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STRUCTURAL CHANGE AND COMPARATIVE ADVANTAGE IN MANUFACTURING*

An overview of recent developments in developed and developing countries

Prepared by the
Statistics and Survey Unit
Division for Industrial Studies

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Contents

Foreword

The study of structural change and its relationship to international comparative advantage is the subject of recently initiated research undertaken jointly between the Manufactures Division in UNCTAD and the Division for Industrial Studies (Statistics and Survey Unit) in UNIDO. This research has three major goals, namely a statistical, an analytical and a policy-oriented one. As regards the first goal, it is intended to provide detailed and consistent statistical information on the structure of manufacturing employment, output and trade as well as on its changes over time for a fairly broad selection of countries. The second goal is to establish an analytical framework that will serve to examine empirically - on the basis of that statistical information - structural change (and, in particular, structural adjustment) in the context of the international economy. The third goal, finally, can be defined as that of identifying major policy implications of the empirical results obtained.

The present study [1/] is to be seen as a starting point in respect of the objectives stated above. Its major purpose is to provide an overview of recent changes in the structure of manufacturing employment and output in a number of developed and developing countries and to relate these changes to concomitant alterations of comparative advantage. The statistical data used are sufficiently detailed to serve as a basis for outlining structural changes both in a country and in an industry perspective. Moreover, the methodological tools employed to examine the relationship between structural change and comparative advantage could form the elements of a standard analytical framework for future empirical work. Based on the methodology and some of the results presented here, future analyses of a narrower scope than the present one will also have to tackle attendant policy questions.

1/ This study was prepared jointly by Abdur Rahman, who worked as a consultant for the Manufactures Division of UNCTAD and by staff of the Statistics and Survey Unit of the Division for Industrial Studies of UNIDO.

1. Introduction

One way to characterize the motion of a growing economic system is by tracing its interrelated structures of production, distribution, consumption and trade. Pertinent changes - e.g., of the structures of prices, output mix and employment - are normally attributed to a number of causal factors among which technological progress, demographic factors, consumer tastes, economic organization and the nature of various economic policies figure prominently. With regard to these processes, the manufacturing sector is of particular interest due to some special features related to supply as well as demand conditions. Thus, manufacturing production is characterized by significant complementarities of activities as well as by an important role of scale economies which may arise from indivisibilities of various kinds. Moreover, demand for manufacturing output usually shows an income elasticity in excess of one - a fact which has important growth implications.

The present study examines changes in the composition (in terms of 28 industrial branches) of employment, output and trade of the manufacturing sector. Such changes are surveyed for a comparatively large sample of 14 developed market economies and 14 developing countries and for the period between the mid-1970s and the early 1980s. Given the wide range of countries under consideration, the objective could not be an in-depth analysis of structural transformation of each of the economies for which data were at hand. What was attempted instead, is a fairly general characterization of recent structural changes in the manufacturing sector of developed and developing countries and attendant comparisons between these two broad country groups as well as between some of their regional subgroups.

The two questions that will be treated in the present context are:

(i) Which were the basic features of structural change in manufacturing of developed and developing countries between the mid-1970s and the early 1980s?

(ii) To what extent could such change be interpreted as adjustment to the pattern of international comparative advantage?

The second section tries to answer question (i) in the form of an overview of changes in the structure of manufacturing employment and output. An attempt is made to highlight broad trends by viewing statistical

information in a regional perspective, as well as to indicate some noticeable country developments in order to refine the general picture. In addition, an industry-specific view is adopted in a brief comparative discussion of declining versus expanding industries. The third section is devoted to question (ii) and starts with a brief methodological discussion of the problems involved in "measuring" comparative advantage. It continues with a review of recent changes in comparative advantage of the countries surveyed. Its major results are derived from a regression analysis of the relationship between (changes in) comparative advantage and structural change of employment and production. The fourth section presents a few concluding remarks, while in the annex the underlying data base is described.

2. An overview of structural change in employment and output

2.1 Structural change in a country group perspective

The major part of the present section will focus on some quantitative characteristics that are normally used to describe the structural transformation (with respect to employment and output) of the manufacturing sector of a given country. In a first step, broad trends of structural changes within (regional) country groupings will be analyzed on the basis of data that were aggregated accordingly. This country-group view is expected to yield a rough impression of trends of structural change that prevailed in a given region (or country group) over the second half of the 1970s. In a second step, selected country-specific information will be used to refine the general picture and interpret its basic features.

If the broad aggregate structures of manufacturing employment and output of developed market economies on the one hand and of developing countries on the other are considered, the pace of overall change over the second half of the 1970s appears to be of the same order of magnitude for both country groups. This is indicated by similar degrees of variation across industrial branches of both the employment and the output growth rates. While for the former country group employment and output growth exhibited standard deviations of 1.5 and 2.1 around means of -0.9 and 1.2, respectively, the corresponding deviations for the latter group were 1.6 and 2.4 with means of 4.2 and 5.7, respectively. A major difference between the two highly aggregate patterns of growth, however, lies in the fact that the rates are

invariably positive for the developing country aggregate, whereas their sign varies in the case of the developed market economies aggregate.

Table 2.1 shows average growth patterns of employment and output for 6 groups of the country sample.[1/] Even at such a high level of aggregation the data suggest a remarkable degree of structural change within the manufacturing sector. The widest range of growth rates is displayed by Japan's manufacturing output, with a minimum of -3.0 per cent for furniture and a maximum of 14.1 per cent for professional goods. The output aggregates of other developed market economies show smaller variations of growth rates across branches. The respective ranges are from -2.0 per cent (footwear) to 9.0 per cent (plastic products) for North America, from -3.9 per cent (leather) to 2.4 per cent (plastic products as well as food products) for EEC countries and from -3.5 per cent (pottery) to 5.8 per cent (professional goods) for EFTA countries. Within the EEC group the steepest decline of output was recorded for Belgium's leather industry (-9.7 per cent average annual "growth"), while the fastest expansion occurred in Denmark's output of professional goods (11.1 per cent average annual growth). Finland's production of the same product category was the leader in terms of branch-specific growth in EFTA countries, whereas the most pronounced decline of output in this country group was recorded for Norway's petroleum and coal production. In general, the range of employment growth rates in the developed market economies groups is found to be considerably narrower than that for output growth rates - with the exception of EEC countries. This indicates that changes of the output structure are usually more marked than those of the employment structure.

Both the EEC and the EFTA aggregate data subsume quite diverse country-specific developments. If two of the large EEC economies - France and the Federal Republic of Germany - as well as two of the smaller members of the group - Belgium and the Netherlands - are compared with the EEC aggregate growth pattern, the industries with maximum aggregate growth of output are seen to have expanded in all four countries, whereas the minimum-growth industry (in aggregate terms) declined in each of the selected economies. However, the country patterns of output growth showed quite distinct characteristics otherwise.

1/ The design of groups follows the usual regional scheme with the addition of sub-dividing the European part of the sample into EEC and EFTA countries.

Table 2.1 Average annual growth rates of employment (EMP) and output (VA)[a/], 1976 - early 1980s, by industry and by broad groups within the country sample

ISIC	Industry	North America		Japan		E E C		E F T A		Asia		Latin America	
		EMP	VA	EMP	VA	EMP	VA	EMP	VA	EMP	VA	EMP	VA
311/2	Food products	-0.1	2.6	1.4	1.2	-0.1	2.4	-0.2	1.1	2.8	7.0	2.1	3.6
313	Beverages	-0.4	4.2	-2.5	1.3	-2.7	0.7	-2.2	1.0	6.4	7.5	3.2	8.4
314	Tobacco	-1.1	0.7	-1.3	1.2	-1.5	1.3	0.0	0.8	4.2	8.5	-2.4	6.0
321	Textiles	-1.7	0.5	-2.6	-0.3	-5.7	-2.3	-3.6	-2.1	2.6	3.0	-2.3	3.1
322	Wearing apparel	-0.4	-0.8	0.7	0.2	-5.1	-2.1	-4.3	-2.4	3.4	3.1	3.6	4.3
323	Leather and products	-1.1	-1.0	1.6	-0.6	-4.0	-3.9	-3.5	-1.2	1.8	6.2	-0.8	0.6
324	Footwear	-1.8	-2.0	1.0	0.2	-2.6	-2.0	-0.2	1.1	8.7	2.3	5.1	1.9
331	Wood products	-0.2	-1.0	-3.4	-3.0	-2.8	-2.3	-1.1	-0.7	2.9	3.7	1.6	4.8
332	Furniture	2.0	2.7	-0.8	-3.0	-0.8	0.0	0.4	-0.1	9.1	6.5	3.5	9.5
341	Paper and products	0.6	2.9	-1.2	2.4	-2.6	1.8	-1.4	2.9	5.8	7.3	2.2	7.4
342	Printing, publishing	3.2	3.6	1.4	1.6	-0.7	2.2	0.8	1.5	3.2	2.5	1.4	-0.4
351	Industrial chemicals	0.6	4.5	-3.4	1.7	-2.6	0.2	0.0	2.9	6.6	9.4	2.0	7.6
352	Other chemical products	1.3	5.3	0.5	6.8	-0.7	1.4	1.4	5.1	7.1	7.9	3.6	7.9
353	Petroleum refineries	2.0	-0.7	-1.7	-2.4	-0.8	-0.2	0.6	0.9	4.7	5.6	2.4	7.6
354	Petroleum, coal products	0.0	-0.5	1.0	0.0	-3.4	-3.2	0.2	-3.5	8.0	7.4	3.9	9.9
355	Rubber products	-2.2	1.3	-0.1	3.3	-3.2	-1.5	-3.8	-1.2	4.1	8.2	0.9	4.6
356	Plastic products	4.5	9.0	3.0	2.9	1.2	2.4	-0.9	0.7	9.3	1.4	5.0	5.8
361	Pottery, china etc.	-2.2	1.6	-0.2	-0.2	-4.0	0.7	-3.7	-3.5	8.1	2.6	4.2	5.4
362	Glass and products	-0.6	2.5	-1.8	-1.4	-2.8	2.0	-1.9	5.1	3.9	9.7	4.4	5.9
369	Non-metal prod., n.e.c.	0.0	1.7	-0.5	2.7	-1.7	-0.5	-2.2	-1.2	5.6	7.6	4.6	6.9
371	Iron and steel	-1.2	-0.7	-2.1	0.6	-4.5	-1.0	-2.6	0.5	4.8	5.6	2.4	8.6

Table 2.1 (continued)

ISIC	Industry	North America		Japan		E E C		E F T A		Asia		Latin America	
		EMP	VA	EMP	VA	EMP	VA	EMP	VA	EMP	VA	EMP	VA
372	Non-ferrous metals	0.8	0.3	-1.6	1.3	-2.6	0.3	0.0	-0.6	6.8	8.0	3.4	1.9
381	Metal products	1.7	2.0	0.0	2.4	-2.9	0.6	-1.8	1.9	5.3	7.9	1.7	9.7
382	Machinery, n.e.c.	4.0	5.2	0.5	6.3	-1.0	1.3	0.0	1.2	6.4	7.5	3.7	4.3
383	Electrical machinery	4.1	5.6	2.6	12.1	-1.7	2.0	-0.1	3.4	6.4	9.3	3.7	8.9
384	Transport equipment	0.6	0.7	-0.2	4.0	-0.9	1.7	-1.2	-3.2	9.9	3.4	1.4	6.1
385	Professional goods	3.4	3.1	1.8	14.1	-3.4	1.9	-4.9	5.8	8.4	5.2	-0.1	2.8
390	Other industries	0.1	1.4	-0.7	2.6	-3.2	2.0	-3.4	-1.4	3.2	1.7	0.5	4.8

a/ Value added at 1975 prices.

For France (with 1 per cent annual growth of manufacturing output) relatively high value added growth rates (of well over 3 per cent) were recorded (apart from the residual category of "other industries") for glass, printing and petroleum refineries, modest ones for food products and machinery, n.e.c. (including computers), and negative ones for (among the larger industries) textiles, iron and steel and transport equipment. The most marked contraction of employment took place in iron and steel (-4.9 per cent), while only food products, printing, as well as "other chemical products" showed (slight) employment growth. By contrast, growth of employment was remarkably high for some industrial branches in the Federal Republic of Germany, among them food products (3.5 per cent) and transport equipment (3 per cent), whereas employment was reduced by 3 to 5 per cent annually in the iron and steel, textiles and wearing apparel industries. This last industrial branch showed also the sharpest reduction of output (-3 per cent), followed by "other industries" and by leather, while rates of output expansion in excess of 4 per cent were recorded for such diverse industries as paper, transport equipment and plastic products. Thus, the two large countries selected (for which manufacturing value added grew at about equal rates) exhibited a pronounced decline of several of the labour-intensive or technologically mature industries for which comparative advantage has - at least in part - shifted to industrially less advanced countries.

Belgium, an example of a small country with about zero overall output growth in manufacturing, experienced drastic differences in growth performance among the smaller ones of its industries, like the declining leather and footwear and the rising professional goods industries. Among those branches that accounted for higher value added shares, both the vigorous expansion of food products and of transport equipment (4.1 and 5.4 per cent, respectively) and the noticeable decline of (once more) textiles and of iron and steel (-1.9 and -3.0 per cent respectively) are to be noted. With respect to employment, the only industry that showed a positive growth rate, was that of petroleum refineries. The Netherlands, on the other hand (showing about 1 per cent overall output growth), displayed remarkable employment growth for some of its smaller industries - footwear, professional goods (6.3 and 3.0 per cent, respectively) - as well as for the relatively large branch of printing and publishing (2.6 per cent). Exceptionally high losses o employment were recorded for the overall declining branches textiles, wearing apparel and iron and steel (-8.9, -11.2 and -3.9 per cent, respectively). The former two

branches were also among those whose output was reduced most drastically. Finally, expansion of output by more than 3 per cent annually took place in food products, printing and electrical machinery. In summary, the two small EEC countries considered individually have followed the generally prevailing trends of structural change, at least as far as the decline of industries in developed market economies is concerned.

Two examples of EFTA countries give an impression of the wide range of growth performance in that group as well. Austria - displaying a growth rate of manufacturing value added of almost 3 per cent per annum - showed only small rates of output decline, but considerable growth of some of its major industrial branches such as electrical machinery and food products (6.3 and 3.9 per cent, respectively). Employment growth on the other hand was basically confined to furniture, machinery, n.e.c., and transport equipment (2.5, 3.9 and 1.3 per cent, respectively), while remarkable losses of over 3 per cent annually occurred in textiles, wearing apparel and wood products. By comparison, Sweden - which showed a slight overall contraction of manufacturing output - recorded high negative rates of employment "growth" in the same three branches, and somewhat lower ones in its large industries iron and steel, metal products and machinery, n.e.c. The reduction of output on the other hand was considerable in the important transport equipment industry (-4.4 per cent) as well as in some smaller branches like wearing apparel and furniture.

Turning to developing countries, higher intensity of structural change in output than in employment can be observed for the aggregate of the Latin American countries in the sample, whereas Asian developing countries as a whole displayed about the same variation of output and of employment growth rates. For the latter country group minimum and maximum output growth rates were recorded for plastic products (1.4 per cent) and for glass (9.7 per cent) while the former showed minimum output growth in printing (-0.4 per cent) and the corresponding maximum in petroleum products (9.9 per cent).

Interesting examples of differing growth performance within the two regional groupings might be obtained, e.g., by selecting for closer scrutiny countries that may be called "first-generation" exporters of manufacture as

well as countries that have recently been labelled "new exporting countries".[1/] In the Latin American region Brazil (with almost 6 per cent annual growth of output) is a typical representative of the first group. Its comparatively advanced stage of industrial development is reflected, e.g., in high output growth (around 10 per cent per annum) of capital- and/or skill-intensive industries like the chemical industries or parts of the engineering industries. While these industries showed also positive rates of employment growth, those were in almost all cases lower than the output growth rates, indicating an increase in labour productivity. Among the traditional industries, wearing apparel and footwear recorded also substantial gains of employment (around 10 per cent per annum), coupled, however, with a considerable productivity decline. As regards Colombia - a member of the second country group - high output growth of branches that accounted for a substantial portion of manufacturing value added was found for beverages and transport equipment (about 6 per cent per annum), while a number of smaller industries (glass, footwear and furniture) displayed value-added growth rates of over 7 per cent with the overall result being 3.6 per cent output growth in manufacturing. With respect to employment, the decline of the high-weight branch of textiles (-3 per cent) is the most remarkable feature.

Among the Asian developing countries of the sample, the Republic of Korea provides a typical example of a first-generation exporter. Its high growth of manufacturing value added (over 13 per cent per annum) was led by vigorous expansion of branches like iron and steel and electrical machinery (23.1 and 16.5 per cent, respectively), while the only contraction of output was recorded for wood products. Extraordinarily high gains in employment of over 12 per cent per annum occurred in plastic products as well as in transport equipment, whereas a decline was recorded for tobacco, leather, wood products and industrial chemicals. Indonesia - a second-generation exporter of manufactures - in comparison displayed positive signs for almost all growth rates of output and employment, where total manufacturing output grew at over 13 per cent per annum. Higher-than-average output growth in branches with noticeable contributions to the manufacturing total was recorded for wood products, industrial chemicals and non-metal products, while an analogous development with respect to employment was observed for the first one of these branches as well as for electrical machinery.

1/ For a definition of this group see O. Havrylyshyn and I. Alikhani, "Is there cause for export optimism? An inquiry into the existence of a second generation of successful exporters", Weltwirtschaftliches Archiv, vol. 118, no.4 (1982), pp. 651-663

The selected developing countries illustrate the differences in industrial advancement within this country group - also by virtue of the differential nature of structural change. Moreover, the complementarity between decline in the developed and rise in the developing countries of a number of industrial branches - a point that will be elaborated below - shows up to a certain degree in the analyzed data.

Comparisons of the growth rates of output and employment reveal an overall trend of increasing labour productivity throughout most of the industrial branches in both developed and developing countries. With respect to the former country group it should be noted that for a number of industries a decline of employment - which may to some extent be the result of increased import competition from developing countries - was coupled with a rise in output, due to remarkable increases in labour productivity. Examples of such "compensation" for employment losses in the developed market economies as a whole are found in beverages, tobacco, paper, industrial chemicals, rubber, pottery, glass, non-metal products, non-ferrous metals, metal products, transport equipment and "other industries".

While the results of table 2.1 yield an impression of the magnitude of structural changes in the manufacturing sector of broad country groups, table 2.2 summarizes some country-specific information. For each country in the given sample indices are shown that indicate the degree of overall structural change in the country's manufacturing employment and output, respectively.[1/] From these figures it emerges as a general feature that, on average, structural change was more pronounced in the developing than in the developed countries surveyed - a characterization which was hidden in the aggregate data discussed before. Furthermore, in both country groups generally output exhibited a higher degree of structural transformation than employment.

In the developed market economies sample Japan showed the highest index value of structural change in output, followed by Norway, and Belgium. By contrast, the Federal Republic of Germany, Austria and Canada displayed the

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1/ For the definition of this index of structural change see footnote a/ of table 2.2.

Table 2.2 Indices of structural change[a/] of employment and output[b/], exports and imports, by country, 1976 to early 1980s

A. Developed market economies

Country	Employment	Output b/	Average annual rate of GDP growth (per cent)
Austria	0.96	0.87	2.6
Belgium	0.97	1.19	1.5
Canada	0.57	0.91	2.8
Denmark	0.91	1.04	1.3
Finland	0.65	1.13	3.5
France	0.60	1.01	2.3
Germany, F.R.	0.91	0.77	2.5
Italy	0.57	1.11	2.4
Japan	0.72	1.62	4.6
Netherlands	1.14	1.10	1.4
Norway	0.96	1.27	3.5
Sweden	0.75	1.13	0.9
United Kingdom	1.10	0.92	0.3
United States	0.90	0.92	2.8

Table 2.2 (continued)

B. Developing countries

Country	Employment	Output b/	Average annual rate of GDP growth (per cent)
Argentina	1.22	0.93	1.0
Brazil	1.10	1.15	4.7
Chile	2.90	2.47	6.0
Colombia	1.14	0.95	5.0
Hong Kong	1.58	...	11.0
India	1.20	1.49	4.4
Indonesia	1.14	2.72	7.8
Korea, Rep.	1.47	1.75	6.5
Malaysia	1.94	...	7.2
Mexico	0.67	1.54	7.5
Philippines	1.86	1.23	5.6
Singapore	1.89	2.08	10.7
Tunisia	2.86	1.92	6.0
Turkey	0.93	1.69	2.4

a/ Calculated as half the sum of absolute differences of the shares at the beginning and the end of the period, divided by the number of intervening years.

b. Value added at 1975 prices.

three lowest values of that index. With regard to employment, structural change is seen to have been most marked in the Netherlands, the United Kingdom and again Belgium, whereas Italy, Canada and France showed the most stable employment structures. In the developing countries sample on the other hand Indonesia took the lead in terms of the degree of structural change of manufacturing output, while Argentina, Colombia and Brazil showed the lowest corresponding index values. The structure of manufacturing employment changed most rapidly in Chile and Tunisia, and most slowly in Mexico, Turkey and Brazil.

On the basis of the data given in table 2.2 it can be tested whether there is a systematic relationship between the pace of structural change and overall economic growth. Simple correlations across countries between indices of structural change in employment and output on the one hand and GDP-growth rates on the other support the conjecture that the pace of structural change is positively related with economic growth.[1/] The relationship is in all probability that of an interdependence. Structural change is expected to promote growth by facilitating the re-allocation of resources and thereby increasing the efficiency of their use. On the other hand, economic growth is likely to foster structural change, for example, by reducing adjustment costs.

2.2 Structural change in an industry perspective

A view complementary to the country-specific one outlined in the first part of the present section will be presented in the following, where information on structural change will summarily be discussed from an industry-specific angle. This discussion is not intended to give a full account of structural change in all industries of the manufacturing sector across developed and developing countries. It will rather focus on selected industrial branches whose performance in terms of structural change between the mid-1970s and the beginning of the 1980s appeared to be in some sense remarkable. In this context, the labels "declining industries" and "expanding industries" - mainly applied in connection with structural transformation taking place in the developed countries - circumscribe developments that are typically chosen for more thorough investigation.

1/ The pertinent Pearson correlations between the GDP growth rate and the index of structural change were 0.45 for employment and 0.62 for output, both significant at the 1 per cent level.

An obvious way to discriminate between the two broad types of industries mentioned above is by comparing the relative rise or decline of output and employment across industrial branches. Such comparisons can be made on the basis of the various branches' growth rates or the changes of their shares in total manufacturing. Some empirical results were summarized in table 2.3 which can serve to highlight broad developments in the two groups of developed market economies and developing countries. Thus,the 14 developed market economies as a whole are seen to have displayed a marked relative decline of both output and employment in textiles, wearing apparel and leather. In addition, relatively fast declining output shares were observed for food products, footwear and petroleum products, whereas a pronounced decline of the employment share was also recorded for iron and steel, pottery and rubber products. Typical examples of expanding industries - with respect to both output and employment - were electrical machinery, plastic products, professional goods, machinery n.e.c. (including computers) and printing.

As regards the corresponding summary picture of the highly hetereogenous developing countries group, expansion of output between 1976 and the early 1980s was strongest in electrical machinery, furniture and petroleum products, while employment grew most vigorously in plastic products, professional goods and footwear. A noticeable decline of both output and employment shares on the other hand was recorded for leather and textiles. Output shares declined remarkably for printing and footwear. The substantial differences between the rankings by output growth on the one hand and by employment growth on the other, again point to sometimes dramatic changes in labour productivity over the period studied.

2.2.1 Declining industries

In the present context, an industry is labelled as "declining" (in the developed market economies as a whole), if both its output and employment shares in total manufacturing decreased remarkably over the period under study. The data summarized in table 2.3 depict changes in the structures of employment and output in the two broad country aggregates and can therefore serve the purpose of identifying declining as well as expanding industries in the above sense. While these data appear to be useful to indicate

Table 2.3 Relative expansion[a/] of industries in developed market economies and developing countries, 1976 to early 1980s

ISIC Code	Industry	Developed market economies b/		Developing countries b/	
		Employment	Output c/	Employment	Output c/
311/2	Food products	1.04	1.00	0.96	0.93
313	Beverages	0.92	0.99	1.02	1.06
314	Tobacco	0.96	0.95	0.97	1.04
321	Textiles	0.84	0.86	0.91	0.89
322	Wearing apparel	0.92	0.79	1.04	0.97
323	Leather and products	0.92	0.80	0.88	0.88
324	Footwear	0.93	0.82	1.13	0.85
331	Wood products	0.92	0.82	0.96	0.95
332	Furniture, fixtures	1.04	0.93	1.05	1.14
341	Paper and products	0.97	1.02	1.01	1.03
342	Printing, publishing	1.10	1.02	0.95	0.80
351	Industrial chemicals	0.94	1.02	1.02	1.07
352	Other chemical products	1.03	1.12	1.06	1.05
353	Petroleum refineries	1.05	0.88	1.10	1.01
354	Petroleum, coal products	0.99	0.83	1.09	1.12
355	Rubber products	0.91	0.92	1.01	0.97
356	Plastic products n.e.c.	1.18	1.17	1.16	1.00
361	Pottery, china etc.	0.89	0.92	1.12	0.98
362	Glass and products	0.92	0.98	1.03	1.03
369	Non-metal products, n.e.c.	0.97	0.94	1.06	1.02
371	Iron and steel	0.87	0.87	1.00	1.07
372	Non-ferrous metals	0.97	0.92	1.06	0.91
381	Metal products	0.99	0.94	1.00	1.11
382	Machinery, n.e.c.	1.07	1.09	1.05	0.95
383	Electrical machinery	1.09	1.20	1.08	1.16
384	Transport equipment	1.01	0.97	1.07	1.03
385	Professional goods	1.06	1.14	1.14	0.98
390	Other industries	0.96	0.94	0.95	0.91

a/ The relative expansion of each industry is measured by the ratio of the industry's share in total manufacturing at the end of the period to the corresponding share at the beginning of the period.

b/ Cover only the countries surveyed in the present study.

c/ Value added at 1975 prices.

general trends in the development of the various industrial branches in the two groups of developed and developing countries, they need to be supplemented by more detailed information.

To start with an example of a typical "sunset" industry in the developed countries, clothing (wearing apparel) is seen to have fallen in the 14 developed market economies from an output share of 2.5 per cent in 1976 to less than 2 per cent in the early 1980s. The corresponding decline of the employment share was from 5.1 per cent to less than 4.7 per cent. Among various subgroups within the developed countries sample, the EFTA countries showed the steepest decline in output (-2.4 per cent average annual growth of constant value added), while for the EEC countries surveyed the sharpest decrease of employment (an average annual rate of "growth" of -5.1) was recorded. For other industries that can be said to decline in the industrialized countries, likewise the European developed market economies generally displayed the fastest relative decreases of output and employment. Thus, in the leather industry both variables experienced the strongest decline in EEC countries with average annual rates of -3.9 per cent and -4.0 per cent, respectively. Footwear contracted equally strongly in output in the EEC and in North America with corresponding average annual decreases of slightly less than -2.0 per cent, while employment in that branch shrank fastest in the EEC countries (by an average annual rate of -2.6 per cent). Wood products fell steepest - both in output and employment - in Japan (average annual rates of -3.0 and -3.4 per cent, respectively), whereas the decline of petroleum and coal products was led by EFTA countries with respect to output (average annual rate of -3.5 per cent) and by EEC countries with respect to employment (average annual rate of -3.4 per cent). Textiles contracted fastest in the EEC countries - by -2.3 per cent annually in output and by -5.7 per cent in employment. And the same is true for iron and steel with corresponding average annual growth rates of -1.0 and -4.5 per cent.

The decline in the industrialized countries of most of the above-mentioned industries is a well-known fact that has figured prominently in much of the industrial policy discussion of the recent past. Industries like textiles, clothing, petrochemicals and iron and steel are involved in a wide range of disputes, mainly about trade and adjustment policies.

Viewed from this angle, the statistical information presented in this section substantiates some of the reasons for the developed countries' policy concern in respect of certain industrial branches. Import competition from the developing countries is normally listed among the causes of the decline in developed countries of industries that are of the "traditional" labour-intensive type, e.g., clothing, leather or footwear. To what extent the relative decline of a certain industry in the developed countries is paralleled by a concomitant relative rise of the same industry in the developing countries can be seen from the data of table 2.3. They show that such mirror-like development in the two country groups has taken place e.g., in petroleum products with respect to both output and employment. For iron and steel the decline of the developed countries' output share was accompanied by a vigorous corresponding expansion of output in the developing countries. Finally, both for wearing apparel and for footwear employment shares in the developing countries as a whole increased between the mid-1970s and the early 1980s.

2.2.2 Expanding industries

Shifts in international competitiveness are expected to entail the gradual relocation of traditional or of technologically mature industries from the developed to the developing countries. An example for an industry of the latter type is provided by iron and steel which showed - for the selected developing countries as a whole - a strong relative output expansion. Latin American countries in particular displayed high rates of output growth over the period under consideration, with an annual average of 8.6 per cent. The highest relative increase in the output share for developing countries, however, was recorded for electrical machinery, with value added growth rates of 9.3 per cent and of 8.9 per cent for the Asian and the Latin American parts of the country sample, respectively. Furniture - occupying rank 2 in terms of relative output expansion - grew at an annual rate of 6.5 per cent in Asian and of 9.5 per cent in Latin American countries of the given sample.

That the rise and decline of industries in the two broad groups of developed and developing countries need not necessarily be complementary, is

best exemplified by the empirical fact that for both country groups the electrical machinery industry showed the relatively most vigorous expansion of output, where Japan was the leader with an average annual rate of 12.1 per cent. Among other industries that expanded in developed market economies is that of plastic products for which an extraordinarily high growth rate of 9.0 per cent was recorded for North America. Furthermore, professional goods exhibited the maximum value added growth rate of 14.1 per cent within the Japanese manufacturing sector. Finally, the rise of the share of machinery, n.e.c. (including computers) in manufacturing value added of the developed market economies was mainly based on high growth in Japan (6.3 per cent) and North America (5.2 per cent).

3. International comparative advantage and structural adjustment

One particular explanation of structural change is that of an adjustment of employment and output structures to prevailing patterns of competitiveness as they are reflectd in the structure of international trade. Such patterns in turn are usually held to be based on differences - among countries and across industries - in relative efficiency, according to the principle of comparative advantage. In response to the second question raised in the introduction, the present section examines the relationship between comparative advantage and structural change. It starts out with a discussion of how to "measure" comparative advantage empirically and it proceeds to an assessment of changes in comparative advantage over the period studied and in the countries and industries surveyed. Finally, the hypothesized relationship between comparative advantage and structural change in employment and output is subjected to empirical scrutiny.

3.1 Measures of comparative advantage

The basic problem in measuring or "revealing" comparative advantage may be seen in the fact, that the rigorous definition of the notion is usually cast in terms of autarky price relationships. All empirical economic data, however, refer to events in a trading world. Thus, "true" indices based on pre-trade prices cannot be obtained, and all "measures" of comparative

advantage have to be considered as approximations of the underlying "true" relationships.

An obvious method to measure comparative advantage would be by comparison of post-trade relative prices, assuming that those prices indicate relative efficiency in the production of the various manufactured products. However, since post-trade prices are strongly influenced by trade flows themselves, this approach is not very useful as a way to identify actual patterns of comparative advantage. A similar argument applies to indicators that are based on actual costs instead of autarky domestic costs. Another, purely heuristic, approach is suggested by a "naive" interpretation of the principle of comparative advantage as follows. A country that enjoys a comparative advantage in certain products will specialize in the production and export of those products. On the other hand, it will despecialize in products for which it has a comparative disadvantage, so that these products will have to be imported to satisfy consumption. As a consequence, the existence of exports would indicate comparative advantage while imports would be indicative of comparative disadvantage. However, both for theoretical and empirical reasons, such a simplistic method to "measure" comparative advantage needs refinement.

One way to assess the various countries' degree of comparative advantage might be to compare the volumes of exports or imports of a particular product. Again heuristically, the ranking of countries by the magnitude of exports (imports) could be equated with the corresponding ranking by the degree of comparative advantage (disadvantage). However, size effects are likely to bias such measures. Therefore, a minimum requirement for a reasonable indicator is to adjust trade flows for country size. The aggregative character of statistical information on international trade creates other problems for an assessment of comparative advantage across "industries" or "commodities". Even the most detailed trade statistics deal with product categories rather than individual products. As a result, countries generally appear as both importers and exporters of a given product category. It is easily seen that two-way (or intra-industry) trade - which originates from imports of one particular product and the exports of

another product within the same category - invalidates the simplistic export-only or import-only measures of comparative advantage or disadvantage. A solution to this problem is to use net trade instead of exports or imports alone. Net exports of a given product category, for example, may be taken as an indication that exports of products with a comparative advantage surpass imports of products with a comparative disadvantage within the same category. Depending on the level of aggregation of the trade data used, such an indicator (adjusted for country size) could by and large portray the comparative advantage profile of a country (across industries) or of an industry (across countries) or of countries and industries simultaneously.

The use of trade data to derive the indicators under consideration, raises problems of still another nature. Due to government policies in support of an industry trade flows are likely to reflect underlying patterns of comparative advantage to a lesser extent than they would in a free trade environment. At least two different ways to deal with the problem of such distortions have been suggested. One is to construct indices that incorporate export data only. Assuming that government intervention does not "create" comparative advantage, exports are accepted as a measure of comparative advantage, whereas import data - due to the wide-spread use of tariff and non-tariff measures - are suspected to bias the indicators under study. In an alternative view a certain "symmetry" between the policy measures affecting imports and those influencing exports is emphasized and indices based on net trade are suggested to measure comparative advantage.

The deliberations outlined above led to the specification of a number of concurring indexes or measures of comparative advantage both in the theoretical and the empirical literature. One of the most popular measures of this type is Balassa's export performance ratio.[1/] It is based on the comparison of a given country's commodity structure of exports with the corresponding structure of world exports and is defined as the ratio of the share of a given industry in total manufacturing exports of the country under

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1/ See B. Balassa, "Trade liberalization and 'revealed' comparative advantage", The Manchester School of Economic and Social Studies, vol. 33 (1965), pp. 99-123.

consideration to the corresponding share for the trading world as a whole. Some authors used it as a dichotomous indicator of comparative advantage in the following sense: a given country enjoys a comparative advantage in a given product, if the share of the products' exports in total manufactured exports by the country is greater than the share of world exports of the product in world manufactured exports. One of the arguments behind the use of "normalized" export figures of this kind to "reveal" comparative advantage is that they are not prone to the import-bias mentioned previously. Another rationale centers around comparisons of the actual trading world with a "hypothetical" world, where the factors determining the distribution among countries and commodities of trade flows are absent.

The comparison of data which pertain to post-trade equilibria with hypothetical characteristics of a "comparative-advantage neutral" world as a means to reveal comparative advantage forms the basis of a number of alternative formulations of comparative advantage indices. In this connection indices have been suggested which either incorporate production (or consumption) data along with information on trade or are based on production alone.[1/]

The problems involved in matching trade and production data at a sufficiently disaggregate level, together with some recent results of trade theory render indices that are based on (net) trade a better choice than other measures. The sign of net trade (positive in the case of net exports and negative in the case of net imports) is suggested as a "proxy" indicator of the existence or non-existence of comparative advantage which is at least correct on average across products and/or countries. Moreover, if net exports of a given product by a given country are adjusted for country size and for the weight of the product in world trade, such an index can be expected to measure the degree of comparative advantage - again in a way which can be said to be correct at least in the above "weak" sense of an on-average relationship between the indicator and unobservable pre-trade prices.

1/ Examples are found in H.P. Bowen, "On the theoretical interpretation of indices of trade intensity and revealed comparative advantage", Weltwirtschaftliches Archiv, vol. 119 (1983), pp. 464-472.

In view of the impossibility to specify the "best" index of comparative advantage, and also the alternative interpretations given to the various measures, the question of consistency among them appears to be of considerable interest. Pertinent empirical tests which are briefly reported elsewhere,[1/] revealed a high degree of inconsistency among alternative indices. In general, only the definitionally similar measures of comparative advantage proved to be acceptably consistent, where the degree of consistency increased from cardinal to ordinal, and further on to dichotomous comparisons.

The methodological choice made for the present study - namely Balassa's index of relative export performance - may be viewed from a theoretical angle as a "second-best" solution to the measurement problem discussed. However, its advantages in an empirical sense lie in avoiding a bias that could result from the use of import data and in the suitability of the non-negative export performance index for assessing changes in revealed comparative advantage.

3.2 Recent changes in comparative advantage

Based on the methodology outlined above, an attempt can be made to assess patterns of international comparative advantage and their changes in the course of time. As was mentioned previously, the measure of relative export performance (EP) - Balassa's widely used index of "revealed" comparative advantage - appears to be a good choice for indicating, in particular, changes in comparative advantage. EP-values by industrial branch were calculated for each country surveyed and for the two periods 1976 and "early 1980s". On the basis of this information, some salient features of patterns of comparative advantage (as revealed by actual trade patterns) will be discussed in the following paragraphs, with the focus being on dynamic rather than static characteristics. To begin with the developed market economies, the summary given in table 3.1 reveals some surprising features. While conventional

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1/ See UNIDO, Industry in the 1980s - Structural Change and Interdependence (Sales No. E.85.II.B.8), Chapter V.

Table 3.1 Changes in export performance (EP), 1976 - early 1980s

A. Developed market economies

Country	Marked increase in EP	Marked decrease in EP	Leading three branches in terms of EP, early 1980s
Austria	furniture	petroleum products	wood products
	beverages	tobacco	wearing apparel
	non-ferrous metals	electrical machinery	non-metal products
Belgium	pottery	footwear	glass
	petroleum ref.	furniture	petroleum ref.
	food products	wearing apparel	non-ferrous metals
Canada	pottery	wearing apparel	paper
	petroleum ref.	beverages	wood products
	furniture	transport equipment	non-ferrous metals
Denmark	wood products	petroleum ref.	food products
	paper	rubber products	furniture
	furniture	beverages	plastic products
Finland	misc. chemical prod.	transport equipment	paper
	tobacco	pottery	wood products
	non-metal products	machinery, n.e.c.	wearing apparel
France	non-ferrous metals	tobacco	beverages
	industr. chemicals	professional goods	glass
	glass	wearing apparel	rubber products
Germany, F.R.	food products	petroleum products	petroleum products
	paper	non-metal products	industrial chemicals
	tobacco	machinery n.e.c.	furniture
Italy	tobacco	petroleum products	footwear
	furniture	petroleum ref.	furniture
	wood products	rubber products	non-metal products
Japan	tobacco	wood products	electrical machinery
	petroleum products	footwear	iron and steel
	machinery, n.e.c.	wearing apparel	pottery
Netherlands	tobacco	professional goods	petroleum ref.
	wood products	furniture	tobacco
	pottery	petroleum ref.	food products
Norway	petroleum products	beverages	non-ferrous metals
	professional goods	footwear	paper
	petroleum ref.	non-metal products	petroleum ref.
Sewden	beverages	footwear	paper
	petroleum ref.	tobacco	wood products
	petroleum products	pottery	furniture
United Kingdom	petroleum products	petroleum ref.	beverages
	wearing apparel	furniture	tobacco
	tobacco	glass	printing
United States	pottery	plastic products	tobacco
	beverages	iron and steel	machinery, n.e.c.
	footwear	tobacco	professional goods

Table 3.1 (continued)

B. Selected developing countries

Country	Marked increase in EP	Marked decrease in EP	Leading three branches in terms of EP, early 1980s
Argentina	non-ferrous metals petroleum ref. petroleum products	tobacco wearing apparel non-metal products	leather food products printing
Brazil	petroleum ref. paper plastic products	tobacco leather wearing apparel	food products footwear wood products
Hong Kong	petroleum products beverages machinery, n.e.c.	furniture plastic products textiles	wearing apparel plastic products leather
India	beverages professional goods other chemical prod.	non-ferrous metals petroleum products iron and steel	leather textiles wearing apparel
Korea, Rep.	tobacco transport equipment non-ferrous metals	petroleum products wood products printing	footwear wearing apparel leather
Mexico	petroleum products furniture transport equipment	non-ferrous metals tobacco paper	food products printing glass
Singapore	non-ferrous metals tobacco plastic products	footwear professional goods wood products	petroleum ref. electrical machinery wood products

Note: EP is Balassa's export performance index; ISIC 390 ("other manufactures") was excluded from the rankings studied.

theory would suggest skill- and technology-intensive industries to dominate those countries' international competitiveness, the data on relative export performance indicate considerable competitive strength in a number of natural-resource based industrial branches. Thus, wood products are found among the leading three industries (in terms of export performance) in the cases of Austria, Canada, Finland and Sweden, while furniture displayed such outstanding export performance in the cases of Denmark, the Federal Republic of Germany, Italy and Sweden. Likewise, tobacco ranked among the top three in the Netherlands, the United Kingdom and the United States. The overall picture of relative export performance of the developed market economies takes on some of the more familiar features, if for each country the upper quarter of the distribution by EP-values is considered. Capital-intensive iron and steel is found in that range for Austria, Belgium, France, Japan, Norway and Sweden, while the same holds true for parts of the capital- and technology-intensive chemical industry in the cases of Belgium, Canada, Denmark, France, the Federal Republic of Germany, the Netherlands, Norway, the United Kingdom and the United States. Likewise, the EP-values of transport equipment exceeded the upper quartile for Canada, Japan, Norway and the United States.

As regards shifts in comparative advantage of the developed market economies between the mid-1970s and the early 1980s, again natural-resource based industries like beverages and tobacco show both marked increases and decreases of EP-values. The same is true for furniture and petroleum refineries. In these and a number of other industrial branches remarkable shifts of comparative advantage have occurred within the group of developed market economies. While no industry can be identified that would represent a typical "gainer" in terms of developed countries' competitive strength, typical "losers" in this sense are wearing apparel and footwear. Marked decreases of EP-values were recorded for Belgium, Canada, France, and Japan in the case of the former and for Belgium, Japan, Norway, and Sweden in the case of the latter industrial branch.

A more conventional picture of comparative advantage and its changes in the course of time emerges for developing countries as compared with developed countries. First, with respect to the static pattern of competitiveness prevailing at the beginning of the 1980s, a few industries of the natural-resource based or the labour-intensive type are seen to dominate comparative advantage of the developing countries surveyed. Among

them are food products, wood products, wearing apparel, leather and footwear. Marked improvements in the export performance of several developing countries over the period under consideration were recorded for natural-resource based industries like beverages, tobacco and non-ferrous metals as well as for furniture and petroleum products. In addition, some of the more advanced developing countries displayed gains in competitiveness in petroleum refineries (Argentina, Brazil), plastic products (Brazil, Singapore) and transport equipment (Republic of Korea, Mexico).

Table 3.2 presents a measure of the overall structural transformation of export performance (or revealed comparative advantage) for each country studied. According to these results the extent of such transformation was much larger in the developing than in the developed countries. While the corresponding index values (for export performance vis-à-vis all trade partners) for the latter group of countries range between 0.13 (Federal Republic of Germany) and 0.36 (Sweden) with a mean of 0.26, the minimum and maximum values in the case of developing countries are 0.30 (Hong Kong) and 2.01 (Indonesia), respectively, with the corresponding mean being 0.94. If export performance of each country vis-à-vis different trading partner groups is considered, the high rate of transformation of export performance of both developed and developing countries vis-à-vis the centrally planned economies (CPECs) emerges as a salient feature. As far as the developed market economies are concerned, a general distinction can be made between the three trading partner groups considered here with respect to the speed of transformation of export performance. For 10 out of the 14 developed market economies surveyed, the following transformation pattern was observed: the comparative advantage pattern in relation to other developed market economies (DMECs) proved to be the most stable one with the index of transformation ranging from 0.18 (Netherlands) to 0.37 (Finland). Changes were more pronounced in respect of trade relationships with developing countries (DCs) with the corresponding minimum and maximum values of the transformation index being 0.27 (France) and 1.34 (Finland). The highest degrees of transformation of export performance were recorded for trade with CPECs, where the two extreme index values were 0.51 (France) and 1.81 (Canada). These results stress the significance of changes in comparative advantage of the developed vis-à-vis the developing countries. Consequently, it would appear plausible

Table 3.2 Indices of transformation of export performance between 1976 and the early 1980s

A. Developed market economies

Country	Export performance vis-á-vis			
	World	DMECs	CPECs	DCs
Austria	0.34	0.30	0.99	0.62
Belgium	0.22	0.22	0.99	0.46
Canada	0.33	0.38	1.81	0.66
Denmark	0.27	0.29	0.97	0.43
Finland	0.33	0.37	1.63	1.34
France	0.16	0.17	0.51	0.27
Germany, Federal Rep.	0.13	0.12	0.36	0.44
Italy	0.24	0.27	0.39	0.19
Japan	0.35	0.59	1.11	0.41
Netherlands	0.15	0.18	0.61	0.51
Norway	0.34	0.37	1.10	1.04
Sweden	0.36	0.34	1.04	0.58
United Kingdom	0.17	0.21	0.72	0.28
United States	0.20	0.24	1.19	0.21

Table 3.2 (continued)

B. Developing countries

Country	Export performance vis-á-vis			
	World	DMECs	CPECs	DCs
Argentina	0.91	1.36	1.67	0.71
Brazil	0.62	1.04	1.27	0.57
Chile	1.32	1.97	...	0.99
Colombia	0.91	0.99	1.96	1.54
Hong Kong	0.30	0.29	0.38	0.03
India	0.67	1.50	1.32	0.91
Indonesia	2.01	2.19	...	2.11
Korea, Republic of	0.72	0.60	...	1.27
Malaysia	0.84	1.03	2.06	0.79
Mexico	0.79	0.96	2.15	0.63
Philippines	0.87	0.89	0.87	1.07
Singapore	0.52	0.90	1.74	0.49
Tunisia	0.94	1.66	1.62	1.49
Turkey	1.11	1.74	1.67	1.54

Note: The above index of transformation was computed as the standard deviation of the logarithm of DEP (as defined in the text) across the 28 branches studied.

for such changes to play a non-negligible role in the process of structural change in the developed market economies. Regularities of the type observed for the transformation of the developed countries' export performance vis-à-vis the other DMECs, the CPECs and the DCs could not be identified as a general feature of developing countries' trade patterns.

3.3 The relationship between comparative advantage and structural change

Whenever an attempt is made to relate changes in the structure of employment and output to international comparative advantage, fundamental conceptual difficulties arise. They have to do with the fact that structural change, by its very nature, reflects dynamic processes in an economy, whereas the concept of comparative advantage is an intrinsically static one. Therefore, the usefulness of (neo-)classical trade theory and its fundamental principle of comparative advantage for the study of economic growth and development has often been questioned. Nevertheless, intuitive arguments for a significant impact of comparative advantage on structural change appear to be strong enough to serve as a basis for empirical investigations.

3.3.1 Regression equations

Notwithstanding the severe problems associated with the formulation of a theoretical model to analyze the impact of comparative advantage forces on the complex process of structural transformation, conventional trade theory can be taken as a basis to state some hypotheses about the existence and the nature of such impact. Both the descriptive (positive) and the prescriptive (normative) aspects of the theory of comparative advantage suggest that the commodity structures of a country's production and trade evolve (at least to some extent) in accordance with the underlying pattern of relative efficiency. At a given point in time this pattern may be taken as being largely determined by the interplay between factor intensities of the various industries' production processes and factor endowments of the country

under consideration. The commodity pattern of production and trade can in general not be expected to reflect precisely the structure of actual comparative advantage. However, formal trade theory suggests that countries tend to develop trade structures that accord - on average - with comparative advantage patterns. Consequently, it might be expected that structural changes exhibit a tendency to strengtnen the correspondence between patterns of specialization in production and trade on the one hand and underlying comparative advantage on the other. This view gives rise to an interpretation of structural transformation of an open economy as adjustment to the prevailing pattern of international competitiveness. In other words, structural adjustment of this type takes countries' and industries' competitive strength in the international economy as the norm.

If patterns of international comparative advantage were stable over a sufficiently long period, structural adjustment could be seen as convergence of the industry composition of employment, output and trade towards structures that reflect best a given underlying pattern of relative efficiencies of the various industries. However, in the real world of changing factor endowments of countries and altering factor intensities of industrial production processes, comparative advantage itself must be expected to change in the course of time. Therefore, the simplistic model of "structural convergence" towards a static "comparative advantage norm" cannot be upheld as a realistic description of structural adjustment. It has to be complemented at least by some notion of an adjustment of the economic structure to changes in the pattern of international comparative advantage. For the case of a particular country this aspect of structural adjustment is best exemplified in terms of stages of comparative advantage[1/] and the concomitant structural transformations. The stages approach to the analysis of comparative advantage maintains that a country's international competitiveness changes in a

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1/ See, e.g., B. Balassa, "The changing pattern of comparative advantage in manufactured goods", The Review of Economics and Statistics, vol. 61, 1979, pp. 259-266.

systematic fashion, mainly as a result of variations in factor abundance or scarcity. Accordingly, structural changes in employment, production and trade may be expected to be closely related - both in direction and size - to changes in underlying comparative advantage. In summary, it can be hypothesized that the patterns of international comparative advantage at a given point in time as well as their changes in the course of time are - through their provoking a re-allocation of resources - important determinants of structural changes.

Since a rigorous theoretical underpinning of the relationship between structural change and (change in) comparative advantage cannot be given, corresponding empirical investigations have to be based on intuitive arguments rather than formal modelling. Moreover, in setting up a conceptual framework for empirical analyses, it has to be borne in mind that factors related to international competitiveness are only part of the wide spectrum of conceivable determinants of the complex process of structural transformation of employment and output. Therefore, it appears reasonable to limit the present empirical analysis to an examination of the relationship between comparative advantage and structural change, rather than attempting at a comprehensive explanation of the latter.

In addition to the conceptual problems mentioned previously, the usual questions about appropriate measurement concepts arise. Those related to the measurement of comparative advantage have been dealt with extensively in a previous section, where it has been reported that neither on theoretical nor on empirical grounds any one in the multitude of proposed indicators of comparative advantage can be established as the single best measure. While current trade theory would favour an indicator based on net exports, such a measure obviously poses problems for the assessment of relative changes in comparative advantage, as they are of interest in the present context. Consequently, Balassa's export performance index (EP) was chosen as a measure of revealed comparative advantage (RCA) in this study. While there is no theoretically sound way of interpreting EP as a dichotomous, ordinal or cardinal indicator of comparative advantage or comparative disadvantage in a strict sense, it may be accepted - for reasons outlined previously - as reflecting approximately relative efficiency relationships among industries

and countries. Structural change of output or employment for a given branch, on the other hand, is measured by the ratio of the branch's share in total manufacturing employment or output (value added) at the end of the period to its share at the beginning of the period.

To analyze the relationship between comparative advantage (as revealed by export patterns) and structural change, two alternative regression equations were tested. The first one is designed to deal separately with the structure of comparative advantage and with the change in that structure. Here, like in most theoretical studies, the country's comparative advantage is defined in respect of the whole of its trading partners. The corresponding regression equations are written as:

$$(1a) \quad \log DE_{ij} = a_i^E + b_i^E \log EP_{ij} + c_i^E \log DEP_{ij} + u_{ij}^E$$

$$(1b) \quad \log DV_{ij} = a_i^V + b_i^V \log EP_{ij} + c_i^V \log DEP_{ij} + u_{ij}^V$$

where i stands for a country, j for a branch (or industry), the superscripts E and V for employment and value added, respectively, DE and DV are the ratios of structural change in employment and output (value added) defined above, EP is the export performance index at the beginning of the period, DEP is the ratio of EP at the end of the period to EP at the beginning of the period and u is a disturbance term with the usual properties. The logarithmic form was chosen with a view to the possibility to interpret its coefficients as elasticities.

A second version of a regression of a structural-change dependent variable on comparative-advantage independent variables was devised with the aim of differentiating between comparative advantage vis-á-vis different trading partners. Three broad country groups, namely those of the developed market economies (DMECs), the centrally planned economies (CPECs) and the developing countries (DCs), were taken into account as the trading partners of each of the countries surveyed. In view of the small number of observations available for estimating each country equation, the number of independent variables in this alternative version was kept low by combining EP and DEP into one variable (named EPD) which is defined as follows:

(2) EPD = 1/2 EP (1 + DEP)

This composite indicator of RCA was introduced into empirical analyses by Balassa[1/] as a crude form of projected RCA. The alternative regression equations then read as follows:

$$(3a)\quad \log DE_{ij} = d_i^E + \sum_k e_{ik}^E \log EPD_{ijk} + u_{ij}^E$$

$$(3b)\quad \log DV_{ij} = d_i^V + \sum_k e_{ik}^V \log EPD_{ijk} + u_{ij}^V$$

where k runs through the three country groups listed above.

Once more it has to be stressed that these regression equations are far from representing a complete model of structural change. A host of factors other than those related to comparative advantage can be imagined to determine the way in which economic structures alter in the course of time. Nevertheless, statistical analysis of the comparative advantage-structural change relationship will not be impaired significantly, if the omitted variables are not systematically correlated with the RCA-measures used.

Empirical results on the relationship between structural change in employment and output and (revealed) comparative advantage are summarized in table 3.3. Estimates of the coefficients of equations (1a), (1b), (3a) and (3b) were obtained for 14 developed market economies and the same number of developing countries on the basis of data for the mid-1970s and the early 1980s, where the samples used generally covered the 28 3-digit ISIC branches of the manufacturing sector. In addition to the equations listed above special cases of equations (3a) and (3b) were estimated with the three country groups DMECs, CPECs and DCs merged into one. (In the table only those groups of equations are shown that contain at least one significant coefficient with the expected sign.)

A salient feature of the estimation results is the large number of insignificant coefficients. Out of 360 coefficient estimates, less than a

1/ B. Balassa, "Trade liberalization and 'revealed' comparative advantage", The Manchester School of Economic and Social Studies, vol. 33, 1965, pp. 99-123.

Table 3.3 Regression of structural change of employment and output (value added) on comparative advantage measures, 1976 - early 1980s

A. Developed market economies

Country	depend. variable	Independent variables						$\bar{R}^2$
		EP	DEP	EPD vis-á-vis World	EPD vis-á-vis DMECs	EPD vis-á-vis CPECs	EPD vis-á-vis DCs	
Belgium	E	n.s.	0.42 a/	n.s.	n.s.	n.s.	0.12 c/	0.31 – 0.02
	V	n.s.	0.63 a/	n.s.	n.s.	-0.15c/	n.s.	0.42 – 0.05
Denmark	E	0.11 a/	n.s.	0.11 a/	n.s.	n.s.	n.s.	0.25 0.27 –
Finland	E	n.s.	n.s.	n.s.	-0.04 c/	0.03 c/	0.03 b/	– – 0.17
	V	0.05 b/	0.28 b/	n.s.	n.s.	-0.06c/	n.s.	0.19 – 0.10
France	E	n.s.	n.s.	n.s.	-0.15 a/	0.07 b/	0.13 a/	– – 0.51
Germany, F. R.	E	0.16 c/	0.43 c/	n.s.	n.s.	-0.17 b/	0.18 b/	0.08 – 0.24
	V	0.16 a/	0.41 b/	0.09 c/	n.s.	n.s.	0.08 c/	0.20 0.03 0.20
Japan	E	n.s.	0.21 b/	n.s.	0.09 a/	n.s.	n.s.	0.16 – 0.17
	V	0.09 b/	0.53 a/	0.11 a/	0.18 a/	n.s.	n.s.	0.43 0.23 0.34

Table 3.3 (continued)

A. Developed market economies

Country	depend. variable	Independent variables						$\bar{R}^2$
					EPD vis-á-vis			
		EP	DEP	World	DMECs	CPECs	DCs	
Netherlands	E	n.s.	n.s.	n.s.	n.s.	0.09 b/	0.11 c/	– / – / 0.16
	V	n.s.	n.s.	n.s.	n.s.	-0.07 c/	n.s.	– / – / 0.03
Sweden	E	n.s.	n.s.	n.s.	-0.10 b/	n.s.	0.07 b/	– / – / 0.23
United Kingdom	E	n.s.	n.s.	n.s.	n.s.	n.s.	0.14 b/	– / – / 0.07
	V	n.s.	0.41 c/	n.s.	n.s.	n.s.	n.s.	0.11 / – / –
United States	E	0.11 a/	n.s.	0.10 a/	0.07 c/	n.s.	0.11 c/	0.29 / 0.32 / 0.31
	V	0.12 a/	n.s.	0.11 a/	n.s.	n.s.	n.s.	0.21 / 0.22 / –

Table 3.3 (continued)

B. Developing countries

Country	depend. variable	Independent variables						$\bar{R}^2$
					EPD vis-á-vis			
		EP	DEP	World	DMECs	CPECs	DCs	
Argentina	E	n.s.	n.s.	n.s.	-0.10 b/	n.s.	0.20 b/	–
	V	n.s.	n.s.	n.s.	n.s.	n.s.	0.10 c/	–
Brazil	E	n.s.	n.s.	n.s.	-0.10 b/	n.s.	0.12 c/	–
Chile	E	0.07 b/	n.s.	0.06 c/	n.s.	n.s.	n.s.	0.09
Colombia	V	n.s.	n.s.	-0.03 b/	0.11 c/	-0.05 c/	n.s.	0.10
Hong Kong	E	n.s.	0.45 b/	-0.05 b/	n.s.	-0.09 c/	n.s.	0.61
India	V	n.s.	n.s.	n.s.	n.s.	0.04 c/	-0.08 c/	0.34
Mexico	E	n.s.	0.07 b/	n.s.	n.s.	n.s.	n.s.	0.15
	V	-0.05 b/	0.14 b/	-0.06 b/	-0.07 c/	n.s.	n.s.	0.31
Singapore	E	n.s.	0.55 a/	n.s.	0.18 b/	-0.11 b/	n.s.	0.14
	V	n.s.	n.s.	n.s.	0.27 b/	-0.10 c/	n.s.	0.22
Tunisia	E	n.s.	0.25 a/	n.s.	0.16 b/	n.s.	n.s.	0.26
								–
								0.38
								–
								0.29
								–
								0.33
								0.26
								–
								0.76

Note: In the dependent-variable column E stands for employment and V for value added. Coefficients were estimated by the weighted-least-squares method, where employment/value added of the initial year provided the weights for the employment/output equation. Letters a, b and c indicate significance at the 1%, 5% and 10% levels, respectively, whereas n.s. stands for "not significant at the 10% level". $\bar{R}^2$ is the adjusted multiple correlation coefficient.

quarter proved to be significantly different from zero at a 10 per cent confidence level. Out of the significant coefficients, only slightly more than 50 per cent showed the expected positive sign. Thus the available data support in general only weakly the hypothesis that comparative advantage and its change over time has a noticeable impact on structural transformation of employment and output. As will be discussed in some detail below, this support is considerably less weak for the group of developed market economies than for that of developing countries.[1/]

3.3.2 Results for developed market economies

In a sample of 14 developed market economies, four members (Austria, Canada, Italy and Norway) did not show any significant coefficient. For the other DMECs surveyed the number of statistically significant elasticity estimates varied from one (Sweden) to seven (Federal Republic of Germany). Judged on the basis of the number of significant coefficients with the expected sign, in general the employment equations performed somewhat better than the output equations.

As regards equations (1a) and (1b), the level of EP index and its change generally appeared to be significant at about the same degree. The dynamic version of the export performance measure (EPD) performed rather unsatisfactorily, when applied to the "rest of the world" in respect of each country. However, its break-down into three different trading partner groups (DMECs, CPECs and DCs) revealed some systematic comparative advantage-

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1/ The generally low values of the (adjusted) multiple correlation coefficient are not surprising, given the simplistic regression "model". In addition, one might suspect statistical inference to suffer from collinearity of the independent variables in the case of equations (3a) and (3b), since comparative-advantage patterns of a country vis-á-vis different regions might be quite similar. However, diagnostic statistics indicate that - with the given sample - this problem need not be taken seriously.

structural change relationship. One salient feature is that revealed comparative advantage vis-á-vis the developing countries shows a stronger relationship with structural change than revealed comparative advantage vis-á-vis the other two groups - a finding that will be discussed in some detail later on.

Among the individual developed market economies surveyed, the Federal Republic of Germany, the United States and Japan exhibited - in the second half of the 1970s - structural change patterns that accorded by and large with comparative advantage and its changes in the course of that period. To start with the Federal Republic of Germany - the country with the greatest number of positively significant coefficients - only one regression (namely that of employment on the dynamic version of the RCA indicator vis-á-vis the whole trading world) has failed to produce a significant parameter estimate. Among the other formulations, (1a) and (1b) are characterized by uniformly significant coefficients. Thus, for both employment and output structural change from 1976 onwards appears to reflect to a considerable extent the country's pattern of comparative advantage as well as shifts in this pattern. As regards the role of comparative advantage vis-á-vis different trading partners, that with respect to developing countries proved to be significant for structural change - in employment slightly more so than in output.

The results for the United States yield a similarly clear corroboration of the hypotheses stated earlier. There is again one regression - namely that of value added on comparative advantage vis-á-vis the three country groups - which has no significant coefficient. And in general, the relationship between comparative advantage and structural change is comparatively stronger for employment than for output. Not only comparative advantage vis-á-vis the developing countries, but also that vis-á-vis the

other developed market economies showed the expected relationship with structural change of employment between the mid-1970s and the early 1980s. A potential explanation for this is the particular role of the United States as a leader in terms of international competitiveness that is founded on human capital and technology. Such a position in the international economy is usually ascribed to the United States with respect to both the developing countries and to most of the developed ones.

This latter characteristic of structural change being influenced by comparative advantage vis-á-vis the developed market economies figures prominently in the empirical results for Japan too - both with regard to employment and output structures. Again the exceptional position of that country in terms of international competitiveness in the industrialized world points to possible explanations of that result. While there is again one regression - employment on comparative advantage vis-á-vis the rest of the world - that has no statistically significant coefficient, the results for Japan (like those for the United States) do not contain one single coefficient with a negative sign. Unlike the estimates for the United States, however, those for Japan reveal a stronger correspondence between comparative advantage and structural change in output than in employment.

Two other major developed market economies in the sample - France and the United Kingdom - differ substantially from the three country patterns outlined above. France exhibits - in the case of employment - only the "usual" positive response of structural change to comparative advantage vis-á-vis the developing countries as well as vis-á-vis the centrally planned economies. The former is also true for the United Kingdom for which in addition a modestly strong relationship between overall change in comparative advantage and structural transformation of output was recorded.

As regards the smaller developed market economies, the results for Belgium and Finland lend modest support to the basic hypotheses, where again comparative advantage vis-á-vis the developing countries shows the expected correspondence with structural change of employment. This latter relationship also accounts for about the only significant coefficient in the cases of the Netherlands and Sweden, while for Denmark the association between comparative advantage vis-á-vis all trading partners and structural change of employment seems to be characteristic.

In summary, developed market economies display a broad spectrum of patterns of the comparative advantage-structural change relationship. Empirical results corroborate to a limited extent (and to a widely varying degree across countries) the hypothesis of an impact of comparative advantage on structural transformation in several developed market economies over the late 1970s. Accordingly, with the above qualifications structural change of employment and output of those economies can in part be interpreted as adjustment to patterns of international competitiveness. The relative size of such adjustment steps is usually small, as an elasticity interpretation of the estimated coefficients suggests. Thus, a 10 per cent change in the comparative-advantage indicator is likely to induce at most a 4 to 6 per cent change of the corresponding employment or output share, with the latter rates of change lying around 1 per cent, however, in the majority of cases.

A salient feature of recent structural adjustments in developed market economies is the dominant role played by comparative advantage vis-á-vis developing countries. In this connection it should be noted, that none of the significant coefficients carries the wrong sign, and, therefore, in no instance the direction of structural change has been a·ay from that particular comparative advantage relationship. These results are in line with traditional trade theory which holds that comparative advantage determines inter-industry trade (the exchange of goods between different industries) rather than intra-industry trade (the exchange of goods within an industry).

As trade between developed and developing countries is predominantly of the first type - whereas trade among developed countries to a large part represents the second type - a comparative-advantage impact on structural change in developed market economies should rather stem from trade with developing countries. From a policy perspective, the (albeit not very strong) signs indicating the existence of such a relationship in a number of cases may give rise to cautious optimism concerning the possibilities of trade-related adjustment. Whether the extent of such adjustment of employment and output structures of developed countries to shifts in comparative advantage vis-á-vis the developing countries can be considered "sufficient", however, is a question that remains to be answered.

3.3.3 Results for developing countries

In general, the relationship between comparative advantage and structural change - if noticeable at all - was much more weakly apparent for developing than for developed countries, with the number of significantly positive elasticity estimates for the former ranging between one (Brazil, Colombia, Hong Kong, and India) and three (Singapore) per country.[1/] In terms of the total number of such coefficients, the employment equations performed better than the output equations.

Due to the much higher degree of heterogeneity of the developing than the developed countries sample, considerable variation across countries in the relationship between comparative advantage and structural change had to be expected. In order to facilitate the discussion of individual country results, developing countries were again classified in the two subgroups of first-generation exporters of manufactures and new exporting countries.

The first group contains the following members of the present sample: Argentina, Brazil, Hong Kong, Mexico, the Republic of Korea and Singapore.

1/ Among the 14 developing countries surveyed, four (Indonesia, the Philippines, the Republic of Korea and Turkey) did not display a single significantly positive regression coefficient.

Even within this subgroup the whole range of possible patterns of the comparative advantage-structural change relationship is present. While for the Republic of Korea no definite relationship between comparative advantage and structural change in the late 1970s could be detected, structural transformation of both employment and output of Singapore is seen to accord with the country's comparative-advantage position vis-á-vis the developed market economies. This latter result fits nicely into the picture of export-led industrialization with the policy prescription of adjustment to trends in international competitiveness. At the same time, however, it comes as a surprise that the Republic of Korea does not display an adjustment pattern similar to that of Singapore or of Hong Kong, an economy for which changes in the employment structure showed the hypothesized correspondence with overall change in comparative advantage. As regards Latin American countries, there is also some evidence of comparative advantage being a co-determinant of structural change. Mexico's changing structure of employment and output, for example, partly responded to changes in overall comparative advantage, while comparative advantage vis-á-vis other developing countries exhibited the predicted relationship with structural transformation over the second half of the 1970s in Argentina and Brazil.

Two members, namely Colombia and Tunisia, of the group of new exporting countries, also showed (weak) signs of the hypothesized relationship. By contrast, other countries in this group (like Indonesia and the Philippines) are characterized by rather erratic patterns of the relationship under consideration.

On the basis of the results of table 3.3 it might be stated as a general result, that structural change in developing countries over the late 1970s could only to a very limited extent be seen as adjustment to comparative-advantage patterns. Even for countries with expressly export-oriented policy approaches (like the Asian first-generation exporters), an impact of comparative advantage on structural change is not recognizable uniformly.

4. Concluding remarks

Out of the many conceivable questions about structural change and structural adjustment, two rather general ones have been chosen to delineate the scope of the present empirical analysis:

(i) Which were the broad characteristics of changes in the structures of manufacturing employment and output in developed and developing countries between the mid-1970s and the beginning of the 1980s?

(ii) To what extent can structural change of countries' manufacturing employment and output over that period be interpreted as structural adjustment to a changing pattern of international comparative advantage?

With respect to the first question, it can be stated that - within the country sample under consideration - structural change was more intensive in the developing than in the developed countries. Viewing all selected countries together, the expected positive relationship between the "degree" of structural change and overall economic growth was found to be corroborated by empirical facts. Furthermore, the sometimes substantial differences in the growth performance of employment and output in the various industrial branches pointed to sizeable changes in labour productivity, where broadly aggregated data bore out the prevalence of upward trends in both developed and developing countries.

An examination at the industrial branch level of relative decline or rise in the two broad groups of countries reveals only a limited degree of complementarity, by which is meant the simultaneity of an industry's decline in the developed countries and rise in the developing countries.[1/] However, such complementarity is bound to manifest itself if rise and decline of branches are measured in absolute rather than in relative terms. Each contraction of an industry (in terms of employment, of output or of both) in the developed market economies is paralleled by a corresponding expansion in the developing countries' sample. In summary, trends in the restructuring of world industrial production appear to be not so easily traceable in considerably aggregate statistical information, but demand more detail for

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1/ A clearer picture of such mirror-image developments may emerge, when more disaggregate industry data are investigated.

their analysis with respect to both countries and industries.

Notwithstanding the foregoing qualifications, some broad developments - most of them well-known and widely discussed, a few others not so frequently mentioned - are to be noted, in particular those regarding the decline of industries in the developed market economies. The majority of those industries that declined most markedly over the period studied - namely, textiles, clothing (wearing apparel), iron and steel, leather and footwear, wood and petrochemicals - figure prominently in today's trade policy disputes and in the broader "industrial policy" discussion. Further decline of industries of the above type is to be expected on the basis of theoretically predicted shifts of comparative advantage mainly in labour-intensive and/or technologically mature industries to less industrialized countries. The characterization "shift" seems to be empirically justified at least in the cases of footwear, petroleum products and iron and steel, since these branches were among those that expanded most vigorously in the developing countries surveyed. By contrast, one of that country groups' expanding industries (electrical machinery), showed a similar performance in the developed countries, while a few others (like textiles and leather) displayed declining shares in total manufacturing for both groups. The last-mentioned empirical fact indicates that in the developing countries as a whole some "traditional" industries continue to lose ground to other types as the industrialization process proceeds.

Some of the above developments point to phenomena that have to do with the second question. Part of a tentative answer is, that empirical data support only to a limited extent the hypothesis about comparative advantage being a major determinant of structural change in employment and output.[1/] This support is somewhat stronger in the case of developed than in that of developing countries. Moreover, it is comparative advantage vis-à-vis the developing countries which shows the predicted relationship with structural change in the developed countries. This finding accords both with

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1/ Among the possible reasons for the scant evidence of a comparative advantage-structural change relationship are of course the high level of data aggregation and measurement problems discussed previously.

the structure of the data examined here and with theoretical reasoning. Structural change as described in this study can be characterized as "inter-industry" change that takes place among the 28 branches of the manufacturing sector. Accordingly, "inter-industry" differences in competitiveness - which are usually explained by comparative (cost) advantages or disadvantages - must be assumed to be among the determinants of such structural change. Thus, comparative advantage of the developed vis-à-vis the developing countries - which typically is of an inter-industry nature - is supposed to impact on structural change. In general, a wide variation across countries in the nature and strength of the comparative advantage-structural change relationship has to be expected, given the important role which is played in this context by policy factors not taken into account in the present analysis.

5. Annex

The sources of the data analyzed in the preceding text are the UNIDO Data Base of industrial statistics (for employment and real value added) and the UN trade tapes (for exports and imports). The concordance scheme used to combine employment, production and trade data is based on the Classification of Commodities by Industrial Origin (United Nations publications, Sales No. E.71.XVII.15) The countries and years covered by the analysis are given in the summary table below.

Coverage of countries (by region) and years

Country	Period
A. Developed market economies	
North America	
Canada	1976 - 1981
United States	1976 - 1981
Japan	1976 - 1982
EEC	
Belgium	1976 - 1982
Denmark	1976 - 1982
France	1976 - 1981
Germany, Federal Republic of	1976 - 1981
Italy	1976 - 1981
Netherlands	1976 - 1980
United Kingdom	1976 - 1981
EFTA	
Austria	1976 - 1981
Finland	1976 - 1981
Norway	1976 - 1982
Sweden	1976 - 1981
B. Developing countries	
Africa	
Tunisia	1976 - 1981

Country	Period
Asia	
Hong Kong	1976 - 1981
India	1976 - 1979
Indonesia	1976 - 1981
Korea, Republic of	1976 - 1981
Malaysia	1976 - 1979
Philippines	1976 - 1980
Singapore	1976 - 1982
Turkey	1976 - 1981
Latin America	
Argentina	1976 - 1980
Brazil	1976 - 1980
Chile	1976 - 1980
Colombia	1976 - 1981
Mexico	1976 - 1979