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MARKET STRUCTURE, TRADE AND INDUSTRY WAGES

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INTRODUCTION

The combination of increasing unemployment and widening wage inequality in OECD countries in the 1980s has raised concerns about the role of foreign trade as a cause of these trends. In particular, some commentators have highlighted growing competition from low-wage developing economies in OECD labour markets. Under specific conditions, which include perfectly competitive markets, the traditional Heckscher-Ohlin-Samuelson(HOS) trade model provides two predictions concerning the links between trade and wages. First, it predicts the equalisation of **relative** factor prices.’ This implies that, opening OECD markets to competition from low-wage countries should lead to a decrease in the relative price of domestic unskilled labour. Secondly, foreign competition from countries with relatively abundant low-skill labour forces may induce an absolute fall in the real wage of OECD unskilled workers – a result known as the Stolper-Samuelson theorem.

Recent work on models of international trade with imperfect competition (*e.g.* Helpman and Krugman, 1985) has challenged this traditional view by stressing the role of market structures in shaping the pattern of trade and the income distribution effects of trade flows. For example, in the latter type of models, even if it can be shown that there is still a tendency towards factor price equalisation, there may be additional gains from trade that are not captured in the HOS model which can – under certain conditions – reverse the Stolper-Samuelson result.

The empirical evidence on the impact of trade on the wage structure is controversial and is largely confined to the United States. Some recent studies suggest that increased import competition reduces wages and employment of low-skilled workers (*e.g.* Revenga, 1992). Other analyses find no evidence in the data for such a negative link (*e.g.* Lawrence and Slaughter, 1993).

To our knowledge no empirical study introduced market structure explicitly as a determinant of the link between international trade and industry wages. This paper aims to take a step towards filling this gap. It also tries to extend the country coverage of the analysis by dealing with a large sample of OECD countries using the OECD Structural Analysis data base (STAN).

The paper comprises three parts, as follows. The first part specifies a classification of individual sectors according to market structure characteristics. Then a set of indicators is computed from STAN in order to test if the results by industry grouping match the stylised facts that could be expected on *a priori* grounds. The second part of the paper describes the evolution of import penetration trends in twelve OECD countries during the period 1970-90, with respect to both the market structure classification and exporting regions. Special attention is paid to import penetration trends from Asian Newly Industrialised Economies (NIEs). Finally, an econometric model of industry relative wage rates is estimated using panel data. This model encompasses both the characterisation of industries by type of market structure, as well as import penetration and export intensity variables.

I. MARKET STRUCTURE

A. Characterisation of industries by type of market structure

In principle, characterising industries according to their market structure requires a set of micro-economic indicators: concentration ratios, size of mark-ups, degree of returns to scale, product differentiation, etc. Unfortunately, this type of information is not available on a sufficiently systematic basis to allow for detailed cross-country and industry comparisons. In order to overcome this lack of data and bring market structure into the analysis of industry patterns, the strategy was followed here of using *a priori* information on the likely types of market concentration and product differentiation to be found in each sector.[2] The 22 individual industries of the STAN data base[3] were classified into several subsets. Each group was characterized, on the one hand, by the dynamics of market concentration and, on the other, by the extent of product differentiation.

With respect to the dynamics of **concentration,** two types of market structures are usually identified in the literature: fragmented and segmented industries.[4]

In **fragmented industries,** the number of firms grows in parallel with output growth, thus output expansion is achieved through the creation of new firms and concentration decreases when market size increases. Typically, fragmented industries have relative low set-up costs and can create a wide range of product variety (or so-called horizontal differentiation, see Box 1). Textiles or machine tools are good examples of fragmented industries.

In **segmented industries,** the number of firms remains relatively stable when market size increases; therefore concentration also tends to remain stable. The forces causing market segmentation are often related to large set-up (or sunk) costs. Also, when strong non-price competition occurs in segmented markets, it is usually focused on the relative quality of different brands (or so-called

Box 1: **The dimensions of product differentiation**

Basically, product differentiation can take place either through innovation or by adding new varieties of existing products. Accordingly, it unfolds along two dimensions: ***i)*** vertical differentiation; and ***ii)*** horizontal differentiation.

Suppose that the ranking of quality characteristics of a given range of products is the same for all consumers, Then, two vertically differentiated products must have different prices and the consumers associate the lowest price with the lowest quality brand. Indeed, if prices are equal, the lowest quality brand will be pushed out of the market.

On the other hand, when products are differentiated horizontally, there is no implicit product ranking by consumers. This implies that two varieties of the same product can have equal prices and coexist in the market. In other words, horizontal differentiation corresponds to a pure consumers' preference for variety.

Producers choose the most appropriate combination of differentiating characteristics according to their marketing strategy. Both forms of product differentiation relax price competition. However, competing along the vertical dimension generally needs costly investments, namely R&D and/or advertising in order to create a brand image, and therefore can generate large price gaps among the same type of products, whereas horizontal differentiation is generally associated with a more uniform distribution of prices (see Encaoua, 1989).

vertical differentiation). Chemical drugs or aerospace are two examples of segmented industries with high product differentiation.

Real-world industries are typically a mixture of these two extreme cases. For example, in most industries one can identify a core of dominant large-scale firms and a fringe of small and medium-sized competitors. Nonetheless, at the level of industrial detail used in this study, differences are sufficiently marked to make this classification meaningful.

The characterisation of the **product differentiation** dimension is more difficult because the potential number of differentiating characteristics of **a** given product can be very large. These product characteristics are usually classified into horizontal and vertical dimensions. But, for the purposes of this study, a looser criterion was adopted by only distinguishing two cases: "homogenous" (or low-differentiated) and "differentiated" products. Basically, the former category corresponds to the case where products originating from different producers are very substitutable (or virtually homogenous). The "differentiated" group includes both the horizontal and vertical types of product differentiation.

Table **1. Stylised facts characterising each type of market structure**

Product differentiation	Concentration dynamics	
	Fragmented **(F)**	Segmented ***(S)***
	HF	**HS**
Low differentiated or homogenous products (H)	• Strong price competition • High substitutability among products • Low concentration • Low entry costs • Small or no scale economies • Low market power	• Quantity competition • High substitutability among products • High concentration • High entry costs • Large-scale economies
	DF	**DS**
Differentiated products (D)	• Price and non-price competition • Extensive horizontal differentiation • Low concentration • Moderate entry costs • Scale economies	• Strong non-price competition • Extensive vertical differentiation • High concentration • High entry costs • Large-scale and scope economies • Strong market power

When product differentiation categories are combined with the market concentration characteristics, a relatively clear characterisation of market structure prototypes emerges. These are described in the 2 x 2 matrix in Table 1 which lists some stylised facts referring to the distinguishing characteristics of each group. The correspondence between the 22 industries of the STAN data base and the four sub-groups described by Table 2 was made on *a priori* grounds using an "educated guess" approach. The purpose of the next section is to compute a set of indicators for each industry grouping in order to verify whether this classification matches with the market characteristics described in Table 1.

B. Some empirical regularities in the STAN data base

To describe the characteristics of each industry grouping, several indicators can be computed from STAN (see data appendix). Twelve countries are included in our sample: United States, Japan, Germany (west), France, Italy, United Kingdom, Canada, Australia, Finland, the Netherlands, Norway and Sweden. In order to be comparable across countries, all indicators are normalized by the total manufacturing average in each country:

Relative wage rate = $(W_i/E_i)/(W_T/E_T)$
Relative margin rate = $[(V_i - W_i)/V_i]/[(V_T - W_T)/V_T]$
Relative investment rate = $(GFC_i/V_i)/(GFC_T/V_T)$
Relative R&D intensity = $(R\&D_i/V_i)/(R\&D_T/V_T)$
Relative import penetration ratio = $[M_i/(Q_i + M_i - X_i)]/[M_T/(Q_T + M_T - X_T)]$
Relative export intensity = $(X_i/Q_i)/(X_T/Q_T)$

where:

W = Employee compensation
E = Number of employees
V = Value added
Q = Gross output
FC = Gross capital formation
R&D = R&D expenditure
X = exports
M = imports

and subscripts i and T correspond, respectively, to a given industry and to total manufacturing industries. All variables, except E, are expressed in value terms: The set of indicators was computed for each country and industry and averaged over the period 1970-1990.[6] When all information is available, this produces 264 (12 countries x 22 industries) data points split into the four industry groupings according to the key given in Table 2.

Table 2. Classification of industries (STAN) according to their market structure'

Product differentiation	Fragmented	Segmented
Low differentiated or homogenous products	3. 'Textiles, apparel and leather 4. Wood products and furniture 11. Non-metallic mineral products 26. Other manufacturing	5. Paper products and printing 9. Petroleum products furniture 10. Rubber and plastic 13. Iron and steel 14. Non-ferrous metals 21. Shipbuilding and repair
Differentiated products	16. Metal products 17. Non-electrical machinery 18. Office and computing machinery 19. Electrical machines 20. Radio, N ,communications 25. Professional goods	2. Food, beverages and tobacco 7. Chemicals excluding drugs 8. Drugs and medicine 22. Motor vehicles 23. Aircraft 24. Other transport equipment

1. The numbers before each industry referto the classification in the STAN data base {see data Appendix for more details).

Table 3 provides some basic statistics on the mean and dispersion of these indicators for each market structure grouping. Notwithstanding the large cross-sectional variance, some empirical regularities are found in the sample.

Relative wages tend to be lower in the fragmented industries with low product differentiation. Indeed, in this latter group only 10 per cent of the data points are above total manufacturing average compared with 70 per cent or more in the other groups. This confirms that product market power has a positive spill-over effect on wages.'

Table **3. Average characteristics according to the type of market structure, 1970-1990**

(12OECD countries, STAN data base)

	Market structure types			
	Fragmented		Segmented	
	Homogenous	Differentiated	Homogenous	Differentiated
	HF	DF	HS	DS
Relative wage rate	0.84 *0.13* (10%)	1.11 *0.20* (72%)	1.19 *0.27* (78%)	1.14 *0.20* (76%)
Relative margin rate[1]	0.86 *0.67* (44%)	0.75 *0.59* (21%)	0.92 *0.85* (40%)	0.95 *0.61* (47%)
Relative investment rate	0.86 *0.69* (25%)	0.78 *0.30* (15%)	1.35 *0.76* (67%)	1.01 *0.37* (46%)
Relative R&D intensity	0.23 *0.21* (0%)	2.02 *2.22* (56%)	0.44 0.33 (9%)	2.77 *2.99* (72%)
Relative import penetration ratio	1.09 *0.76* (46%)	1.63 *0.94* (69%)	1.04 *0.61* (46%)	1.32 *1.16* (58%)
Of which: from Asian NIEs	3.03 *2.80* (63%)	1.74 *1.80* (49%)	1.00 *1.95* (27%)	0.21 *0.23* (1%)
Relative export intensity	0.82 *0.71* (29%)	1.53 *1.11* (64%)	1.02 *0.77* (39%)	1.16 *1.06* (47%)

1. The gross margin rate can be negative in some cases. This explains why its mean is below one in all groups.

Note: All indicators are expressed relative to country averages of all manufacturing industries (= 1.00). Standard deviations are in italics. Figures in parentheses show the percentage number of data points which are above the manufacturing average.

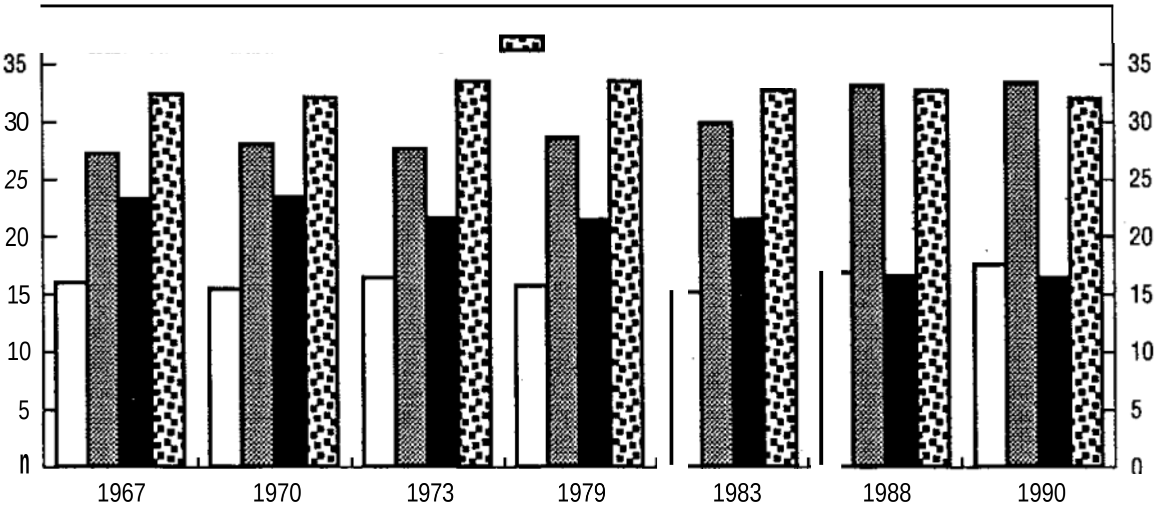
Source: STAN data base.

The two groups of segmented industries where concentration tends to be relatively stable have the highest **relative gross margins,** as could be expected. Nonetheless, the quality of this indicator seems less reliable as, in many cases, the gross margin is negative; this cannot be excluded, but seems implausible for an average calculated over twenty years.

Relative investment is above average for segmented industries, particularly the low-differentiation industries that include large-scale manufacturing sectors such as Iron & Steel or Shipbuilding & Repair. It also emerges rather clearly from the data that the highest **relative R&D intensities** are associated with industries producing differentiated products.[8] This suggests that R&D spending is indeed an important element of the non-price competition among firms.

The **relative import penetration** ratios are more evenly distributed across the four sub-groups. The only group presenting a specific pattern is the fragmented differentiated (DF) group which displays a high proportion (69 per cent) of above-average penetration ratios. It is also worth noting that this group has the highest mean and the largest proportion (64 per cent) of above-average export intensities. These two observations reveal that the bulk of intra-industry trade is located in this set of industries. This result is in accordance with, and could be expected from, the market structure characteristics of the group.

Table 3 also gives the relative import penetration ratios from the Asian NIEs. It appears that only the two cases of fragmented industries have an above-



Legend: HF: Fragmented, low-differentiation industries.
DF: Fragmented, high-differentiation industries.
HS: Segmented, low-differentiation industries.
DS: Segmented, high-differentiation industries.
Source: CEPII, CHELEM data base (see data appendix)

average penetration of imports from the Asian NIEs with a particularly high mean for the fragmented low-differentiation group (HF). The latter possibly reflects the fact that the HF group tends to be relatively unskilled-labour-intensive. However, the data also show above-average penetration in the fragmented differentiated product group (DF). This supports the view that import competition from the NIEs may not be necessarily focused in low-wage unskilled industries: it may also be related to the fragmented structure existing in some sectors which allows for easy entry of foreign firms because competition operates mainly through prices or horizontal differentiation (see Table 1).

The **relative export intensity** indicator can be interpreted as a rough measure of revealed comparative advantage. This shows that OECD countries tend to have their revealed comparative advantage clustered in the high-differentiation industries which account for the bulk of international trade. This can be verified in Figure 1 where world trade is split according to the four-group classification. The two groups of industries with highly differentiated products accounted for a growing share of world trade, reaching roughly 65 per cent of total exports in manufactures by 1990.

II. IMPORT PENETRATION TRENDS IN TWELVE OECD COUNTRIES

A. Penetration trends at the level of total manufacturing industries

Import penetration of domestic demand (M/D) for manufacturing products increased over the period 1970-90 in all countries of our sample, although there was a large cross-country dispersion of growth rates and levels (Table **4).** Indeed, the average level of import penetration over the period 1985-90 ranges from around 5 to 65 per cent of domestic demand. The twelve countries of our sample fall into three broad groups: *i)* the Netherlands? Norway, Sweden, Canada and Finland have penetration rates higher than 30 per cent of domestic demand; *ii)* the United Kingdom, France, Germany, Australia and Italy have rates of 20 to 30; and *iii)* the United States and Japan have the lowest import penetration rates of 13.3 and 5.4 per cent, respectively.

During the 1980s, annual growth rates of import penetration ranged from less than **1** per cent in Japan, Norway and Italy to 6.5 per cent in the United States. The pace of penetration decreased in many countries compared with the 1970s, except in Finland and Norway where the pace increased significantly in the 1980s and the United States, Canada and the Netherlands where it grew roughly at the same pace in the two decades. Consequently, there is no evidence of an overall acceleration in the speed of import penetration rates in the 1980s.

Statistics for the export intensity indicator *(WQ)* over the same periods are also shown in Table **4.** There is a very strong correlation (0.92) between import

Table **4.** Trends **for** import penetration and export intensity

(total manufacturing industries)

	Import penetration ratio			Export intensity		
	Average growth rates[1]		Average levels	Average growth rates'		Average levels
	1970s	1980s	1985-90 MID2	1970s	1980	1985-90 X/Q[3]
United States	6.1	6.5	13.3%	6.9	1.3	8.4%
Japan	3.7	0.8	5.4%	2.8	-2.3	12.4%
Germany (West)	4.2	2.6	24.6%	3.4	2.4	32.4%
France	4.0	3.4	27.7%	4.5	1.9	27.1%
Italy	3.0	0.8	21.0%	3.8	-1.1	23.2%
United Kingdom	5.1	3.3	29.3%	4.5	1.3	25.1%
Canada	2.2	2.5	36.4%	2.5	1.5	35.0%
Australia	4.7	2.2	23.9%	2.5	-0.7	13.2%
Finland	0.0	2.3	30.3%	2.7	0.4	34.0%
Netherlands	2.7	2.8	64.7%	2.5	2.0	66.9%
Norway	-0.6	0.8	42.2%	-0.5	0.3	31.2%
Sweden	2.5	1.2	40.9%	2.5	0.8	45.0%

1. Measured as trend growth rates over the periods 1971-80 and 1981-90 respectively (in percentage).
2. Import penetration is defined as the ratio of imports to apparent consumption (domestic production minus exports plus imports).
3. Export intensity is defined as the ratio of exports to domestic production.

Source: OECD/DSTI STAN database.

penetration and export intensity. In other words, in countries in which a relatively large share of their demand for manufactures is satisfied by imports, it appears that a relatively large part of their domestic industrial production is exported, and vice versa. This observation recalls the strong role of intra-industry trade in OECD countries, noted above. In this perspective, the low penetration rates of the United States and Japan stand out less given that these two countries have the lowest export intensities in the sample, respectively **8.4** and **12.4** per cent of their industrial production. Trade imbalances are reflected here by the disproportion between the import penetration ratio and export intensity – as in the case of Japan.

Similar to the trend in the import penetration ratio, there was a general deceleration in export intensity growth between the two periods; in Japan, Italy and Australia, it actually fell during the **1980s.**

B. Penetration trends by exporting region

The Asian NIEs are often thought by conventional wisdom to be important sources of import penetration growth in OECD countries. Table 5 decompose the overall import penetration ratio by country for the Asian NIEs (South Korea,

Table 5. **Regional breakdown *of* import penetration rates, total manufacturing industries**

Market country	Source country: OECD. excluding Japan — Average growth[1] 1970s	OECD. excluding Japan — Average growth[1] 1980s	OECD. excluding Japan — Average levels 1985-90 Mj/D[2]	Japan — Average growth[1] 1970s	Japan — Average growth[1] 1980s	Japan — Average levels 1985-90 Mj/D[2]	Asian NIEs — Average growth[1] 1970s	Asian NIEs — Average growth[1] 1980s	Asian NIEs — Average levels 1985-90 Mj/D[2]	Other regions — Average growth[1] 1970s	Other regions — Average growth[1] 1980s	Other regions — Average levels 1985-90 Mj/D[2]
United States	4.4	5.1	5.9%	7.3	7.6	3.1%	14.5	10.7	2.2%	10.5	4.0	2.1%
Japan	-0.1	0.1	2.9%	..	..	..	14.2	4.4	1.3%	2.9	-1.9	1.3%
Germany (West)	3.4	2.5	20.0%	7.5	8.9	1.7%	14.5	6.5	1.0%	5.7	0.0	2.0%
France	3.6	3.3	23.5%	11.2	6.8	1.0%	26.6	10.0	0.6%	5.0	1.7	2.6%
Italy	1.6	0.8	17.8%	5.6	8.5	0.5%	14.3	6.3	0.4%	3.6	-2.4	2.3%
United Kingdom	6.3	3.3	23.9%	8.4	6.3	1.8%	8.6	6.9	1.4%	-0.1	0.1	2.2%
Canada	2.4	1.4	29.1%	0.4	5.4	3.2%	12.5	9.5	2.2%	1.6	8.4	1.8%
Australia	1.4	2.0	12.8%	6.1	2.8	5.8%	16.9	5.1	3.1%	10.5	0.4	2.2%
Finland	-1.4	2.2	24.1%	1.0	6.3	2.1%	22.3	12.9	0.7%	2.6	-3.7	3.4%
Netherlands	1.7	3.0	55.4%	7.1	7.5	2.5%	12.3	8.4	1.9%	6.9	-2.9	4.9%
Norway	-0.2	0.4	35.5%	-2.0	-2.3	2.2%	13.4	7.2	1.7%	-3.6	5.9	2.9%
Sweden	1.8	1.4	35.2%	10.2	6.4	2.2%	12.3	7.2	1.3%	5.2	-5.1	2.2%

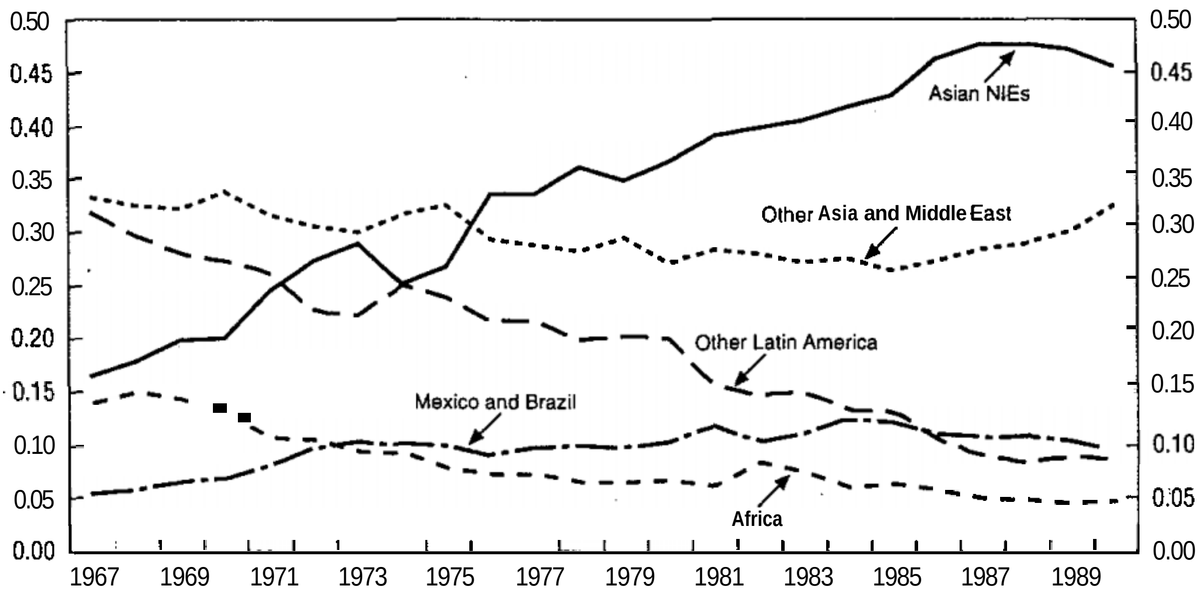
and 1981-90, respe ively (in per cent).
ountry j to total app ent consumption (domestic production minus exports plus imports).
HELEM data base see data Appendix).

Taiwan, Hong Kong and Singapore), other LDCs and OECD countries. As a comparison point imports from Japan were split from the rest of OECD countries. The import ratios are expressed not as percentage of total imports but as percentages of total demand for manufactures. In this way, they directly give the share of each exporting region in a given national market and add up to the overall penetration ratio shown in Table 4.

Intra-OECD trade accounts for the largest share of import penetration in all countries. By the end of the 1980s, the share of Asian NIEs never exceeds 2-3 percent of domestic demand in OECD markets. Moreover, market penetration from the NIEs tends to be lower in European countries than in the rest of the OECD. Partly because it started from very low base levels, exports from Asian NIEs to OECD markets grew rapidly in the period 1970-90. For example, during the 1980s the market share of Asian NIEs soared at around 10 per cent per year in the United States and France. However, there is no acceleration of this process in the 1980s compared with the 1970s and despite that imports of Asian NIEs grew at a very fast rate they still account for only a small share of domestic demand in all OECD countries.

Therefore, the rapid export growth over the last two decades of the Asian NIEs is not particularly striking with respect to their penetration in OECD markets. Their remarkable insertion in international trade flows should rather be compared with other LDCs' export performance. This point is made in Figure 2 which gives the breakdown of overall LDCs' exports. The share of Asian NIEs has risen from

Figure 2. Share of LDCs exports of manufactured products



Source: CEPII. CHELEM **data base (see data appendix).**

around 15 per cent by 1967 to roughly 50 per cent of total manufactured exports from LDCs, by 1990. In contrast, the share of all other developing regions remained stable or declined over the same period.[10]

III. INDUSTRY WAGES AND OPENNESS TO TRADE: AN ECONOMETRIC EVALUATION

This section looks in detail at the links between industry relative wage rates and the two foreign trade indicators defined above. This is carried out through the estimation of an equation involving a pooling of data across industries, and estimated country by country. This section addresses the following questions:

i) Does the four-way industry classification adopted here help to explain the pattern of relative wages in each country and inter-industry variance in the wages?

ii) Are there any significant differences across groupings in the impact of import penetration and export intensity on industry relative wage rates?

The specification of industry relative wages used here is rather different from those conventionally used in the literature on labour economics. It focuses entirely on product market characteristics and omits commonly used variables such as sectoral vacancy rates, union density, measures of work-force characteristics, etc. It may be interpreted as a reduced form of a more generic framework where the impact on industry wages of productivity gaps and trade variables depends on the type of market structure:

Industry relative wage rate = f (Market structure, Productivity, Trade).

Given the qualitative nature of the market structure groupings, it seems sensible to model it through fixed-effects, *i.e.* the inter-group heterogeneity is captured by a dummy variable taking the value 1 if the sector belongs to the group and zero elsewhere. In order to make a crude adjustment for productivity differentials across industries, relative value-added per worker[11] was introduced in the equation. The effects of trade are represented by the import penetration and the export intensity variables. The complete equation to be estimated for each country is then the following:

$$RW_{it} = \sum_{k = HF, HS, DF, DS} \alpha_{kit} \bullet D_{kit} + \beta \bullet VAW_{it} + \sum_{k = HF, HS, DF, DS} \gamma_{kit} \bullet MP_{kit} + \sum_{k = HF, HS, DF, DS} \delta_{kit} \bullet XI_{kit} + u_{it}$$

with:

i	=	1, ..., 22 industries
t	=	1970, ..., 1990 (depending on the country)
RW	=	industry relative wages
D	=	market structure specific fixed-effects
VAW	=	industry relative Value-added per worker
MP	=	relative Import penetration
XI	=	relative Export intensity

The indexes HF, HS, DF and DS correspond to the four-way grouping of industries classified according to market structure characteristics (see Table 1). All variables in the equation are expressed in relative terms to the average of total manufacturing industries. The equation was first estimated without the trade variables (the "basic equation") and, in a second step, the trade variables were added to the equation. The estimation was carried out by ordinary least squares, and the results of this regression are shown in Table 6.

A high proportion of the observed wage rate variance across industries is already explained by the basic equation. In the complete model, the trade variables add significant explanatory power to the equation. Moreover, the industry dummies are significantly different from a common intercept term, except in three cases: Germany, the Netherlands and Sweden. These results can be derived from the F-tests reported in Table 7. The sign of the relative output per worker is significant in all countries and positive – as expected – except for the Netherlands.

According to common wisdom, relative import penetration could be expected, *ceteris paribus*, to lower industry relative wage ratios whereas relative export intensity, *ceteris paribus*, could raise wage ratios. The overall results supply rather weak in supporting of this intuition. Among the 48 coefficients estimated for the relative import penetration variables, 25 are positive (of which 17 are significant) and 23 are negative (14 significant). The same pattern applies for the relative export intensity variables: 22 coefficients are positive (of which 11 are significant) and 26 are negative (16 are significant). On this basis, it seems that the sign of the relation between relative wage rates and the trade variables is rather ambiguous.

However, much stronger results can be obtained by considering the results at the level of the four industry sub-groupings. Indeed, the estimates provide evidence that import penetration is associated with reduced relative wages mainly in industries producing relatively standardized products. More precisely, in the fragmented low-differentiation group (HF) all twelve coefficients are negative and seven are significant at the 5 per cent level. The same applies for half of the cases (six) in the segmented low-differentiation group (HS). By contrast, in differentiated product industries most of the estimated coefficients are positive; in the segmented group (DS) eight coefficients are positive and significant.[12] In the fragmented (DF) group, the relation between import penetration and industry relative wages is rather weak as only four coefficients are significant (three positive and one negative).

Table 6. Panel estimates for the relative wage equation[1]

	Fixed effects[2]				Value-added per worker'	Import penetration'				Export intensity'				R^2	NOB
	HF	HS	DF	DS		HF	HS	DF	DS	HF	HS	DF	DS		
Australia	0.333''	0.450''	0.553''	0.438''	0.592''									0.737	384
	0.310''	0.372''	0.555''	0.212**	0.615''	-0.048	0.138''	0.049	0.217''	0.103	-0.075''	-0.235**	-0.048	0.799	384
Canada	0.539''	0.778''	0.631''	0.638''	0.390''									0.720	408
	0.722''	0.780''	0.578''	0.469''	0.395''	-0.310''	0.017	0.009	0.206''	-0.007	-0.019	0.029	-0.083'	0.815	408
Finland	0.803''	1.052''	0.965''	0.986''	0.064''									0.549	434
	0.958''	1.090**	0.964''	0.916''	0.059''	-0.053''	-0.059''	0.075''	0.081''	-0.090**	0.027	-0.118''	-0.075''	0.648	414
France	0.813''	1.152''	1.125''	1.029''	0.087''									0.461	273
	1.153''	0.875''	0.589''	1.007''	0.105''	-0.581''	-0.305''	-0.054	0.103	0.241	0.580**	0.426	-0.080	0.632	273
Germany	0.771**	0.956''	1.008''	1.077**	0.073''									0.622	396
	0.896**	0.924''	0.882''	0.841**	0.074''	-0.262''	-0.054'	0.114**	-0.157''	0.260''	0.097''	-0.040	0.341''	0.807	396
Italy	0.641''	0.918''	0.965''	0.891**	0.212''									0.382	326
	0.783**	1.189**	0.821**	1.015''	0.082'	-0.149	0.023	0.362''	-0.257**	0.051	-0.185'	-0.146''	0.398''	0.573	326
Japan	0.713''	0.977''	0.858''	0.911**	0.162''									0.722	412
	0.731**	0.880''	0.885''	0.784''	0.202''	-0.048''	-0.033''	0.022	0.010''	0.031	0.059''	-0.054''	0.037''	0.789	412
Netherlands	0.919**	1.187**	0.960''	1.240''	4.046''									0.175	324
	1.164''	1.141''	1.247''	1.201**	4.074''	-0.304	-0.531''	-0.260''	0.744''	0.112	0.614''	0.117*	-0.702''	0.386	324
Norway	0.866''	1.014''	1.017''	1.003**	0.037''									0.470	432
	0.916''	0.998**	1.054''	0.943''	0.036''	-0.154''	-0.042'	-0.101	0.058**	0.217**	0.046''	-0.012	-0.017	0.563	432
Sweden	0.719''	0.923''	0.932''	0.762''	0.164**									0.732	446
	0.884''	0.859''	0.945''	0.954''	0.167**	-0.026	0.051'	-0.027	-0.364''	0.179**	-0.010	0.019	0.214''	0.790	426
United Kingdom	0.752''	0.972''	0.902**	0.955''	0.117''									0.667	405
	0.805''	0.961''	0.849''	0.697''	0.120**	-0.028	0.062	0.003	0.063'	0.004	-0.077	0.026	0.153''	0.786	386
United States	0.598''	0.844''	0.807''	0.890**	0.241''									0.728	436
	0.694''	0.795''	0.728''	0.608''	0.227''	-0.237''	0.087''	0.022	0.095''	0.351''	-0.028	0.040''	0.164**	0.859	436

1. Variable expressed in relative terms to the tot manufac iring average.
2. Dummy variable taking the value of 1 when the industry belongs to a grouping and 0 elsewhere

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

Coefficients are significantly different from zero at the 1 per cent level.

NOB Number of observations.

Legend: HF fragmented, low-differentiation industries. DF fragmented, high-differentiation industries. HS: segmented, low-differentialion industries. DS: segmented. high-differentiation industries.

Table 7. Test statistics for the industry-relative wage rate equation

	F-test Trade variables jointly null	F-test No industry-specific effects
Australia	14.43**	8.42**
Canada	25.30**	72.72**
Finland	4.40**	4.44**
France	15.17**	4.32**
Germany	46.10**	2.23
Italy	17.48**	15.24**
Japan	15.82**	13.49**
Netherlands	13.37**	0.63
Norway	11.24**	11.11**
Sweden	4.28**	1.10
United Kingdom	7.83**	27.04**
United States	49.32**	14.98**

** The test is significant at the 1 per cent level.
Note: The critical values at 1 per cent are $F(3, \infty) = 3.78$ and $F(8, \infty) = 2.51$.

The strongest effect of export intensity on industry relative wages is obtained for the segmented high-differentiation industries where seven out of twelve coefficients are positive and significant. For the other industry groupings the evidence is rather mixed.

These results point to the following conclusions:

i) The impact of import penetration on industry wages seems in line with traditional H-O-S trade theory predictions in industries with low product differentiation. In other words, import penetration is associated with lower relative wages if firms have low market power and/or products are homogenous. As a consequence, increasing import penetration in these industries may lead to income distribution conflicts among the owners of relatively scarce production factors (such as low-skilled labour) in the importing country.

ii) In industries where competition takes place mainly through product differentiation, there is no evidence that increasing openness to trade leads to reduced industry relative wages. On the contrary, industries can be open to competition in both domestic and foreign markets and still have above-average wages.

In the latter case there is no basis for expecting a potential income distribution conflict between the owners of production factors that are intensively used in the production of differentiated products. The reason is that the impact of trade on income distribution in the presence of strong product differentiation and scale economies may be very different from the one predicted by the Heckscher-Ohlin-

Samuelson paradigm. In trade models with imperfect competition, it turns out that, when products are sufficiently differentiated,[13] a reverse "Stolper-Samuelson" result can occur (see Box 2). If so, the arguments related to income distribution conflicts may not be valid. Trade theory suggests exactly the opposite, *i.e.* import penetration may be essential to benefit from increasing returns to scale or the welfare effects of greater product variety in all sectors.

Box 2: What happens to the Stolper-Samuelson theorem in the presence of imperfect competition?

The basic result from the Heckscher-Ohlin-Samuelson (H-O-S) model on income distribution (the Stolper-Samuelson theorem) is that – assuming that there is no redistribution mechanism at work – owners of factors of production which are scarcer in a country than in the rest of the world will lose as a result of trade relative to the autarkic situation.

Compared with the H-O-S framework, additional sources of gains (and losses) from trade can arise in presence of increasing returns and product differentiation. The question is whether the gains can offset or even reverse the negative "Stolper-Samuelson" effects of trade on income distribution.

Some answers to this question can be found in the literature on international trade theory. For example, the Helpman-Krugman monopolistic competition model suggests that the net impact of trade on income distribution could depend crucially on three factors (see, Helpman and Krugman, **1985,** Chapter **9):**

i) the degree or extent of economies of scale:
ii) the elasticity of substitution between varieties (both domestic and imported) of a given product, which measures the preference for product diversity;
iii) the similarity of factor endowments between the two trading countries.

Intuitively, there is a trade-off between scale and product diversity as creating new brands can prevent producers from exploiting the scale economies resulting from existing products. However, when products are highly differentiated the gains from increased product diversity are likely to be large, as well as the equilibrium scale of production. If products are rather homogenous, the net gain from trade will depend on how similar the countries are in terms of their factor endowments. If we define an appropriate index of factor endowment "similarity" and relate it to the intensity of intra-industry trade, then if countries are similar enough all factors will still gain from trade. In other words, intra-industry type trade can lead to fewer income distribution conflicts among countries and sectors than the traditional case of inter-industry specialisation.

IV. CONCLUSIONS

This paper aims to bring market structure considerations into the explanation of the links between international trade and industry relative wages. In order to identify the market structure prototypes, the paper uses a four-way classification where each industry is grouped according to its product differentiation and market concentration characteristics.

The empirical evidence for twelve OECD countries reported here suggests that the interactions between market structure and trade variables, on the one hand, and the pattern of industry wages, on the other hand, are closely related. Indeed, the estimated impact of import penetration on industry relative wages appears to be largely negative in industries with low product differentiation. This result could be expected on the basis of the traditional Stolper-Samuelson theorem. Conversely, in industries with high product differentiation and large scale economies the estimated coefficients of the import penetration variables tend to be significantly positive in a majority of cases. This result can be found in the trade theory models with imperfect competition. The latter suggest indeed that in the presence of scale economies and product differentiation there is no systematic negative link between increased import penetration and below-average wages.

These results have two important policy implications. First, they give some support to the idea that the intensification of foreign competition may lower wages in those sectors where typically OECD countries have low or have lost market power, relative to rest of manufacturing industry. In some cases, this may require policy measures ensuring that the owners of relative scarce production factors (such as unskilled labour) receive their share of the overall benefits from increased openness to international trade. Secondly, from the analysis of trade patterns and the econometric results it emerges that, in those industries where OECD countries have a strong market position, relative wages are not driven down by import penetration. On the contrary, the results show that openness to trade could even raise relative wages in these sectors.

The market structure aspects developed here could provide a useful framework for further analysis in this area. Namely, more data on market structure is required as the latter was captured in this paper in a very stylised way. Those should be associated with data on a range of labour market variables and industry rents in order to give a complete picture of the market structure mechanisms at work. Data on producer prices would also enable a better assessment of the product differentiation dimension. Finally, the wage structure should be related to sectoral employment patterns including both the manufacturing and service industries.

NOTES

1. A recent paper by O'Rourke and Williamson (1992) puts this result into a historical perspective of increasing international integration.
2. This type of classification procedure is often used in industrial economics. See, for example, OECD (1987) and Buigues and Jacquemin (1989).
3. For full details on STAN, see OECD (1992).
4. See Sutton (1991), Part I.
5. In its present state, the STAN database does not have constant price data in a sufficient detailed basis.
6. Depending on the countries, this time frame can be smaller.
7. Probably due to rent sharing mechanisms. Recent empirical investigations on the relation between market structure, wages and productivity can be found in Haskel (1991) and Higuchi (1987).
8. Because of data constraints, this variable is only available for six countries in the sample: France, Germany (west), Italy, Japan, the United Kingdom and the United States.
9. The indicator may be not totally reliable for the Netherlands because of a large amount of re-exports towards other European countries which can induce an upward bias in the measure of import penetration.
10. Another way of showing this would be fo calculate a concentration index of LDCs exports. The result of this calculation, available from the author upon request, is that the concentration of LDCs exports doubled during the period 1967 to 1990, mainly due to the above-average market share gains from the Asian NIEs.
11. There is no constant price data in the STAN data base so it is impossible to compute a .true measure of relative labour productivity. The relative value added per worker was calculated by dividing the ratio between value added and total employment in a given sector by the same variable calculated at the level of total manufacturing. However, the OECD ISDB data base (which has a lower sectoral detail) was used to calculate the correlation between the relative output per worker in value and volume terms. This correlation was above 0.85 in all countries of our sample. Therefore, the results should be not deeply modified by the use of one or the other of these variables.
12. In some cases, intra-firm trade (IFT) in high-differentiation sectors may be part of'the explanation for the observed link between market structure and the positive impact of import penetration over industry wages. See Jarrett (1979) for an empirical test on the relation between IFT intensity and wages in the U.S. manufacturing industries.

13. Oliveira Martins and Toujas-Bernate (1992) made an attempt to estimate elasticities of substitution within product bundles for domestic and imported goods. They found them to be typically low, implying a high degree of product differentiation by country of origin, a result which is in line with the usual estimates of trade elasticities.

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Appendix

DATA SOURCES

The primary data sources for this paper are the STAN[1] and the CHELEM[2] data bases.

in its present siate, the STAN data base isolates 22 individual industries (see table below). Namely, it enables *to* break down the Chemicals and the Metal product sectors into a relevant product detail. STAN covers the period from 1970 to 1990. The country cover-

The sectoral breakdown of the STAN database

Code STAN	ISIC groups	Classification description
1	3000	TOTAL MANUFACTURING
2	3100	Food, beverages and tobacco
3	3200	Textiles, apparel and leather
4	3300	Wood products and furniture
5	3400	Paper products and printing
6	3500	Chemical products
7	351 + 352 – 3522	Chemicals excluding drugs
8	3522	Drugs and medicines
9	353 + 354	Petroleum refineries and products
10	355 + 356	Rubber and plastic products
11	3600	Non-metallic mineral products
12	3700	Basic metal industries
13	3710	Iron and steel
14	3720	Non-ferrous metals
15	3800	Fabricated metal products
16	3810	Metal products
17	382-3825	Non-electrical machinery
18	3825	Office and computing equipment
19	383-3832	Electrical machines excluding communications
20	3832	Radio, TV and communications equipment
21	3841	Shipbuilding and repairing
22	843	Motor vehicles
23	3845	Aircraft
24	3842 + 3844 + 3849	Other transport equipment
25	3850	Professional goods
26	3900	Other manufacturing

age of STAN is limited to only twelve OECD countries: Australia, Canada, Finland, France, Germany (West), Italy, Japan, the Netherlands, Norway, Sweden, the United Kingdom and the United States.

The CHELEM data base is built by the French Institute CEPII.[3] CHELEM allows to decompose total exports and imports by origin and destination, both for OECD countries but **also** for all non-OECD regions. **This** source **is** a complete and harmonized world trade matrix for 32 regions and **72** products, for the period **1967-1990.** The correspondence used in this paper between the nomenclatures of the STAN and CHELEM databases is available from the author upon request.

NOTES

1. **See OECD (1992).**
2. **CHELEM stands for "Cornptes Harmonisés sur les Echanges et L'Économie Mondiale".**
3. **Centre d'Études Prospectives et d'Informations Internationales. The CEPII is a French public research Institute.**