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The Impact of Trade on Labour Markets: An Analysis by Industry

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THE IMPACT OF TRADE ON LABOUR MARKETS: AN ANALYSIS BY INDUSTRY

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THE OECD JOBS STUDY: WORKING PAPER SERIES

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SUMMARY

This technical working paper presents the method of analysis used by the Secretariat to shed light on the possible links between foreign trade, employment and relative wages by industrial sector and type of labour.

The conclusions drawn from the study indicate, *inter alia*, that overall the impact of changing trade patterns on labour market conditions appears to be significant but generally small relative to other factors. The most significant relationships between trade competition and relative employment (and wages) are observed in the high-skill industries.

L’IMPACT DES ÉCHANGES SUR LES MARCHÉS DU TRAVAIL : UNE ANALYSE PAR SECTEUR

RÉSUMÉ

Ce document de travail technique expose la methode d’analyse employée par le Secrétariat dans le but mettre en relief les liens éventuels et entre les échanges internationales, l’emploi et les salaires relatifs par secteur industriel et niveau de qualification.

Les conclusions de l’étude indiquent, entre autres, que l’effet des flux des échanges sur les conditions du marché du travail est significatif mais, en général inférieur à ceux d’autres facteurs. Les rapports les plus significatifs entre la concurrence internationale et l’emploi relatif et les salaires se trouvent dans les industries à haute technologie.

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THE IMPACT OF TRADE ON LABOUR MARKETS: AN ANALYSIS BY INDUSTRY

As part of the OECD Jobs Study, the Secretariat has carried out regression analysis on a large number of OECD countries and industries to shed some light on the possible links between foreign trade, employment and relative wages by industrial sector and type of labour [see Chapter III of the OECD Jobs Study published main report]. This working paper presents in some detail the method of analysis and results.

I. RELATIVE EMPLOYMENT AND TRADE INTENSITY: REGRESSION ANALYSIS

1. Introduction

Changes in trade intensity by sector may be associated with changes in relative employment, where "relative employment" means employment by sector relative to manufacturing employment overall. It is the case that employment in manufacturing has fallen over time in OECD countries irrespective of their degree of openness, or how this has evolved. In the approach retained here, the trend fall in employment in manufacturing was assumed to be explained by structural factors (including longer-term trends towards greater openness), while period-to-period changes in trend relative employment by sector were assumed to be influenced by other factors, including changes in import and export penetration.

A priori, it might be expected that rising import penetration in some industries or industry groupings would be associated with a decline in relative employment in those industries, either because relative industry product demand would decline, and also relative labour demand; or because productivity gains in the exposed industry would be relatively higher. Above average productivity gains will occur if the rise in import penetration either wipes out low-productivity firms or forces existing firms to raise their productivity (if they can) to compete with imports. In either case, the coefficient on import penetration would be negative. A link at the industry level would, however, not necessarily imply that aggregate (un)employment is affected.

Similarly, sectors with rising export intensity may experience faster increases in employment (or slower falls) relative to the average for manufacturing -- in which case it can be expected *a priori* that the coefficient on this variable would be positive. However, a negative relationship between relative employment and export intensity is also possible under two circumstances: i) trade expansion reflects growing outside reprocessing, with different parts of the production process being increasingly located in different countries and with rising exports being more than offset by declining local production; or ii) producers are attempting to improve their competitive position on foreign markets via productivity gains associated with rationalisation.

The basic questions to be addressed are thus the following:

-- Are changes in relative employment of individual industries associated with changes in relative import penetration and export intensity of that industry?

-- Are there any significant differences across industry groupings in the impact of trade competition on relative employment? More precisely, are industries employing a larger share of manual workers more sensitive to trade influences than others?

-- Are there distinct patterns across countries or regions in the relationship between changes in relative employment on the one hand and import penetration and export intensity on the other?

2. Equation specification

Time-series regressions were estimated country by country for 12 OECD countries, over the period 1970-89, pooling together data for 21 industries [STAN database]. The regressions were also estimated for three groups of industries (as shown in Table 1) classified according to the proportion of workers that falls in the manual labour category, a proxy for average sectoral skill level.[2]

The dependent variables in the estimated equations are the changes in the share of employment in industry "i" for country "j", relative to manufacturing (m) employment in that country (Eij/Emj). Explanatory trade variables are changes in relative import penetration rates and changes in relative export intensity. In an attempt to control for differences in productivity growth across industries, the change in relative value added per worker is introduced in the equation. Because of data limitations, the latter is in nominal terms, and changes in relative product prices cannot be isolated. The equations were estimated first, with variables expressed as year-to-year changes over the period 1970-89; second, with variables expressed as average changes during three successive cycles (1973-79, 1979-85, 1985-89).[3]

"Fixed effects" are included in the estimation, using dummy variables to account for the effects of omitted industry-specific variables. The dummy variables attempt to capture the long-run relationship between changes of relative employment on the one hand and both omitted variables (demand shifts over time, industry investment...) and trend contribution of variables in the model that are not captured by the coefficients on short-term variations.[4] In addition, it is not possible in this framework to capture endogenous relationships among the right-hand side variables in the equations.

Some caveats should be mentioned. First, the regression analysis cannot capture shifts in the composition of employment *within* individual industries, as between skilled and unskilled (manual and non-manual) labour. The degree of disaggregation in the STAN database does not allow the detection of these possibly trade-induced employment shifts. Second, the analysis attempts only to assess the link between employment changes in one industry and trade flows in that industry. It does not include indirect employment effects of trade, stemming for example from the employment content of inputs supplied by other manufacturing industries and by the non-manufacturing sectors. Third, the approach followed here cannot capture the job-reduction induced by anticipatory rationalisation by entrepreneurs who expect international competition to intensify.

3. Detailed estimation results

Results for individual industries suggest the following:

i) In a first set of estimations without the trade variables, the industry-specific dummies, together with the output-per-worker and business cycle variables (when included), explain a substantial proportion of the observed employment variability across industries (about a third generally and as much as half in France, Italy, Australia and the Netherlands);

ii) When the trade variables are added, they improve the explanatory power of the basic equation in all but four (Germany, France, Norway and Australia) of the countries reported, as shown by the F-test presented in Table 2, Column 1;

iii) Allowing for country-specific/industry-specific coefficients on trade variables (some 250 coefficients), so as to draw on all sources of variation available, the estimation results in a predominant proportion of negative coefficients (two-thirds in the case of import penetration; a little less for export intensity). But the coefficients appear to be statistically well determined for a small number of industries only;[5]

When regressions were estimated for three groups of industries, with industries partitioned according to the proportion of manual workers employed, and a single coefficient for the trade variables was estimated across industries in each grouping[6], the relationships between relative employment changes and trade competition differed according to the type of industry exposed, but not markedly so:

i) In nearly every country, changes in relative import penetration appear to be *negatively* associated with relative employment changes in all three industry groupings (27 of all 36 coefficients are negative); in general, the coefficients for the "low-manual" grouping are larger in magnitude and better determined statistically than for the other categories of industries (Table 4);

ii) Changes in export intensity are *negatively* associated with relative employment in a majority of cases (25 of the 36 coefficients, Table 4); while this pattern is highly predominant in the "high-manual" industry grouping -- where perhaps producers attempt to improve their competitive position by increasing labour productivity -- in the "low-manual" grouping, there is a *positive* association between relative employment and export intensity in four European countries and Canada; however, only a few of the estimated coefficients (positive or negative) are statistically significant.

The fixed-effect dummies and output-per-worker variables were left unconstrained across industries in the above specification, thus allowing for industry-specific coefficients. Regressions including the 3-grouping trade variables were also estimated under the constraint that a single coefficient for the fixed-effect dummies be estimated across industries in each grouping, despite the loss of some explanatory power of the equation.[7] Results suggest that the following pattern applies to fixed-effects dummies for a majority of countries. The coefficients are generally positive, statistically significant and large in magnitude in the "low-manual" category, and negative in the "high-manual" industries, reflecting the continuous shift of employment away from high-manual (low-skill) industries and towards "low-manual" (higher-skill) industries (Table 5).

4. Alternative specifications

A variety of alternative specifications was tried; relative investment ratios and R&D ratios were included on the right-hand side of the equation instead of relative output per worker. These variables tend to be correlated with productivity [Englander and Gurney (1993)] so that they often come out as significant, with little effect on the sign and significance of the estimated coefficients of the trade variables and dummies in the model reported above. Since the R&D data are available only for 6 countries, and the alternative specifications do not give more conclusive results than those defined above, they are not reported here.

i) Average changes over cycles

At the cost of a substantial reduction in the number of observations, the regressions were estimated with data expressed as average changes over successive cycles (1973-79, 1979-85, 1985-89) rather than annual changes.[8] Such a specification allows for slow-moving influences to be captured. The resulting estimates could then yield coefficients on some of the variables larger and more significant than those produced on the basis of annual changes (discussed in the above section). On the other hand, the degrees of freedom are reduced relative to those in the annual change specification. The regressions were run, first, under the constraint that a single coefficient for the trade variables be estimated across industries (Table 6), and then allowing for a coefficient to be estimated across industries in each of the three groupings (with the partitioning again based on the proportion of manual workers). Country estimates are included in Tables 6 to 9, along with estimates for three OECD areas, where data are pooled together across groups of countries (successively, a sample of 12 OECD countries, North America and across eight European countries).

For the sample of 12 OECD countries, the regression explains about a third of the inter-industry/cross-country estimation variance in changes of relative employment. It produces coefficients of the expected sign (negative) on import penetration and value added per worker that are significant at the customary levels (Table 6). The coefficient on export intensity is also negative and statistically significant, but smaller in magnitude. The pattern is the same across North America and across 8 European countries although the coefficient on export intensity loses its significance.

The weakness of links between changes in relative employment and export intensity reflects the mixed results apparent at a more disaggregated level. To examine these links over full cycles at the industry level, regressions were run pooling together sectoral data under the constraint that, for each industry, a single coefficient be estimated across the 12 OECD countries. Results set out in Table 8 are broadly in line with the evidence produced on the basis of the various other specifications retained (annual changes, country-by-country, or more restrictive specifications, alike):

i) The industry-specific dummies and productivity variables explain almost half the observed employment variability across industries and countries;

ii) The trade variables improve the explanatory power of the basic equation, as shown by the F-test;

iii) There is a predominant proportion of negative coefficients on the import variable, but they are statistically well determined only in four industries (Metal Products, Office and Computing Machinery, Radio-T.V.-Communication, Shipbuilding & Repair);

iv) There are as many positive as negative coefficients on the export variable;

v) The coefficients on the productivity proxy are generally negative, significant and large in magnitude; those on fixed-effects are both positive and negative, usually well determined and also large in magnitude; the estimated coefficients on the trade variables, where they are statistically significant, tend to be small.

In all three regions reported, when the 21 industries are regrouped into three categories, changes in import penetration appear to be negatively related with relative employment in all *three industry groupings* (Tables 7 and 9). In Europe, there is some evidence that the link may be slightly stronger in the "high-manual" (low-skill) industries than in the other industries, while in North America, the link appears to be stronger and be better determined in the "low-manual" grouping (Table 10).

The sign of the relationship between changes in relative export intensity and relative employment is not well determined. A closer examination at the country level, however, shows some evidence of a strong positive (well determined) influence of changes in relative export intensity on relative employment for France and the United Kingdom, and it concerns essentially the "low-manual" (high-skill) group of industries. Thus, over a cycle, high-skill industries, faced with rising export intensity, seem to experience faster increases (or slower reductions) in employment, relative to the average. The coefficients estimated on the basis of the annual change specification were smaller in magnitude and not statistically significant, which would suggest that positive influences not well determined in the short run are coming through with increased significance and magnitude when lagged responses are allowed for.

The pattern applying to "fixed-effect" dummies is similar to that observed in the estimates based on annual changes. Here again, the coefficients on fixed effects are respectively negative for industries employing a large proportion of manual workers, and positive in the "low-manual" grouping; they are particularly large in magnitude and well determined for the European country sample, reflecting the constant shift of employment away from low-skill industries and towards high-skill industries.

ii) Trade with the non-OECD regions

In the general context of links between trade competition and employment, the issue of a more specific influence of trade with non-OECD regions deserves attention for reasons discussed in Section II. It is useful to recall some of the specificities of trade with these countries relative to total trade: first, trade in manufactures with these countries has expanded very rapidly in recent years, although their weight in total OECD trade remains small; second, this trade is concentrated in a few industries; third, there is a large gap in the average level of labour skill (and the average level of labour costs) between the labour force of OECD countries and that of non-OECD countries; fourth, exports of manufactured goods to these countries have risen almost as rapidly as imports from them.

To throw some light on the issue, the regression analysis developed above was carried out isolating the component of OECD trade *vis-a-vis* non-OECD partners. For this purpose, a broad correspondence was established between the Foreign Trade Commodity classification (SITC Rev 2) and the industrial classification available in STAN. It was then possible to estimate regressions relating the change in relative employment to relative import penetration rates and export intensity by industry, using specifically imports from the non-OECD and exports to the non-OECD, relative to total import penetration and export intensity for manufacturing.[9] Data are expressed as average changes over successive cycles rather than annual changes, so that potential links might come through with increased magnitude and be better determined. The non-OECD area here does not include OPEC countries, so that the results are not biased by the impact of the changes in trade patterns with OPEC countries that resulted from oil shocks and the "counter-oil shock."

The results indicate that, as expected, there is a significant negative association between the change in relative employment and relative import penetration from the non-OECD countries, and that it is well determined for a small number of specific industries (Textiles, Clothing, Leather; Office and Computing Machinery; Radio-TV-Communication). Coefficients are relatively small in magnitude, reflecting the small share of trade with these countries in total OECD trade. When industries are regrouped into three categories, the influence of trade with the non-OECD is more manifest in the "low-manual" grouping (Table 10).

II. RELATIVE WAGES AND TRADE INTENSITY: REGRESSION ANALYSIS

1. Introduction

This section examines the links between changes in relative wages and trade competition by sector. It does not attempt to provide an explanation for inter-industry wage differentials or changes in them. Changes in trade intensities may be associated with changes in relative wages under two circumstances: i) either earnings of all worker categories in the industry are affected, or ii) a change in the skill composition of workers is induced leading to a change in average compensation in the industry. The degree of disaggregation in the data used in this study does not permit a distinction to be made between the two types of effects.

Even in theory, the association between changing import penetration and changing relative wages could go either way. A rise in import penetration may be associated with reduced relative wages in the sector as employers respond to increased competition by holding down costs (unless labour is perfectly mobile across industries). Alternatively, rising relative wages (and costs) may make the industry more vulnerable to imports, or outsourcing of production involving lower-skilled workers may lead to a rise in average compensation; either mechanism would produce a positive association between relative wages and import penetration.

A rise in export intensity, on the other hand, may be associated with rising relative wages, because industries which have to compete on foreign markets tend to employ more skilled workers as well as do more research and development, etc. But a negative relationship between changes in export intensity and relative wages is also possible, as export-oriented firms succeed in holding down labour costs in order to compete in the international environment. In many cases, particular industries are both import-intensive and export-intensive relative to the manufacturing average because of the importance of intra-industry trade, blurring industry differences.

The basic questions to be addressed are thus the following:

-- Is there evidence that changes in relative wages of individual industries are associated with changes in relative import penetration and/or export intensity of that industry?

-- Are there significant differences across industries in the relationship between trade competition and relative wages? More precisely, has increased openness shifted relative labour demand in favour of higher skills?

-- Are there distinct patterns across countries or regions in the relationship between changes in relative wages and changes in trade competition?

2. Equation specification

Regressions were estimated, country by country for 12 OECD countries, pooling together 21 industries, and for three industry groupings based on the proportion of workers that falls in the manual labour category.[10] The model was first estimated in its most simple form, including "fixed-effect" dummies and output per worker variables as well as a business cycle variable, with unconstrained coefficients, and without the trade variables. In a second step, the trade variables were added to the equation, allowing for different responsiveness across industries, and in a third step, the coefficients on the trade variables were constrained to be equal across industries in each grouping.

The dependent variable in the estimated equations is the change in average labour cost per employee (a proxy for wages and skills) in industry "i", relative to total manufacturing. Trade variables on the right-hand side of the equation are defined as the change in relative import penetration and the change in relative export intensity as in the previous section. The regressions were estimated first, with variables expressed as year-to-year changes over the period 1970-89; second, with variables expressed as changes during three successive cycles (1973-79, 1979-85, 1985-89).[11]

3. Detailed estimation results

The estimations based on *year-to-year* changes produce mixed results that can be briefly described as follows:

i) The basic specification (without the trade variables) explains a small proportion of the observed relative wage variability across industries: ranging from 10 to 30 per cent in a large number of countries, reaching 40 per cent in the U.S. and Japan, and over 80 per cent in Australia;

ii) The trade variables improve the explanatory power of the equation in 5 of the 12 countries reported: Japan, Germany, the U.K., Norway and Sweden, as shown by the F-test presented in Table 11;

iii) The relationship between changes in relative wages and trade competition is ambiguous. When country-specific/ industry-specific coefficients on trade variables (some 250 coefficients)

are estimated, there is no predominant pattern in the sign of the relationships, with both negative and positive coefficients observed on the import and export variables;

iv) When the 21 industries are regrouped into three categories, there does not appear to be conclusive evidence that the relationships differ significantly according to the type of industry exposed. In particular, industries with a high proportion of manual labour do not appear to be more vulnerable to changes in relative trade competition than other industries, or, if they are, the adjustment does not seem to take place through relative wage changes (Table 12).

The coefficients on the "fixed-effect" dummies, when constrained to be the same across industries in each grouping, are predominantly negative in the "high-manual" category, and positive in the "low-manual" grouping (Table 13). However, they are statistically significant in a few instances only. Changes in output per worker explain a substantial part of the inter-industry variance of changes in relative wages, with important country differences, the link being particularly strong and widespread in Australia.

Estimates based on *changes over cycles* produce results that are better determined statistically than those based on annual changes. Some evidence is found -- more suggestive than conclusive -- of links over the longer run between changes in relative wages and trade competition, with differences according to the type of industry exposed. Results for individual countries and selected OECD areas are set out in Tables 14 to 15, from which the following points can be drawn:

i) Estimates carried out industry by industry produce mostly insignificant results (Table 14);

ii) When the 21 industries are regrouped into three categories (high, medium and low manual), the link between changes in import penetration and relative wages tends to be positive in industries employing a low proportion of manual labour (high-skill industries), where 9 out of 12 coefficients are positive, of which 6 are statistically significant (Table 15). This pattern suggests that firms in high-skill industries may have reacted to intensified import competition by changing the production process, employing a more highly skilled work force[12]. Another possibility is that increasing labour costs have made these industries vulnerable to import penetration;

iii) The estimation produces both negative and positive coefficients on export intensity, most being insignificant. In high-skill industries, the dominant pattern is, however, a negative association between changes in export intensity and relative wages -- indicating perhaps that exporters hold down labour costs to compete in the international environment (or that relative export performance tends to worsen when relative labour costs rise)[13];

iv) When the coefficient on the fixed-effect dummies is constrained to be the same for all industries in each grouping, results indicate that for a majority of countries, the coefficients are positive in the "low-manual" grouping, and negative in the "high-manual" industries. Relative wages tend to increase in high-skill industries, while there appears to be a downward trend in industries characterised by a high proportion of manual labour.

III. CONCLUSION

In order to draw some tentative conclusions, it is useful to pull together results from the two sets of analysis -- that relating changes in relative employment to trade intensity and that relating changes in relative wages to trade intensity. Results from both sets of regressions over the medium-term (i.e. relating changes over successive cycles) are shown in Table 16 for selected OECD areas. They suggest the following broad conclusions:

i) The most significant relationships between trade competition and relative employment (as well as between trade and relative wages) are observed in the high-skill industries ("low-manual" category) contrary to a widespread belief that low-skill industries ("high manual" category) are more vulnerable to changes in trade competition;

ii) The positive association between relative wages and import penetration in Europe in high-skill industries (seen in conjunction with the negative link between relative employment and trade) suggests that the adjustment to rising import penetration is not taking place through wage changes, but rather through relative employment changes. Firms may be reducing their work force where import competition intensified; or they may be changing the production process employing a higher skilled, but reduced, work force. In Canada, a pattern similar to that in Europe is observed;

iii) On the export side, the results can be interpreted as firms in high-skill industries holding down labour costs in order to compete on foreign markets, by constraining average wages, as seems to be the case in Europe, (although the magnitude of the relationship is small), or by reducing employment -- or constraining it to rise less than on average -- thus increasing relative productivity. In the case of Japan, no evidence was found of statistically significant links between relative employment, wages and trade;[14]

iv) The impact of trade with non-OECD countries is found to be statistically significant but small in magnitude (much smaller than that of intra-OECD trade, just as the level of trade with non-OECD countries is small relative to intra-OECD trade).

Overall, the impact of changing trade patterns on labour market conditions appears to be significant but generally small relative to other factors. The trend terms in the equations suggest that there are significant long-term influences at work. In the relative employment equations, they reflect the rise of relative demand for labour in high-skill industries in most countries under review. In the relative wage equations, the trend terms also suggest that structural factors are moving in favour of skilled labour. There is evidence in a number of countries that relative wages may be responding to the steady increase in demand in high-skill industries.[15] The upward trend may also reflect a steady change in the skill composition of workers in these industries.

It is important to emphasize that this empirical analysis does not measure the impact of changing trade patterns on aggregate employment or unemployment. This impact depends not only on how many workers are displaced from a given sector, as a result of foreign competition, but on how long it takes workers to find jobs in expanding sectors, which in turn depends on how transferable human skills are and how flexible the labour market is.

Notes

1. Bénédicte Larre is Principal Administrator in the Country Studies Branch of the Economics Department. The author would like to thank Joaquim Oliveira Martins and Raymond Torres for their support and very useful discussions. She also thanks Nick Vanston, Jørgen Elmeskov and John Martin for suggestions and comments on a previous version of this paper, as well as Christophe Madaschi who provided outstanding research assistance.

2. In European countries, industries were grouped according to the average proportion of manual/non manual workers calculated for individual industries using Eurostat data for 1984, assuming that the shares do not vary much across time and countries. For the U.S., the criterion used is the proportion of production workers employed in individual manufacturing industries, as published in the Bureau of Labour Statistics, *Employment and Earnings*, 1985. There is a close correspondence between the classifications retained for Europe and the U.S. For Canada, somewhat arbitrarily, the industry partitioning is made following that for the U.S., while for Australia, the European classification is adopted. For Japan, finally, the partitioning is made according to the proportion of production workers by industry, from the December 1989 Survey of the Ministry of Labour.

3. With import penetration, MP, defined as Imports/(Output+Imp.-Exp.) and export intensity, XI, as Exports/Output, the relation can be written as:

   $$d(Eij/Emj) = a\ DUMMij + b\ d(MPij/MPmj) + c\ d(XIij/XImj) + f\ d(PRODij/PRODmj) + g\ BCj$$

   where:

   d denotes changes calculated
   -- first, on a year-to-year basis (the annual change specification)
   -- second, as average growth rates from beginning to end of three successive cycles

   PROD = nominal value added per worker.

   BC = a business cycle variable (proxied by the deviation from a Hoddrick-Prescott filter trend), included in the annual change specification only, unconstrained, to allow for different responsiveness of individual industries to the cycle. When countries are pooled together, the business cycle variable is included to account for possible for possible differences in the cyclical position of each economy.

   DUMM = industry-specific (or group-specific) fixed effects, taking the value 1 in turn for each individual industries and 0 for all the others (or 1 if the industry belongs to the group and 0 elsewhere). On the advantages and drawbacks of using a fixed-effects, and alternative approaches to estimating cross-sectional/time-series data, see Cheng Hsiao (1986).

4. The inclusion of fixed-effect dummies also has the effect of reducing spurious correlations among the variables in the model arising from the fact that they are trending over time.

5. When a single coefficient is estimated across all industries on the trade variables, the negative coefficients on export intensity are statistically significant for 4 countries only, while the coefficients on import penetration are significant for 8 countries (Table 3).

6. The constrained specification with 3 group-specific trade variables rather than the complete set of 21 industry-specific trade variables implies a loss of explanatory power of the equation for

some countries. However, the constrained specification still performs relatively well, as shown by the F-test reported in Table 2, Column 2; and in the case of Germany, it performs better than the unconstrained specification.

7. Including a complete set of 21 industries dummies rather than constraining the specification to three group-specific dummies adds significant explanatory power to the equation in all but three countries (Table 2, Column 3).

8. Apart from the difference in the time-periods over which changes are calculated, and the fact that no business cycle variable is included here, the equation specification is the same as that presented above. Likewise, variables are expressed relative to the average for manufacturing, so that the relation may be written as:

d.REij= a DUMMij + b d.RMPij + c d.RXIij + f d.RPRODij

where:

d denotes average changes over three time periods,
REij = the relative share of employment in industry i for country j (Eij/Emj),
RMPij = the relative import penetration rate,
RXij = relative export intensity,
RPRODij = relative value added per worker,
DUMM = industry specific (or group-specific) fixed effects, taking the value 1 in turn for each individual industries and 0 for all the others (alternatively, 1 if the industry belongs to a specific group and 0 elsewhere).

9. Import penetration *vis-a-vis* the non-OECD (o) for industry i and country j is defined relative to import penetration *vis-a-vis* the world (w) for total manufacturing (m) and country j: MPoij/MPwij. Likewise, relative export intensity is: XIoij/XIwij, so that the denominator in the relative trade variables -- average import penetration (export intensity) for total manufacturing -- is the same as that in the general specifications used elsewhere.

10. Alternatively, regressions were estimated for three broad industry groupings classified by average wage level. There is a close correspondence between the two sets of groupings, as shown in Table 1. Industries with a high proportion of manual labour are typically "low" or "medium-wage" industries (one noteworthy exception being the motor vehicle industry, a "high-manual" industry that is also in the "high-wage" category in a number of countries). On the other hand, industries that employ a low proportion of manual labour tend to belong, with a few exceptions, to the "high-wage" category. Estimates of regressions based on the relative wage-level split seem to broadly coincide with those based on the proportion of manual labour employed, so they are not reported here.

11. With import penetration, MP, defined as Imports/(Output+Imp.-Exp.) and export intensity, XI, as Exports/Output, the relation can be written as: d(Wij/Wmj)= a DUMMij + b d(MPij/MPmj) + c d(XIij/XImj) + f d(PRODij/PRODmj) + g BCj

where:

d denotes changes calculated
-- first, on a year-to-year basis (the annual change specification)
-- second, as average growth rates from beginning to end of three successive cycles

PROD = nominal value added per worker.

BC = a business cycle variable (proxied by the deviation from a Hoddrick-Prescott filter trend), included in the annual change specification only, unconstrained, to allow for different responsiveness of individual industries to the cycle. When countries are pooled together, the business cycle variable is included to account for possible for possible differences in the cyclical position of each economy.

DUMM = industry-specific (or group-specific) fixed effects, taking the value 1 in turn for each individual industries and 0 for all the others (or 1 if the industry belongs to the group and 0 elsewhere). On the advantages and drawbacks of using a fixed-effects, and alternatives approaches to estimating cross-sectional/time-series data, see Cheng Hsiao (1986).

12. Oliveira Martins (1994), who introduces market structure as a determinant of the links between foreign trade and relative wages, finds that the relationship between import penetration and relative wages tends to be significantly positive in a grouping of industries characterised by high product differentiation. This may not be inconsistent with the results presented here, since many of the industries classified by Oliveira Martins as "highly differentiated" are precisely high-skill ("low-manual") industries according to the classification used here.

13. In the high-skill ("low-manual") industry grouping, 8 out of the 12 coefficients are negative, 4 of which are statistically well determined. When observations are pooled across the 8 European countries, and a single coefficient is estimated for the area, it is statistically significant and negative in this grouping. In North America the coefficient is not statistically significant.

14. Higuchi (1989) finds that the erosion of international competitiveness in Japan has affected both relative employment and wages. The appreciation of the Yen, by reducing profits of traded goods industries, has forced firms to offset increased labour costs by raising productivity, rationalizing production -- reflected in cuts in working hours, and/or dismissals of workers -- as well as developing new products and technology. At the same time, senior workers, who in Japan are more at risk of losing their job than younger workers, are under pressure to accept lower wages. So the responsiveness of wages appears to be concentrated on one category of labour (senior workers). This may not be inconsistent with the results presented here, since the analysis here refers to relative sectoral employment and wages of *all* categories of workers.

15. This is what Katz and Revenga (1989) found for the U.S. over the period 1967-87.

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Table 1. **Industries according to the proportion of manual workers employed**.

United States		**Japan**		**European countries**	
Proportion of manual workers employed[1]	Memorandum item: Wage category[2]	Proportion of manual workers employed[3]	Memorandum item: Wage category [2]	Proportion of manual workers employed[4]	Memorandum item: Wage category[5]
High		High		High	
3. Textiles, Apparel, Leather	low wage	2. Food, beverages & tobacco	low wage	3. Textiles, apparel, leather	low wage
4. Wood products, furniture	"	3. Textiles, apparel, leather	"	4. Wood products, furniture	"
10. Rubber, plastic	medium wage	4. Wood products, furniture	"	10. Rubber, plastic	medium wage
11. Non-metallic mineral products	"	10. Rubber, plastic	medium wage	11. Non-metallic mineral products	"
13. Iron and steel	"	11. Non-metallic mineral	"	16. Metal products	"
21. Shipbuilding and repair	medium wage	21. Shipbuilding and repair	high wage	21. Shipbuilding and repair	"
22. Motor vehicles	high wage	22. Motor vehicles	"	22. Motor vehicles	high wage
Medium		Medium		Medium	
2. Food, beverages & tobacco	low wage	13. Iron and steel	high wage	2. Food, beverages & tobacco	low wage
5. Paper products & printing	medium wage	14. Non-ferrous metals	"	5. Paper products & printing	medium wage
14. Non-ferrous metals	"	16. Metal products	medium wage	13. Iron and steel	"
16. Metal products	"	25. Professional goods	"	14. Non-ferrous metals	"
17. Non-electrical machinery	"			17. Non-electrical machinery	"
19. Electrical machines	low wage			25. Professional goods	"
Low		Low		Low	
7. Industrial chemicals	high wage	5. Paper products & printing	high wage	6. Chemicals	high wage
8. Drugs, medicine	"	7. Industrial chemicals	"	7. Industrial chemicals	"
9. Petroleum products	"	8. Drugs, medicine	"	8. Drugs, medicine	"
18. Office & computing machinery	"	9. Petroleum products	"	9. Petroleum products	"
20. Radio-TV-communications	medium wage	17. Non-electrical machinery	"	18. Office & computing machinery	"
23. Aircraft	high wage	18. Office & computing	medium wage	19. Electrical machines	medium wage
24. Other transport equipment	low wage	19. Electrical machines	"	20. Radio-TV-communications	"
25. Professional goods	medium wage	20. Radio-TV-communications	"	23. Aircraft	high wage
		23. Aircraft	high wage	24. Other transport equipment	medium wage
		24. Other transport equipment	medium wage		

1. Proportion of production workers employed in manufacturing industries, based on the U.S. Bureau of Labor Statistics, *Employment and Earnings*, 1985.
2. Classification based on average compensation per employee for the country calculated from the OECD/DSTI STAN database.
3. Proportion of production workers employed in manufacturing industries, based on Japan Ministry of Labour Survey of December 1989.
4. Number of manual/non-manual workers employed in individual industries, across European countries, calculated on Eurostat 1984 data.
5. Classification based on average compensation per employee in 1980-89, across European countries, calculated from the OECD/DSTI STAN database.

Table 2. **Test statistics for the relative employment regressions**

	F-Test Industry specific (1)	Trade variables Group specific (2)	F-Test industry specific dummies (3)
United States	1.86**	1.41	2.04**
Canada	1.63*	3.07**	0.61
Japan	1.54*	3.03**	4.28*
Australia (4)	0.87	1.43	0.89
Germany	0.94	2.91**	3.85**
France	0.93	1.48	5.74**
Italy	2.89**	2.53**	2.60**
United Kingdom	3.11**	1.71	4.29**
Netherlands (4)	3.36**	12.35**	3.07**
Norway	0.40	0.90	1.39
Sweden	2.35**	5.98**	3.82**
Finland (4)	2.96**	7.73**	2.66**

1. Adding industry-specific trade variables (21 industries) to the most simple specification -- that includes dummies, relative output per worker for 21 industries, as well as business cycle variable if available -- improves the explanatory power of the equation.

2. Adding 3 group-specific trade variables to the most simple specification improves the explanatory power of the equation.

3. The complete set of 21 industry-specific dummies performs significantly better than a constrained specification with 3 group-specific dummies.

4. No business cycle variable is included in the equations estimated for these countries.

* The test is significant at the 5 per cent level.

** The test is significant at the 1 per cent level.

Table 3. **Relative employment across 21 industries, with constrained coefficients (1)**

(Annual changes)

	Import Penetration	Export Intensity	R^2	Number of Observations
United States	-0.03*	-0.03	0.32	395
Canada	-0.06**	0.03*	0.39	368
Japan	-0.02**	-0.03**	0.44	371
Australia	0.01	-0.02	0.79	344
Germany	0.02	-0.08**	0.37	360
France	-0.04*	-0.01	0.48	281
Italy	-0.05*	0.01	0.54	298
United Kingdom	-0.02*	-0.09**	0.45	363
Netherlands	0.02	-0.20**	0.50	289
Sweden	-0.12**	0.01	0.33	397
Norway	-0.13	-0.01	0.22	392
Finland	-0.07**	-0.01	0.25	388

1. Twenty-one industry specific dummies are included in the equation, as well as relative output per worker. A business cycle variable is included (except for Australia, the Netherlands and Finland), with unconstrained coefficients, allowing for different responsiveness across industries;

* Coefficient significantly different from zero at the 5 per cent level.

** Coefficient significantly different from zero at the 1 per cent level.

Source: Estimates from OECD/DSTI STAN database.

Table 4. **Relative employment across 3 industry-groupings (1)**
(Annual changes)

	Import Penetration			Export Intensity			R^2	Number of Observations
	LM	MM	HM	LM	MM	HM		
United States	-0.02	-0.02	-0.06	-0.07*	-0.01	0.01	0.33	395
Canada	-0.13**	-0.06	-0.04**	0.04	0.02	0.04	0.40	368
Japan	-0.0	-0.02	-0.02**	-0.07**	-0.01	-0.03	0.44	371
Australia	0.11*	-0.06	0.01	-0.07**	0.03	-0.01	0.80	344
Germany	0.03	-0.09	0.01	-0.11**	0.05	-0.06	0.37	360
France	-0.10*	-0.06	-0.01	0.02	0.03	-0.03	0.48	281
Italy	-0.14**	-0.04	-0.02	0.13**	-0.01	-0.06	0.55	298
United Kingdom	-0.09*	-0.03	-0.01	-0.01	-0.15**	-0.06*	0.46	363
Netherlands	0.28**	0.21**	-0.10*	-0.60**	-0.27*	-0.08*	0.57	289
Sweden	-0.16**	-0.16*	-0.02	0.05*	-0.18*	-0.14*	0.35	397
Norway	-0.29	0.06	-0.07	-0.01	-0.29	-0.02	0.22	392
Finland	-0.37*	-0.08	0.01	0.02	-0.12**	-0.03	0.32	388

LM: "Low-manual worker" industries.

MM: "Medium-manual worker" industries.

HM: "High-manual worker" industries.

* Coefficient significantly different from zero at the 5 per cent level.

** Coefficient significantly different from zero at the 1 per cent level.

1. Twenty-one industry specific dummies are included in the equation, as well as relative output per worker. A business cycle variable is included (except for Australia, the Netherlands and Finland), with unconstrained coefficients, allowing for different responsiveness across industries.

Source: Estimates based on the OECD/DSTI STAN database.

Table 5. **Relative employment across 3 industry-groupings, with constrained fixed effects (1)**

	Dummies			Import Penetration			Export Intensity			R^2	Number of Observations
	LM	MM	HM	LM	MM	HM	LM	MM	HM		
United States	0.81*	0.16	-0.08	0.0	-0.01	-0.06*	-0.09**	0.0	0.0	0.25	395
Canada	0.70	-0.18	0.01	-0.13**	-0.08	-0.05	0.04	0.02	0.05*	0.38	368
Japan	0.56*	-0.27	-0.53	0.01	-0.02	-0.03**	-0.06**	0.0	-0.04	0.30	371
Australia	1.91**	1.95**	1.24*	0.13*	-0.07	0.01	-0.09**	0.04	0.0	0.79	344
Germany	0.69*	0.0	-0.72*	0.0	-0.12*	0.02	-0.08*	0.04	-0.05	0.23	360
France	0.92*	0.46	-0.96*	-0.12*	-0.08	0.0	0.04	0.03	-0.03	0.30	281
Italy	2.13**	-0.34	0.06	-0.13**	-0.01	-0.02	0.13**	-0.02	-0.06*	0.47	298
United Kingdom	1.23**	-0.40	0.03	-0.08*	-0.05	-0.02	0.01	-0.14**	-0.06*	0.32	363
Netherlands	1.59**	1.06*	-0.77	0.25**	0.17	-0.13**	-0.52**	-0.25*	-0.11**	0.49	289
Sweden	1.58**	0.26	-0.93*	-0.18**	-0.18*	-0.01	0.07*	-0.16	-0.18**	0.22	397
Norway	7.54**	1.71	-0.79	-0.38*	0.03	-0.09	0.0	-0.25	-0.01	0.16	392
Finland	3.86**	1.60**	-0.07	-0.36**	-0.09	0.0	0.02	-0.10*	0.0	0.22	388

LM: "Low-manual worker" industries

MM: "Medium-manual worker" industries

HM: "High-manual worker" industries

* Coefficient significantly different from zero at the 5 per cent level.

** Coefficient significantly different from zero at the 1 per cent level.

1. A relative output per worker variable is included for each industry, as well as a business cycle variable (except for Australia, the Netherlands and Finland), with unconstrained coefficients to allow for different responsiveness across industries.

Source: Estimates based on the OECD/DSTI STAN database.

Table 6. **Relative employment across 21 industries, with constrained coefficients (1) (Changes over three time periods)**

	Import Penetration	Export Intensity	Productivity	R^2	Number of Observations
OECD (2)	-0.12**	-0.05**	-0.16**	0.26	677
North America (3)	-0.14**	-0.03	0.05	0.31	123
8 European countries	-0.18**	-0.01	-0.10**	0.36	438
United States	-0.23**	-0.03	0.14	0.48	63
Canada	-0.10	0.0	-0.14	0.37	60
Japan	-0.01	-0.11*	0.09	0.69	59
Australia	-0.07	0.07	-0.82**	0.80	57
Germany	0.16*	-0.29**	-0.18	0.72	57
France	-0.24*	0.04	-0.44**	0.79	45
Italy	-0.04	0.03	-0.05	0.73	43
United Kingdom	0.05	-0.09	-0.21	0.60	60
Netherlands	0.24*	-0.58*	0.12	0.84	48
Sweden	-0.44**	0.05	-0.01	0.76	63
Norway	-0.11	-0.09*	0.04	0.81	62
Finland	-0.26*	0.12*	-0.02	0.45	61

1. The variables are expressed as average changes over three time-periods (1973-79, 1979-85, 1985-89), using OECD's STAN database. Twenty-one industry-specific dummies are included in the equation.

2. Based on inter-industry observations for 12 OECD countries.

3. United States and Canada.

* Coefficient significantly different from zero at the 5 per cent level.

** Coefficient significantly different from zero at the 1 per cent level.

Source: Estimates based on the OCED/DSTI STAN database.

Table 7. **Relative employment across 3 industry-groupings (1)**
(Changes over three time-periods)

	Import Penetration			Export Intensity			Productivity	R^2	Number of observations
	LM	MM	HM	LM	MM	HM			
OECD (2)	-0.08**	-0.11*	-0.19**	-0.05	0.0	0.32	0.16**	0.32	677
North America (3)	-0.24**	-0.11	-0.08	-0.06	-0.03	0.05	0.05**	0.35	123
8 European countries	-0.15**	-0.14*	-0.23**	0.01	0.02	-0.10*	-0.11**	0.37	438
United States	-0.29*	-0.13	-0.17	-0.11	0.14	0.04	-0.10	0.52	63
Canada	-0.20*	0.04	-0.03	0.00	-0.04	-0.01	-0.11	0.39	60
Japan	-0.14	-0.02	0.02	-0.09	-0.14	-0.06	0.08	0.70	59
Australia	0.13	-0.41	-0.39	0.04	0.06	0.06*	-0.82**	0.82	57
Germany	0.36*	-0.09	0.12	-0.46**	0.05	-0.26**	-0.14	0.75	57
France	-0.43**	0.01	-0.24	0.76**	0.07	-0.29*	-0.37**	0.89	45
Italy	0.05	-0.16	0.09	-0.32	0.11	0.12	-0.04	0.78	43
United Kingdom	-0.64	-0.02	0.24*	0.79*	-0.47	-0.16	-0.14*	0.68	60
Netherlands	0.40*	0.08	-0.45	-0.86**	-0.20	-0.16	0.07	0.87	47
Sweden	-0.35	-0.14	-0.29	0.07	0.23	-0.28	-0.04	0.78	63
Norway	-0.14	0.24	-0.16	-0.13*	-0.46*	0.10	0.06	0.85	62
Finland	-0.27	0.00	-0.29*	O.10	0.23	0.17	0.02	0.46	61

LM: "Low-manual worker" industries.

MM: "Medium-manual worker" industries.

HM: "High-manual worker" industries.

* Coefficient significantly different from zero at the 5 per cent level.

** Coefficient significantly different from zero at the 1 per cent level.

1. The variables are expressed as average changes over three time-periods (1973-79, 1979-85, 1985-89). Twenty-one industry-specific dummies are included in the equation.

2. Based on inter-industry observations for 12 OECD countries.

3. The United States and Canada.

Source: Estimates based on the OECD/DSTI STAN database.

Table 8. **Relative employment across 21 industries: industry-specific coefficients**
(Changes over three time-periods)

Industries	OECD (1)				Europe (2)			
	Dummies	M	X	Output per worker	Dummies	M	X	Output per worker
Food, beverages & tobacco	-0.08	-0.16	-0.10	-0.36	0.37	-0.05	-0.08	-0.05
Textiles, Apparel, Leather	-3.07**	-0.02	-0.04	-0.37	-3.49**	0.09	0.04	-0.09
Wood products, Furniture	-0.32	-0.05	-0.06	-0.32	-0.09	-0.17	-0.11	-0.05
Paper products & printing	1.10**	-0.20	0.09	-0.65**	1.01*	-0.13	-0.12	-0.42
Industrial chemicals	0.46	-0.04	0.09	-0.26*	0.75	-0.03	-0.08	-0.13
Drugs, Medicine	2.70**	-0.10	0.01	-0.36*	2.96**	-0.50*	0.18	-0.07
Petroleum products	0.28	0.12*	-0.06	-0.01	1.46**	0.11	0.14	-0.08
Rubber, Plastic	1.24**	-0.13	-0.02	0.45**	0.82	-0.37	-0.22	-0.45
Non-metallic mineral products	-0.55	0.10	0.01	-0.20	-0.31	0.27	-0.08	-0.02
Iron and steel	1.76**	-0.03	0.12	-0.37**	-1.76**	-0.09	0.20	-0.32*
Non-ferrous metals	0.16	-0.16	0.04	-0.10	0.23	-0.22	0.09	-0.05
Metal Products	0.17	-0.30*	0.09	-0.94**	0.46	-0.42	0.21	-0.43
Non-electrical machinery	0.27	-0.33	-0.02	-0.45**	0.12	-0.14	-0.38	-0.04
Office & computing machinery	4.17**	-0.21*	-0.21*	-0.64**	5.19**	0.27	-0.72**	-0.02
Electr. mach.	0.96	-0.171	-0.18	-0.02	0.14	0.10	0.05	-0.10
Radio-TV-comm.	2.33**	-0.77**	-0.10	-1.23	1.79**	-0.38	-0.12	-0.24
Shipbuilding & repair	-4.29**	-0.19**	0.03	-0.46**	-6.4**	-0.31**	-0.17**	-0.51**
Motor vehicles	1.21*	0.05	0.54**	-0.07*	1.21*	-0.05	0.33	-0.07
Aircraft	2.70**	0.0	-0.03	-0.12	3.25**	-0.19*	0.07	-0.28**
Other transport equipment	-3.86**	-0.06	-0.06*	0.86**	-2.00**	-0.61**	0.06	-0.47**
Professional goods	0.68	-0.18	0.12	-0.75**	1.49**	-0.20	0.09	-0.28**

1. Sectoral data for twelve OECD countries are pooled together; $R^2 = 0.44$; 677 observations.
2. Data for 8 European countries; $R^2 = 0.52$; 438 observations.
* Coefficients significantly different from zero at the 5% level.
** Coefficients significantly different from zero at the 1% level.

Source: Estimates based on the OECD/DSTI STAN database.

Table 9. **Relative employment across 3 industry-groupings, with constrained fixed effects**
(Changes over three time periods)

	Dummies			Import Penetration			Export Intensity			Value added per worker	R^2	Number of Observations
	LM	MM	HM	LM	MM	HM	LM	MM	HM			
OECD (1)	1.18**	0.32	-0.75**	-0.04	-0.13*	-0.15**	-0.07**	0.02	-0.06*	-0.15**	0.12	677
North America (2)	0.20	0.21	-0.42	-0.17**	-0.01	-0.08	-0.13**	-0.06	0.07	0.01	0.15	123
8 European countries	1.34**	0.30	-0.89**	-0.16**	-0.12	-0.19**	0.01	0.02	-0.12*	-0.08**	0.13	438
United States	-0.37	0.45	-0.63	-0.06	-0.01	-0.15	-0.27**	0.04	0.00	0.09	0.24	63
Canada	0.90*	0.10	-0.37	-0.21*	-0.13	-0.11	-0.05	-0.06	0.17	-0.18*	0.23	60
Japan	0.56	-0.08	-1.53*	0.04	-0.07	0.05	0.00	-0.09	-0.03	0.16	0.14	59
Australia	0.85	0.60	0.25	0.28**	-0.32	-0.34	-0.22**	0.13	0.04	-0.76**	0.74	57
France	1.20	0.72	-0.75	-0.55**	0.22	-0.47	0.55**	-0.19	0.11	-0.66**	0.51	45
United Kingdom	0.75	-0.95	-0.09	-0.68**	-0.38	0.15	0.86**	-0.06	-0.08	0.14	0.26	60
Italy	0.55	-0.35	0.12	0.17	-0.12	0.16	-0.20	0.11	-0.08	-0.07*	0.17	43
Sweden	1.10*	-0.06	-1.06	-0.38*	-0.28	-0.50**	0.13	-0.14	-0.31	-0.07	0.44	63
Netherlands	0.41	0.26	-0.43	0.24	-0.11	-0.15	-0.64**	-0.16	-0.42*	-0.18*	0.66	47
Finland	2.58**	1.00	0.07	-0.38	-0.08	-0.33**	0.02	0.21	0.20	0.04	0.21	61
Norway	3.87**	1.05	-1.63*	-0.42	0.09	-0.16	-0.03	-0.37	0.13	-0.05	0.31	62

LM: "Low-manual worker" industries
MM: "Medium-manual worker" industries
HM: "High-manual worker" industries.

* Coefficients significantly different from zero at the 5% level.

** Coefficients significantly different from zero at the 1% level.

1. Based on inter-industry observations for 12 OECD countries.

2. The United States and Canada.

Source: Estimates based on the OECD/DSTI STAN database.

Table 10. **Relative employment and trade vis-a-vis the non-OECD area**
(Changes over three time-periods)

OECD (12 countries)	Import penetration, from:		Export intensity, towards:	
	World	non-OECD (1)	World	non-OECD (1)
Industry groupings				
"Low-manual"	-0.08**	-0.03**	-0.05**	-0.03**
"Medium-manual"	-0.11*	-0.04*	0.0	0.0
"High-manual"	-0.19**	-0.01	-0.06**	-0.01
Selected industries (2)				
Textiles, Apparel, Leather	-0.02	-0.16*	-	-
Wood products, furniture	-	-	-0.06	-0.14*
Iron and Steel	-	-	0.12	0.10**
Office & Computing Mach.	-0.21*	-0.19**	-0.21*	-0.09
Radio-TV-Communication	-0.77**	-0.14**	-	-
Other transport equipment(3)	-	-	-0.06*	-0.05**
8 European countries	Import penetration from:		Export intensity, towards:	
	World	non-OECD (1)	World	non-OECD (1)
Industry groupings				
"Low-manual"	-0.15*	-0.03**	0.01	-0.01
"Medium-manual"	-0.14*	-0.04	0.02	-0.02
"High-manual"	-0.23**	0.0	-0.10*	-0.02
Selected industries (2)				
Textiles, Apparel, Leather	0.09	0.29*	-	-
Wood products, Furniture	-	-	-0.11	-0.20**
Petroleum Products	-	-	0.14	0.06*
Non-electrical machinery	-	-	-0.38	-0.31*
Office & Computing Mach.	0.27	-0.24**	-0.38	-0.31*
Other transport equipment (3)	-	-	0.06	-0.03**

1. Trade *vis-a-vis* the non-OECD economies, (excluding OPEC countries).
2. Only industries for which coefficients on trade variables are significantly different from zero are reported here.
3. Other than Shipbuilding, Motor vehicles and Aircraft industries.

* Coefficients significantly different from zero at the 5% level.

** Coefficients significantly different from zero at the 1% level.

Source: Estimates based on the OECD/DSTI STAN database.

Table 11. **Test statistics for the relative wage regressions**

	F-Test Industry-specific (1)	Trade variables Group-specific (2)
United States	0.69	1.02
Canada	1.16	1.17
Japan	1.90**	3.27**
Australia (3)	0.74	0.68
Germany	1.62*	2.61**
France	0.49	0.95
Italy	1.19	3.09**
UK	1.81*	5.16**
Netherlands (3)	0.75	3.06**
Norway	1.44*	0.85
Sweden	2.16**	6.36**
Finland (3)	1.13	1.69

1. Adding trade variables with unconstrained coefficients across industries to the most simple specification -- that include dummies, relative output per worker for 21 industries and a business cycle variable if available, -- improves the explanatory power of the equation.

2. Adding 3 group-specific trade variables to the basic specification improves the explanatory power of the equation.

3. No business cycle variable is included in the equations estimated for these countries.

* The test is significant at the 5% level.
** The test is significant at the 1% level.

Table 12. **Relative wages across 3 industry-groupings (1)**
(Annual changes)

	Import Penetration			Export Intensity			R^2	Number of Observations
	LM	MM	HM	LM	MM	HM		
United States	-0.01	0.04	-0.02	0.03*	-0.02	0.02	0.40	395
Canada	-0.01	-0.03	-0.01	-0.01*	0.0	0.0	0.34	368
Japan	-0.01	0.01	0.02**	0.03	0.0	0.05**	0.48	371
Australia	-0.0	0.04	-0.01	0.01	0.0	-0.02*	0.84	344
Germany	-0.11**	-0.03	-O.04	0.15**	-0.0	-0.01	0.29	355
France	0.15*	-0.03	-0.03	-0.05	-0.07	0.05	0.24	237
Italy	-0.18*	-0.03	-0.06	-0.11	-0.04	0.02	0.22	281
United Kingdom	-0.05*	0.02	0.04**	-0.01	-0.03	-0.03	0.29	363
Norway	0.0	-0.02	0.0	-0.0	-0.01	-0.01	0.23	390
Finland	0.07**	0.0	-0.02	-0.02**	0.01	0.01	0.12	388

LM: "Low-manual worker" industries.

MM: "Medium-manual worker" industries.

HM: "High-manual worker" industries.

1. Twenty-one industry specific dummies are included in the equation, as well as relative output per worker. A business cycle variable is included (except for Australia, the Netherlands and Finland), with unconstrained coefficients, allowing for different responsiveness across industries.

* Coefficients significantly different from zero at the 5% level.

** Coefficients significantly different from zero at the 1% level.

Source: Estimates, using the OECD/DSTI STAN database.

Table 13. **Relative wages across 3 industry-groupings, with constrained fixed effects** (1)
(Annual changes)

	Dummies			Import Penetration			Export Intensity			R^2	Number of Observations
	LM	MM	HM	LM	MM	HM	LM	MM	HM		
United States	0.46*	-0.03	-0.13	-0.01	0.04	-0.03	0.03*	-0.01	0.01	0.38	395
Canada	0.14	-0.04	-0.03	-0.01	-0.01	-0.01	-0.01	-0.01	0.0	0.28	368
Japan	0.19	-0.16	-0.04	-0.02*	0.0	0.01**	0.03*	0.0	0.06**	0.47	371
Australia	0.18	0.23	-0.20	0.0	0.04	-0.01	0.02	0.0	-0.03*	0.83	344
Germany	0.40	-0.36	0.02	-0.11**	-0.02	-0.04	0.15**	-0.03	-0.02	0.27	355
France	-0.43	-0.68	0.20	0.13*	0.01	-0.04	-0.04	-0.09	0.05	0.21	237
Italy	4.30**	0.10	-0.49	-0.14	-0.04	-0.08	-0.09	-0.04	0.03	0.18	281
United Kingdom	0.66**	0.08	-0.40*	-0.05*	0.02	0.04**	-0.01	-0.03	-0.03	0.27	363
Netherlands	0.24	-0.59	0.19	0.48**	0.08	0.05	-0.03	-0.16	0.01	0.29	286
Sweden	0.15	-0.18	-0.26	0.06*	0.10*	0.03	-0.06**	0.04	0.11**	0.26	397
Norway	0.09	0.0	-0.05	0.0	-0.02	0.0	0.0	0.0	-0.01	0.20	390
Finland	-0.08	-0.07	-0.34	0.07**	0.0	-0.02*	-0.02**	0.0	0.01	0.12	388

LM: "Low-manual worker" industries

MM: "Medium-manual worker" industries

HM: "High-manual worker" industries

* Coefficients significantly different from zero at the 5% level.

** Coefficients significantly different from zero at the 1% level.

Source: Estimates using the OECD/DSTI STAN database.

Table 14. **Relative wages across 21 industries: industry-specific coefficients**

(Changes over three time-periods)

Industries	OECD (1)				Europe (2)			
	Dummies	M	X	Output per worker	Dummie	M	X	Output per worker
Food, beverages & tobacco	0.32	0.16	-0.08	0.14	-0.01	0.08	-0.09	0.04
Textiles, Apparel, Leather	-0.04	-0.06	0.05	0.36	-0.14	-0.09	0.07	0.14
Wood products, Furniture	-0.05	-0.01	-0.01	0.33	-0.30	-0.02	-0.01	0.21
Paper products & printing	-0.13	-0.02	-0.01	0.57**	0.03	0.0	-0.07	0.10
Industrial chemicals	0.20	-0.04	0.07	0.18	0.21	-0.01	0.04	-0.02
Drugs, Medicine	0.44	0.04	-0.04	0.14*	0.30	0.01	0.02	0.08
Petroleum products	1.22**	0.09	-0.05	-0.04	1.57**	0.18*	-0.07	-0.05
Rubber, Plastic	-0.20	0.11	0.07	0.33*	-0.06	0.10	0.30	0.36
Non-metallic mineral products	-0.04	0.02	0.04	0.29	-0.16	0.09	0.03	0.17
Iron and steel	-0.78*	-0.05	-0.08	0.09	-1.30**	-0.03	0.03	-0.05
Non-ferrous metals	0.07	0.19	0.03	-0.01	0.16	0.43	-0.37	-0.03
Metal Products	0.08	0.02	0.06	0.73**	-0.02	0.01	0.05	0.11
Non-electrical machinery	-0.04	-0.02	-0.04	0.56**	-0.07	-0.07	-0.02	-0.08
Office & computing machinery	0.05	-0.05	0.0	0.13	1.58*	0.77*	-0.43**	-0.02
Electr. mach.	0.05	0.03	0.05	0.38**	0.28	-0.06	-0.03	0.14
Radio-TV-comm.	-0.28	0.16	-0.05	0.57**	0.02	-0.09	-0.06	-0.11
Shipbuilding & repair	0.04	0.0	0.08*	0.10	-0.04	-0.13	0.18**	-0.17
Motor vehicles	-0.77*	-0.01	-0.13	0.15**	-0.48	-0.07	0.25	0.12**
Aircraft	0.32	0.12*	-0.05	0.22*	0.39	0.33**	-0.09*	0.32*
Other transport equipment	1.15*	0.07	0.01	0.41**	1.32*	0.47**	-0.09*	0.59**
Professional goods	-0.22	0.05	0.0	0.12	-0.05	0.18	-0.13	-0.11

1. Sectoral data for twelve OECD countries are pooled together; R^2 = 0.20; 659 observations.

2. Data for 8 European countries; R^2 =0.18; 420 observations.

* Coefficients significantly different from zero at the 5% level.

** Coefficients significantly different from zero at the 1% level.

Source: Estimates based on the OECD/DSTI STAN database.

Table 15. **Relative wages across 3 industry-groupings, with constrained fixed effects**
(Changes over three time periods)

	Dummies			Import Penetration			Export Intensity			Value Added per worker	R^2	Number of observations
	LM	MM	HM	LM	MM	HM	LM	MM	HM			
OECD (1)	0.37	-0.24	-0.16	0.06*	0.05	0.02	-0.02	0.0	0.04*	0.14**	0.09	659
North America (2)	0.22*	-0.05	-0.19	0.04*	0.08*	-0.01	-0.01	-0.01	-0.02	0.15**	0.39	123
8 European countries	0.64**	-0.24	-0.15	0.18**	0.10	-0.04	-0.05*	-0.05	0.10**	0.05*	0.06	420
United States	0.37*	0.08	-0.36*	0.01	0.09*	-0.0	0.04	-0.03	-0.02	0.19**	0.57	763
Canada	0.05	-0.14	-0.04	0.07*	0.05	-0.04	-0.04	0.0	-0.01	0.09**	0.26	60
Japan	0.10	-0.17	0.20	0.01	-0.01	0.01	-0.02	0.01	0.05	0.16**	0.43	59
Australia	0.31	-0.02	-0.27	-0.16*	0.21	0.28*	0.07*	0.06	-0.07*	0.70**	0.77	57
Germany	0.13	-0.50*	-0.10	0.24**	0.03	-0.06	-0.34**	-0.09	0.05	0.08	0.21	56
France	1.00*	0.10	-0.04	0.54**	0.01	-0.14	-0.75*	0.0	0.13	0.21*	0.61	31
Italy	2.53**	-0.35	-1.03*	1.74**	-0.07	-0.45**	-1.44*	0.09	0.49**	0.12	0.79	40
United Kingdom	0.67**	0.14	-0.34*	0.10*	0.05	-0.06*	-0.07	-0.02	-0.02	0.09**	0.44	60
Netherlands	0.73	-1.30	0.55	0.25	0.94	0.58	-0.02	-1.17	-0.15	-0.03	0.08	47
Sweden	-0.04	0.02	0.02	-0.16*	0.29	0.13	0.05	-0.01	0.01	0.09	0.21	63
Norway	-0.02	-0.06	-0.26**	-0.07*	0.0	0.01	0.02*	-0.05	0.02	0.0	0.19	62
Finland	0.33	-0.01	-0.36	0.13*	0.12*	-0.04	-0.04**	0.0	0.02	-0.04*	0.23	61

LM: "Low-manual worker" industries

MM: "Medium-manual worker" industries

HM: "High-manual worker" industries

1. Based on inter-industry observations for 12 OECD countries.

2. The United States and Canada.

* Coefficients significantly different from zero at the 5% level.

* * Coefficients significantly different from zero at the 1% level.

Source: Estimates using the OECD/DSTI STAN database .

Table 16. **Relative employment and wages across 3 industry-groupings, with constrained fixed-effects**
(Changes over three time periods)

	Dummies			Import Penetration			Export Intensity			Value added per worker	R^2	Number of Observations
	LM	MM	HM	LM	MM	HM	LM	MM	HM			
United States												
Relative Wages	0.37*	0.08	-0.36*	0.01	0.09*	-0.0	0.04	-0.03	-0.02	0.19**	0.57	63
Relative Empl.	-0.37	0.45	-0.63	-0.06	-0.01	-0.15	-0.27**	0.04	0.0	0.09	0.24	63
Canada												
Relative Wages	0.05	-0.14	-0.04	0.07*	0.05	-0.04	-0.04	0.0	-0.01	-0.09**	0.26	60
Relative Empl.	0.90*	0.10	-0.37	-0.21*	-0.13	-0.11	-0.05	-0.06	0.17	-0.18*	0.23	60
Japan												
Relative Wages	0.10	-0.17	0.20	0.01	-0.01	0.01	-0.02	0.01	0.05	0.16**	0.43	59
Relative Empl.	0.56	-0.08	-1.53*	0.04	-0.07	0.05	0.00	-0.09	-0.03	0.16	0.14	59
8 European Countries												
Relative Wages	0.64**	-0.24	-0.15	0.18**	0.10	-0.04	-0.05*	-0.05	0.10**	0.05*	0.06	420
Relative Empl.	1.34**	0.30	-0.89**	-0.16**	-0.12	-0.19**	0.01	0.02	-0.12	-0.08*	0.13	420

LM: "Low-manual worker" industries

MM: "Medium-manual worker" industries

HM: "High-manual worker" industries

* Coefficients significantly different from zero at the 5% level.

Source: OECD Secretariat estimates using the STAN database.

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