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Hakemli Makale

# The Structure of Structural Change and Growth

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**Abstract**

This paper examines the relationship between the structure of manufacturing production/trade and industrial development and tests whether there is structural convergence, i.e., whether the industrial structures of developed and developing countries are becoming similar. Our results suggest that there is a strong relationship between industrial structure and growth. We also show that the industrial structures of developed and developing countries change over time but do not converge, i.e. the "polarized" structure of the world economy persists despite changes in industrial structure.



**Keywords:** Industrial structure, technology, structural convergence, factor analysis.
**JEL Codes:** O14, O50, F02

## Yapısal Değişimin Yapısı ve Ekonomik Büyüme

**Öz**

Bu makalede imalat sanayii üretimi ve ticaretinin yapısı ile sınai gelişme arasındaki ilişki incelenmekte ve yapısal yakınsama olup olmadığı, yani gelişmiş ve gelişmekte olan ülkelerin sanayi yapılarının benzer hale gelip gelmediğini analiz edilmektedir. Sonuçlarımız, sanayi yapısı ile büyüme arasında güçlü bir ilişki olduğunu öne sürmektedir. Ayrıca, gelişmiş ve gelişmekte olan ülkelerin sanayi yapılarının zaman içinde değiştiği ancak yakınsamadığı, yani sanayi yapısındaki değişikliklere ragmen dünya ekonomisinin "kutuplaşmış" yapısının sürdüğünü göstermektedir.

**Anahtar Sözcükler:** Endüstriyel altyapı, teknoloji, yapısal uyum, faktör analizi.
**JEL Kodları:** O14, O50, F02

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*In so far as the industrialisation remains an engine of development, structural change and technological growth and modernization, growing manufactured exports are a sign that this engine is working. (Lall, 2000a, s. 338)*

## Introduction

For much of the past century, manufacturing has been viewed as the engine of economic growth (Cornwall & Cornwall, 2002; Thirlwall, 1999 and 2002). This perception of manufacturing is due to the fact that productivity in manufacturing tends to be higher than in other sectors such as agriculture or services, so that growth in manufacturing raises the average productivity of a given economy. In addition, manufacturing is the key sector for the development and diffusion of new technologies, which increase the productivity not only of manufacturing but also of other sectors of the economy, thus enabling further economy-wide growth. In the later stages of industrialization, however, it is the structure of manufacturing itself, and in particular its technological structure, that matters for growth and competitiveness (Fagerberg, 2002; Montobbio & Rampa, 2005). The technological structure of manufacturing therefore plays an important role in industrial development simply because it represents the technological level and capacity of a given economy. Moreover, the presence and development of leading industries within the manufacturing sector is essential for sustainable economic growth for an underdeveloped economy (Abegaz, 2002; Amsden, 2001). The structure of a country's manufacturing trade, especially its exports, is at least as important as its production structure. As Lall (2000b, s. 7) puts it, "export structures dominated by high-technology intensive products have better growth prospects than others".



There is a strong relationship between industrial development and the technological structure of manufacturing production and trade: the shift in production and trade from low-technology, labor-and resource-intensive production to high-technology, specialized and science-based production may well lead to rapid and sustained industrial development and economic growth.

As developing countries accumulate capital and expand their manufacturing sectors, their incomes are expected to rise rapidly, so that there could be convergence in (per capita) income levels and the "poor" countries will catch up with the "rich" countries. A substantial theoretical and empirical literature on catching-up and convergence has accumulated since the early 1990s. Empirical studies have failed to support early theories of convergence, and

the convergence literature has diverged by proposing new concepts to explain empirical regularities, and recent studies have focused on explaining why the "poor" countries do not catch up with the "rich" countries (for recent reviews, see Johnson and Papageorgiou, 2020; Kremer, Jack & You, 2022; Smith, 2024).

Studies of convergence have usually relied on level variables, i.e., per capita income, productivity, and so on. Convergence in the industrial structure of countries, on the other hand, has received little attention, especially at low levels of disaggregation. Abegaz (2002) is one of the few to report that although there is measurable but weak structural convergence between developed and less developed countries, emerging economies have made significant progress in converging towards the structure prevailing in developed countries. He summarizes the importance of the issue of convergence/divergence in inter-industry production structure for the economics of growth, trade and industrial organization as follows:

> First, its existence suggests that the dominant forces that drive industrialisation consist of growing similarities in technology, preferences and income levels rather than differences in factor endowments, institutions, history, or geography. The existence of significant differences in the speed of convergence throws some light on the ongoing debate with regard to the efficacy of broad-based versus well-targeted industrial policies that are designed to promote productivity driven growth. (Abegaz, 2002, s. 71)



In a similar paper, Wacziarg (2004) tests whether "country pairs that converge in per capita income also tend to converge in their sectoral similarity, measured by the bilateral correlation of their sectoral labor shares" and finds that there is structural convergence: countries with similar income levels have similar industrial structures. Palan and Schmiedeberg (2010) examine structural convergence among Western European countries using sectoral employment data. Their results indicate strong convergence at the broad sectoral level (a shift from industry to services), but "the results regarding inter-industry convergence are mixed": they found increasing divergence in technology-intensive manufacturing industries and both convergence and divergence trends in other industries. A recent study of African countries (Bako Ousmane, 2022) finds that sectoral structures (shares of agriculture, industry and services) become more similar as income gaps narrow. He also shows that structural transformation Granger-causes economic growth.

Although there are only a few studies on structural convergence, these studies show that there appears to be structural convergence at the broad sectoral level: as income levels rise, the share of industry and later services increases, but the evidence on the structure of industry itself is ambiguous.

In this paper, we do not focus on either income or structural convergence, because the concepts of "convergence" imply similarity. On the contrary, we explicitly assume that the world economy is characterized by a (hierarchical) division of labor: countries are specialized in certain activities specific to the period under investigation, and the structure of exports, and hence the structure of the industry, reveals the pattern of specialization. The position of a country within the international division of labor determines the pace and direction of its development. The pattern of specialization of all countries changes over time because of technological and economic change at the global level, but the hierarchical structure remains intact and the "developed"/"industrialized" countries maintain their dominant position. For example, if we accept a version of the long-wave theory (the so-called Kondratieff cycles), each technological revolution creates its leading sectors, and "developed" countries specialize mostly in these leading, dynamic sectors, which generate and diffuse the "new" technologies that define the technological revolution (for a discussion on technological revolutions and long-wages, see Mandel, 1975 and 1978).



This paper therefore examines the evolution of the structure of manufacturing across countries, since the structure of production and trade, especially exports, of a given country reflects its endowments (natural resources, capital, labour and technology), and capabilities (OECD, 1996; Krugman, 1995; Lall, 2000a; Montobbio & Rampa, 2005) The following questions are addressed: First, do the industrial structures of economies show similarities or are they persistently different? Second, how does industrial structures change over time? More importantly, third, is there a relationship between industrial structure, structural change and industrial development?

Our contribution to the literature is threefold. First, we document the pace and direction of structural change in a large number of countries over a long period of time. Second, we show that the structure of industry in both developed and developing countries is in a state of constant flux, so that it is not possible to define an "ideal" or "typical" structure for developed and developing countries independent of the techno-economic paradigm they are living through. Finally, despite changing industrial structures, there are persistent differences in the patterns of specialization between developed and

developing countries. However, there are a few developing countries that are breaking the pattern of specialization of developing countries and joining the group of developed countries.

The paper is organized as follows: The next section examines the evolution of industrial structure in terms of its technology intensity in value added, exports and imports. Section three summarizes the methodology used to cluster countries in terms of their industrial and trade structures, and presents the analysis on the dynamics of country groups/clusters. Section four summarizes the main findings of the paper.

**Technology and Structural Dynamics**

This section assesses the structure of manufacturing production and trade in terms of their technological intensity (see Appendix A for the technological characteristics of industries). Industries are classified as low, medium or high technology intensive on the basis of their R&D intensity, which is measured as the ratio of business enterprise R&D to production for the OECD area as a whole (OECD, 1992). The use of technology intensity rather than technology orientation allows for a three-dimensional presentation. Interpretations will not differ as these two measures of technology are reflections of each other (Türel, 2003, s. 26).

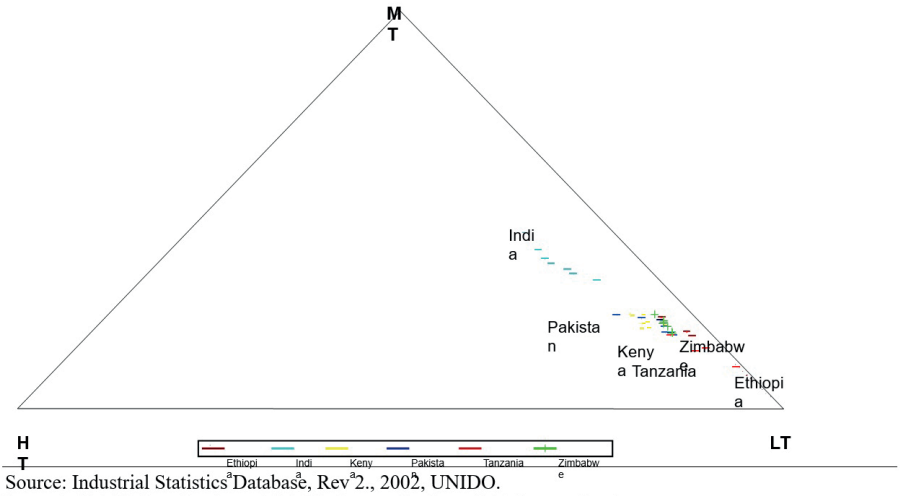


***Structure of Manufacturing Value Added***

The evolution of industrial structure for different groups of countries is presented in Figures 1.a-1.f. Each data point for a country represents the 5-year average share of industry value added by technology intensity for 7 periods; 1965-69, 1970-74, 1975-79, 1980-84, 1985-89, 1990-94, and 1995-99. Note also that the point where the country name is written represents the last sub period, 1995-99. For a given country and time period, a point in the middle of the triangle reflects that total manufacturing value added is equally distributed among three different technology-intensive industries.[1]

Our results show that most manufacturing value added in most low-income countries is generated by low-technology industries (see Figure 1. a). The share of medium- and high-technology industries in total manufacturing is relatively higher only in India and Pakistan among the low-income countries. Moreover, the industrial structure of Indian manufacturing is quite similar to that of high-income countries. Interestingly, however, the Indian manufacturing sector is more oriented towards medium-technology industries than high-technology industries.

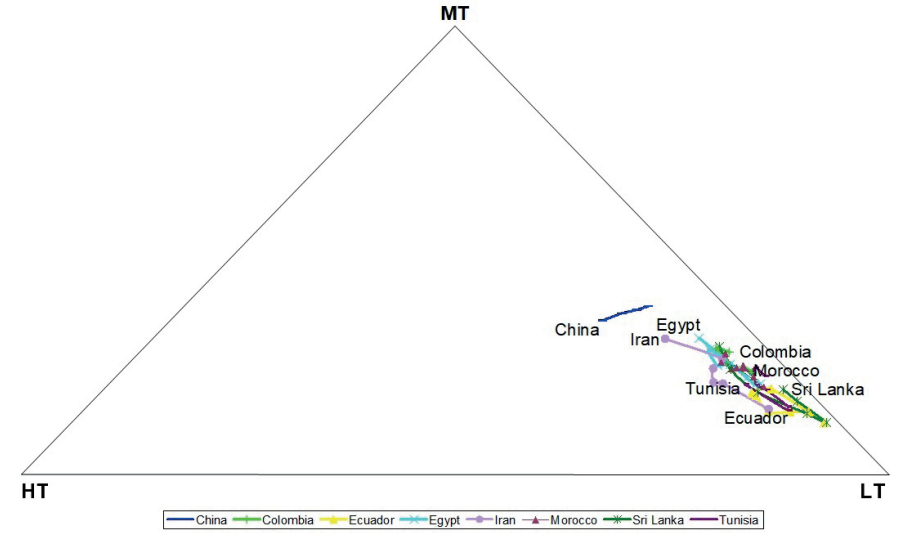
**Figure 1.1 Production structure, low income countries, 1965-99.**




Source: Industrial Statistics Database, Rev 2., 2002, UNIDO.
Legend: HT: High-technology; MT: Medium-technology; LT: Low-technology.

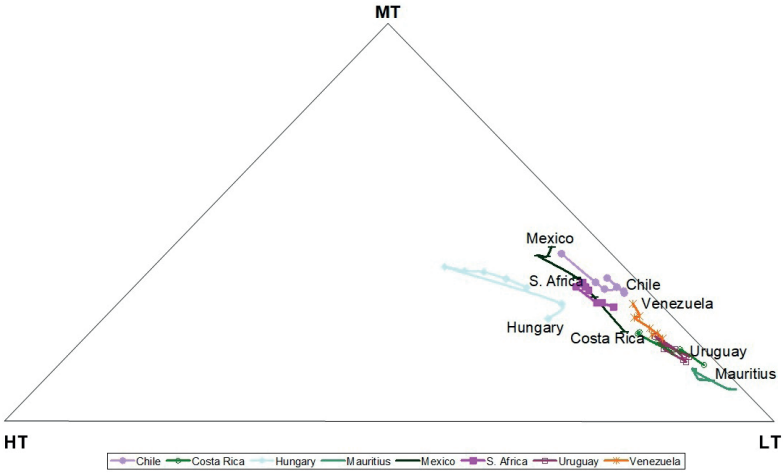


**Figure 1.2 Production structure, selected middle income countries, 1965-99.**




Source: Industrial Statistics Database, Rev 2., 2002, UNIDO.
Legend: HT: High-technology; MT: Medium-technology; LT: Low-technology.

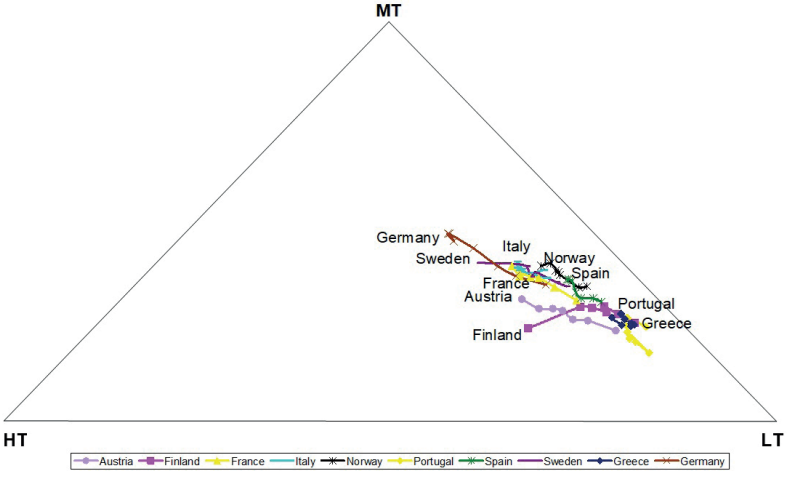
**Figure 1.3 Production structure, selected middle income countries, 1965-99.**




Source: Industrial Statistics Database, Rev 2., 2002, UNIDO.
Legend: HT: High-technology; MT: Medium-technology; LT: Low-technology.



**Figure 1.4 Production structure, selected high income countries, 1965-99.**




Source: Industrial Statistics Database, Rev 2., 2002, UNIDO.
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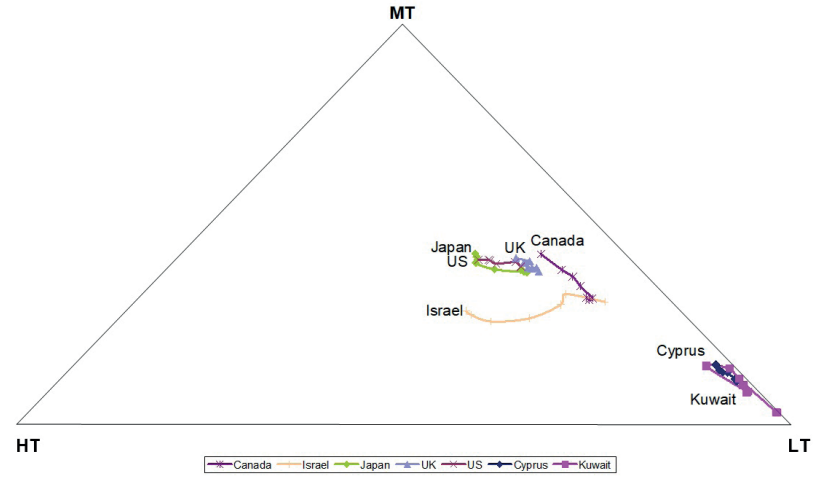
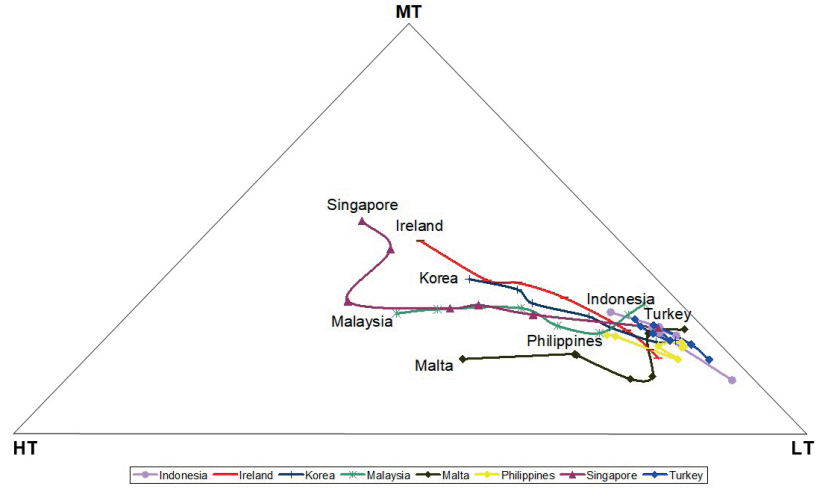
**Figure 1.5 Production structure, selected high income countries, 1965-99.**




Source: Industrial Statistics Database, Rev 2., 2002, UNIDO.
Legend: HT: High-technology; MT: Medium-technology; LT: Low-technology.



**Figure 1.6 Production structure, fast growing countries, 1965-99.**




Source: Industrial Statistics Database, Rev 2., 2002, UNIDO.
Legend: HT: High-technology; MT: Medium-technology; LT: Low-technology.

In the middle income country groups, industrial structures and their evolution are mixed (Figure 1. b-c). While the share of low technology intensive industries in total manufacturing is quite high in some countries (Sri Lanka, Ecuador, Morocco, Colombia, Mauritius, Uruguay and so on), the share of medium and high technology in some other low income countries (China, Iran, Mexico, South Africa, Hungary) is not negligible. One other important finding on industrial structures of middle income countries is that there is no consistent tendency through more technology intensive production with the exception of Iran and China. Industrial structures of non-continental European countries with high income have more heterogeneous distribution as compared to high income continental European countries (see Figure 1. d and e.). High income non-continental European countries, thereby, may be classified into two distinct groups: The first group is the small, non-industrialized but rich economies such as Kuwait, Cyprus. The members of other group, on the other hand, are mostly large, industrialized countries like the US and Japan. While manufacturing value added of the first group is based mainly on low-technology, the second group of countries has not only a dynamic structure but also a structure allowing for more equal distribution of manufacturing value added among three different technology intensive industries (see Figure 1. d).



In contrast to the other European countries, the industrial structures of Portugal and Greece composed mainly of low technology industries. Moreover, these countries have not achieved any major change in their industrial structures in this period. In this country group, Germany, Sweden, France, Finland, and Austria have not only more technology intensive manufacturing but also a dynamic industrial structure oriented towards both medium and high technology.

When the structures of fast growing countries are examined, the findings are striking (see Figure 1. f.) Among the fast growing countries, we found that the manufacturing industries of Indonesia, Turkey, and Philippines are mainly composed of low technology industries. Furthermore, during the period under study, industrial structures of these economies have not changed much as compared to the other members of this group. On the other hand, industry structures of Korea, Malaysia, Singapore, Ireland, and Malta have shown radical changes from 1965 to 1999. We observe that, of these countries, while the lion's share of manufacturing value added was accounted by low technology industries, production has shifted towards medium and high technology industries at the end of the period.

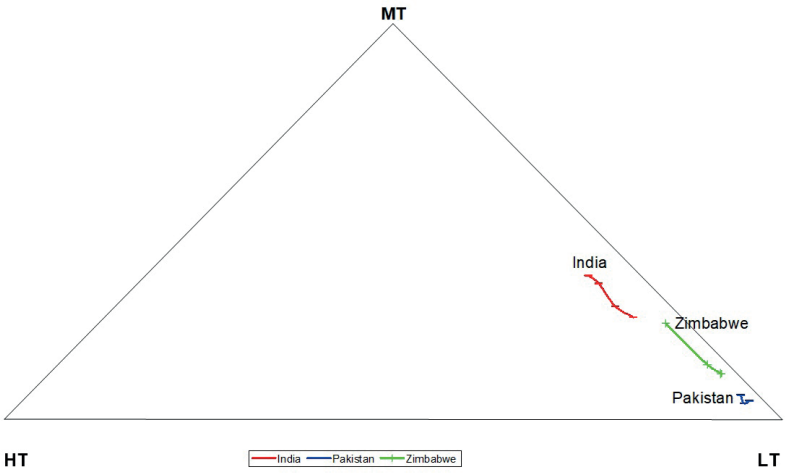
As a fast growing country, the evolution of Turkish manufacturing industry reveals a disappointing pattern. With its current industrial structure, Turkish manufacturing industry is similar to that of a low income country. One interesting finding is the shift of manufacturing towards low technology in the early 1980s when export-based "industrialization" policies have been adopted.

The findings on the evolution of industrial structure of economies, in sum, suggest that the level of development is not independent of industrial structure. With few exceptions, well performing countries showed a dynamic industrial structure by increasing the share of medium and high technology industries relative to that of low technology from 1965 to 1999 (see Korea, Ireland, Singapore, Malaysia, and Malta in Figure 1.f) Those who were not able to change their industrial structure in favour of high and medium-technology turned out to be the ones who were unsuccessful in triggering industrial development.

***Structure of Manufacturing Exports and Imports***

The composition of manufacturing exports and imports and their evolution from 1981 to 1999 are shown in Figure 2.a-l. The interpretations of the data presented in the figures are the same as in the previous section. The first observation is that while the structure of manufacturing exports shows quite significant differences among different income groups, the structure of imports of these different country groups is very similar, as expected for fast-growing country groups. We found that for all income groups, imports are almost equally distributed among three different technology-intensive industries. However, there are some outliers in some of the country groups: Mauritius among the upper-middle-income countries, and Sri Lanka, Tunisia, Egypt, and Morocco in the middle-income group are the countries that show dissimilarities compared to their country group. These countries' manufacturing imports are more composed of low and medium technology intensive products relative to their country group.

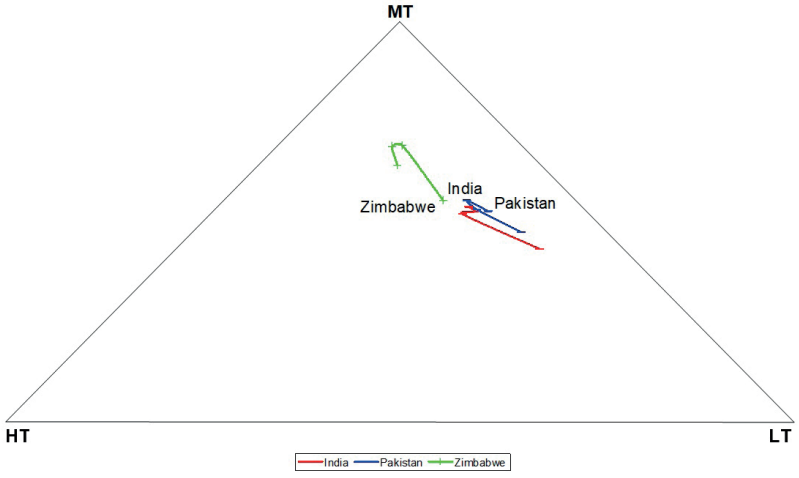
**Figure 2.1 Export structure, low income countries, 1981-99.**




Source: Industrial Demand Supply Database, Rev 2., 2002, UNIDO.
Legend: HT: High-technology; MT: Medium-technology; LT: Low-technology.

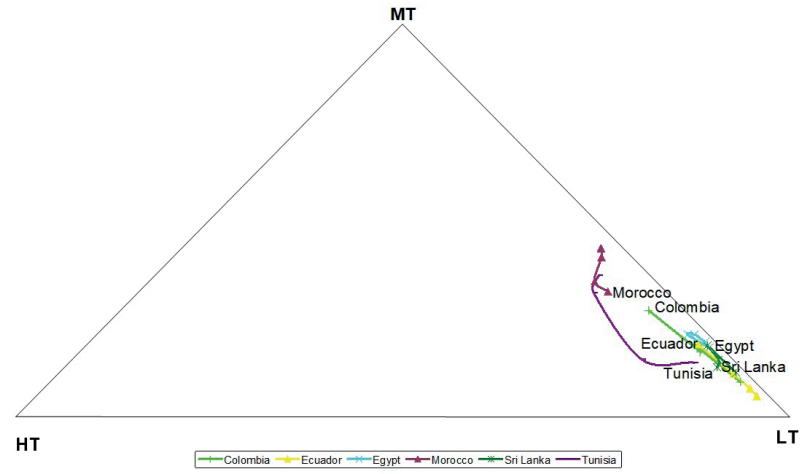


**Figure 2.2 Import structure, low income countries, 1981-99.**




Source: Industrial Demand Supply Database, Rev 2., 2002, UNIDO.
Legend: HT: High-technology; MT: Medium-technology; LT: Low-technology.

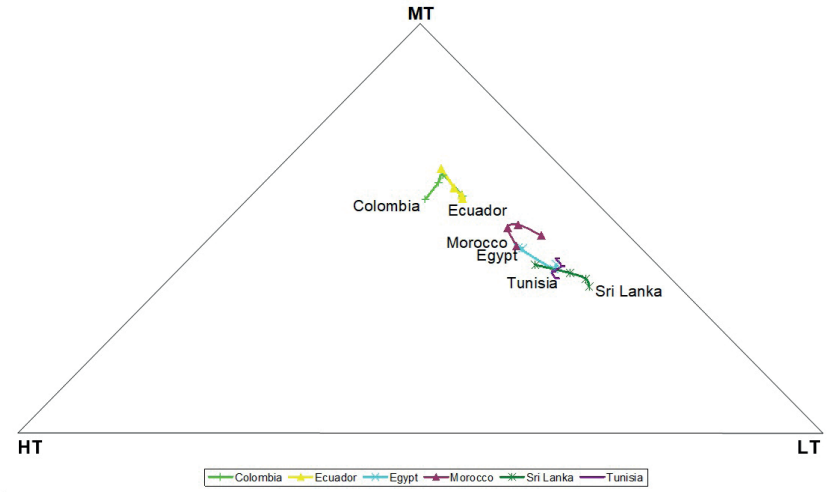
**Figure 2.3 Export structure, selected middle income countries, 1981-99.**




Source: Industrial Demand Supply Database, Rev 2., 2002, UNIDO.
Legend: HT: High-technology; MT: Medium-technology; LT: Low-technology.

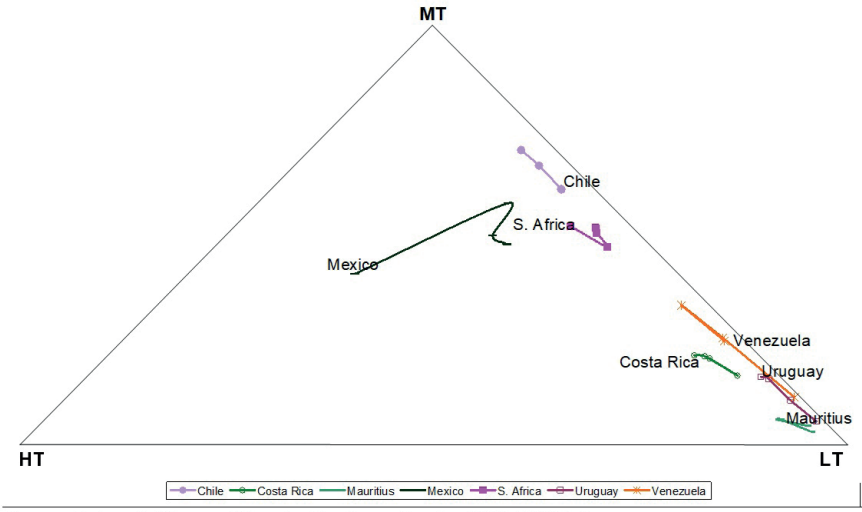


**Figure 2.4 Import structure, selected middle income countries, 1981-99.**




Source: Industrial Demand Supply Database, Rev 2., 2002, UNIDO.
Legend: HT: High-technology; MT: Medium-technology; LT: Low-technology.

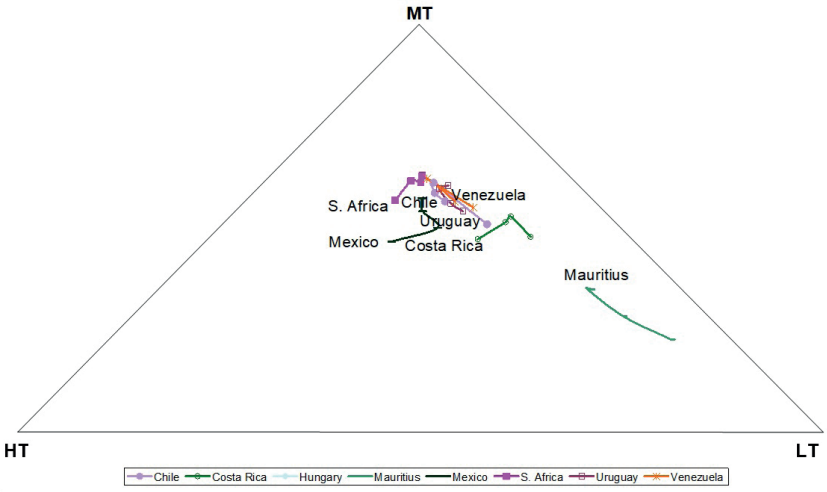
**Figure 2.5 Export structure, selected middle income countries, 1981-99.**




Source: Industrial Demand Supply Database, Rev 2., 2002, UNIDO.
Legend: HT: High-technology; MT: Medium-technology; LT: Low-technology.

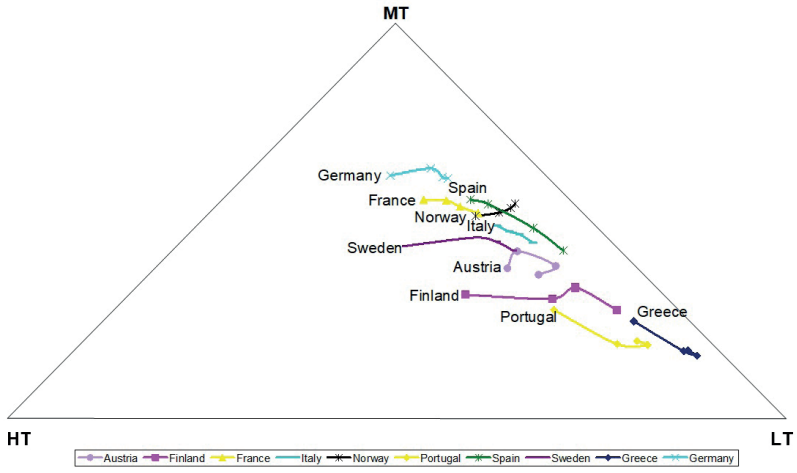


**Figure 2.6 Import structure, selected middle income countries, 1981-99.**




Source: Industrial Demand Supply Database, Rev 2., 2002, UNIDO.
Legend: HT: High-technology; MT: Medium-technology; LT: Low-technology.

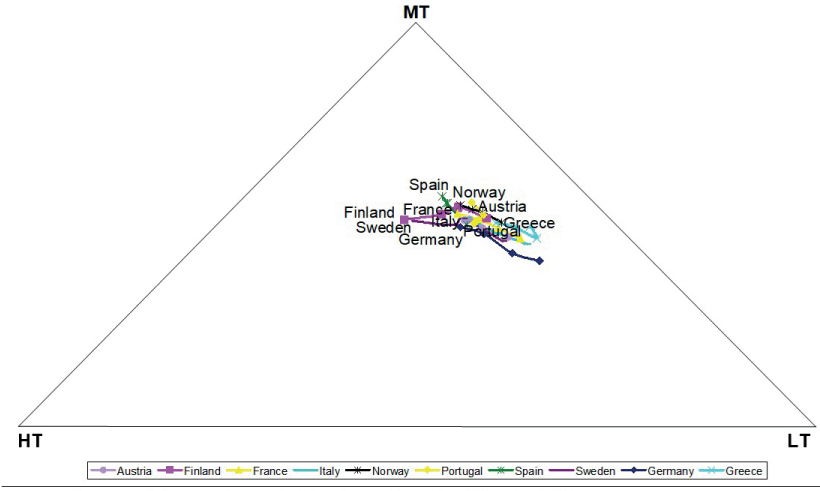
**Figure 2.7 Export structure, selected high income countries, 1981-99.**




Source: Industrial Demand Supply Database, Rev 2., 2002, UNIDO.
Legend: HT: High-technology; MT: Medium-technology; LT: Low-technology.

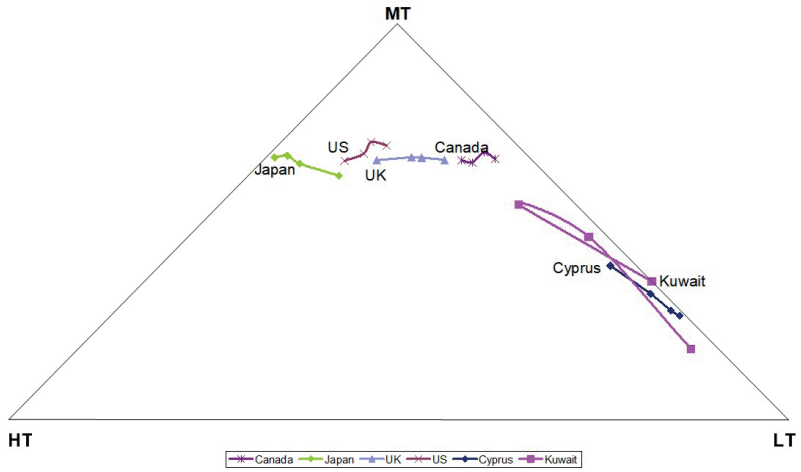


**Figure 2.8 Import structure, selected high income countries, 1981-99.**




Source: Industrial Demand Supply Database, Rev 2., 2002, UNIDO.
Legend: HT: High-technology; MT: Medium-technology; LT: Low-technology.

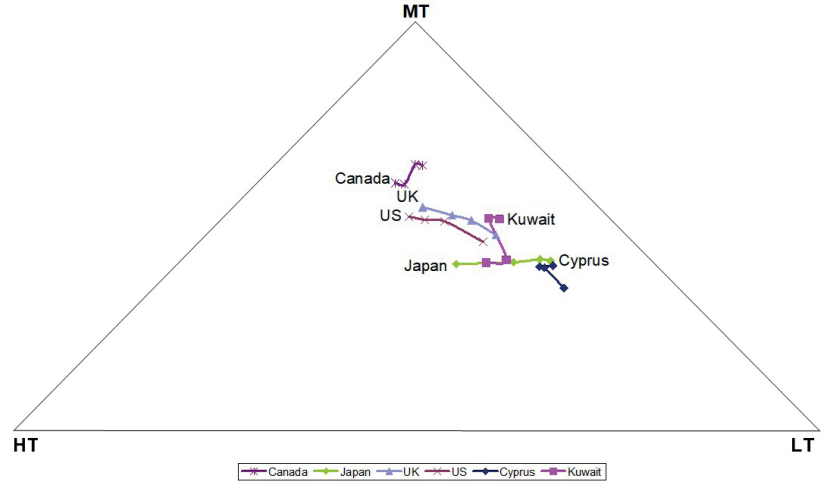
**Figure 2.9 Export structure, selected high income countries, 1981-99.**




Source: Industrial Demand Supply Database, Rev 2., 2002, UNIDO.
Legend: HT: High-technology; MT: Medium-technology; LT: Low-technology.

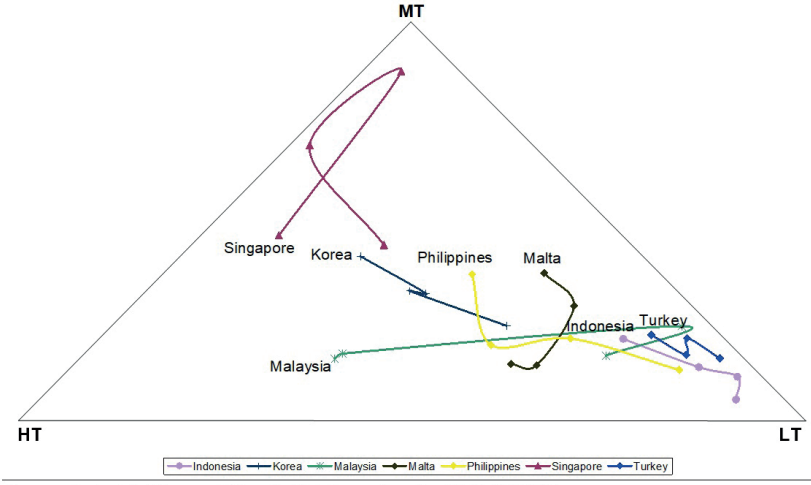


**Figure 2.10 Import structure, selected high income countries, 1981-99.**




Source: Industrial Demand Supply Database, Rev 2., 2002, UNIDO.
Legend: HT: High-technology; MT: Medium-technology; LT: Low-technology.

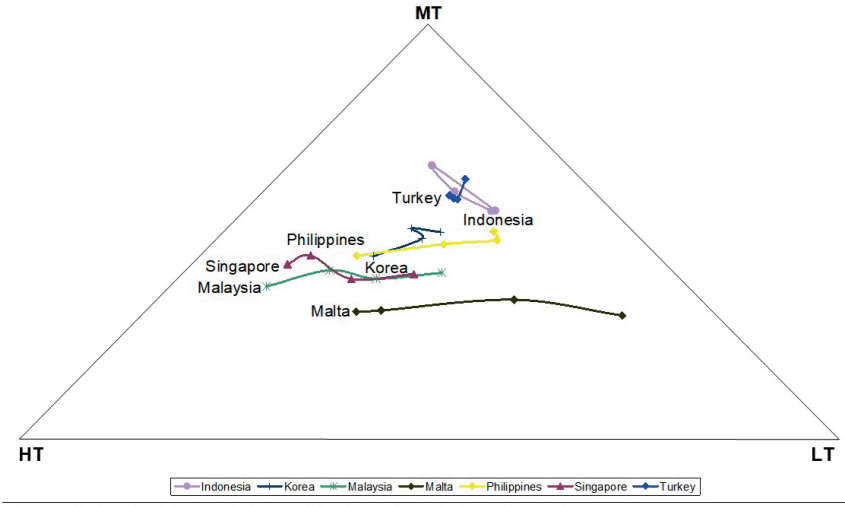
**Figure 2.11 Export structure, fast growing countries, 1981-99.**




Source: Industrial Demand Supply Database, Rev 2., 2002, UNIDO.
Legend: HT: High-technology; MT: Medium-technology; LT: Low-technology.



**Figure 2.12 Import structure, fast growing countries, 1981-99.**




Source: Industrial Demand Supply Database, Rev 2., 2002, UNIDO.
Legend: HT: High-technology; MT: Medium-technology; LT: Low-technology.

For exports, the picture is much more complex: Low-income countries are very similar to lower-middle-income countries in that most of their manufacturing exports are in low-technology intensive industries (about 80-90 percent) (see Figure 2.a and c.). Only India and Morocco have a slightly better position with respect to the export structure of these two groups. A more interesting result is that especially in lower middle-income countries, the structure of manufacturing exports has developed through low technology intensive industries, i.e.; Morocco, Tunisia, Egypt and Sri Lanka. The technological structure of exports is more heterogeneous in upper-middle-income countries. In this group of countries, Venezuela, Costa Rica, Uruguay and Mauritius have a manufacturing industry that exports mostly low-technology products, while the share of medium-high-technology exports in total manufacturing exports of Chile and South Africa is quite high. Among lower-middle-income countries, Mexico is the only one with a manufacturing sector in which the shares of medium- and high-technology intensive products are quite high. Moreover, the Mexican manufacturing exports show a radical evolution towards high technology intensive exports (see Figure 2. e).

Among high-income countries, we observed that the structure of manufacturing exports of European countries is more dynamic than that of other high-income countries (see Figure 2. g and i). We found that the shares of medium- and high-technology intensive exports in total manufacturing are quite large in European countries, with the exception of Portugal and Greece. In these two countries, the share of low technology exports in manufacturing is very high (around 80 percent), despite the fact that the share of medium and high technology exports of manufacturing in these two countries has shifted towards medium and high technology products, especially in the recent period. A final observation on the structure of trade is the fact that continental European countries have very similar import structures in terms of technology intensity (see Figure 2. h).



For the other high-income group, the picture is different from the European countries. While Kuwait and Cyprus have an export structure similar to that of middle-income countries, the United States, the United Kingdom, Canada and Japan have manufacturing industries that mainly export medium- and high-technology products (see Figure 2. i). In particular, the manufacturing exports of Japan and the United States are more technology-intensive than those of the other high-income countries. Among this group of high-income countries, Japan has the most technology-intensive export structure, while Canada has the least technology-intensive export structure compared to the other high-income/industrialized countries. Finally, we observed that the structure of UK manufacturing exports in this group of countries is almost the same as that of Germany.

From 1981 to 1999, in terms of the technological structure of trade, fast-growing countries are different from all country groups, which exhibit both heterogeneous distribution and dynamic structure. Radical changes in the composition of manufacturing exports of Korea, Malaysia, Singapore and the Philippines are observed over the period (see Figure 2.k): While the share of low-technology exports in the manufacturing industries of Korea, Malaysia, Singapore, and the Philippines decreased by about two times from the first to the last period, the share of high-technology exports in total manufacturing exports of these countries increased from 22 to 46 percent in Malaysia, 22 to 30 percent in Korea, 26 to 37 percent in Singapore, and 08 to 20 percent in the Philippines. The worst performers in this group in terms of changing the structure of manufacturing towards more technology-intensive exports were Indonesia and Turkey. In contrast to the other groups of countries, the large share of high-tech imports in total manufacturing, especially in Malta, Malaysia, Singapore and the Philippines, may to some extent reflect the weight of assembly production and exports in total manufacturing.

In summary, countries first export what they produce: There is, of course, a one-to-one relationship between the structure of production and exports in manufacturing in terms of technology intensity. Second, there is a positive relationship between income levels and a more technologically intensive export structure: As income rises, the share of medium- and high-technology manufacturing exports increases at the expense of low-technology exports for most countries, or vice versa. The structure of imports in terms of technology intensity, on the other hand, varies considerably with income level.



**The Evolution of Industrial Structures and the Patterns of Specialization**

In the previous section, we argued that countries have industrial structures with different technological dynamics over time. We observed that, on the one hand, the structure of the manufacturing industries of some economies shifted towards more technology-intensive production (Korea, Ireland, Malaysia, Israel, Singapore, etc.), while on the other hand, some other economies were not able to change their industrial structure significantly (Turkey, Venezuela, Uruguay, Costa Rica, and the other low-income countries except India). Not surprisingly, those that did manage to change their industrial structure turned out to be either developed countries today or those that have experienced remarkable growth rates and are candidates to become developed countries in the future under normal circumstances.

This section is therefore devoted to finding an answer to the following question: Have the structures of manufacturing industries in different countries converged or diverged over the past 35 years? In order to answer this question, we used factor analysis, which allows us to classify countries in terms of their industrial structure and to observe changes in this classification or movements between these classes over time. Factor analysis allows one to represent the variables of interest as a linear combination of a few random variables, called factors (interested readers can refer to Rencher (2002) for more details). In a sense, factor analysis is a form of matrix reduction, since it is difficult to interpret the correlations in a matrix with a large dimension.

Factor analysis is performed for both manufacturing production and trade for each period. Each period represents 5-year averages of industry shares. The variables used in the analysis were sectoral shares of value added, exports and imports of total manufacturing. While manufacturing value added is used for production, both export and import shares are used simultaneously for trade. The sample includes 42[2] countries with heterogeneous levels of development and industrial structures, consisting of 28 manufacturing industries.[3]



The results of the factor analysis carried out for manufacturing value added suggest that between 73 and 79 percent of the correlations between the industrial structures of the countries in our sample for the 7 periods can be explained by 3 factors (see Table 1). We assume that each factor represents a typical industrial structure. The results thus imply that there are essentially 3 different country groups/clubs in terms of manufacturing structure (see Table 2). In fact, a better definition would be two-plus-one rather than three different clubs, because the plus-one club is more like a transitional club, where countries belong for some time and eventually move to club one or two. The first club is mainly composed of industrialized countries of a certain period (Canada, Finland, France, Germany, USA, UK, etc.). The second club, on the other hand, is made up mostly of less industrialized countries, i.e.; Ecuador, Chile, Colombia, Sri Lanka, Uruguay, and so on. The third club, which we have called the plus-one or transition club, is composed of countries that do not belong to the other two clubs for a certain subperiod (Turkey, Portugal, Pakistan, Indonesia, Egypt, Morocco, etc.).

The interpretation of the factor analysis results for a given country will be as follows: Korea, for example, was in the club of less industrialized countries (C2) in the first two periods. It then moved to the transitional club (C3) in 1975-79 and remained in this club for another period (1980-84). Korea took its

place in the industrialized country club in the 1985-89 period and maintained its place in this club for the rest of the periods covered by this study. It should be noted that a country's membership in the club of industrialized countries does not necessarily mean that it is at the same level of industrialization or development as the other countries in this club, i.e. Indonesia, Malaysia and India. What it does mean is that the structure of the manufacturing industry of such a country is similar to that of the other countries in the same club.

**Table 1 Results of factor analysis, industrial structure, 1965-99.**

| | | 1965-69 | | 1970-74 | | 1975-79 | | 1980-84 | | 1985-89 | | 1990-94 | | 1995-99 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *EV.* | *Cum* | *EV.* | *Cum* | *EV.* | *Cum* | *EV.* | *Cum* | *EV.* | *Cum* | *EV.* | *Cum* | *EV.* | *Cum* |
| Factors | **1** | 17.41 | 0.44 | 16.33 | 0.39 | 19.07 | 0.45 | 21.11 | 0.50 | 22.66 | 0.44 | 19.35 | 0.46 | 19.53 | 0.48 |
| | **2** | 7.66 | 0.63 | 10.12 | 0.63 | 8.65 | 0.66 | 8.33 | 0.70 | 11.46 | 0.66 | 10.04 | 0.70 | 9.85 | 0.72 |
| | **3** | 4.30 | 0.73 | 4.96 | 0.75 | 5.57 | 0.79 | 3.73 | 0.79 | 4.61 | 0.76 | 2.95 | 0.77 | 2.91 | 0.79 |
| | **4** | 2.78 | 0.80 | 2.74 | 0.81 | 2.22 | 0.85 | 2.04 | 0.84 | 3.09 | 0.80 | 2.88 | 0.84 | 2.40 | 0.85 |
| | **5** | 1.55 | 0.84 | 2.30 | 0.87 | 1.71 | 0.89 | 1.63 | 0.88 | 2.03 | 0.84 | 1.34 | 0.87 | 1.68 | 0.89 |
| | **6** | 1.21 | 0.87 | 2.20 | 0.92 | 1.56 | 0.92 | 1.21 | 0.91 | 1.83 | 0.88 | 1.29 | 0.90 | 1.39 | 0.92 |
| | **7** | 1.17 | 0.90 | 1.03 | 0.94 | 1.20 | 0.95 | 1.04 | 0.93 | 1.61 | 0.91 | 1.18 | 0.93 | 0.92 | 0.94 |
| | **8** | 0.88 | 0.92 | 0.87 | 0.97 | 0.69 | 0.97 | 0.71 | 0.95 | 1.21 | 0.93 | 0.81 | 0.95 | 0.72 | 0.96 |
| | **9** | 0.73 | 0.94 | 0.64 | 0.98 | 0.53 | 0.98 | 0.57 | 0.96 | 1.03 | 0.95 | 0.54 | 0.96 | 0.58 | 0.98 |
| | **10** | 0.66 | 0.96 | 0.54 | 0.99 | 0.39 | 0.99 | 0.39 | 0.97 | 0.86 | 0.97 | 0.54 | 0.97 | 0.39 | 0.99 |

Source: Calculated using Industrial Demand Supply Database, Rev 2., 2002, UNIDO.
Legend: EV: Eigenvalue, Cum: Cumulative proportions explained by the corresponding factors.

**Table 2.1 Country clubs with respect to industrial structure, industrialised countries, 1965-99.**

| | 1965-69 | 1970-74 | 1975-79 | 1980-84 | 1985-89 | 1990-94 | 1995-99 |
|---|---|---|---|---|---|---|---|
| **Club 1 (Industrialised Countries)** | ***n.a.*** | ***C2*** | ***C3*** | ***C3*** | ***C3*** | ***C3*** | ***Indonesia*** |
| | ***C2*** | ***C2*** | ***C3*** | ***C3*** | ***C3*** | ***India*** | ***India*** |
| | ***C2*** | ***C2*** | ***C3*** | ***C3*** | ***Korea*** | ***Korea*** | ***Korea*** |
| | ***C3*** | ***C3*** | ***C2*** | ***C2*** | ***Malaysia*** | ***Malaysia*** | ***Malaysia*** |
| | ***C2*** | ***C2*** | ***C2*** | ***C2*** | ***Ireland*** | ***Ireland*** | ***Ireland*** |
| | ***C3*** | ***Singapore*** | ***Singapore*** | ***Singapore*** | ***Singapore*** | ***Singapore*** | ***Singapore*** |
| | Austria | Austria | Austria | Austria | Austria | Austria | Austria |
| | Canada | Canada | Canada | Canada | Canada | Canada | Canada |
| | Finland | Finland | Finland* | Finland | Finland | Finland | Finland |
| | France | France | France | France | France | France | France |
| | Germany | Germany | Germany | Germany | Germany | Germany | Germany |
| | Italy | Italy | Italy | Italy | Italy | Italy | Italy |
| | Japan | Japan | Japan | Japan | Japan | Japan | Japan |
| | Netherlands | Netherlands | Netherlands | Netherlands | Netherlands | Netherlands | Netherlands |
| | Norway | Norway | Norway | Norway | Norway | Norway | Norway |
| | Spain | Spain | Spain | Spain | Spain | Spain | Spain |
| | Sweden | Sweden | Sweden | Sweden | Sweden | Sweden | Sweden |
| | UK | UK | UK | UK | UK | UK | UK |
| | USA | USA | USA | USA | USA | USA | USA |
| | S. Africa | S. Africa | S. Africa | S. Africa | S. Africa | S. Africa | S. Africa |
| | *Iceland* | *Iceland* | *C2* | *C2* | *C2* | *C2* | *C2* |

Source: Industrial Statistics Database, Rev 2., 2002, UNIDO.
Legend: C1 (country club 1); C2 (country club 2); C3 (country club 3)
Notes: * Rotated factor loadings is less than 0.3. Each row in the table corresponds to a specific country. C1, C2, and C3 show the club of a country in that period.

**Table 2.2 Country clubs with respect to industrial structure, less industrialised countries, 1965-99.**

| Club 2 (Less Industrialised Countries) | 1965-69 | 1970-74 | 1975-79 | 1980-84 | 1985-89 | 1990-94 | 1995-99 |
|---|---|---|---|---|---|---|---|
| | ***India*** | ***India*** | ***C3*** | ***C3*** | ***C3*** | ***C1*** | ***C1*** |
| | ***Korea*** | ***Korea*** | ***C3*** | ***C3*** | ***C1*** | ***C1*** | ***C1*** |
| | ***Ireland*** | ***Ireland*** | ***Ireland*** | ***Ireland*** | ***C1*** | ***C1*** | ***C1*** |
| | ***C3*** | ***C3*** | ***Malaysia*** | ***Malaysia*** | ***C1*** | ***C1*** | ***C1*** |
| | ***n.a.*** | ***Indonesia*** | ***C3*** | ***C3*** | ***C3*** | ***C3*** | ***C1*** |
| | Egypt | Egypt | C3 | C3 | C3 | Egypt | Egypt |
| | Chile | Chile | Chile | Chile | Chile | Chile | Chile |
| | Colombia | Colombia | Colombia | Colombia | Colombia | Colombia | Colombia |
| | Costa Rica | Costa Rica | Costa Rica | Costa Rica | Costa Rica | Costa Rica | Costa Rica |
| | Ecuador | Ecuador | Ecuador | Ecuador | Ecuador | Ecuador | Ecuador |
| | Sri Lanka | Sri Lanka | Sri Lanka | Sri Lanka | Sri Lanka | Sri Lanka | Sri Lanka |
| | Uruguay | Uruguay | Uruguay | Uruguay | Uruguay | Uruguay | Uruguay |
| | C3 | Philippines | Philippines | Philippines | Philippines | Philippines | Philippines |
| | C3 | C3 | Cyprus | Cyprus | Cyprus | Cyprus | Cyprus |
| | C3 | C3 | Honduras | Honduras | Honduras | Honduras | Honduras |
| | C1 | C1 | Iceland | Iceland | Iceland | Iceland | Iceland |
| | C3 | C3 | Jordan | Jordan | Jordan | Jordan | Jordan |
| | C3 | C3 | Panama | Panama | Panama | Panama | Panama |
| | Greece | Greece | C3 | C3 | C3 | Greece | Greece |
| | Morocco | Morocco | C3 | C3 | C3 | Morocco | Morocco |
| | *C3* | *C3* | Venezuela | Venezuela | Venezuela | Venezuela | Venezuela |
| | *Malta* | *Malta* | *Malta*[*] | *Malta* | *Malta* | *C3* | *C3* |
| | *C3* | *C3* | *Mauritius* | *Mauritius* | *Mauritius* | *C3* | *C3* |
| | *Tunisia* | *Tunisia* | *Tunisia* | *Tunisia* | *Tunisia* | *C3* | *C3* |
| | *Pakistan* | *Pakistan* | *C3* | *C3* | *C3* | *C3* | *C3* |
| | *Portugal* | *Portugal* | *C3* | *C3* | *C3* | *C3* | *C3* |
| | *Turkey* | *Turkey* | *C3* | *C3* | *C3* | *C3* | *C3* |

Source: Industrial Statistics Database, Rev 2., 2002, UNIDO.
Legend: C1 (country club 1); C2 (country club 2); C3 (country club 3)
*Note*: [*] Rotated factor loadings is less than 0.3. Each row in the table corresponds to a specific country. C1, C2, and C3 show the club of a country in that period.



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**Table 2.3 Country clubs with respect to industrial structure, transition club, 1965-99.**

| | 1965-69 | 1970-74 | 1975-79 | 1980-84 | 1985-89 | 1990-94 | 1995-99 |
|---|---|---|---|---|---|---|---|
| **Club 3 (Transition Club)** | ***Malaysia*** | ***Malaysia**** | ***C2*** | ***C2*** | ***C1*** | ***C1*** | ***C1*** |
| | ***C2*** | ***C2*** | ***Korea*** | ***Korea*** | ***C1*** | ***C1*** | ***C1*** |
| | ***C2*** | ***C2*** | ***India*** | ***India*** | ***India*** | ***C1*** | ***C1*** |
| | ***n.a*** | ***C2*** | ***Indonesia*** | ***Indonesia*** | ***Indonesia*** | ***Indonesia*** | ***C1*** |
| | ***Singapore*** | ***C1*** | ***C1*** | ***C1*** | ***C1*** | ***C1*** | ***C1*** |
| | C2 | C2 | C2 | C2 | C2 | Malta | Malta |
| | Mauritius | Mauritius | C2 | C2 | C2 | Mauritius | Mauritius |
| | C2 | C2 | Pakistan | Pakistan | Pakistan | Pakistan | Pakistan |
| | C2 | C2 | Portugal | Portugal | Portugal | Portugal | Portugal |
| | C2 | C2 | C2 | C2 | C2 | Tunisia | Tunisia |
| | C2 | C2 | Turkey | Turkey | Turkey | Turkey | Turkey |
| | *C2* | *C2* | *Egypt* | *Egypt* | *Egypt* | *C2* | *C2* |
| | *C2* | *C2* | *Morocco* | *Morocco* | *Morocco* | *C2* | *C2* |
| | *C2* | *C2* | *Greece* | *Greece* | *Greece* | *C2* | *C2* |
| | *Cyprus* | *Cyprus* | *C2* | *C2* | *C2* | *C2* | *C2* |
| | *Honduras* | *Honduras* | *C2* | *C2* | *C2* | *C2* | *C2* |
| | *Jordan* | *Jordan* | *C2* | *C2* | *C2* | *C2* | *C2* |
| | *Panama* | *Panama* | *C2* | *C2* | *C2* | *C2* | *C2* |
| | *Philippines* | *C2* | *C2* | *C2* | *C2* | *C2* | *C2* |
| | *Venezuela* | *Venezuela* | *C2* | *C2* | *C2* | *C2* | *C2* |

Source: Industrial Statistics Database, Rev 2., 2002, UNIDO.
Legend: C1 (country club 1); C2 (country club 2); C3 (country club 3)
Note: * Rotated factor loadings is less than 0.3. Each row in the table corresponds to a specific country. C1, C2, and C3 show the club of a country in that period.

The results of the factor analysis applied to manufacturing value added suggest that there is no general structural convergence in manufacturing production from 1965 to 1999. The number of clubs did not change during this period. The number of countries that managed to change their membership from club 2 or 3 to club 1, the favourable club, is limited (India, Indonesia, Ireland, Korea, Malaysia and Singapore)[4]. It is no coincidence that these countries, with the exception of India, have achieved fairly high growth rates in manufacturing during this period. Moreover, this finding is supported by the findings in the previous section that the industrial structures of these countries have undergone remarkable changes in favour of more technology-intensive industries. We also found that the change in industrial structures and the entry of these countries into the club of industrialized countries occurred in the post-1980 period for Korea, Malaysia, and Ireland and in the 1990s for India and Indonesia.

In general, there is a consistent relationship between the results of the factor analysis and the analysis of the previous section, which examines the industrial structure of economies and its evolution in terms of technological intensity. More specifically, the countries with more dynamic industrial structures were able to move from either Club 2 or 3 to Club 1.



We also conducted a factor analysis for trade in manufactured goods for 41 countries over 4 periods.[5] The results of the factor analysis of trade are not very different from those of production. Again, we assumed that each factor represents a typical trade structure. We found four factors to be significant in explaining the correlations between countries' trade structures (see Table 3 for eigenvalues and cumulative proportions explained). However, we kept only the first three factors because the number of countries related to the fourth factor was very small (only two countries in the first two periods). Second, it allows us to compare and interpret the results of the factor analysis applied to manufacturing trade with that applied to value added. Three factors explain about 70-75 percent of the correlations between the trade structures of the countries in the sample.

The results of the factor analysis applied to manufacturing trade are quite similar to those of production: First, no strong convergence pattern in the structure of trade between countries was observed from 1981 to 1999, but there are country clubs formed by countries with similar trade structures (see Table 4. a-c). The countries in these clubs differ slightly from the clubs formed with respect to the structure of manufacturing value added above. For example, in the first period of trade data (1981-85), there is only one country,

the Netherlands, that is not in the club of industrialized countries constructed with respect to the structure of manufacturing trade. On the contrary, the factor analysis carried out on the value added in manufacturing suggests that this country belongs to the club of industrialized countries. Similarly, in the last period there are a few countries whose production and trade structure are not similar, i.e.; India, Philippines and Portugal. A final observation, if it is not too speculative, is that the change in manufacturing trade structure lags the change in production structure by one period in Korea, Indonesia and Malaysia. This is equivalent to saying that countries produce and then export. In other words, a period of industrial development strategy based on import substitution may precede and lay the foundation for successful export performance.

In order to see the differences in the industrial structures of the country clubs identified by the previous factor analysis based on manufacturing value added, the first nine industries with the largest share of total manufacturing value added, together with their rank, technology intensity and orientation for three selected periods (1965-69, 1980-84 and 1995-99) are presented in Table 5.a-c. In interpreting these tables, it should be kept in mind that the industrialized (Club 1) and less industrialized (Club 2) country clubs represent a typical and deterministic industrial structure, while the transitional club (Club 3) has different characteristics and does not reflect a consistent industrial structure. Therefore, instead of presenting the results of this analysis for the Transitional Club (Club 3), we have taken into account the change in the industrial structure of the countries that moved from the other two clubs to the Industrialized Club in the most recent period. This allows us to see how the manufacturing structures of these countries change over time.



**Table 3 Results of factor analysis, trade structure, 1981-99.**

| | | 1981-84 | | 1985-89 | | 1990-94 | | 1995-99 | |
|---|---|---|---|---|---|---|---|---|---|
| | | *EV.* | *Cum* | *EV.* | *Cum* | *EV.* | *Cum* | *EV.* | *Cum* |
| Factors | **1** | 18.82 | 0.45 | 18.73 | 0.45 | *19.01* | *0.46* | 20.29 | 0.49 |
| | **2** | 7.02 | 0.62 | 6.82 | 0.61 | *6.67* | *0.62* | 6.93 | 0.65 |
| | ***3*** | *3.33* | *0.70* | *4.12* | *0.71* | *4.24* | *0.72* | *3.89* | *0.75* |
| | **4** | 2.25 | 0.75 | 2.61 | 0.77 | *2.21* | *0.77* | 2.01 | 0.79 |
| | **5** | 1.77 | 0.80 | 1.84 | 0.82 | *1.74* | *0.81* | 1.73 | 0.84 |
| | **6** | 1.53 | 0.83 | 1.46 | 0.85 | *1.55* | *0.85* | 1.47 | 0.87 |
| | **7** | 1.22 | 0.86 | 1.28 | 0.88 | *1.13* | *0.88* | 1.11 | 0.90 |
| | **8** | 0.99 | 0.88 | 1.02 | 0.91 | *1.02* | *0.90* | 0.85 | 0.92 |
| | **9** | 0.92 | 0.91 | 0.80 | 0.93 | *0.89* | *0.92* | 0.68 | 0.93 |
| | **10** | 0.82 | 0.93 | 0.78 | 0.94 | *0.75* | *0.94* | 0.59 | 0.95 |

Source: Calculated using Industrial Demand Supply Database, Rev 2., 2002, UNIDO.
Legend: EV: Eigenvalue, Cum: Cumulative proportions explained by the corresponding factors.

**Table 4.1 Country clubs with respect to trade structures, industrialised countries, 1981-99.**

| | 1981-84 | 1985-89 | 1990-94 | 1995-99 |
|---|---|---|---|---|
| Club 1 (Industrialised Countries) | ***C3*** | ***C2*** | ***C2*** | ***Indonesia*** |
| | ***C3*** | ***C2*** | ***C2*** | ***Netherlands*** |
| | ***C2*** | ***C2*** | ***C2*** | ***Philippines*** |
| | ***C3*** | ***C3*** | ***C3*** | ***Portugal*** |
| | ***C2*** | ***C2*** | ***Malaysia*** | ***Malaysia*** |
| | Austria | Austria | Austria | Austria |
| | Canada | Canada | Canada | Canada |
| | Finland | Finland | Finland | Finland |
| | France | France | France | France |
| | Germany | Germany | Germany | Germany |
| | Italy | Italy | Italy | Italy |
| | Japan | Japan | Japan | Japan |
| | Korea | Korea | Korea | Korea |
| | Norway | Norway | Norway | Norway |
| | S. Africa | S. Africa | S. Africa | S. Africa |
| | Singapore | Singapore | Singapore | Singapore |
| | Spain | Spain | Spain | Spain |
| | Sweden | Sweden | Sweden | Sweden |
| | UK | UK | UK | UK |
| | USA | USA | USA | USA |

Source: Industrial Statistics Database, Rev 2., 2002, UNIDO.
Legend: C1 (country club 1); C2 (country club 2); C3 (country club 3)
Note: Each row in the table corresponds to a specific country. C1, C2, and C3 show the club of a country in that period.

**Table 4.2 Country clubs with respect to trade structures, less industrialised countries, 1981-99.**

| | 1981-84 | 1985-89 | 1990-94 | 1995-99 |
|---|---|---|---|---|
| Club 2 (Less Industrialised Countries) | ***C3*** | ***Indonesia*** | ***Indonesia*** | ***C1*** |
| | ***C3*** | ***Netherlands*** | ***Netherlands*** | ***C1*** |
| | ***Malaysia*** | ***Malaysia*** | ***C1*** | ***C1*** |
| | ***Philippines*** | ***Philippines*** | ***Philippines*** | ***C1*** |
| | C3 | C3 | C3 | Morocco |
| | C3 | C3 | C3 | Greece |
| | C3 | C3 | Jordan | Jordan |
| | Chile* | Chile | Chile | Chile |
| | Colombia | Colombia | Colombia | Colombia |
| | Costa Rica | Costa Rica | Costa Rica | Costa Rica |
| | Ecuador | Ecuador | Ecuador | Ecuador |
| | Honduras | Honduras | Honduras | Honduras |
| | Iceland | Iceland | Iceland | Iceland |
| | India | India | India | India |
| | Panama | Panama | Panama | Panama |
| | Uruguay | Uruguay | Uruguay | Uruguay |
| | C3 | Venezuela | Venezuela | Venezuela |
| | *Mauritius* | *C3* | *C3* | *C3* |

Source: Industrial Statistics Database, Rev 2., 2002, UNIDO.
Legend: C1 (country club 1); C2 (country club 2); C3 (country club 3)
Note: * Rotated factor loadings is less than 0.3. Each row in the table corresponds to a specific country. C1, C2, and C3 show the club of a country in that period.



**Table 4.3 Country clubs with respect to trade structures, 1981-99.**

| | 1981-84 | 1985-89 | 1990-94 | 1995-99 |
|---|---|---|---|---|
| Club 3 (Transition Club) | ***Indonesia*** | ***Indonesia*** | ***Indonesia*** | ***C1*** |
| | ***Netherlands*** | ***C2*** | ***C2*** | ***C1*** |
| | ***Portugal*** | ***Portugal*** | ***Portugal*** | ***C1*** |
| | C2 | Mauritius | Mauritius | Mauritius |
| | Egypt | Egypt | Egypt | Egypt |
| | Cyprus | Cyprus | Cyprus | Cyprus |
| | Malta | Malta | Malta | Malta |
| | Sri Lanka | Sri Lanka | Sri Lanka | Sri Lanka |
| | Pakistan | Pakistan | Pakistan | Pakistan |
| | Tunisia | Tunisia | Tunisia | Tunisia |
| | Turkey | Turkey | Turkey | Turkey |
| | *Greece* | *Greece* | *Greece* | *C2* |
| | *Morocco* | *Morocco* | *Morocco* | *C2* |
| | *Jordan* | *Jordan* | *C2* | *C2* |
| | *Venezuela* | *C2* | *C2* | *C2* |

Source: Industrial Statistics Database, Rev 2., 2002, UNIDO.
Legend: C1 (country club 1); C2 (country club 2); C3 (country club 3)
Note: Each row in the table corresponds to a specific country. C1, C2, and C3 show the club of a country in that period.

The results of this analysis have interesting implications: First, the top five industries with the largest shares in total manufacturing account for about 50 percent of total manufacturing value added. Second, the figures imply that while the top five industries in Club 1 do not change from 1965 to 1999, the ranking of the industries, and thus the technology intensity and orientation, does change. For example, in Club 1, the first industry is the food industry with 11 percent share of total manufacturing value added in the 1965-69 period, it falls to the 4th rank with 9 percent share in the last period. In fact, from 1980-84 to 1995-99, even the rank of industries in the club of industrialized countries does not change. Third, the change in the first nine industries and their ranks have changed the most in both less industrialized and catching-up countries from 1965 to 1999 (see Table 5. a-c).

We found that while the industries with the largest share of total manufacturing in the club of industrialized countries, club 1, are mostly medium or high technology intensive industries, especially the first five industries, in the club of less industrialized countries, the value added is produced by low technology intensive industries in all periods. Accordingly, when comparing the orientation of the industries of the clubs, we found that the industries in the industrialized countries are mostly scale-intensive or specialized supplier industries, while they are resource or labor-intensive industries in the industrialized countries. Another interesting finding is that the food industry (ISIC-311), which is a low-technology and resource-intensive industry, has a quite significant weight in total manufacturing in all clubs: its share is more than 10 percent even in the industrial country club. This result can be justified as follows: the characteristics of an industry can differ from one country to another, especially in terms of technological structure. For example, the food industry (ISIC-311) in an industrialized country is not the same as the food industry in a less industrialized country in terms of both production and process technologies used, even though it is defined as a low-technology and labor-intensive industry at the 3-digit ISIC level.



With regard to the technological structure and orientation of industries, the most significant change can be observed in the “catching-up” country club, where industrial structures evolved towards more technology-intensive, specialized and science-based production between 1965 and 1999 (see Table 5. a-c). For example, while textiles (ISIC-321) and food (ISIC-311) (low technology and labor and resource intensive industries) accounted for about 24 percent of total manufacturing value added in this group of countries in the period 1965-99, their share fell to 13 percent by the end of the 1990s.

Similarly, Office and Computer Machinery and Equipment (ISIC-382) and Radio, TV and Communication Equipment and Electrical Machinery (ISIC-383) were not observed among the top nine industries in the first period, but their share in total manufacturing increased incredibly to 28 percent in the period 1995-99.

**Table 5.1 Industry rankings with respect to value added share in total manufacturing for different country clubs, 1965-69.**

| | | 1965-69 | | | |
|---|---|---|---|---|---|
| | **Rank** | **Industry** | **Technology** | **Orientation** | **Share** |
| **Industrialised Countries** | 1 | 311 | LT | RI | 0.11 |
| | 2 | 384 | MT/HT | SI/SB | 0.09 |
| | 3 | 382 | MT/HT | SS/SB | 0.09 |
| | 4 | 383 | HT | SS | 0.07 |
| | 5 | 381 | LT | LI | 0.07 |
| | 6 | 371 | LT | SI | 0.06 |
| | 7 | 321 | LT | LI | 0.05 |
| | 8 | 342 | LT | RI | 0.05 |
| | 9 | 341 | LT | RI | 0.05 |
| | | | | *Total share* | *0.63* |
| **Less Industrialised Countries** | 1 | 311 | LT | RI | 0.17 |
| | 2 | 321 | LT | LI | 0.17 |
| | 3 | 313 | LT | RI | 0.07 |
| | 4 | 352 | MT/HT | SI/SB | 0.07 |
| | 5 | 314 | LT | RI | 0.05 |
| | 6 | 369 | LT | RI | 0.05 |
| | 7 | 381 | LT | LI | 0.04 |
| | 8 | 384 | MT/HT | SI/SB | 0.04 |
| | 9 | 353 | LT | RI | 0.04 |
| | | | | *Total share* | *0.68* |
| **Catch-up Countries** | 1 | 311 | LT | RI | 0.12 |
| | 2 | 321 | LT | LI | 0.12 |
| | 3 | 384 | MT/HT | SI/SB | 0.06 |
| | 4 | 313 | LT | RI | 0.06 |
| | 5 | 353 | LT | RI | 0.05 |
| | 6 | 352 | MT/HT | SI/SB | 0.05 |
| | 7 | 314 | LT | RI | 0.05 |
| | 8 | 342 | LT | RI | 0.05 |
| | 9 | 355 | MT | SI | 0.04 |
| | | | | *Total share* | *0.60* |

Source: Calculated from Industrial Statistics Database, Rev 2., 2002, UNIDO.
Legend: HT: High-technology; MT: Medium-technology; LT: Low-technology; RI: Resource-intensive; LI: Labour-intensive; SI: Scale-intensive; SS: Specialised-supplier; SB: Science-based.

**Table 5.2 Industry rankings with respect to value added share in total manufacturing for different country clubs, 1980-84.**

| | | 1980-84 | | | |
|---|---|---|---|---|---|
| | **Rank** | **Industry** | **Technology** | **Orientation** | **Share** |
| **Industrialised Countries** | 1 | 382 | MT/HT | SS/SB | 0.11 |
| | 2 | 383 | HT | SS | 0.10 |
| | 3 | 384 | MT/HT | SI/SB | 0.10 |
| | 4 | 311 | LT | RI | 0.09 |
| | 5 | 381 | LT | LI | 0.07 |
| | 6 | 342 | LT | RI | 0.05 |
| | 7 | 371 | LT | SI | 0.05 |
| | 8 | 351 | MT | SI | 0.05 |
| | 9 | 341 | LT | RI | 0.05 |
| | | | | *Total share* | *0.65* |
| **Less Industrialised Countries** | 1 | 311 | LT | RI | 0.20 |
| | 2 | 313 | LT | RI | 0.08 |
| | 3 | 353 | LT | RI | 0.07 |
| | 4 | 322 | LT | LI | 0.07 |
| | 5 | 369 | LT | RI | 0.06 |
| | 6 | 314 | LT | RI | 0.06 |
| | 7 | 321 | LT | LI | 0.05 |
| | 8 | 352 | MT/HT | SI/SB | 0.05 |
| | 9 | 381 | LT | LI | 0.04 |
| | | | | *Total share* | *0.69* |
| **Catch-up Countries** | 1 | 311 | LT | RI | 0.11 |
| | 2 | 383 | HT | SS | 0.11 |
| | 3 | 321 | LT | LI | 0.08 |
| | 4 | 384 | MT/HT | SI/SB | 0.07 |
| | 5 | 382 | MT/HT | SS/SB | 0.06 |
| | 6 | 352 | MT/HT | SI/SB | 0.06 |
| | 7 | 314 | LT | RI | 0.05 |
| | 8 | 351 | MT | SI | 0.05 |
| | 9 | 353 | LT | RI | 0.05 |
| | | | | *Total share* | *0.65* |

Source: Calculated from Industrial Statistics Database, Rev 2., 2002, UNIDO.

Legend: HT: High-technology; MT: Medium-technology; LT: Low-technology; RI: Resource-intensive; LI: Labour-intensive; SI: Scale-intensive; SS: Specialised-supplier; SB: Science-based.

**Table 5.3 Industry rankings with respect to value added share in total manufacturing for different country clubs, 1995-99.**

| | | 1995-99 | | | |
|---|---|---|---|---|---|
| | **Rank** | **Industry** | **Technology** | **Orientation** | **Share** |
| **Industrialised Countries** | 1 | 382 | MT/HT | SS/SB | 0.12 |
| | 2 | 383 | HT | SS | 0.11 |
| | 3 | 384 | MT/HT | SI/SB | 0.10 |
| | 4 | 311 | LT | RI | 0.09 |
| | 5 | 381 | LT | LI | 0.07 |
| | 6 | 342 | LT | RI | 0.06 |
| | 7 | 352 | MT/HT | SI/SB | 0.06 |
| | 8 | 341 | LT | RI | 0.05 |
| | 9 | 351 | MT | SI | 0.04 |
| | | | | *Total share* | *0.70* |
| **Less Industrialised Countries** | 1 | 311 | LT | RI | 0.22 |
| | 2 | 353 | LT | RI | 0.09 |
| | 3 | 313 | LT | RI | 0.08 |
| | 4 | 352 | MT/HT | SI/SB | 0.07 |
| | 5 | 369 | LT | RI | 0.06 |
| | 6 | 322 | LT | LI | 0.06 |
| | 7 | 314 | LT | RI | 0.05 |
| | 8 | 321 | LT | LI | 0.05 |
| | 9 | 351 | MT | SI | 0.04 |
| | | | | *Total share* | *0.70* |
| **Catch-up Countries** | 1 | 383 | HT | SS | 0.17 |
| | 2 | 382 | MT/HT | SS/SB | 0.11 |
| | 3 | 311 | LT | RI | 0.08 |
| | 4 | 352 | MT/HT | SI/SB | 0.08 |
| | 5 | 384 | MT/HT | SI/SB | 0.07 |
| | 6 | 351 | MT | SI | 0.07 |
| | 7 | 321 | LT | LI | 0.05 |
| | 8 | 371 | LT | SI | 0.04 |
| | 9 | 381 | LT | LI | 0.04 |
| | | | | *Total share* | *0.72* |

Source: Calculated from Industrial Statistics Database, Rev 2., 2002, UNIDO.
Legend: HT: High-technology; MT: Medium-technology; LT: Low-technology; RI: Resource-intensive; LI: Labour-intensive; SI: Scale-intensive; SS: Specialised-supplier; SB: Science-based.

Looking at the evolution of the structure of exports in terms of technology intensity and orientation, the results are no different from those for production. We find that while less industrialized countries did not experience significant changes in the technological structure of their exports, the structure of manufacturing exports in the catching-up countries shifted towards more technology- and skill-intensive exports between 1981 and 1999 (see Table 6.a-b). In fact, there were no major changes in the structure of manufacturing

exports of the group of industrialized countries, i.e. the ranking of industries did not change much. On the other hand, we found that the share of technology-intensive exports increased between the 1980s and the 1998s. The share of technology-intensive exports (ISIC-382, ISIC-383, and ISIC-384) increased from 37 percent in 1980-84 to 46 percent in 1995-99. Among these industries, only ISIC-383 (radio, TV and communication equipment and electrical machinery) has a share of 3 percent in total manufactured exports at both the beginning and the end of the period (see Table 6.a-b).

In the group of catching-up countries, the share of high-technology exports increases, while that of low-technology exports decreases radically from 1981 to 1999. For example, the shares of ISIC-382 (office and computer machinery and equipment) and ISIC-383 (radio, TV and communication equipment and electrical machinery) in total manufacturing exports rose from initial levels of 7 and 14 percent, respectively, to 12 and 24 percent, respectively, in the latest period. At the same time, exports of food products (ISIC-311) fell from 16 to 8 percent in the second half of the 1990s.

**Table 6.1 Industry rankings with respect to export share in total manufacturing for different country clubs, 1980-84.**

| | | 1980-84 | | | |
|---|---|---|---|---|---|
| | *Rank* | *Industry* | *Technology* | *Orientation* | *Share* |
| **Industrialised Countries** | 1 | 384 | MT/HT | SI/SB | 0.15 |
| | 2 | 382 | MT/HT | SS/SB | 0.13 |
| | 3 | 351 | MT | SI | 0.09 |
| | 4 | 383 | HT | SS | 0.09 |
| | 5 | 371 | LT | SI | 0.07 |
| | 6 | 341 | LT | RI | 0.07 |
| | 7 | 311 | LT | RI | 0.06 |
| | 8 | 353 | MT | RI | 0.05 |
| | 9 | 372 | MT | RI | 0.05 |
| | | | | *Total share* | *0.79* |
| **Less Industrialised Countries** | 1 | 311 | LT | RI | 0.33 |
| | 2 | 353 | MT | RI | 0.15 |
| | 3 | 322 | LT | LI | 0.10 |
| | 4 | 372 | MT | RI | 0.07 |
| | 5 | 321 | LT | LI | 0.05 |
| | 6 | 351 | MT | SI | 0.05 |
| | 7 | 331 | LT | SI | 0.04 |
| | 8 | 383 | HT | SS | 0.03 |
| | 9 | 352 | MT | SI | 0.03 |
| | | | | *Total share* | *0.88* |
| **Catch-up Countries** | 1 | 311 | LT | RI | 0.16 |
| | 2 | 353 | MT | RI | 0.15 |
| | 3 | 383 | HT | SS | 0.14 |
| | 4 | 321 | LT | LI | 0.10 |
| | 5 | 331 | LT | SI | 0.07 |
| | 6 | 382 | MT/HT | SS/SB | 0.07 |
| | 7 | 322 | LT | LI | 0.06 |
| | 8 | 371 | LT | SI | 0.06 |
| | 9 | 384 | MT/HT | SI/SB | 0.05 |
| | | | | *Total share* | *0.89* |

Source: Calculated from Industrial Statistics Database, Rev 2., 2002, UNIDO.

Legend: HT: High-technology; MT: Medium-technology; LT: Low-technology; RI: Resource-intensive; LI: Labour-intensive; SI: Scale-intensive; SS: Specialised-supplier; SB: Science-based.

**Table 6.2 Industry rankings with respect to export share in total manufacturing for different country clubs, 1995-99.**

| | | 1995-99 | | | |
|---|---|---|---|---|---|
| | **Rank** | **Industry** | **Technology** | **Orientation** | **Share** |
| **Industrialised Countries** | 1 | 382 | MT/HT | SS/SB | 0.17 |
| | 2 | 384 | MT/HT | SI/SB | 0.15 |
| | 3 | 383 | HT | SS | 0.14 |
| | 4 | 351 | MT | SI | 0.07 |
| | 5 | 341 | LT | RI | 0.06 |
| | 6 | 371 | LT | SI | 0.04 |
| | 7 | 311 | LT | RI | 0.04 |
| | 8 | 352 | MT/HT | SI/SB | 0.04 |
| | 9 | 372 | MT | RI | 0.04 |
| | | | | *Total share* | *0.78* |
| **Less Industrialised Countries** | 1 | 311 | LT | RI | 0.25 |
| | 2 | 322 | LT | LI | 0.11 |
| | 3 | 353 | LT | RI | 0.09 |
| | 4 | 321 | LT | LI | 0.07 |
| | 5 | 372 | MT | RI | 0.07 |
| | 6 | 351 | MT | SI | 0.07 |
| | 7 | 352 | MT/HT | SI/SB | 0.05 |
| | 8 | 383 | HT | SS | 0.03 |
| | 9 | 341 | LT | RI | 0.03 |
| | | | | *Total share* | *0.80* |
| **Catch-up Countries** | 1 | 383 | HT | SS | 0.24 |
| | 2 | 382 | MT/HT | SS/SB | 0.12 |
| | 3 | 321 | LT | LI | 0.10 |
| | 4 | 311 | LT | RI | 0.08 |
| | 5 | 351 | MT | SI | 0.07 |
| | 6 | 384 | MT/HT | SI/SB | 0.05 |
| | 7 | 322 | LT | LI | 0.05 |
| | 8 | 331 | LT | SI | 0.05 |
| | 9 | 353 | LT | RI | 0.04 |
| | | | | *Total share* | *0.82* |

Source: Calculated from Industrial Statistics Database, Rev 2., 2002, UNIDO.

Legend: HT: High-technology; MT: Medium-technology; LT: Low-technology; RI: Resource-intensive; LI: Labour-intensive; SI: Scale-intensive; SS: Specialised-supplier; SB: Science-based.

## Conclusions

Examining the manufacturing industries of various countries in terms of their technology intensity revealed the existence of a strong correlation between the technological structure of manufacturing production and exports and industrial performance. While less developed countries have an industrial structure composed of low technology production and exports, the industrial structure of industrialized countries is mostly composed of medium and high technology production and exports. More importantly, it is shown that the countries with high growth performance, the fast growing countries, have a more dynamic industrial structure in favor of technologically sophisticated industries (Ireland, South Korea, Malaysia, Malta and Singapore). They have been able to radically shift their industrial structure towards medium and high technology industries in the 1980s and 1990s.

The results of the factor analysis provided additional evidence on the structure of structural change and its relationship with industrial growth. The results suggest that there is no evidence of convergence in industrial structure. On the contrary, our analysis showed the existence of three different clubs with respect to the production and trade structure of countries, which are mostly consistent with the development stage of countries. While one of these clubs is composed of less developed countries in a given period, the other turned out to be a club formed mostly by developed countries. The countries that managed to move from the other club to the club of developed countries were those with high growth rates, such as Korea, Ireland, Malaysia and Singapore.



The results therefore seem to indicate that there is a persistent international division of labor in industrial production and trade, even if groups of countries change their industrial structures. While less developed countries specialize in low-technology, low-skill, labour- and resource-intensive industrial activities and gradually change their structures towards medium-technology industries, they do not converge towards the evolving structure of developed countries. Thus, the world economy seems to maintain the polarized grouping of countries as “industrialized” and “less industrialized”.

An examination of the rank (share) of each industry in total manufacturing, both in terms of production and exports, has revealed interesting implications: while the industries with the largest share in total manufacturing in the club of industrialized countries tend to be medium- or high-technology intensive industries, in the club of less industrialized countries the value added is produced and exported by low-technology intensive industries in all periods.

With respect to the technological structure of industries, the most significant change is observed in the "catching-up" country club, where industrial structures evolved towards more technology-intensive and specialized and/or science-based production between 1965 and 1999.

Although all these results provide evidence for the link between industrial structure and growth, they do not support the assumption that the international division of production in terms of absolute/comparative advantages can narrow the gap between developed and underdeveloped countries. Therefore, in order for underdeveloped countries to achieve long-term sustainable industrial development and catch up with developed countries, they should consciously move away from low-technology/low-skill, labor- and/or resource-intensive production and trade to high-technology/high-skill, specialized and science-intensive production and exports.

## Notes

1 These figures show the shares of high, medium and low-tech manufacturing value added in a given country. Note that there are three variables, but since the sum is 100%, there are only two independent variables that can be plotted in a two-dimensional space. For example, if the share of low tech manufacturing is 100%, a country is in the left bottom corner (LT). If low-tech and medium-tech each account for 50%, i.e. the share of high-tech is 0%, then the country will be in the middle of the LT and MT corners. If the share of a sector gets larger, the country gets closer to the corner of that sector.



2 In fact, we were able to run the factor analysis for 50 countries for manufacturing value added. However, in order not to lose the link between production and trade and to compare the results of the factor analysis carried out for manufacturing value added with manufacturing trade, we have taken those countries for which trade data are available with the exception of Ireland.

3 In factor analysis, we first calculate correlation coefficients for production/trade structures between countries and obtain a 42 by 42 correlation matrix. Factor analysis is applied to the correlation matrix and factors are extracted using the principal factor method. The number of factors extracted is determined by the scree test and the amount of variance explained by the extracted factors (see tables 1 and 3 for eigenvalues and cumulative variance explained). We decided to extract three factors for both production and trade structures. Then the factors are rotated by varimax rotation to

improve the interpretability of the factors. The countries are placed in the group that has the highest loading on that factor.

4 It is worth noting that China was another country that moved from Club 2 to Club 1 in the 1995-99 period. We have not included this country in the analysis for the reason given in footnote 3.

5 Factor analysis was conducted for four periods because trade data were available from 1981 to 1999 for three-digit ISIC level.

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