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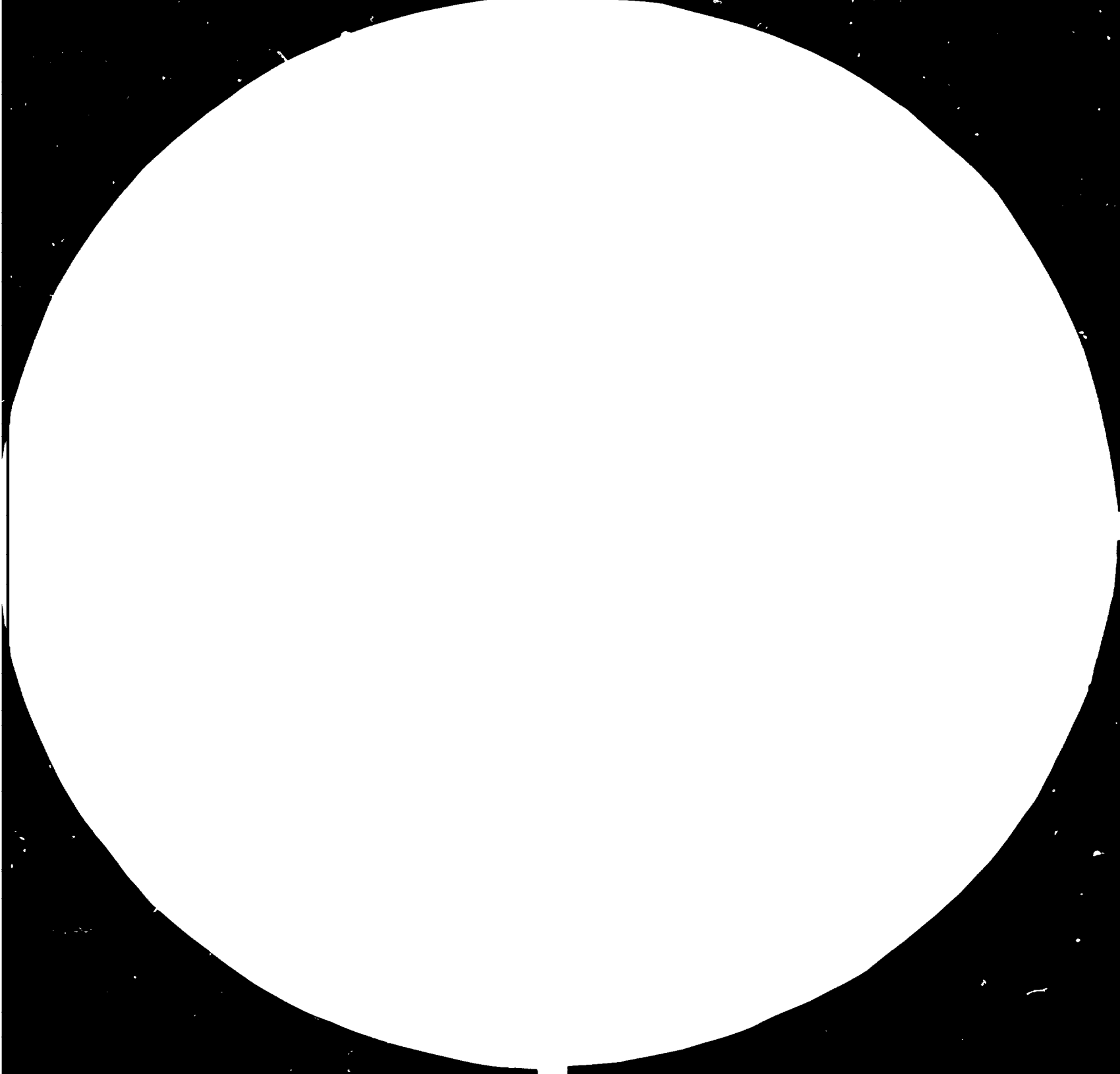


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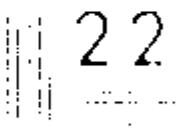
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SKILL INTENSITY OF MANUFACTURING INDUSTRIES:

TRENDS IN THE LAST DECADE IN DEVELOPED AND DEVELOPING COUNTRIES

I. Introduction

In the present chapter the skill or human capital intensity of the manufacturing industries is examined. Comparisons between the developed market economies and developing countries and by examining the changes in this respect that occurred during the decade of the 1970s.[1/]

Studies on international trade flows predominantly and conclusively show that, rather than physical capital, human capital, i.e., accumulated skills, is a more important determinant of trade - particularly in manufactured products - between poorer and richer countries; implying that human capital is a relatively more scarce and less mobile factor of production.[2/] An analogue to this exists in the "growth accounting" literature where it is found that accumulation of physical capital and increase in the labour force

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1/ Since the profile of average wages and salaries across industries which is used in the analysis to proxy skill differences (see, Section II) is predominantly policy determined in the centrally planned economies, these countries are excluded from the comparisons.

2/ See, for example, W.H. Branson and N. Monoyios, "Factor Inputs in U.S. Trade", Journal of International Economics, vol. 7, 1977, pp. 111-131; H. Forstner "The Changing Pattern of International Trade in Manufactures: A Logit Analysis", Weltwirtschaftliches Archiv, vol. 120, 1984, pp. 1-17; S. Hirsch, "Capital or Technology? Confronting the Neo-Factor Proportions and Neo-Technology Accounts of International Trade", Weltwirtschaftliches Archiv, vol. 110, 1974, pp. 535-563; D.B. Keesing, "Labor Skills and Comparative Advantage" American Economic Review, vol. 56, 1966, Papers and Proceedings, pp. 249-258 and "Labor Skills and the Structure of Trade in Manufactures", in P.B. Kenen and R. Lawrence, eds., The Open Economy, Columbia University Press, New York, 1968, pp. 3-18; P.B. Kenen, "Skills, Human Capital and Comparative Advantage", in W.L. Hansen, ed., Education, Income and Human Capital, Columbia University Press, New York, 1970, pp. 195-230; H. Waehrer, "Wage Rates, Labor Skills, and United States Foreign Trade", The Open Economy, op. cit.

leave a substantial residual to be explained by technological advancement and human capital formation.[1/]

Exploiting existing comparative advantage dictates that the developing countries - which are relatively scarcely endowed with human capital - should concentrate their efforts to promote production and exports of products which require low grade skills. On the other hand, to enable them to diversify their production structure and exports, and to benefit from technological innovations, developing countries must give high priority to building up their human capital stock.

Most technological innovations originate in developed countries where the cost of unskilled labour is substantially higher than that in developing countries and where physical capital and skilled manpower is relatively abundant. Hence, these innovations occur in capital and skill intensive techniques, and on the whole have a labour saving bias, i.e. further replacing unskilled labour by physical capital and a smaller but highly skilled manpower.[2/] In some processes the scope of this substitution may be large enough to cause factor intensity reversals, i.e. transforming an unskilled labour intensive industry into one of the most capital intensive ones. In many products, using the 'old technology' which employs more unskilled labour would still pay in many populous developing countries, and they would preserve

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1/ See E.F. Denison, Accounting for United States Economic Growth 1929-1969, The Brookings Institution, Washington D.C, 1963 and R. Solow, "Technical Change and the Aggregate Production Function", Review of Economics and Statistics, vol. 39, 1957, pp. 312-320.

2/ See, for example, M. Merhav, Technological Dependence, Monopoly and Growth, Pergamon Press, Oxford, 1969.

their international competitiveness. However, the productivity differential resulting from a technological innovation can be of such a magnitude that, despite substantially lower wages, using the 'old technology' and competing with the developed countries may not be possible.1/

Although this mechanism is acknowledged, previous comparisons of industries' relative factor intensities did not capture significant differences between the developed and developing countries. On the whole, capital and skill intensive industries in the developed countries appeared to be so in the developing countries as well.2/ However, there are several rather recent developments which can be expected to influence industries' relative factor use in a radical way.

The first phenomenon was the emergence of a number of developing countries as major exporters of a variety of manufactures exerting a significant competitive pressure in the world markets especially in products which were traditionally labour intensive while wages for unskilled labour were rapidly increasing in most of the developed market economies as a result of egalitarian wage policies.

The second impetus was the steep rise in energy prices which made the application of numerous technical innovations economically feasible, and led to major changes in the production processes. The third and probably the most

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1/ Furthermore, even if an innovation in developed countries does not erode the comparative advantage of developing countries in a certain product, it gives them an edge in absolute advantage, i.e. they obtain the same output with less inputs.

2/ Comparison of the relative factor intensities of the United States and that of the United Kingdom, Japan and India revealed a rather close resemblence (see H.B. Lary, Imports of Manufactures from Less Developed Countries, Columbia University Press, New York, 1968). When these data for the United States which pertained to 1965 were compared with that of 1976 no major changes in relative factor intensities were found. (See H.D. Tuong and A. Yeats, "On Factor Proportions as a Guide to the Future Composition of Developing Country Exports", Journal of Development Economics, vol. 7, 1980, pp. 521-539).

important and ongoing event is the improvements in information and control systems and the wide use of industrial robots following the revolution in the semi-conductor technology.

Radical changes in the modes of production by the introduction of new techniques may still be confined to a limited, though growing, number of product lines. Apparent changes in the factor content of an industry also reflect changes in its product mix. As a result of increased internationalization of production, countries may narrow down their specialization, producing only those products/components, and undertaking only those processes in which they have a comparative advantage.[1/] However, if in some industries significant factor intensity changes of more general character are occurring, this has crucial policy implications for the developing countries.

In the most rudimentary manner, the comparative advantage of a country shifts towards more capital intensive products if the rate of net investments is greater than the increase in its work force. This says nothing about production levels in specific industries, their specific factor content or the commodity composition of trade. At the time when investments are made, it makes sense to treat capital as a malleable homogeneous input since investible funds can be used either to produce (or import) capital goods or to upgrade the skills of the work force. Once the investment is made, however, capital is no more malleable, and especially in the short run, it is basically fixed and sector-specific; while, for instance, transportation equipment can be used in different sectors, textile machines cannot be transformed into steel mills or turned into mechnical engineers.

1/ For example, it is alieged that in the face of strong competition from the developing countries, developed market economies have managed to regain comparative advantage in some textile products. Although the case is not well documented it appears to be a mixed case of increased specialization, automization and outward processing.

Just as the rate of investment in different sectors, the allocation of investment between physical capital and human capital determines the future pattern of international comparative advantage. To achieve an international division of labour in which the developing countries have a diversified industrial capacity, and since, as the recent record shows, the only way they can expand their exports without triggering protectionism in the developed countries is product diversification,[1/] the developing countries have to build up their human capital stock by acquiring diversified skills. While some capital goods embodying new technologies may be imported from developed countries, the lack of skills to operate them efficiently may constitute a more serious bottle-neck. While it may not be realistic for most developing countries to be major producers and exporters of products requiring high skills in the near future, this does not exclude the possibility - and in certain cases necessitates - efforts to acquire high-grade skills in specific areas.

It is beyond controversy to state that by investment planning countries can steer their future pattern of comparative advantage within a relatively broad range determined by their productive capacities and their ability to raise investible funds. Furthermore, probably the most important component of investment planning according to which governments can implement effective policies is manpower planning covering areas such as formal education and other training programmes. Given these, monitoring the technological changes which alter factor, in particular, skill requirements in production processes becomes a prerequisite - as a number of developing countries seem to have

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1/ For the documentation of the recent upsurge in protectionist measures facing particularly the exports of the developing countries see, "Protectionism and Structural Adjustment in the World Economy", report by the UNCTAD Secretariat, February 1984, (TD/B/981).

realized. Also to avoid costly mistakes in undertaking large projects which often involve long gestation periods, studying indications of changes in production technology appears to be as important as market research. Both the accomplishments and failures of some developing countries in the iron and steel industry are cases in point.

The available consistent cross-country data used in the empirical analysis in this chapter are too aggregated to give precise guidance to policy makers. However, emphasizing the fact that there are differences in the relative skill intensity of industries in the developed and developing countries, and that significant changes in this respect may be occurring is a first step for in-depth sectoral analyses.

II. Measurement of skill intensity

In a simplified manner, the wealth created, i.e. the value added in a productive activity can be attributed to physical capital (e.g. machines and equipment), and to persons involved in the production. Since human participation includes both rudimentary labour services and application of special skills, the share of wages and salaries in value added can be further split into two components, the compensation for unskilled labour and returns to skills. Put differently, in a pure market situation the difference in pay between an unskilled labourer, i.e. an able person with only a minimum education and training, and a skilled labourer consists of returns to human capital, i.e. skills acquired through education and training. Therefore, to the extent that differences in wages and salaries in the labour market reflect differences in productive skills - which implies that equivalent skills and unskilled labour gets the same pay in all industries - an industry which has relatively high average wages and salaries per employee is a relatively human capital intensive one. Similarly, in the absence of pure profits the relative level of the non-wage/salary component of value added per employee in an industry reflects the intensity of the use of physical capital. Finally, total value added per employee, the standard measure of productivity can be interpreted as the total capital intensity of industries to the extent that aggregation of physical and human capital makes economic sense.[1/]

1/ The aggregation of physical and human capital in economic analysis was first suggested by J. Bhagwati in "The Pure Theory of International Trade", Economic Journal, vol. 74, 1964, pp. 17-26, and P.B. Kenen in "Nature Capital and Trade" Journal of Political Economy, vol. 73, 1965, pp. 437-470 and the practice was followed in several empirical studies. More recently, the conditions under which factors of production can be aggregated in economic analysis have been investigated by, e.g. E.R. Berndt and L.R. Christensen in "The Internal Structure of Functional Relationships: Separability, Substitution and Aggregation", Review of Economic Studies, vol. 40, 1973, pp. 403-410.

Measuring factor intensities of industries by the contribution of the factors to the value added has several shortcoming.[1/] Other than the fact that the hardship of the occupations affect the level of wages and salaries in addition to skill differences, the most prominent inaccuracies stem from non-competitive elements in markets including those imposed by regulations. Excessive profits can persist in some industries for prolonged periods which leads to the over estimation of the contribution of physical capital. Employees may have a stronger bargaining power in certain industries leading to wage and salary differences with other industries which are not related to differences in skill requirements. Finally, there are institutional differences among industries (and more so across industries-and-countries) in wage settlements related to the structure of the industries, degree of unionization, regulations and ownership.

Despite these shortcomings, many empirical studies find wages and salaries per employee to be a reasonably accurate proxy for the skill intensity of industries for many countries.[2/] In making cross country comparisons of industries' relative factor intensities in general, however, an additional major problem is encountered which is of mainly statistical nature. This arises from differences in the product mixes of the same industries in different countries, and is pronounced when the aggregation level of industry data is high.

1/ For a detailed discussion of these shortcomings see Imports of Manufactures from Less Developed Countries, op. cit., a comprehensive study which uses this measure of factor intensity.

2/ See e.g. "Inputs of Manufactures..." op.cit.

Data

Manufacturing industries were analyzed at the ISIC 3-digit level, excluding two branches - professional and scientific equipment, photographic and optical goods (ISIC 385) and other manufactures (ISIC 390) - which can be expected to have significantly different product mixes in different countries. The country sample had to be limited to 12 developed market economies and six developing countries (listed in table 1) for which data on value added, wages and salaries and number of employees were available for 1970 or 1971, and 1979 or 1980, and for which there was production in each of the 26 industrial branches under examination.1/

The three main variables used in the analyses are wages and salaries per employee, as a measure of skill intensity, non-wage value added per employee, as a measure of physical capital intensity, and total value added per employee. Whenever data were available, two-year averages (1970-71, and 1979-80) were calculated to reduce the impact of cyclical factors.2/ Each ratio was transformed into rankings within each country, then for each industry, unweighted averages of rankings in the two country groups were employed in the analysis.3/

1/ In addition to lack of data for the period concerned, a number of developing countries had to be excluded either because employment figures pertained to "persons engaged" which includes unpaid family members and active owners, or they had no production in one or more industrial branches. The data on the remaining 18 countries contain some statistical discrepancies, namely differences in the minimum size of establishments covered and differences in the valuation of value added (see table 1). While most developed market economies measured value added at factor values (which excludes indirect taxes but includes subsidies to production), most developing countries used producers' prices (which includes indirect taxes but excludes subsidies). Data on Norway fulfilled the criteria to be included in the country sample, but had to be excluded because of an apparent change in the valuation concept used in between the two periods under consideration.

2/ First the ratios for 1970, 1971, 1974 and 1980, then averages of 1970-71 and 1979-80 were calculated.

3/ In taking group averages, transformation of national data into rankings first eliminates the problems of exchange rate conversions.

Table 1. Country Coverage and Data Specification for Variables Value-added, Wages and Salaries, and Number of Employees

Country	Years included: First period	Years included: Second period	Minimum size of establishments covered: number of employees	Valuation concept used
Developed market economies:				
Australia	1970-71	1979-80	1970-71, 1; 1979-80, 4	factor values
Austria	1970-71	1979-80	1(20)[a/]	producers' prices
Canada	1970-71	1979-80	1	factor values
Denmark	1970-71	1979-80	6[b/]	factor values
Finland	1970-71	1979-80	5	factor values
Germany, Fed. Rep.	1970-71	1979	1970-71, 10; 1979, 20[c/]	producers' prices
Italy	1970-71	1979-80	20	unspecified
Japan	1970-71	1979-80	1	unspecified
Netherlands	1970-71	1979-80	1	factor values
Sweden	1970-71	1979-80	5	factor values
United Kingdom	1970-71	1979-80	1	factor values
United States	1970-71	1979-80	1	factor values
Developing countries:				
Chile	1970-71	1979	10(50)[a/]	producers' prices
Colombia	1970-71	1979-80	5(10)[a/][d/]	producers' prices
Korea, Rep. of	1970-71	1979-80	5	producers' prices
Malaysia	1970-71	1979	5[e/]	factor values
Philippines	1970-71	1979	1971-71, 5; 1979, 1	producers' prices
Turkey	1070-71	1979-80	1(10)[a/]	producers' prices

Source: UNIDO data base: information supplied by the Statistical Office of the United Nations Secretariat, with estimates by the UNIDO secretariat.

Note: The list of countries above cover, as of date, all countries from which value-added, wages and salaries, and number of employees were reported - or could be estimated - and were positive for all 26 3-digit ISIC sectors (i.e. all ISIC sectors except ISIC 385 and 390) in 1970 or 1971, and 1979 or 1980. Norway was an exception which fulfilled these criteria yet it was excluded because of an apparent change in the valuation concept used in between the two periods.

a/ Adjustments made by the UNIDO secretariat to increase the coverage of data; in parentheses the minimum size of establishments covered in the national source.

b/ Denmark: 1970 coverage problems; 1979-80 value-added figures per ain to establishments with 20 or more employees.

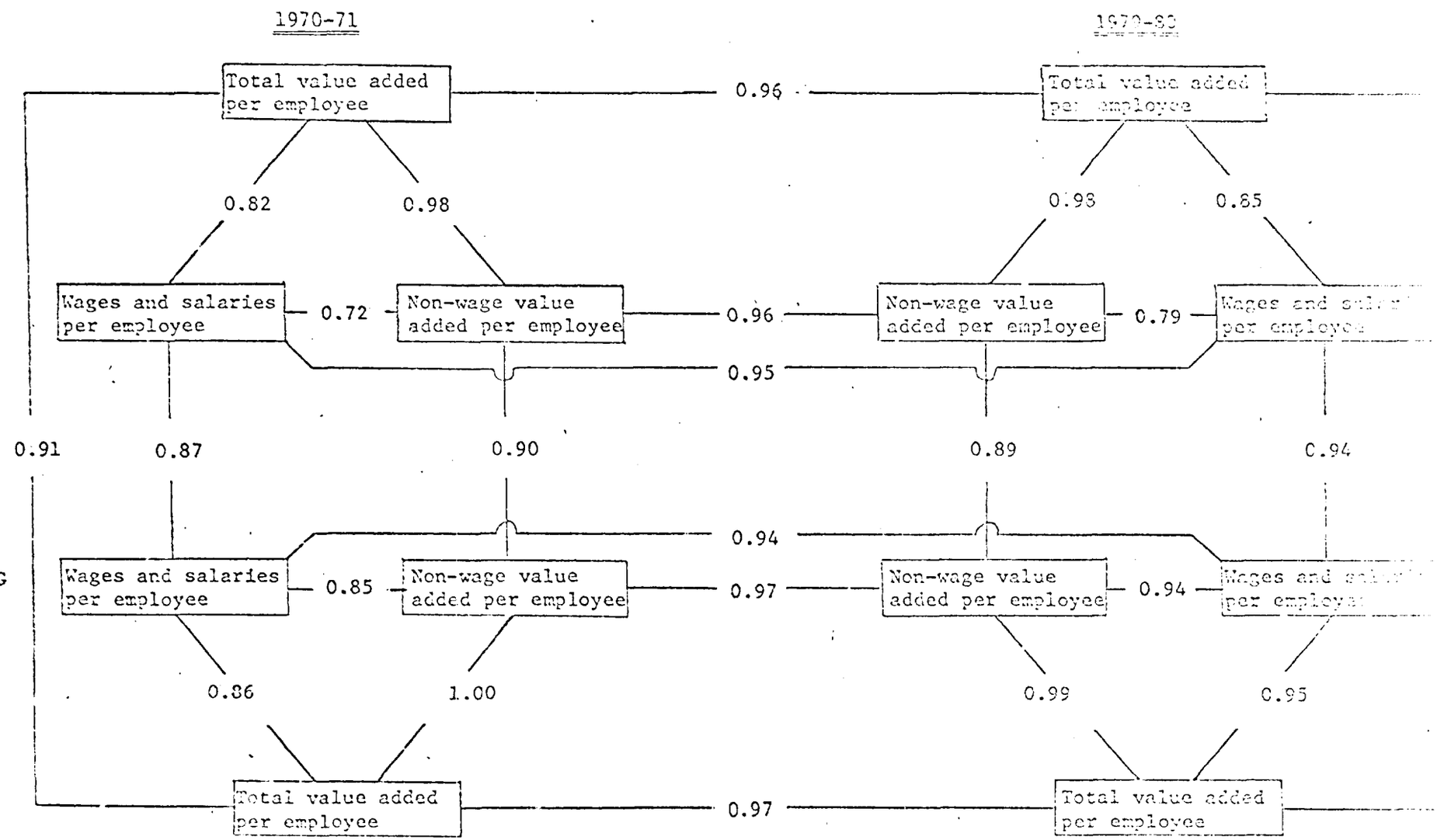
c/ Germany, Federal Republic: While 1970-71 figures exclude handcraft industries and non-industrial activities, 1979 data include them.

d/ Colombia: 1970 data also at the national source cover establishments with 5 or more employees.

e/ Malaysia: 1979 data also include some establishments with less than 5 employees.

Figure 1 gives the Spearman rank order correlation coefficients (a standardized measure of the resemblance of two rankings) between the average measures of skill intensity, physical capital intensity, and total capital intensity in the developed market economies and the developing countries for 1970-71 and 1979-80. The emerging picture is that the three measures are strongly correlated with each other within the country groups, over the time periods and across the two country groups. The cross country and over time close resemblance of the industries' rankings in respective factor intensities may be interpreted as the existence of a rather uniform pattern. However, given the strong correlation between the measures of skill intensity and physical capital intensity - which is a mixture of two phenomena, an economic fact and an effect related to the inaccuracy of the proxies used - this interpretation has to be qualified.

Figure 1 Spearman rank order correlation coefficients between average rankings in value added per employee, wages and salaries per employee and non-wage value added per employee in 26 manufacturing industries in the developed market economies and the developing countries, 1970-71 and 1979-80



Source: UNIDO data base, see table 1.

Note: The 26 industries cover all manufacturing branches at the ISIC 3-digit level except ISIC 385 and 390. The [illegible] developed market economies and the six developing countries included in the sample are listed in [illegible].

III. Average skill intensity rankings of manufacturing industries in the period 1970-71 to 1979-80

In 1970-71 the rank order correlation coefficient between the industries' average skill intensity rankings of the 6 developing and the 12 developed countries was 0.87, and by 1979-80 the correspondence of the rankings in the two groups of countries became stronger yielding a rank order correlation coefficient of 0.94.

Table 2 lists separately the 26 manufacturing industries in declining order of skill intensity in 1970-71 in the developed market economies and the developing countries; gives the average rankings and the coefficient of variation (standard deviation/mean) within each country group, and the differences in the average rankings between the two groups. With some difference in order, except transport equipment (ISIC 384) in the developing countries, the same 6 industries - petroleum refineries (ISIC 353), industrial chemicals (ISIC 351), iron and steel (ISIC 371), non-ferrous metals (ISIC 372), printing and publishing (ISIC 342) and other chemicals (ISIC 352) - top the list in both the developed and the developing country groups. Also 4 out of 6 industries at the bottom of the skill intensity scale - wearing apparel (ISIC 322), footwear (ISIC 324), textiles (ISIC 321) and leather products (ISIC 323) - were common in both lists.

The third column in table 2 gives the differences in the average skill intensity rankings between the developed and the developing country samples. A positive rank difference implies that the industry is relatively less skill intensive in the developed country group compared to the developing one (and the converse for a negative rank difference). In this respect, pottery, china

	I Average ranking (coefficient of variation)			II Average ranking (coefficient of variation)			III Difference in ranks
	ISIC	Industrial branch		ISIC	Industrial branch		ISIC	Industrial branch	
1	353	Petroleum refineries	1.08 (0.27)	353	Petroleum refineries	1.00 (0.00)	361	Pottery, china and earthenware	7.
2	351	Industrial chemicals	3.67 (0.39)	351	Industrial chemicals	4.17 (0.67)	352	Other chemicals	3.
3	371	Iron and steel	5.75 (0.56)	352	Other chemicals	4.67 (0.44)	314	Tobacco	3.
4	372	Non-ferrous metals	7.00 (0.56)	372	Non-ferrous metals	5.00 (0.74)	321	Textiles	3.
5	384	Transport equipment	7.17 (0.52)	371	Iron and steel	6.00 (0.38)	372	Non-ferrous metals	2.
6	342	Printing and publishing	7.67 (0.70)	342	Printing and publishing	8.50 (0.34)	355	Rubber products	1.
7	352	Other chemicals	8.58 (0.50)	341	Paper and products	9.17 (0.57)	341	Paper and products	1.
8	38.	Machinery, excluding electrical	8.83 (0.17)	313	Beverages	10.17 (0.55)	324	Footwear, excluding rubber or plastic	1.
9	369	Other non-metallic mineral products	9.58 (0.41)	384	Transport equipment	10.33 (0.44)	383	Machinery electric	1.
10	313	Beverages	10.50 (0.44)	314	Tobacco	10.33 (0.70)	362	Glass and products	1.
11	354	Miscellaneous products of petroleum and coal	10.92 (0.77)	362	Glass and products	11.50 (0.38)	356	Plastic products	1.
12	341	Paper and products	11.08 (0.38)	383	Machinery electric	12.17 (0.14)	322	Wearing apparel, excluding footwear	0.
13	362	Glass and products	12.75 (0.35)	355	Rubber products	12.67 (0.36)	313	Beverages	0.
14	314	Tobacco	13.50 (0.47)	361	Pottery, china and earthenware	13.33 (0.63)	353	Petroleum refineries	0.
15	381	Fabricated metal products	13.50 (0.19)	382	Machinery, excluding electrical	13.67 (0.78)	323	Leather products	-0.
16	383	Machinery electric	13.67 (0.25)	369	Other non-metallic mineral products	15.00 (0.22)	371	Iron and steel	-0.
17	355	Rubber products	14.58 (0.28)	354	Miscellaneous products of petroleum and coal	15.17 (0.50)	351	Industrial chemicals	-0.
18	311/2	Food products	17.92 (0.18)	381	Fabricated metal products	17.00 (0.17)	342	Printing and publishing	-0.
19	331	Wood products, excluding furniture	19.17 (0.23)	356	Plastic products	18.17 (0.23)	311/2	Food products	-1.
20	356	Plastic products	19.25 (0.08)	311/2	Food products	19.50 (0.12)	331	Wood products, excluding furniture	-1.
21	332	Furniture, excluding metal	20.58 (0.15)	321	Textiles	19.83 (0.21)	384	Transport equipment	-3.
22	361	Pottery, china and earthenware	20.75 (0.13)	331	Wood products, excluding furniture	20.83 (0.18)	381	Fabricated metal products	-3.
23	323	Leather products	21.08 (0.26)	323	Leather products	21.17 (0.14)	332	Furniture, excluding metal	-3.
24	321	Textiles	22.83 (0.06)	324	Footwear, excluding rubber or plastic	22.50 (0.12)	354	Miscellaneous products of petroleum and coal	-4.
25	324	Footwear, excluding rubber or plastic	24.00 (0.09)	332	Furniture, excluding metal	24.17 (0.07)	382	Machinery, excluding electrical	-4.
26	322	Wearing apparel, excluding footwear	25.58 (0.04)	322	Wearing apparel excluding footwear	25.00 (0.04)	369	Other non-metallic mineral products	-5.

Source: UNIDO Data Base, see table 1.

a/ Skill intensity measured by wages and salaries per employee.

b/ For the list of the (12) developed market economies and the (6) developing countries which are covered, see table 1.

c/ Difference in average rankings = average ranking in the developed market economies - average ranking in the developing countries. A positive (negative) difference implies that the industrial branch was relatively less (more) skill intensive in the developed market economies.

and earthenware (ISIC 361) leads the list with a difference in average rankings of 7.4, followed by other chemicals (ISIC 352), tobacco (ISIC 314), textiles (ISIC 321) and non-ferrous metals (ISIC 372) - all having a ranking difference of at least two.

From the bottom of the third list in table 2, industrial branches, which appeared to be relatively less skill intensive in the developing countries were other non-metallic mineral products (ISIC 369), non-electrical machinery (ISIC 382), miscellaneous petroleum and coal products (ISIC 354), non-metallic furniture (ISIC 332), fabricated metal products (ISIC 381), transport equipment (ISIC 384), wood products excluding furniture (ISIC 331) and food products (ISIC 311/2).

The comparison of industries' relative skill intensity between the developing countries and the developed market economies is repeated in table 3 for 1979-80, and the comparison of the two periods, 1970-71 and 1979-80 is given in table 4. Columns I and II in this table give the change in average skill intensity rankings during the period under consideration for the developed market economies and the developing countries, respectively; whereas column III is the difference between these changes in the two country groups (III = I - II). The industrial branches are listed in decreasing order of their difference in average rankings in the two periods.

In the developed market economies, five industries became relatively more skill intensive by promoting at least one rank during 1970-71 to 1979-80. These were tobacco products (ISIC 314), beverages (ISIC 313), paper and products (ISIC 341), pottery, china and earthenware (ISIC 361) and textiles (ISIC 321). From the bottom of the list the industries which became less skill intensive can be identified. Those which declined by at least one ranking in terms of average skill intensity were fabricated metal products (ISIC 381), leather products (ISIC 323), non-electrical machinery (ISIC 382),

Industries in decreasing order of the difference in average skill intensity rankings a/ in the developed market economies and the developing countries

	I		I Average ranking (coefficient of variation)		II	II Average ranking (coefficient of variation)		III = I - II Difference in average rankings
	ISIC	Industrial branch		ISIC	Industrial branch		ISIC	Industrial branch	
1	353	Petroleum refineries	1.33 (0.47)	353	Petroleum refineries	1.17 (0.35)	352	Other chemicals	5.75
2	351	Industrial chemicals	3.17 (0.33)	351	Industrial chemicals	2.67 (0.31)	354	Miscellaneous products of petroleum and coal	2.92
3	371	Iron and steel	7.17 (0.60)	352	Other chemicals	4.50 (0.27)	355	Rubber products	2.67
4	372	Non-ferrous metals	7.50 (0.54)	372	Non-ferrous metals	7.00 (0.51)	321	Textiles	2.25
5	313	Beverages	7.58 (0.48)	313	Beverages	7.50 (0.67)	362	Glass and products	1.50
6	342	Printing and publishing	8.42 (0.68)	371	Iron and steel	8.00 (0.40)	383	Machinery electric	0.75
7	341	Paper and products	8.75 (0.58)	354	Miscellaneous products of petroleum and coal	8.50 (0.60)	372	Non-ferrous metals	0.50
8	384	Transport equipment	8.92 (0.42)	384	Transport equipment	9.17 (0.40)	351	Industrial chemicals	0.50
9	314	Tobacco	9.33 (0.61)	341	Paper and products	9.83 (0.59)	361	Pottery, china and earthenware	0.42
10	352	Other chemicals	10.25 (0.55)	342	Printing and publishing	10.17 (0.46)	353	Petroleum refineries	0.17
11	382	Machinery, excluding electrical	10.67 (0.23)	314	Tobacco	11.00 (0.51)	313	Beverages	0.08
12	369	Other non-metallic mineral products	10.92 (0.42)	362	Glass and products	11.17 (0.35)	323	Leather products	0.00
13	354	Miscellaneous products of petroleum and coal	11.42 (0.79)	355	Rubber products	12.17 (0.57)	311/2	Food products	-0.17
14	362	Glass and products	12.67 (0.35)	383	Machinery electric	13.00 (0.41)	322	Wearing apparel, excluding footwear	-0.25
15	383	Machinery electric	13.75 (0.29)	382	Machinery, excluding electrical	13.33 (0.22)	356	Plastic products	-0.25
16	355	Rubber products	14.83 (0.33)	369	Other non-metallic mineral products	13.33 (0.21)	384	Transport equipment	-0.25
17	381	Fabricated metal products	15.58 (0.13)	311/2	Food products	17.83 (0.15)	324	Footwear, excluding rubber or plastic	-0.67
18	311/2	Food products	17.67 (0.24)	381	Fabricated metal products	18.33 (0.11)	371	Iron and steel	-0.83
19	356	Plastic products	18.58 (0.10)	361	Pottery, china and earthenware	18.67 (0.29)	341	Paper and products	-1.08
20	331	Wood products, excluding furniture	18.58 (0.25)	356	Plastic products	18.83 (0.14)	332	Furniture, excluding metal	-1.17
21	361	Pottery, china and earthenware	19.08 (0.30)	321	Textiles	19.50 (0.17)	331	Wood products, excluding furniture	-1.58
22	332	Furniture, excluding metal	21.17 (0.09)	331	Wood products, excluding furniture	20.17 (0.23)	314	Tobacco	-1.67
23	321	Textiles	21.75 (0.12)	332	Furniture, excluding metal	22.33 (0.13)	342	Printing and publishing	-1.75
24	323	Leather products	23.00 (0.08)	323	Leather products	23.00 (0.08)	369	Other non-metallic mineral products	-2.42
25	324	Footwear, excluding rubber or plastic	23.67 (0.12)	324	Footwear, excluding rubber or plastic	24.33 (0.03)	382	Machinery, excluding electrical	-2.67
26	322	Wearing apparel, excluding footwear	25.25 (0.07)	322	Wearing apparel, excluding footwear	25.50 (0.02)	381	Fabricated metal products	-2.75

Source: UNIDO Data Base, see table 1.

a/ Skill intensity measured by wages and salaries per employee.

b/ For the list of the (12) developed market economies and the (6) developing countries which are covered, see table 1.

c/ Difference in average rankings = average ranking in the developed market economies - average ranking in the developing countries. A positive (negative) difference implies that the industrial branch was relatively less (more) skill intensive in the developed market economies.

	I			II			III = I − II
	ISIC	Industrial branch	Difference in average ranks, 1970-71 to 1979-80	ISIC	Industrial branch	Difference in average ranks, 1970-71 to 1979-80	ISIC	Industrial branch	Difference
1	314	Tobacco	4.17	354	Miscellaneous products of petroleum and coal	6.67	361	Pottery, china and earthenware	7.33
2	313	Beverages	2.92	313	Beverages	2.67	314	Tobacco	4.83
3	341	Paper and products	2.33	332	Furniture, excluding metal	1.83	341	Paper and products	3.00
4	361	Pottery, china and earthenware	1.67	311/2	Food products	1.67	324	Footwear, excluding rubber or plastic	2.17
5	371	Textiles	1.08	369	Other non-metallic mineral products	1.67	372	Non-ferrous metals	1.50
6	356	Plastic products	0.67	351	Industrial chemicals	1.50	356	Plastic products	1.33
7	331	Wood products, excluding furniture	0.58	384	Transport equipment	1.17	342	Printing and publishing	0.92
8	351	Industrial chemicals	0.50	331	Wood products, excluding furniture	0.67	322	Wearing apparel, excluding footwear	0.83
9	322	Wearing apparel, excluding footwear	0.33	355	Rubber products	0.50	383	Machinery electric	0.75
10	324	Footwear, excluding rubber or plastic	0.33	321	Textiles	0.33	321	Textiles	0.75
11	311/2	Food products	0.25	362	Glass and products	0.33	371	Iron and steel	0.58
12	362	Glass and products	0.08	382	Machinery, excluding electrical	0.33	313	Beverages	0.25
13	383	Machinery electric	-0.08	352	Other chemicals	0.17	323	Leather products	-0.08
14	355	Rubber products	-0.25	353	Petroleum refineries	-0.17	331	Wood products, excluding furniture	-0.08
15	353	Petroleum refineries	-0.25	322	Wearing apparel, excluding footwear	-0.50	353	Petroleum refineries	-0.08
16	354	Miscellaneous products of petroleum and coal	-0.50	314	Tobacco	-0.67	362	Glass and products	-0.25
17	372	Non-ferrous metals	-0.50	341	Paper and products	-0.67	355	Rubber products	-0.75
18	332	Furniture, excluding metal	-0.58	356	Plastic products	-0.67	381	Fabricated metal products	-0.75
19	342	Printing and publishing	-0.75	383	Machinery electric	-0.83	351	Industrial chemicals	-1.00
20	369	Other non metallic mineral products	-1.33	381	Fabricated metal products	-1.33	311/2	Food products	-1.42
21	371	Iron and steel	-1.42	342	Printing and publishing	-1.67	352	Other chemicals	-1.83
22	352	Other chemicals	-1.67	324	Footwear, excluding rubber or plastic	-1.83	382	Machinery, excluding electrical	-2.17
23	384	Transport equipment	-1.75	323	Leather products	-1.83	332	Furniture, excluding metal	-2.42
24	382	Machinery, excluding electrical	-1.83	372	Non-ferrous metals	-2.00	384	Transport equipment	-2.92
25	323	Leather products	-1.92	371	Iron and steel	-2.00	369	Other non-metallic mineral products	-3.00
26	381	Fabricated metal products	-2.08	361	Pottery, china and earthenware	-5.33	354	Miscellaneous products of petroleum and coal	-7.17

Source: UNIDO Data Base, see tables 1, 2 and 3.

Note: The figures in columns I, II and III in this table are obtained by subtracting the figures for respective industries in the corresponding columns of tables 3 from those of table 2. The subtraction of the figures for respective industries in column II from those of column I in this table also yields the figures in column III.

A positive (negative) figure in columns I and II implies that the industrial branch became reletively more (less) skill intensive during the period 1970-71 to 1979-80.

transport equipment (ISIC 384), other chemicals (ISIC 352), iron and steel (ISIC 371) and other non-metallic mineral products (ISIC 369).

In the developing countries, there were more marked changes in industries' relative skill intensities. Six industries moved up nearly two ranks or more: miscellaneous petroleum and coal products (ISIC 354), beverages (ISIC 313), non-metallic furniture (ISIC 332), food products (ISIC 311/2), other non-metallic mineral products (ISIC 369), and industrial chemicals (ISIC 351). On the other hand, pottery, china and earthenware (ISIC 361), iron and steel (ISIC 371), non-ferrous metals (ISIC 372), leather products (ISIC 323), footwear (ISIC 324) and printing and publishing (ISIC 342) became relatively less skill intensive by an order of a ranking difference of two or more.

Column III in table 4 reveals the disparity in relative skill intensity of branches due to changes in the developed market economies and the developing countries during 1970-71 to 1979-80. The three branches at the top of the list - pottery, china and earthenware (ISIC 361), tobacco products (ISIC 314), paper and products (ISIC 341) and footwear (ISIC 324) - became relatively more skill intensive in developed market economies while an opposite trend towards lower skill intensity was observed in developing countries. Starting from the bottom of the list, miscellaneous petroleum and coal products (ISIC 354), other non-metallic mineral products (ISIC 369), transport equipment (ISIC 384), non-metallic furniture (ISIC 332) and non-electrical machinery (ISIC 382) became relatively more skill intensive in the developing countries while the opposite happened in the developed market economies.

Dispersion in skill intensity rankings

Since the patterns described above are based on unweighted means of industries' skill intensity rankings in individual countries, the uniformity of these rankings, i.e. their degree of dispersion in the two country groups

is important for the relevance of the comparisons. From the coefficients of variation (standard deviation/mean) in skill intensity rankings given in parentheses in tables 2 and 3, it is observed that the degree of dispersion varied greatly from industry to industry while the average for the 26 industries was in the range of 0.31 to 0.35 for the two country groups in the two periods. In both country groups the dispersion of the skill intensity rankings of industries were strongly correlated with the relative skill intensity of industries measured by the average rankings, and this relation became even stronger during the period under consideration (see table 5). For the developed market economies the rank order correlation coefficients were 0.77 in 1970-71 and 0.81 in 1979-80, and for the developing countries 0.61 and 0.75, respectively.

Table 6 lists the industries in which the coefficient of variation of skill intensity rankings were the highest in the developed market economies and the developing countries. Each country group had eight industries in which the coefficient of variation was 0.50 or above in 1970-71 or 1979-80, and four of these industries - tobacco (ISIC 314), paper and products (ISIC 341), miscellaneous products of petroleum and coal (ISIC 354), and non-ferrous metals (ISIC 372) - were common to both country groups. In addition, for the developed market economies printing and publishing (ISIC 342), other chemicals (ISIC 352), iron and steel (ISIC 371), and transport equipment (ISIC 384), and for the developing countries, beverages (ISIC 313), industrial chemicals (ISIC 351), rubber products (ISIC 355), and pottery, china and earthenware (ISIC 361) are included in the list.

A casual examination of these industries and countries with extreme rankings reveals some cases where skill intensity differences were mainly due to obvious differences in product mix rather than production technology. In the developed market economies, transport equipment (ISIC 384) appears to be very skill intensive in the Federal Republic of Germany and the United States

Table 5 Spearman rank order correlation coefficients between industries' average relative skill intensity and their degree of dispersion within country groups

		Correlation coefficient
Developed market economies (12)	1970-71	0.77
	1979-80	0.81
Developing countries (6)	1970-71	0.61
	1979-80	0.75

Source: UNIDO Data Base, see tables 1, 2 and 3.

Note: Degree of dispersion is measured by the coefficient of variation = standard deviation/mean. The distribution of the degree of dispersion in skill intensity rankings of 26 manufacturing industries within country groups was the following:

		Mean	Standard Deviation
Developed market economies	1970-71	0.32	0.20
	1979-80	0.35	0.21
Developing countries	1970-71	0.33	0.22
	1979-80	0.31	0.19

Table 6. Manufacturing industries in which countries' skill intensity rankings had the greatest dispersion

ISIC	Industrial branch	Developed market economies (12) 1970-71-1979-80 average ranking	Countries with highest skill intensity (1970-71-1979-80 average ranking)	Countries with lowest skill intensity (1970-71-1979-80 average ranking)	Developing countries (6) 1970-71-1979-80 average ranking	Countries with highest skill intensity (1970-71-1979-80 average ranking)	Countries with lowest skill intensity (1970-71-1979-80 average ranking)
313	Beverages		Coefficient of variation below 0.50		8.8	Colombia, Philippines (5.0) Malaysia (6.5)	Chile (16.5) Turkey (12.0)
314	Tobacco	11.4	Japan (1.0) Austria (3.5)	Denmark (22.0) United States (15.0)	10.7	Chile (3.0) Korea, Rep (7.0)	Philippines (18.5) Turkey (16.5)
341	Paper and products	9.9	Finland (2.5) Canada (4.5)	Germany, F.R., (16.5) United Kingdom (16.0)	9.5	Colombia (3.5)	Malaysia (19.0)
342	Printing and publishing	8.0	Sweden (2.0) Italy (2.5)	Canada (16.0) Netherlands (15.5)		Coefficient of variation below 0.50	
351	Industrial chemicals		Coefficient of variation below 0.50		3.4	Colombia (2.0)	Chile (6.5)
352	Other chemicals	9.4	Germany, F.R., (3.5) Denmark, Sweden (5.0)	Netherlands (19.0) Australia, United Kingdom (12.0)		Coefficient of variation below 0.50	
354	Miscellaneous products of petroleum and coal	11.2	Germany, F.R., (1.5) Denmark (5.0)	Italy (26.0) Netherlands (25.0)	11.8	Chile (5.0)	Colombia (20.5)
355	Rubber products		Coefficient of variation below 0.50		12.4	Colombia (7.5)	Korea, Rep. (21.5)
361	Pottery, china and earthenware		Coefficient of variation below 0.50		16.0	Philippines (6.5) Turkey (10.5)	Korea, Rep. (20.5) Malaysia (20.5)
371	Iron and steel	6.5	Canada, United States (3.0)	Netherlands (15.5) Denmark (10.0)		Coefficient of variation below 0.50	
372	Non-ferrous metals	7.3	Netherlands (1.5) Australia (3.0)	Italy (14.0) Sweden (11.5)	6.0	Chile (2.5) Malaysia (3.5)	Colombia (11.5) Korea, Rep. (9.0)
384	Transport equipment	8.0	United States (3.0) Germany, F.R., (5.0)	Austria (16.5) Australia (11.5)		Coefficient of variation below 0.50	

Source: UNIDO data base, see tables 1, 2 and 3.

Note: The table covers all manufacturing industries for which the coefficient of variation (standard deviation/mean) of skill intensity rankings were 0.50 or above (given in parentheses in tables 2 and 3) in the group of twelve developed market economies or in the group of six developing countries (listed in table 1) for 1970-71 or 1979-80. In each country group the two (three) highest and lowest ranking countries are reported except for some industries in the case of developing countries where the rankings of the remaining countries were in the proximity of the mean ranking.

which are major world suppliers, whereas in Australia and Austria which lack a significant capacity, the industry is not skill intensive. The same goes, for example in miscellaneous products of petroleum and coal (ISIC 354) where the two extremes are the Federal Republic of Germany, traditionally a coal-producing country, and Italy. Paper and products (ISIC 341) is a similar case where Canada and Finland, probably internationally the most competitive producers, and the Federal Republic of Germany and the United Kingdom constitute contrasts.

In the case of developing countries which is a more heterogeneous group in terms of their industrial structure, inter alia, due to major differences in their foreign trade regimes, product mixes and labour market conditions can be expected to show a great variation. This is reflected in industries listed in table 6 where, Chile and Colombia, for example, make for the two extremes in skill intensity rankings.

Some extreme values in the measure of skill intensity are purely statistical artifacts. A case in point is tobacco products (ISIC 314) in Japan where it appears to be the most skill-intensive industry.

IV. Factor intensity of expanding and declining industries in the developed market economies and the developing countries

As international trade expands, countries' production patterns move in the direction to conform more closely to their comparative advantage. Out of the 26 manufacturing industries under consideration it was found that 8 industries had, on the average, a declining value added share in the developed market economies during the 1970-71 to 1979-80 period while this average share was increasing in the developing countries. Four of these industries - textiles (ISIC 321), wearing apparel (ISIC 322), leather products (ISIC 323), and footwear (ISIC 324) - were among the least skill and physical capital intensive industries in both country groups, and three - paper and products (ISIC 341), rubber products (ISIC 355), and glass and products (ISIC 362) - were intermediate in this respect. The only skill and capital intensive industry which experienced a relative decline in the developed countries and expanded in the developing countries was iron and steel (ISIC 371).1/

The same broad pattern is observed in the individual countries when the correlation between the growth of industries' value added and employment and their skill and capital intensity in the initial period (1970-71) are studied. In all developed countries where a significant relation was found, expansion both in value added and employment was positively correlated with skill, physical and total capital intensity of the industries (see table 7).

1/ The share of employment of all these 8 industries declined on the average in the developed market economies. In the developing countries their average share of employment increased in wearing apparel (ISIC 322), leather products (ISIC 323), rubber products (ISIC 355) and iron and steel (ISIC 371).

Italy was the only exception where this relation was a negative one concerning growth in value added, and in Austria and Japan no significant relation was found.

The experience of the developing countries seemed to be just the opposite. Expansion in value added and employment, when significant, was negatively correlated with the skill, physical and total capital intensity of the industries in the initial period. In Chile and Colombia the correlations were insignificant.

Table 7 Correlation of industries' value added and employment growth during 1970-71 – 1979-80 with their factor intensity in 1970-71, in the developed market economies and the developing countries

	Correlation of 1970-71 – 1979-80 growth in value added with 1970-71			Correlation of 1970-71 – 1979-80 growth in employment with 1970-71		
	skill intensity (wages and salaries per employee)	physical capital intensity (non-wage value added per employe)	total capital intensity (total value added per employee)	skill intensity (wages and salaries per employee)	physical capital intensity (non-wage value added per employee)	total capital intensity (total value added per employee)
Developed market economies						
Australia		+		+**	+**	+**
Canada	+*			+*		
Denmark	+*	+	+*	+*	+*	+*
Finland	+*			+**	+*	+**
Germany, Federal Republic of	+*	+	+*	+*	+	+*
Italy	-*	-**	-**	+**	+*	+**
Netherlands	+*	+*	+	+	+*	+*
Sweden	+**	+**	+**	+**	+**	+**
United Kingdom		+			+	
United States	+**	+	+			
Developing countries						
Korea, Republic of	-*	-**	-**	-*	-**	-**
Malaysia		-	-		-	
Philippines	-*	-**	-**	-	-*	-*
Turkey		-*	-*			

Source: UNIDO Data Base, see table 1.

Note: The reported results are based on Spearman rank order correlation coefficients, covering 26 manufacturing industries. Only the signs of coefficients significant at the 20 per cent level are given. Significance at the 10 and 1 per cent level are denoted by * and **, respectively. In the case of Austria, Japan, Chile and [illegible]

V. Profile of industries with changing relative skill intensity

Changes in relative factor intensity of industries may be triggered by changes in relative factor prices, relative prices of intermediate or final goods and services or technological innovations either unrelated to changes in relative prices or induced by such. There are numerous possible combinations of stimuli and responses by the industries. An industry facing lower priced imports, for example, may try to increase its competitiveness by introducing automated machines replacing unskilled labour by skilled operators and it may or may not regain a comparative advantage. Also, an already high skill and capital intensive dynamic industry may become even more skill intensive as a result of a technological breakthrough. Obviously, to identify such scenarios and differentiate causes from effects, the chain of events has to be studied in detail at the sectoral level and at the level of the firms. Still, it is of interest to investigate whether there is a common profile of industries which became relatively more skill intensive in the developed market economies and in the developing countries. To this end, the correlation between increases in average wages and salaries on the one hand, and on the other hand their initial level, industries' physical capital intensity and changes in this, and finally, their growth in terms of value added and employment were studied in the individual countries. The results of the correlation analysis are summarized in table 8.

For the developed market economies it was found that in Austria, the Federal Republic of Germany and the United States increases in average wages and salaries were positively correlated with their inital level in 1970-71, implying that the already skill intensive industries became more so. On the other hand, in Australia, Denmark, Italy, the Netherlands and the United Kingdom this relation was a negative one. Increases in wages and salaries per

Table 8 Correlation of increase in skill intensity with other industry characteristics in the developed market economies and the developing countries

Correlation with:	Correlation of increase in skill intensity 1970-71 - 1979-80: countries yielding coefficients significant at the 20 per cent (denoted by * 10 per cent) level			
	Developed market economies (12)		Developing countries (6)	
	Positive correlation	Negative correlation	Positive correlation	Negative correlation
Skill intensity (wages and salaries per employee), 1970-71	Austria, Germany, Fed. Rep. of, United States*	Australia*, Denmark, Italy*, Netherlands, United Kingdom		Colombia*, Korea, Rep. of, Malaysia*, Philippines,
Physical capital intensity (non-wage value added per employee)				
- 1970-71	Austria*, Finland, Japan*, United Kingdom*, United States*	Italy*	Chile*,	Malaysia*
- increase in 1970-71 - 1979-80	Australia, Canada*, Denmark, Italy*, Netherlands*, United States*		Korea, Rep. of*, Malaysia*, Philippines*, Turkey*	
Growth 1970-71 - 1979-80				
- value added	Germany, Fed. Rep. of*, Italy*, Netherlands*, United Kingdom*, United States*		Chile, Colombia*	Korea, Rep. of
- employment	Denmark*, Germany, Fed. Rep. of*, United Kingdom*	Austrialia*, Austria*, Canada, Italy*, United States	Colombia*	Korea, Rep. of*, Malaysia

Source: UNIDO Data Base, see table 1.

Note: The 12 developed market economies and the 6 developing countries in the sample are listed in table 1. The reported results are based on Spearman rank order correlation coefficients for 26 manufacturing industries. Changes over the period 1970-71 to 1979-80 are measured both by changes in rankings and rates of increase. A country for which a

employee were relatively greater in industries with initially low wages and salaries, possibly pointing to an upgrading of skills (and/or displacement of unskilled labour) in unskilled labour intensive industries. An alternative or more likely a complementary interpretation is an unproportionate increase in wage rates for unskilled labour resulting from egalitarian wage settlements.

In Austria, Finland, Japan, the United Kingdom and the United States the increase in industries' apparent skill intensity was positively correlated with their physical capital intensity in the initial period. The only developed market economy for which there was a significant correlation and constituted an exception to this was Italy.

In the developed market economies, on the whole, increases in industries' skill intensity were accompanied by increases in their physical capital intensity implying substitution of unskilled labour with machines and equipment. This appeared to be the case for Australia, Canada, Denmark, Italy, the Netherlands and the United States.

The final relation investigated was how skill intensity developed in expanding and contracting industries. It was found that in the Federal Republic of Germany, Italy, the Netherlands, the United Kingdom and the United States increases in skill intensity were positively correlated with industries' value added growth. For no developed market economy was this relation negative. Also expansion of employment was positively correlated with increases in skill intensity in Denmark, the Federal Republic of Germany and the United Kingdom, but this relation was negative in Australia, Austria, Canada, Italy and the United States.

The brief analysis of the industries in the developed market economies which experienced relatively greater increases in skill intensity measured by the level of average wages and salaries fall short of distinguishing a uniform

profile or distinct patterns. The evidence, however, conforms with the stylized typology implying two broad scenarios. To the first group would belong countries which are more market oriented, where differences in average wages and salaries to a greater extent reflect skill differences. In these countries the main impetus to changes in industries' factor content would be changes in relative prices e.g. those originating from abroad resulting from increased foreign competition or changes in energy prices, and autonomous technological innovations. To the other scenario would belong countries where the non-market forces play a prominant role in the factor markets. In these countries, to start with, differences in the level of average wages and salaries would be only weakly related to skill differences.[1/] Furthermore, the apparent increases in factor intensities may be a reflection of e.g. increased relative wages for unskilled labour as well as the response of the industries to such changes and changes in the external environment.

In the case of the developing countries, due to their greater heterogeneity, it might be even more difficult to make generalizations concerning the profile of industries which experienced relatively greater increases in skill intensity. In this group, on the whole, it appeared that skills in relatively low pay industries were upgraded. This seemed to be the case in Colombia, Malaysia, the Philippines and the Republic of Korea where increases in average wages and salaries were negatively correlated with their 1970-71 initial level. This observation also most likely reflected the existence of an upward pressure on wages for unskilled labour.

1/ A case in point may be Sweden where none of the relations investigated proved to be significant.

In only two countries increases in skill intensity were correlated significantly with the industries' initial level of physical capital intensity, in Chile positively and in Malaysia negatively. On the other hand, in four countries - Malaysia, the Philippines, the Republic of Korea and Turkey - it appeared that intensification of skills was accompanied by intensification in the use of physical capital.

Finally, it was found that in Chile and Colombia relatively faster expanding industries enjoyed greater increases in wages and salaries. In Colombia, this relation held also for expansion in employment. On the other hand, a notable observation was that in the Republic of Korea - which has become a major producer and exporter of relatively sophisticated manufactures - increases in skill intensity measured by average wages and salaries were relatively small in industries expanding relatively faster both in terms of value added and employment. In Malaysia the same negative relation was found with employment growth.