)*	*(1.80)*	*(2.55)*	*(1.64)*	
Non-linear effect of regulation (net of public ownership)		0.01		-0.02			
		(0.05)		*(-0.07)*			
Public ownership		0.02	0.02				
		(0.17)	*(0.18)*				
Regulation (net of public ownership)*Public ownership		-0.39	-0.38 *	-0.34 **	-0.35 **	-0.31	
		(-1.52)	*(-2.37)*	*(-2.58)*	*(-3.82)*	*(-1.62)*	
Predicted value from basic model						0.17	
						(0.29)	
Predicted value from public monopoly model							0.88
							(1.71)
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
RESET	0.91	0.57	0.57	0.57	0.54	0.91	0.56
R-squared	0.77	0.78	0.78	0.78	0.78	0.77	0.78
Cook-Weisberg	0.03	0.14	0.15	0.16	0.16	0.03	0.12
Observations	112	112	112	112	112	112	112
Countries	12	12	12	12	12	12	12

Note: All equations includes a constant. *, ** denote significance at the 5% and 1% level, respectively.
T-statistics in parentheses. Samples are adjusted for outliers.
Dependent variable in logs.

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