INTERNATIONAL COMPARISONS OF INTER-INDUSTRY WAGE DIFFERENTIALS

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We use OECD data to examine inter-industry wage differentials (relative wages among industries) for 14 OECD countries over the period 1970–85. We find, first, that the industrial wage structures have shown remarkable stability over time in terms of rank order for all the countries in the sample. Second, despite their rank order stability, wage structures show a tendency to expand or contract. While the U.S. has shown increasing industry wage dispersion between 1970 and 1985, the pattern is very mixed for other countries. Unionization is a significant factor in explaining cross-country differences. Third, industry wage rankings show some evidence of becoming increasingly similar across nations over time, and this movement is associated with a convergence of per capita incomes. Fourth, industry wage differentials are positively related to an industry's productivity growth, output growth, capital intensity, and export orientation.

1. INTRODUCTION

Why do wages differ across industries? This is a question of long-standing interest which has received renewed attention in recent years, with new empirical studies (see for example, Krueger and Summers, 1987 and 1988, Dickens and Katz, 1987*a*, *b* and the survey by Groshen, 1991) being joined by a burgeoning theoretical literature (Akerlof and Yellen, 1986 provide a collection of work in this area). Our focus here is on the inter-industry wage differential, defined as the percentage difference between the average wage of an industry and the overall average wage of the economy. Previous empirical work has documented that the rank order of inter-industry wage differentials in the U.S. has stayed remarkably constant over time, even after controlling for skill, working conditions and a variety of other industry-specific factors.

One area that has received relatively little attention to date is the extent to which industrial wage patterns observed in the U.S. (both cross-sectional and time-series) are replicated in other countries. In this paper we seek to fill this gap with a comparative examination of industry wage structures for 14 OECD countries over the period 1960–85. Cross-country comparisons of this type are important for distinguishing among competing theories of wage determination.

Differences across countries would lead to an emphasis on factors specific to nations, such as labor–market institutions, while similarities in wage structures would indicate that a factor common across countries, such as technology, is responsible for wage differences across industries.

We address four main issues in this paper. First, to what extent are industrial wage structures stable over time? Previous work on the subject has examined manufacturing industries only or been limited to a small number of countries. Second, what are trends in industrial wage dispersion in these countries? Recent work documents growing inter-industry earnings inequality in the U.S. since the early 1970s. Thus far, little attention has been given to whether this phenomenon is general among OECD countries.

Third, how similar are industry wage structures among countries and how has the degree of similarity changed over time? Past analysis bearing on this subject either has been restricted mainly to manufacturing industries or has covered limited time periods. Fourth, what factors can explain differing trends in industrial wage differentials among countries and the resulting differences in patterns of wage dispersion over time? Here we attempt to determine whether the disparate trends are due to different underlying economic conditions—for example, cross-country differences in such factors as industry productivity growth, capital intensity, and trade openness—or to differences in institutions such as labor unions.

We find, first, that the industrial wage structures have shown remarkable stability over time in terms of rank order for all the countries in our sample. Second, industry wage structures show some evidence of becoming increasingly similar among nations over time, and this movement is associated with a convergence of per capita income. The industry wage differences are also found to be positively related to an industry's productivity growth, GDP growth, capital intensity and degree of export orientation.

Third, despite their rank order stability, wage structures show a tendency to expand or contract over time, leading to changes in industrial wage dispersion over time. Trends in industrial wage inequality differ substantially across nations. While the U.S. has shown rising inter-industry wage dispersion between 1970 and 1985, others have shown no change and still others have experienced declining dispersion. While differences across countries in trends in industry productivity and capital intensity explain some of this divergence, country-specific factors such as institutions seem to play an important role as well. One such factor is the strength of labor unions in a country, which has a negative association with increases in industry wage dispersion, thus acting as a brake on rising inequality, particularly among manufacturing industries.

The rest of this paper proceeds as follows: In section 2 we describe the data and methods used. In sections 3 to 6 we consider, in turn, the four issues denoted above. Some concluding remarks are offered in Section 7.

2. DATA SOURCES AND METHODS

The primary data source for this study is the International Sectoral Data Base (ISDB) of the OECD.[1] The data set covers fourteen countries, with the

[1]For a description of the data, see Meyer-zu-Schlochtern (1988).

period of availability ranging up to 1960–85, and with most countries having data for at least the 1970–85 period.[2] The ISDB provides compensation and employment data, as well as other relevant series on output and capital stock.

Several pertinent features of the ISDB should be mentioned. First, the 14 countries are all industrialized. While this feature enhances the comparability of the data, it does limit the range of inferences that can be drawn. Second, though the data do cover the entire economy, the level of aggregation is higher than that which is available for many single-country studies, with 20 the maximum number of sectors available for any country. Third, data are not avialable for the same sectoring for all countries, forcing, in many cases, variations in the sectors and countries included in the analysis.

Our basic variable is the industry wage differential. Define the average wage, w^h, in country h as:

$$(1) \qquad\qquad w^h = W^h/E^h,$$

where W^h is total employee compensation in country h and E^h is the number of employees.[3] In analogous fashion, define the average wage in industry i in country h as:

$$(2) \qquad\qquad w_i^h = W_i^h/E_i^h.$$

The industry wage differential of industry i in country h, d_i^h, is then given by:

$$(3) \qquad\qquad d_i^h = \text{Ln}\ (w_i^h/w^h),$$

which shows the percentage difference between an industry's average wage and the average wage for the whole economy in that country.

In Table 1 we present some descriptive data on industry wage differentials for Germany, Japan, and the U.S. in 1985. Industries are ranked according to the U.S. industry wage differential. It is, first, apparent that there is a substantial spread in industry wage differentials. In the U.S., they ranged from a high of 0.55 (55 percent greater than the overall mean) in the electricity, gas, and water sector (utilities) to a low of −0.71 in agriculture. Mining, basic metal products, chemicals, and the machinery and equipment industry also pay rather high wages, while restaurants and hotels, trade, and textiles all pay rather low wages. The industry ranking was similar in Germany, though the spread was smaller, ranging from a high of 0.35 in the electricity, gas, and water sector (also the highest in the U.S.) to a low of −0.52 in restaurants and hotels. The correlation coefficient of industry wage differentials with the U.S. is quite high, at 0.86. Japan's indsutry ranking was less similar to the U.S. than was Germany's. As in the U.S., the electricity, gas, and water sector was the highest paid and agriculture the lowet paid, and the range was similar, from 0.66 to −0.54. However, mining was a high-paying industry in the U.S. and a low-paying one in Japan, whereas government workers were very highly paid in Japan and were paid only about average in the U.S. The correlation coefficient between the two countries is 0.65.

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[2]In the Appendix we provide details on availability of data on employee compensation.

[3]Except as noted below in the case of the Netherlands, we use number of employees rather than total employment (defined as the number of employees plus the number of self-employed), because labor compensation in the OECD data covers only employees.

TABLE 1

INDUSTRY WAGE DIFFERENTIALS FOR GERMANY, JAPAN, AND THE U.S., 1985

	U.S.	Germany	Japan
Electricity, gas & water	0.553 (1)	0.354 (1)	0.659 (1)
Mining	0.525 (2)	0.271 (2)	−0.177 (10)
Basic metal products	0.484 (3)	0.100 (6)	0.497 (3)
Chemicals	0.429 (4)	0.261 (3)	0.365 (4)
Machinery & equipment	0.385 (5)	0.137 (5)	0.068 (6)
Transport, storage & communication	0.344 (6)	0.037 (10)	0.239 (5)
Non-metallic mineral products	0.253 (7)	0.040 (8)	−0.178 (11)
Finance & insurance	0.227 (8)	0.232 (4)	
Paper, printing & publishing	0.198 (9)	0.039 (9)	−0.111 (9)
Food, beverages & tobacco	0.153 (10)	−0.153 (13)	−0.457 (14)
Construction	0.149 (11)	−0.127 (12)	−0.071 (8)
Producers of government services	0.034 (12)	0.056 (7)	0.500 (2)
Real estate	0.015 (13)		
Other manufactured products	−0.038 (14)	−0.327 (18)	−0.054 (7)
Wood & wood products	−0.065 (15	−0.119 (11)	
Community, social & personal services	−0.293 (16)	−0.282 (16)	−0.278 (12)
Textiles	−0.310 (17)	−0.309 (17)	−0.369 (13)
Wholesale & retail trade	−0.314 (18)	−0.174 (14)	
Restaurants & hotels	−0.484 (19)	−0.519 (19)	
Agriculture	−0.707 (20)	−0.257 (15)	−0.539 (15)
Correlation with the U.S.	—	0.86	0.65

Industries are ranked by U.S. industry wage differential. The rank is shown in parentheses.

Unfortunately, due to a lack of appropriate data, we are not able to control for differences in the educational or skill level of workers by industry in the various countries. However, the work of Krueger and Summers (1987) and of Helwege and Wagner (1991) suggests that the failure to do so may not unduly bias the cross-country comparisons.[4]

3. STABILITY OF WAGE DIFFERENTIALS WITHIN COUNTRIES

A considerable amount of past research has focused on the extent to which the wage structure of the U.S. has been stable over time. This literature has been reviewed elsewhere (see, for example, Krueger and Summers, 1987), so it will be discussed only briefly here. Earlier findings of stability for U.S. manufacturing industries (for example, Slichter, 1950) have since been supplemented by more recent work (for example, Krueger and Summers, 1987) showing a high degree of stability in industry wage differentials for both the manufacturing sector and the economy as a whole. Tarling and Wilkinson (1982) and Lawson (1982) both found that the inter-industry wage structure was quite stable in the U.K. in the post World War II period. Papola and Bharadwaj (1970), in an exmaination of manufacturing wages for 17 countries in the period from 1948 to 1965, found a high degree of stability for developed countries, though not for developing ones.

[4]Krueger and Summers (1987) found on the basis of U.S. data that while industrial wage dispersion was reduced by adjusting industry wages for differences in worker characteristics, the ranking of industries by (adjusted) average wages was barely altered. Helwege and Wagner (1991) found that the correlation between the wage structure of the U.S. and that of Germany was hardly affected by the inclusion of industry variables for tenure, experience, education and regional factors.

TABLE 2

CORRELATION OF INDUSTRY WAGE DIFFERENTIALS OVER TIME WITHIN COUNTRY FOR ALL INDUSTRIES AND FOR MANUFACTURING INDUSTRIES. 1960-85

	Correlation Coefficients[a]					Rank Correlations[b]			Coeff. of Concord.[c]
	1980	1975	1970	1965	1960	1980	1975	1970	
A. All Industries									
Australia	0.95	0.92	0.89			0.84	0.84	0.81	0.93
Belgium	0.99	0.95	0.89			0.99	0.92	0.82	0.94
Canada	0.98	0.96	0.75			0.96	0.97	0.74	0.86
Denmark	0.96	0.88	0.85			0.94	0.88	0.85	0.91
Finland	0.98	0.89	0.91	0.89	0.87	0.99	0.84	0.88	0.92
France	0.99	0.97	0.94			0.91	0.93	0.88	0.92
Germany	0.99	0.97	0.96			0.98	0.95	0.94	0.98
Italy	0.98	0.96	0.98			0.98	0.96	0.96	0.98
Japan	0.98	0.93	0.88			0.96	0.93	0.89	0.96
Netherlands	0.99	0.98				0.98	0.92		0.97
Norway	0.97	0.85	0.82	0.80		0.96	0.95	0.87	0.96
Sweden	0.98	0.94	0.91			0.93	0.92	0.89	0.93
U.K.	0.96	0.92	0.69			0.93	0.89	0.66	0.89
U.S.	0.99	0.99	0.97	0.96	0.94	0.97	0.97	0.97	0.99
B. Manufacturing Industries Only									
Australia	—	—	—			---	—	---	---
Belgium	0.98	0.97	0.92			0.95	0.93	0.88	0.95
Canada	0.96	0.96	0.41			0.93	0.97	0.37	0.70
Denmark	0.99	0.95	0.96			0.92	0.93	0.97	0.96
Finland	0.99	0.97	0.96	0.96	0.92	1.00	0.95	0.98	0.98
France	0.98	0.97	0.95			0.88	0.88	0.81	0.88
Germany	0.99	0.99	0.97			0.98	0.97	0.92	0.96
Italy	0.99	0.99	0.93			0.98	0.98	0.92	0.96
Japan	0.94	0.93	0.92			0.88	0.90	0.88	0.96
Netherlands	1.00	0.99				0.95	0.95		0.98
Norway	0.96	0.97	0.97	0.96		0.93	0.98	0.93	0.93
Sweden	0.99	0.97	0.99			0.95	0.95	0.93	0.95
U.K.	0.95	0.95	0.92			0.86	0.90	0.83	0.92
U.S.	0.99	1.00	1.00	0.99	0.99	0.98	0.98	0.98	0.99

[a]Correlation with country h's industry wage differentials (d_i^h) in 1985. For France and the Netherlands, correlations are with 1984. The number of sectors included in the correlations for all industries are: Australia (10); Belgium (16); Canada (18); Denmark (20); Finland (20); France (16); Germany (19); Italy (17); Japan (17); Netherlands (18); Norway (20); Sweden (20); U.K. (17); and the U.S. (20). The number of sectors included in the correlations for manufacturing industries only are: Australia (0); Belgium (8); Canada (9); Denmark (9); Finland (9); France (8); Germany (9); Italy (9); Japan (8); Netherlands (8); Norway (9); Sweden (9); U.K. (8); and the U.S. (9).

[b]Rank correlation with country h's industry wage differentials (d_i^h) in 1985. For France and the Netherlands, correlations are with 1984.

[c]Coefficient of concordance for rank of inter-industry wage differentials over the period 1970 85 (1970-84 for France and 1972-84 for the Netherlands).

Here we examine industry wage differentials in 14 industrialized countries. For each country, inter-industry wage differentials were calculated at the most disaggregated level possible. Three metrics were constructed to test for stability: (i) the correlation coefficient of the differentials for each pair of

years; (ii) the analogous rank correlation coefficients; and (iii) the coefficient of concordance.[5]

As shown in Panel A of Table 2, all three measures indicate that the economy-wide wage structures of all these countries have been very stable during the period examined. While the correlation coefficients with the 1985 wage differentials generally fall the further back in time, they remain high (and statistically significant) in all cases. For 1980, all the coefficients exceed 0.90; for 1975, all but three exceed 0.90; and for 1970, half exceed 0.90 and all are but one greater than 0.80. Results using the rank correlation coefficient are quite similar. Moreover, the coefficients of concordance over the 1970–85 period all exceed 0.90,[6] except for Canada.[7] A comparison of the statistics for all industries shown in Panel A and those for manufacturing industries only presented in Panel B indicates that the degree of stability of wage structures is scarcely affected when the universe is expanded beyond manufacturing.

4. TRENDS IN WAGE DISPERSION WITHIN COUNTRY

A significant amount of recent work has documented and sought to explain growing inter-industry earnings inequality in the U.S. since the early 1970s (see, for example, Bell and Freeman, 1987 and 1988, Kaufman and Stephan, 1987, Davidson and Reich, 1988, and Howell and Wolff, 1991). A few studies exist on cross-country comparisons. Bell and Freeman (1987), using a sample of eight industrialized countries, maintained that the U.S. stood out in terms of its increase in industry wage inequality between 1975 and 1982. However, in a later paper, Freeman (1991) found that between 1978 and 1987 the ratio of wages of the highest paying to lowest paying industry (excluding services) increased in fourteen of the fifteen countries he examined.

We use the variance of the logarithm of industry wage differentials d_i^h to measure inter-industry wage inequality (Table 3). While differences in sectoring requires some caution in making comparisons, the tremendous differences in the degree of industry wage dispersion among this sample of countries is striking. Our dispersion measure ranged from a low of 0.027 (Finland) to a high of 0.217

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[5]Kendall's coefficient of concordance, W, is similar to the rank correlation coefficient except that it is used to assess the degree of agreement of m, rankings (where $m > 2$). The coefficient is defined as follows:

$$W = 12\left[\sum_{j=1}^{n} R_j^2 - 3m^2 n(n+1)^2\right]\Big/ m^2 n(n^2 - 1),$$

where m is the number of sets of rankings (countries in this case), n is the number of objects that are ranked (industry wage differentials here), and R_j is the sum of the ranks assigned to the jth industry.

[6]Daniel (1978) indicates that for large samples $m(n-1)W$ is distributed chi-squared with $n-1$ degrees of freedom, where W is the coefficient of concordance, m is the number of different rankings, and n is the number of objects being ranked. Calculating a chi-squared statistic for the values of W shown on Table 1 leads one to reject, at conventional significance levels, the hypothesis that the wage rankings across years are not associated.

[7]The lower coefficient of concordance for Canada may be due more to an underlying change in the procedures for calculating wage data than to a lesser degree of stability, since there is a major break in the data between 1974 and 1975. In other words, there is a very high degree stability from 1970 to 1974 and from 1975 to 1985.

(the Netherlands[8])—an eight-fold difference—for all industries in 1985 and from 0.022 (Denmark and Norway) to 0.086 (Japan)—a four-fold difference—for manufacturing industries in the same year. The U.S. had the third highest degree of wage dispersion among all industries in 1985 and the second highest among manufacturing industries.

TABLE 3

INEQUALITY IN INTERINDUSTRY WAGE DIFFERENTIALS BY COUNTRY, 1970 AND 1985

	All Industries			Manufacturing Industries		
	1970	1985[a]	Percent change	1970	1985[a]	Percent change
Australia	0.064	0.079	24.6	—	—	—
Belgium	0.046	0.083	80.4	0.033	0.041	26.8
Canada	0.090	0.077	−14.3	0.038	0.037	−2.3
Denmark	0.048	0.030	−38.1	0.030	0.022	−25.3
Finland	0.044	0.027	−38.4	0.026	0.029	13.0
France	0.085	0.091	6.9	0.034	0.069	102.2
Germany	0.049	0.054	10.5	0.028	0.036	28.2
Italy	0.169	0.063	−62.9	0.076	0.023	−69.4
Japan	0.075	0.121	60.6	0.050	0.086	71.1
Netherlands	0.308	0.217	−29.7	0.419	0.272	−35.0
Netherlands[b]	0.204	0.178	−12.8	0.038	0.025	−35.0
Norway	0.037	0.063	71.5	0.015	0.022	48.3
Sweden	0.045	0.049	7.1	0.053	0.028	−47.5
U.K.	0.040	0.087	118.1	0.027	0.043	60.5
U.S.	0.092	0.118	28.6	0.038	0.061	59.6

Note: Inequality is measured by the unweighted variance of the logarithm of industry wage differentials d_i^h. See Table 2 for sectoral coverage. Australia is not included in manufacturing calculations because no detail is available.

[a]The end-year is 1984 for France and the Netherlands and 1983 for Denmark.

[b]The employment concept used is total employment instead of number of employees. See text for discussion.

We next consider changes over time in wage inequality. It should be noted that the stability of the rank order of wage structures over time found in the previous section implies that changes in wage dispersion will occur primarily as a result of a stretching or contraction of the wage structure, rather than a reordering of high- and low-wage industries. As found in earlier studies, inter-industry dispersion shows a relatively large rise for the U.S. between 1970 and 1985.

However, what is striking from the results is that this is *not* a general phenomenon. Denmark, Finland, Italy and the Netherlands show fairly sizable reductions in industry wage dispersion. Australia, Belgium, Japan, Norway, and the U.K. show large increases in dispersion over the time span, and in four of the five, the relative increases were far in excess of that of the U.S. wage dispersion in Canada,

[8]It should be noted that relative to the other countries, there are clearly some anomalies in the Netherlands data set, when number of employees is used as the employment concept. The wage differentials for the transport, storage and communication sector are extremely high while those for basic metal products and other manufactured products are extremely low, relative to the other countries. As a result, we also made calculations using total employment as the denominator in the wage differential calculations. Using this concept, levels of wage dispersion are somewhat lower but trends over time are similar to those with number of employees, as shown in Table 3.

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France, Germany, and Sweden shows little change.[9] Thus, the patterns of industrial wage inequality are quite divergent among these 14 countries. While the wage dispersion trends are somewhat different when attention is restricted to manufacturing industries, the diversity across countries is still quite apparent, as shown in the last column of Table 3.

The results here differ from those of Freeman (1991), noted above, who found rising inter-industry wage inequality more prevalent in his sample of countries. The results here might also be contrasted with those of Green, Coder and Ryscavage (1992), who found *overall* earnings inequality among the employed labor force (not industry wage dispersion) on the rise during the 1980s in all five countries that they studied.[10]

5. CROSS-COUNTRY COMPARISON OF WAGE STRUCTURES

We next investigate whether the high-wage and low-wage industries are the same among countries—that is, whether there is a similarity in wage structures among our sample of countries. We also consider whether the degree of similarity has changed over time.

Previous work has generally found such similarity of wage structure for manufacturing industries in developed countries (see, for example, Lebergott, 1947; Dunlop and Rothbaum, 1955; Krueger and Summers, 1987; and Katz and Summers, 1989). The recent work of Wagner (1990) and Helwege and Wagner (1991), based on microdata rather than aggregate industry data, stands out as exceptions to this rule, finding substantially lower cross-country correlations than the rest of the literature. The results for similarity of wage structures across a broader range of countries are mixed. Papola and Bharadwaj (1970), using a sample of 14 countries spanning the gamut in terms of level of economic development, found that the ranking of manufacturing industries by wage level was quite similar among the developed countries, but not between developed and less developed countries. More recent work by Krueger and Summers (1987) and Katz and Summers (1989), however, indicated these pair-wise correlations to be quite high, regardless of level of industrialization.

In two papers, Krueger and Summers and Helwege and Wagner have also examined how the degree of cross-country similarity in wage structures has

[9]To ensure that these results are representative, sensitivity tests were conducted along three other dimensions. First, similar calculations were made using the coefficient of variation of real wages per employee and an employment-weighted variance of log wage differentials. With minor exceptions, the trends were the same. Second, the same dispersion measures were calculated for as many countries as possible restricting each country to have the same number of sectors. Trends in dispersion were not sensitive to the number of sectors. Third, in order to control for the fact that the degree of dispersion at the end-years may be unrepresentative of the trend over the time period and to control for the fact the events affecting dispersion such as business cycles may have affected countries in different years, time trend regressions were run for the three measures of dispersion. The estimated time trend coefficients were consistent with the results presented in Table 3.

[10]Besides the U.S., they measured changes in inequality in Canada, Sweden, Australia, and Germany. With the exception of the U.S. and Australia, we find little change in industry wage differentials in these countries. While overall earnings inequality is a very different concept from industrial wage inequality, it has been documented that changes industrial wage inequality have played an important role in the growth of overall earnings inequality in the U.S. (see Karoly, 1992).

changed over time. Krueger and Summers (1987) compared the wage structures in 13 countries to that of the U.S. in 1973 and 1982. They found that the cross-country correlation coefficents increased in six countries and declined in seven. The nations showing the largest increase in correlation with the U.S. were among the least developed (Bolivia and Mexico), a result that led the authors to speculate that the process of development may be important in determining the ultimate structure of industry wages. If true, this result would be consistent with the findings of Papola and Bharadwaj (1970) of greater similarity in wage structures among developed countries than between developed and less developed ones. In the second paper, Helwege and Wagner (1991) found a higher degree of similarity between the wage structures of Germany and the U.S. in the mid-1980s (1985 for the U.S. and 1987 for Germany) than in 1979.

TABLE 4

CORRELATIONS BETWEEN U.S. INDUSTRY WAGE DIFFERENTIALS AND INDUSTRY WAGE DIFFERENTIALS OF OTHER COUNTRIES, 1970–85

	All Industries				Manufacturing Industries			
	1970	1975	1980	1985	1970	1975	1980	1985
Australia	0.59	0.66	0.70	0.82	—	—	—	—
Belgium	0.81	0.78	0.82	0.90	0.96	0.89	0.83	0.89
Canada	0.66	0.74	0.78	0.82	0.56	0.91	0.93	0.93
Denmark	0.73	0.82	0.77	0.76	0.90	0.87	0.80	0.82
Finland	0.82	0.72	0.72	0.76	0.95	0.90	0.91	0.91
France	0.90	0.85	0.84	0.81	0.92	0.81	0.82	0.78
Germany	0.82	0.81	0.82	0.86	0.93	0.92	0.89	0.89
Italy	0.71	0.69	0.73	0.78	0.93	0.88	0.89	0.88
Japan	0.63	0.69	0.67	0.65	0.86	0.88	0.86	0.73
Netherlands	0.22	0.22	0.18	0.21	0.23	0.17	0.08	0.12
Netherlands[a]	0.84	0.83	0.81	0.86	0.91	0.94	0.92	0.94
Norway	0.90	0.87	0.80	0.78	0.92	0.95	0.96	0.96
Sweden	0.77	0.80	0.77	0.78	0.79	0.79	0.80	0.74
U.K.	0.69	0.92	0.91	0.93	0.91	0.95	0.88	0.89

Note: For the Netherlands, 1972 is used instead of 1970, and 1984 is used instead of 1985; for France, 1984 is used instead of 1985. The number of industries included for each pair-wise correlation with the U.S. is as follows: Australia (10); Belgium (16); Canada (18); Denmark (20); Finland (20); France (16); Germany (19); Italy (17); Japan (17); Netherlands (18); Norway (20); Sweden (20); U.K. (17); and the U.S. (20). For manufacturing only, the number of industries is: Australia (0); Belgium (8); Canada (9); Denmark (9); Finland (9); France (8); Germany (9); Italy (9); Japan (8); Netherlands (8); Norway (9); Sweden (9); U.K. (8); and the U.S. (9).
[a]The employment concept used is total employment instead of number of employees. See text for discussion.

In our analysis, we also include non-manufacturing sectors. One might suspect that including non-manufacturing industries in such a sample would lessen the overall similarity in wage structure for two reasons: First, country-specific factors such as the resource base may affect wage determination in resource-based industries, such as agriculture, mining, and utilities. Second, foreign competition may play a role in leading to convergence of wages in sectors that produce goods that are traded internationally—particularly, manufacturing. Sectors, such as services, which produce non-tradable output may exhibit less similarity in wages among countries.

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Two methods are used here to assess the trends of similarity over time. The first is to examine the correlation coefficients of wage differentials between the U.S. and other countries for selected years (Table 4). For the wage structures for all industries, the correlation coefficents are quite high (for example in 1970, ranging from 0.60 to 0.90), with the exception of the Netherlands, when number of employees is used as the employment concept.[11] However, no clear pattern emerges for changes in similarity over time, with some countries steadily becoming more similar to the U.S., others steadily less similar, and still others fluctuating. For manufacturing only, the correlation coefficients tend to be higher, though with broadly similar patterns in terms of changes in correlation over time.

The second method for assessing trends of similarity over time is to compute the coefficient of concordance for all countries by year. Due to the wide variation in sectoring schemes, it was necessary to experiment in terms of the number of countries (from 5 to 14) and number of sectors (from 8 to 20) included. Irrespective of the choice, the wage structures in the samples are quite similar and remain so over time (Table 5). The coefficients all exceed 0.6, and in most cases exceed 0.7 and reach as high as 0.8. This is an important finding, given that past research has focused on the degree of similarity among manufacturing industries only, rather than the entire economy as is the case here. The next question is whether there is any evident trend over time in the series. With the exception of the 8-sector sample, the results do indicate that industry wage rankings have become more similar over time for this sample of countries.

As the results reported in the lower panel of Table 4 indicate, the inclusion of non-manufacturing industries makes little difference both in terms of degree of similarity and trends over time. The coefficents of concordance tend to be higher for the samples restricted to manufacturing, though not markedly so, and the tendency toward greater similarity over time appears to be somewhat more pronounced.

We then considered whether the growing similarity in wage structures among these countries is related to the convergence of per capita incomes reported elsewhere in many studies (see Baumol, Blackman, and Wolff, 1989, Chapter 5, for example). For all industries, the simple correlation between the coefficient of concordance and the coefficient of variation of per capita incomes[12] tends to be negative and significant. For the manufacturing samples, the correlations are negative and usually significant. These results provide support for Papola and Bharadwaj's conjecture that wage structures are more similar for countries at a similar level of development. The results here indicate that this is likely to be true even when non-manufacturing sectors are included in the analysis and even among highly advanced economies.

[11]As noted previously, there are some anomalies in the Netherlands data set when numbers of employees are used, which causes the wage structure to differ substantially from other countries. As shown in Table 4, however, when total employment is used instead, the wage structure becomes very close to that of the other countries.
[12]Per capita income data are from Summers and Heston (1988).

TABLE 5.

COEFFICIENTS OF CONCORDANCE FOR INDUSTRY WAGE RANKINGS
(for selected number of countries and sectors)

	Manufacturing and Non-manufacturing Industries[a]					
Number of Countries	5	7	9	10	12	14
Number of Sectors	20	18	17	10	15	8
Year						
1970	0.78	0.68	0.63	0.62	0.66	—
1971	0.80	0.70	0.67	0.67	0.68	—
1972	0.79	0.67	0.66	0.71	0.68	0.70
1973	0.79	0.66	0.65	0.70	0.65	0.66
1974	0.79	0.69	0.69	0.70	0.67	0.66
1975	0.79	0.74	0.74	0.71	0.69	0.65
1976	0.78	0.75	0.75	0.74	0.70	0.67
1977	0.79	0.77	0.77	0.73	0.72	0.65
1978	0.78	0.73	0.73	0.73	0.69	0.67
1979	0.79	0.77	0.75	0.71	0.72	0.67
1980	0.78	0.77	0.74	0.70	0.73	0.68
1981	0.79	0.78	0.75	0.67	0.73	0.67
1982	0.78	0.79	0.76	0.71	0.72	0.66
1983	0.80	0.79	0.75	0.71	0.72	0.66
1984	0.80	0.78	0.72	0.67	0.70	0.65
1985	0.80	0.78	0.74	0.68	—	—

	Manufacturing Industries[b]			
Number of Countries	8	11	12	13
Number of Sectors	9	8	8	8
Year				
1970	0.76	0.75	0.75	—
1971	0.74	0.76	0.76	—
1972	0.72	0.74	0.74	0.69
1973	0.74	0.76	0.72	0.68
1974	0.76	0.78	0.74	0.68
1975	0.83	0.82	0.79	0.74
1976	0.84	0.82	0.78	0.72
1977	0.85	0.83	0.81	0.75
1978	0.81	0.82	0.79	0.73
1979	0.82	0.82	0.79	0.73
1980	0.86	0.83	0.81	0.76
1981	0.89	0.85	0.79	0.74
1982	0.83	0.81	0.79	0.74
1983	0.84	0.81	0.77	0.72
1984	0.86	0.82	0.78	0.70
1985	0.87	0.82	..	.

[a]The countries (C) and sectors (S) included for the coefficients of concordance using all industries are as follows: 5C, 20S—Countries included are Denmark, Finland, Norway. Sweden, and the U.S.; All sectors included except MAN, RET, and FNI. 7C, 18S—Countries included are Canada, Denmark, Finland, Germany, Norway, Sweden, and the U.S.; Sectors excluded are MAN, RWH, HOT, FNS, and RES. 9C, 17S—Countries excluded are Australia, Belgium, France, Netherlands, and Italy; Sectors excluded are MAN, WOD, RWH, HOT, FNS, and RES. 10C, 10S—Countries excluded are Belgium, France, Italy, and the Netherlands; Sectors included are AGR, MIN, MAN, EGW, CST, RET, TRS, FNI, SOC, and PGS. 12C, 15S—Countries excluded are Australia and the Netherlands; Sectors excluded are MIN, MAN, WOD, RWH, HOT, FNI, FNS, and RES. 14C, 8S—All countries inlcuded; Sectors included are AGR, MAN, EGW, CST, RET, TRS, SOC, and PGS.

[b]The countries (C) and sectors (S) included for the coefficients of concordance using all industries are as follows: 8C, 9S—Countries excluded are Australia, Belgium, France, Japan, Netherlands, and the U.K.; All manufacturing industries included. 11C, 8S—Countries excluded are Australia, France, and the Netherlands; All manufacturing industries included except for WOD. 12C, 8S—Countries excluded are Australia and the Netherlands; All manufacturing industries included except for WOD. 13C, 8S—Australia is only country excluded; All manufacturing industries included except for WOD.

TABLE 6

REGRESSIONS OF INDUSTRY WAGE DIFFERENTIALS ON SELECTED VARIABLES POOLED ACROSS ALL COUNTRIES
(for all industries and for manufacturing industries only[a])

			Independent Variables				
	EMPGRTH	GDPGRTH	GPROFIT	K/L	KLGRTH	LPGRTH	TFPGRTH
A. *Dependent Variable: Industry Wage Differential, 1985, All Industries*							
Coefficient	1.46	2.45**	−0.07	0.33**	−0.29	1.42	3.54**
t-ratio	(1.84)	(3.52)	(1.13)	(3.77)	(0.37)	(1.91)	(4.03)
R^2	0.014	0.051	0.006	0.063	0.001	0.015	0.070
Adj. R^2	0.010	0.047	0.001	0.058	−0.004	0.011	0.065
S.E. of Reg	0.293	0.287	0.298	0.291	0.298	0.293	0.288
No. of obs.	234	234	219	215	220	234	219
B. *Dependent Variable: Industry Wage Differential, 1985, Manufacturing Industries[a]*							
Coefficient	1.64	2.56*	−0.36*	2.14**	−0.99	1.69	4.46**
t-ratio	(1.36)	(2.29)	(2.06)	(5.13)	(0.86)	(1.21)	(2.98)
R^2	0.016	0.046	0.041	0.209	0.007	0.013	0.081
Adj. R^2	0.008	0.037	0.031	0.201	−0.003	0.004	0.072
S.E. of Reg	0.263	0.259	0.266	0.242	0.271	0.263	0.261
No. of obs.	112	112	102	102	102	112	102
C. *Dependent Variable: Industry Wage Differential, 1979 and 1985, All Industries[b]*							
Coefficient	1.08*	1.58**	−0.07	0.30**	−0.26	0.78	2.07**
t-ratio	(2.20)	(3.71)	(1.58)	(4.87)	(0.55)	(1.77)	(3.98)
R^2	0.011	0.029	0.006	0.052	0.001	0.007	0.036
Adj. R^2	0.006	0.025	0.002	0.047	−0.004	0.003	0.031
S.E. of Reg	0.288	0.286	0.292	0.285	0.293	0.289	0.288
No. of obs.	467	467	437	440	440	467	437
D. *Dependent Variable: Change in Industry Wage Differential, 1970–85, All Industries*							
Coefficient	−0.11**	0.05*	0.00	0.01*	0.14**	0.15**	0.13**
t-ratio	(4.02)	(2.21)	(0.69)	(2.43)	(5.73)	(6.44)	(4.40)
R^2	0.065	0.021	0.002	0.027	0.131	0.152	0.082
Adj. R^2	0.061	0.016	−0.002	0.022	0.127	0.148	0.078
S.E. of Reg	0.010	0.010	0.010	0.010	0.009	0.009	0.010
No. of obs.	234	234	219	215	220	234	219
E. *Dependent Variable: Change in Industry Wage Differential, 1970–85, Manufacturing Industries*							
Coefficient	−0.20**	−0.05	0.00	−0.01	0.15**	0.20**	0.13
t-ratio	(5.31)	(1.19)	(0.12)	(0.68)	(4.01)	(4.34)	(2.48)
R^2	0.204	0.013	0.000	0.005	0.139	0.146	0.058
Adj. R^2	0.196	0.004	−0.010	−0.005	0.130	0.139	0.048
S.E. of Reg	0.008	0.009	0.010	0.010	0.009	0.009	0.009
No. of obs.	112	112	102	102	102	112	102

F. *Dependent Variable: Industry Wage Differential, 1985, Manufacturing Industries[c]*

Coefficient of EXPW85	1.078*
t-ratio	(1.99)
Coefficient of IMPGDP85	5.970
t-ratio	(0.49)
R^2	0.029
Adj. R^2	0.014
S.E. of Reg	0.303
No. of obs.	135

G. *Change in Industry Wage Differential, 1970–85, Manufacturing Industries[c]*

Coefficient of DEL(EXPW)	0.015
t-ratio	(0.44)
Coefficient of DEL(IMPGDP)	−0.366*
t-ratio	(2.19)
R^2	0.037
Adj. R^2	0.023
S.E. of Reg	0.010
No. of obs.	135

6. FACTORS AFFECTING LEVELS AND TRENDS IN INDUSTRIAL WAGE DIFFERENTIALS

We next consider several factors which may help explain why one industry pays higher wages than another and why an industry's wage differential has risen or fallen over time. The literature on determinants of the U.S. inter-industry wage structure is vast. However, as Dickens and Katz (1987a) pointed out, it is difficult to draw firm conclusions because findings are sensitive to the time period under study and the specification used and because past work has been flawed by econometric problems such as multicollinearity and the difficulty of interpreting regressions using macro-level independent variables with micro-level dependent ones. Dickens and Katz (1987a) carefully tried to take account of these problems and found that the following variables stand out as determinants of inter-industry wages: average years of education, industry profitability, establishment size, and capital-labor intensity.

While it is important to see if such findings apply to other nations, our efforts in this direction were limited by the scarcity of industry-level variables other than the ones that could be derived from the ISDB database. Wage differentials in 1985 pooled across sectors and countries were regressed on independent variables that could be calculated from the OECD dataset, including TFP growth, GDP growth, the gross profit rate, and the capital-labor ratio, with the levels calculated for 1979 and 1985 and the growth rates for the 1970–79, 1979–85, and 1970–85 periods. The analysis was conducted by pooling across all countries and across either all industries or manufacturing industries only. Regressions of industry wage differentials were run for 1979 and 1985 separately and pooled; and regressions of the change in industry wage differentials were run for the 1970–85 period and pooled for the 1970–79 and 1979–85 sub-periods. In addition to the analysis using the variables from the ISDB database, we also matched foreign trade data from the United Nations Trade Series D to the ISDB database.

Representative results are shown in Table 6. In each case (except Panels F and G), the indicated dependent variables is regressed on a constant term and one independent variable, indicated in the column heading above. The variables

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Notes to Table 6: All regressions, unless otherwise indicated, are bivariate, with the dependent variable regressed on a constant term and the independent variable indicated in the column heading above. Key:
  EMPGRTH—average annual employment growth over pertinent period.
  GDPGRTH—average annual GDP growth over pertinent period.
  GPROFIT—average annual gross profit over pertinent period.
  K/L—capital-labor ratio at end of pertinent period.
  KLGRTH—average annual growth in capital-labor ratio over pertinent period.
  LPGRTH—average annual labor productivity growth over pertinent period.
  TFPGRTH—average annual TFP growth over pertinent period.
  EXPW85—exports as a percentage of world exports in 1985.
  IMPGDP85—imports as a percentage of industry GDP in 1985.
  DEL(EXPW)—change in exports as a percentage of world exports between 1970 and 1985.
  DEL(IMPGDP)—change in imports as a percentage of industry GDP between 1970 and 1985.
  [a]Excludes Australia.
  [b]Time dummy included for 1979.
  [c]For regressions including foreign trade variables, the industries included are the nine manufacturing industries plus agriculture and mining.
  *Significant at the 5 percent level, 2-tail test.
  **Significant at the 1 percent level, 2-tail test.

that proved to be most significant in explaining industry wage differentials are TFP growth, GDP growth, the capital-labor ratio, and export openness (Panels A, B, C, and F). Each of these had a positive association with the industry wage differential. A positive relation between the industry wage differential and its capital-labor ratio is consistent with a wide range of theories (Dickens and Katz, 1987a), including efficiency wage theory (high wages are needed to ensure the smooth operation of expensive capital equipment). The positive coefficient for TFP growth is supportive of the argument that technical change increases the demand for learning, and that higher wages are required to induce the increases in ability and effort required for this learning (see Bartel and Lichtenberg, 1988, for example). The positive coefficient on GDP growth indicates that employees in fast growing industries receive higher wages than those in slow growing ones. The coefficients of the trade variables (Panel F) indicate that export-oriented industries pay relatively high wages, a finding consistent with that of Katz and Summers (1989).

As indicated above, multicollinearity makes it difficult to draw strong inferences about these relationships. To get a sense of the robustness of these results, we ran regressions with a multitude of specifications. TFP growth, the capital-labor ratio and export openness tend to remain significant even with the inclusion of the other important variables, but this is not the case for GDP growth.

We did a similar analysis of the determinants of the change in industry wage differentials, in hope of uncovering the reasons for the divergent patterns of wage dispersion trends discussed in section 4. To our knowledge, the only paper touching on this issue is Freeman (1991). He found that industrial wages in the 1980s were more dispersed in countries that were less heavily unionized, and that between 1978 and 1987, the change in inequality was negatively correlated with the initial level of unionization.

As shown in Table 6 (Panels D and E), labor productivity growth, TFP growth, growth in the capital-labor ratio, GDP growth and employment growth each enters as a significant determinant of the change in the industry wage differential. All have a positive sign with the exception of employment growth. The fact that wage differentials are strongly related to an industry's labor and total factor productivity growth is consistent with Bell and Freeman (1987 and 1988), who found that even after controlling for changes in the demographic and skill mix of industry employment, a significant relation existed between industry wages and industry productivity growth.[13] They interpreted this result as an indication of rent-sharing between owners and employers in industries with expanding profits.

The positive relationship found between changes in capital intensity and changes in the industry wage differential is consistent with a number of explanations. For example, investment in new plant and equipment may drive up productivity growth and thereby cause wages to rise; it may be indicative of favorable market conditions for these industries, which would be associated with wage increases; or increasing capital-intensity might be accompanied by substitution of more skilled for less skilled labor, which would cause the average wage in the

[13]This relationship exists for both manufacturing industries and samples of industries covering the entire economy.

industry to rise from changes in the occupational composition of employment. Unfortunately, in a dataset of the type that we are using, it is not possible to discriminate among these alternative explanations.

The fact that GDP growth is positively related to wage growth would support the view that expanding industries have faster than average wage growth, but the negative relationship between employment growth and wage growth would seem to suggest just the opposite. However, these two sets of results are consistent with the finding of a strong positive relation between industry wages and industry labor productivity growth.

Another interesting result is that the change in an industry's import share is negatively related to the change in its wage differential. This suggests that industries which experience growing competition from imports respond by lowering their labor costs. On the other hand, despite the positive association between an industry's export share and the level of its wage differential, there is no significant relation between the change in its export share and the movement of its wage differential over time.

Not surprisingly, multicollinearity also makes inferences difficult in understanding the factors affecting differences in wage growth across industries. We found that the coefficients of the growth in the capital-labor ratio and labor productivity growth, remained positive and significant across a large number of different regression specifications, but this was less true for TFP growth, employment growth, and GDP growth.

Country-Level Analysis. We next considered a number of country-level variables in our analysis, including the country unionization rate (the ratio of the number of employees in unions to the total number of employees), the mean years of schooling of the country's labor force, the degree of openness of the country's economy, the unemployment rate in the country, government spending as a proportion of total GDP, and the country's per capita income. The dependent variable used in our regressions is the dispersion in industry wage differentials across industries within country (the variance of d_i^h in country h), and regressions were run over time and pooled across countries. The only consistently significant result is that the country's overall level of industrial wage inequality is negatively associated with the degree of unionization within the country.[14] This result is somewhat stronger for industry wage dispersion in the economy as a whole than among manufacturing industries alone.

Our results on the relation between unionization and changes in inequality in manufacturing industries are also consistent with Freeman's—that is, those countries with low levels of unionization were the ones that experienced the greatest increase in industry wage inequality. However, when the analysis is extended to the economy as a whole, the relation between changes in inequality and the rate of unionization is no longer statistically significant. This suggests that unions have been more effective in resisting pressures for differing wage packages within manufacturing, whose firms tend to be more heavily unionized. As a final part of

[14]Three sources were used for labor union data: U.S. Congress, Office of Technology Assessment (1987), Freeman (1990), and Freeman (1991). Though the data differ somewhat in country and year coverage, the results tend to be quite consistent among the sources.

our analysis, we considered the relationship between changes in the unionization rate and changes in inter-industry wage inequality. A negative association holds here as well.[15]

7. CONCLUDING REMARKS

The finding in this paper have added to the international dimension of the inter-industry wage literature. A high degree of stability is found in the wage structures of all countries examined. In addition, the wage structures are found to be highly similar across countries, with some tendency exhibited for similarity to increase as per capita incomes converge. We also find that industry wage differentials are positively related to an industry's productivity growth, TFP growth, GDP growth, capital intensity, and degree of export orientation.

Trends in industrial wage dispersion in the 1970–85 period are found to differ markedly among countries. While we were limited in exploring the reasons for such differences, it appears that unions play an important role in resisting the tendancy toward inequality. The particularly high degree of industry wage inequality in the U.S. appears due in part to a weak workers' movement (a low degree of overall unionization) and to the fact that the strength of workers is quite uneven across industries, leading to large inter-industry differences in the extent to which workers have the ability to extract rents. The decline in the unionization rate in the U.S. may have been an important factor leading to increased inter-industry wage dispersion during the 1970s and 1980s.

[15]Another country-level variable which we felt would be an important determinant of the level of industry wage inequality is the country's minimum wage. However, our attempts to construct a cross-national dataset to test for this proved unsuccessful.

AVAILABILITY OF EMPLOYEE COMPENSATION DATA BY COUNTRY, SECTOR, AND YEAR

	AUS	BEL	CAN	DEN	FRA	FIN	GER	ITA	JAP	NET	NOR	SWE	UK	US	Number of Countries
1 AGR	X	X	X	X	X	X	X	X	X	X	X	X	X	X	14
2 MIN	X		X	X		X	X		X		X	X	X	X	10
3 MAN	X	X	X	X	X	X	X	X	X	X	X	X	X	X	14
4 FOD		X	X	X	X	X	X	X	X	X	X	X	X	X	13
5 TEX		X	X	X	X	X	X	X	X	X	X	X	X	X	13
6 WOD			X	X		X	X	X			X	X		X	8
7 PAP		X	X	X	X	X	X	X	X	X	X	X	X	X	13
8 CHE		X	X	X	X	X	X	X	X	X	X	X	X	X	13
9 MNM		X	X	X	X	X	X	X	X	X	X	X	X	X	13
10 BMI		X	X	X	X	X	X	X	X	X	X	X	X	X	13
11 MEQ		X	X	X	X	X	X	X	X	X	X	X	X	X	13
12 MOT		X	X	X	X	X	X	X	X	X	X	X	X	X	13
13 EGW	X	X	X	X	X	X	X	X	X	X	X	X	X	X	14
14 CST	X	X	X	X	X	X	X	X	X	X	X	X	X	X	14
15 RET	X	X	X	X	X	X	X	X	X	X	X	X	X	X	14
16 RWH				X		X	X	X		X	X	X		X	8
17 HOT				X		X	X	X		X	X	X		X	8
18 TRS	X	X	X	X	X	X	X	X	X	X	X	X	X	X	14
19 FNI	X		X	X		X	X		X	X	X	X	X	X	11
20 FNS		X		X	X	X	X			X	X	X		X	9
21 RES				X		X				X	X	X		X	6
22 SOC	X	X	X	X	X	X	X	X	X	X	X	X	X	X	14
23 PGS	X	X	X	X	X	X	X	X	X	X	X	X	X	X	14
No. of Sect.	10	17	19	23	17	23	22	19	18	21	23	23	18	23	
Start year	69	70	70	66	70	60	70	70	70	72	62	70	70	60	
End year	85	85	85	85	84	85	85	85	85	84	85	85	85	85	

An "X" indicates the availability of data.

Sector Abbreviations:

AGR, Agriculture; MIN, Mining and quarrying; MAN, Manufacturing; FOD, food, beverages, and tobacco; TEX, Textiles; WOD, Wood and wood products; PAP, Paper, printing, and publishing; CHE, Chemicals; MNM, Non-metallic mineral products; BMI, Basic metal products; MEQ, Machinery and equipment; MOT, Other manufactured products; EGW, Electricity, gas, and water; CST, Construction; RET, Wholesale, retail trade, restaurants and hotels; RWH, Wholesale and retail trade; HOT, Restaurants and hotels; TRS, Transport, storage, and communication; FNI, Finance, insurance, and real estate; FNS, Finance and insurance; RES, Real estate; SOC, Community, social and personal services; PGS, Producers of government services.

The 20-sector scheme includes: AGR, MIN, FOD, TEX, WOD, PAP, CHE, MNM, BMI, MEQ, MOT, EGW, CST, RWH, HOT, TRS, FNS, RES, SOC, and PGS.

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