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TECHNOLOGY AND INTERNATIONAL TRADE PERFORMANCE OF THE MOST ADVANCED COUNTRIES*

1. Introduction

In the 1980s there was significant growth in trade and production interdependence among the major countries and areas as a result of the remarkable increase of world trade and foreign direct investments.

World trade, despite the proliferation of protectionist measures, has continued to make a substantial contribution to the economic growth of all the major countries. The largest and most rapidly growing part of world trade was in manufactured products, which today accounts for some 85 per cent of total trade in goods.

Most of world trade in manufactures is largely composed of two-way exchanges of fairly similar goods at the sectoral level, so-called 'intraindustry' trade. Industrial countries, which seemed, and were becoming over time, very similar in their factor endowments are the main source of this kind of trade.

Therefore 'intraindustry' trade can not be explained, as a relatively recent and growing literature has shown (1), purely by orthodox trade theory based on national differences in endowments of productive factors. There are other determining factors, such as economies of scale (Dixit and Norman, 1980, ch.9; Krugman, 1981; Ethier, 1982) and product differentiations (Lancaster, 1980; Krugman, 1980; Helpman, 1981).

Another group of contributions has more recently put emphasis on international differences in technological levels and innovative capabilities in order to offer alternative explanations of countries' advantages and specializations in international trade (Krugman 1979, 1986; Soete, 1987; Dosi, Pavitt and Soete, 1989). Such advantages, rather than stemming

from exogenous factor endowments as traditional comparative advantages do, are mostly acquired by different countries according to their different capabilities for generating and diffusing innovations. The international distribution of technological capabilities determines the distribution of comparative (absolute) advantages and produces a hierarchy of national economies which influences the patterns of national trade specializations. At the same time, trade advantages of innovator firms and countries tend to be temporary, as imitators are able to improve their technical capability and narrow the technological gap so as to affect significant changes in the distribution of trade flows between countries and in the patterns of the international division of labor over time.

Such changes have been taking place in the last two decades and have profoundly affected all the major economies. Technological change has forced all the major countries to make wide-ranging domestic adjustments and has continuously modified their relative positions in the world economy. In this respect, the reactions of the major economies followed different patterns and most of all they met with very different success.

To evaluate them, this paper will use a comparative analysis of international trade performance and specialization of all the major countries (US, Japan, EC countries, Asian NICs) in the last two decades, providing some empirical evidence for the international differences in countries' technological levels and innovative capabilities.

The study relies on a new and original data-base to conduct research on the changing pattern of world trade at a rather disaggregated level. The database (SIE - World Trade) is based on United Nations and OECD statistical sources and includes import-export flows from 1970 onwards for more than 80 countries (OECDs, NICs, COMECON and LDCs) at various levels of disaggregation (400 product classes, 98 sectors and 25 commodity groups) [see Appendix]. Unlike previous studies on the same topic based on partial trade data referring only to the 24 OECD countries, the database used here makes it possible to examine the entire world trade matrix and to extend analysis to new,

important competitors on the world trade scene, i.e. the South-East Asian NICs.

To carry out this kind of analysis, one must first briefly examine the empirical and methodological issues associated with the former, particularly with respect to the relationship between a given country's technological capability and its international trade performance.

2. Technology and International Competitiveness: Some Methodological and Empirical Problems.

Technological capabilities are widely recognized as a key factor driving countries' international trade performance and competitiveness. Many methodological and empirical problems, however, are associated with the definition and quantification of such technological levels and innovative capabilities. They arise from the difficulties both of determining sources and effects of technology, and, more generally, of mapping the relations between technological change, trade specialization and international competitiveness of a given country.

A suitable starting point for such an investigation is the result of the considerable volume of theoretical and empirical research on the nature, determinants and effects of innovative activities that has been carried out over the past fifteen years (2).

In very general terms, technology may be defined as a stock of knowledge (technical or managerial) which allows for the introduction of new products or production processes. Innovative activity is thus viewed as the result of a long and complex process of accumulation and appropriation of this knowledge. The means and channels, however, by which this accumulation and appropriation take place, as well as the output of the stock of knowledge which is formed, are not the same for all firms and product groups; technology is a cumulative process and has firm-specific nature, since it is differentiated in both its technical characteristics and its market application (Teece, 1986; Pavitt 1988; Cantwell 1989). Processes of technological accumulation

tend to assume varying sectoral features, in terms of differences in technological opportunities, sources and appropriability conditions (Levin, 1984; Scherer, 1986). Another peculiarity of each sector is the different specific weight that innovation assumes in affecting sectoral profitability and competitiveness relative to all other factors.

It follows that the technological content of various product groups can be differently defined and quantified according to the different typologies and sources of technology which are being considered.

In this respect, the linkages between various industrial sectors assume great importance (Schmookler, 1966; Scherer 1982; Pavitt, 1984). The industrial system of a country should, in effect, be considered not as an ideal portfolio of sectors which are independent of one another, but rather as a structure with its own internal hierarchy, defined by a complex technical interdependence between its various component sectors. Technological change also affects these structural linkages and, through them, affects competitiveness of each sector and hence of the industrial system as a whole (Chesnais, 1986).

These features of technology have important implications for a comparative analysis of international trade specializations and performances of various countries. Particularly, one should take into consideration the main features of technology and innovation briefly mentioned above when developing a taxonomy of industrial sectors with respect to their technological content which aims at synthetically modelling the different national industrial systems for the purpose of comparison.

In this respect, more traditional taxonomies which divide the various industrial sectors into high, medium and low technology-intensity groups of products on the basis of indicators of both technological input (R & D expenditures) and output (patents) are unsatisfactory for an evaluation of a country's technological capabilities and international trade performance (3).

According to such classifications, a country's international trade specialization is considered more suitable for improving

its domestic and external competitiveness the greater the concentration of its export in "high technology" industrial sectors. This latter category should include all those production activities characterized by high demand growth, low price elasticity and high barriers to market entry for newly industrializing countries (NICs). An opposite conclusion is drawn when a country's export specialization is mainly based on 'medium-low technology' industrial sectors.

These classification schemes can be criticized not only because they use technological indicators of little and ambiguous meaning, but, more importantly, because they actually ignore those prominent differences with respect to the mechanisms of introducing and diffusing technologies, already mentioned, between various industrial sectors. Therefore, they tend to reduce technological change to a physiological alternation of "growth" industries (high-tech sectors) and "decline" industries (low-tech sectors).

In this respect, a sectoral taxonomy developed at the Science Policy Research Unit of the University of Sussex by Pavitt (1984) appears more adequate to represent the differences in the opportunities and appropriability mechanisms of technological innovations characterizing various industrial sectors. In Pavitt's taxonomy, industries are divided into four major groups mainly according to a combination of technology sources, user requirements and means of appropriation.

The first group of sectors, so called 'science-based', includes industries such as fine chemicals, electronic components, telecommunications and aerospace, which are all characterized by innovative activities directly linked to high R&D expenditures; their product innovations generate broad spill-over effects on the whole economic system, and a large number of other sectors heavily rely on them as capital or intermediate inputs (4).

A second group of sectors - 'scale-intensive' - includes typical oligopolistic large firm industries, with high capital intensity, wide economies of scale and learning, high technical or managerial complexity and significant in-house production

engineering activities, such as automobiles, certain consumer electronics and consumer durables, the rubber and steel industries.

The third group of industries -'specialized-suppliers' - includes most producers of investment goods in mechanical and instrument engineering, such as the machinery for specialized industries (i.e. machine-tools), and is characterized by a high diversification of supply, high "economies of scope", relatively medium to small companies and a notable capacity for product innovation that enters most sectors of scale-intensive and supplier-dominated groups as capital inputs.

Finally, there is a group of 'supplier-dominated' sectors which encompasses the more traditional consumer and non-consumer goods industries which are net purchasers of process innovations and innovative intermediate inputs from other suppliers of productive equipment and materials (specialized-supplier and scale-intensive sectors); these sectors are notably sensitive to price competition, but are also influenced by 'non-price factors' such as product design and quality. This group includes textiles, clothing, wood and furniture, leather and shoes, ceramics, the simplest metal products.

Pavitt's classification of industrial sectors, as may be expected from any such broad classification, has some limitations, mainly stemming from the heterogeneity of the products included in each group of industries; nevertheless, it has the merit of emphasizing two key aspects of technological change and innovative activities. First, the technological capability of firms and countries is not linked solely to their R&D expenditure or patent acquisitions since the typologies of innovative activity have industry- and firm-specific characteristics. Second, the linkages among different groups of industries and the related complex technological interdependences are of great importance since they affect the competitiveness of the manufacturing system as a whole. Such interdependencies, as shown below, are also very important to achieving a proper understanding of the links between technological capabilities and international competitiveness at the country level.

On the basis of the foregoing considerations, Pavitt's classification scheme for industrial sectors seems more suitable than the traditional ones to deal with innovative capabilities of different countries. It has therefore been used in this paper to carry out a comparative analysis of major countries' international trade performance and specialization.

For this purpose all traded-industrial products, at a highly disaggregated level, have been classified into four groups, science-based, specialized-suppliers, scale-intensive and supplier-dominated, plus the group of the food industries which is considered separately (5). All the other non-industrial products have been grouped into three broad economic categories (6), for a total of nine product groups here considered (see Appendix).

3. The notable rise of Japan in international markets

This and subsequent sections will deal with the major shifts in the world division of labor by analyzing the trade performance and specialization patterns of the United States, Japan, EC countries and the Southeast Asian NICs in the last two decades.

It should be noted that in the present phase of increasing globalization of markets and internationalization of production, competition among countries and firms takes place on many different grounds, i.e. trade, foreign direct investment, etc. International trade, however, as demonstrated below, has continued to play a relevant role in the increasing interdependence among countries and therefore provides a privileged look-out post for evaluating changing competitive patterns of various countries.

The present analysis uses a long-term approach (1970-87) for a clear overall appraisal of the major changes in trade (industrial) structures. It also uses a variety of indicators of a country's competitiveness and trade specialization. While no single indicator can provide an adequate view of a country's international trade performance, it is possible to draw fairly reliable conclusions if various indicators are considered

together.

Among the major countries, Japan undoubtely achieved the best trade performance in the last two decades. To evaluate it, the first two sets of indicators employed are both more directly tied to the competitive position of a country and are worked out below for the manufacturing system as a whole and for all the sectoral groups considered in the preceding section.

The first set of indicators is the share of a country's exports in world exports with reference to each group of products (7). The performance of market share will be considered over a long period (1970-87), to overcome the effects of short-run fluctuations and highlight the major trends characterizing the international competitiveness of a given country. The second set of indicators consists of trade balances by country, either in overall manufacturing or in single sectoral groups standardized by total world trade in each group of products. This indicator highlights the international distribution of trade surpluses and deficits in each group of products by country over time, thus underlining major shifts in relative competitive positions of various countries (8).

In trade of manufactured products, Japan's share in world exports has been increasing continuously (+40 per cent) over the period considered (see Table 1), and standardized trade balances have been growing even more impressively (from 4.7 percentage points in 1970 to 7.4 percentage points in 1987 with respect to world trade in manufactures, see Table 2).

In the case of single sectoral groups, both sets of indicators show a huge rise of the Japanese industry: first, in science-based sectors, with more than a doubling of market shares (from 7.8 per cent in 1970 to 16.2 in 1987, see Table 3) and a sharp increase in trade surpluses (+9.3 points in percentage of world trade for this product group, see Table 4): second, in specialized-suppliers (mechanical engineering), with considerable gains in Japan's shares in world exports (from 6.4 per cent in 1970 to 14.6 in 1987, see Table 5) and rapidly increasing positive trade balances (see Table 6). In the scale-intensive sector, the Japanese industry has further consolidated its

competitive position that was already strong in the early seventies (see Tables 7-8). On the contrary, in traditional sectors - such as textile, clothing, leather and footwear - the halving of export shares (Table 9) and the shift from high surpluses to slight but significative deficits in the mid-1980s (Table 10) show that the Japanese industry has carried out a relative disengagement from these productions, investing heavily abroad and reducing its export propensity.

Using the "Constant Market Shares Analysis", applied here with a new method of calculation, the changes in Japan's market share of manufacturing sector and various sectoral groups in the period 1970-87 have been broken down into two groups of components: 'structural effect' and 'competitiveness effect', each of which represents a different set of determinants of Japan's trade performance (9).

The 'structural effect' refers to the geographic and commodity structure of a country's export relative to the structure and the dynamics of world demand. The structural effect will be positive (negative) if a country concentrates its export on markets and/or commodities that grow faster (slower) than the world average (world demand). This structural effect can be further divided into three elements: the "market effect", due to the export's structure of a country by geographical destination; the "commodity effect", due to the export's structure of a country by products ; the "specific market-commodity effect", due to the structure of a country's exports by specific market and product groups. The competitiveness effect reflects the actual changes of a country's market shares, assuming that its trade structure is constant, and it represents that part of a country's trade performance deriving from its competitive factors ('price' and 'non price').

The results of CMSA (see Table 12) confirm that the Japanese industry achieved the highest gains in the specialized-supplier and science-based industries in terms of both structural and competitiveness effects. This was particularly evident in the 1980s in connection with the deep restructuring process underway after the second oil shock.

Certainly, this sharp strengthening of the competitiveness of Japanese productions may be attributed to many and heterogeneous factors. It is far from easy to identify them, and can not be attempted within the limits of this paper. In general, however, it may be said that a set of macroeconomic and socio-institutional factors, together with a peculiar strategy of industrial development, contributed to the success of Japanese industry. In this respect, a relevant role, as many studies have pointed out (10), was played by structural competitiveness factors, such as a particularly rapid technological change.

These structural factors may be connected with the profound changes which have taken place in the patterns of Japan's trade specialization in the last two decades. It has adapted to the changing dynamic and commodity composition of world demand, as shown below, much more and better than have the specializations of the other partner countries.

To evaluate Japanese specialization patterns, an indicator has been worked out that measures the relative contributions to a country's trade balance (ICTB) of the various groups of sectors in consideration (CEPII, 1983), see Figure 1. If the contribution (positive or negative) of each group of sectors to a country's trade balance is proportionally equivalent to its weight in total trade (import plus export), then the values of the ICTB indicator for that group of sectors (or group of products) will be zero. Hence, positive ICTB values indicate those sectoral groups with positive contributions to trade balance greater than their weight in total trade. Therefore, they represent sectors with comparative advantage in trade specialization of a given country. Opposite considerations are associated with negative ICTB values. They identify those commodity groups for which a country more or less greatly depends on other countries (comparative disadvantages) and which generate a relatively high trade deficit (11). The ICTB indicator has been worked out for each year in the period from 1970 to 1987.

In the case of Japan, in the early 1970s, the scale-intensive and traditional sectors represented the strong points

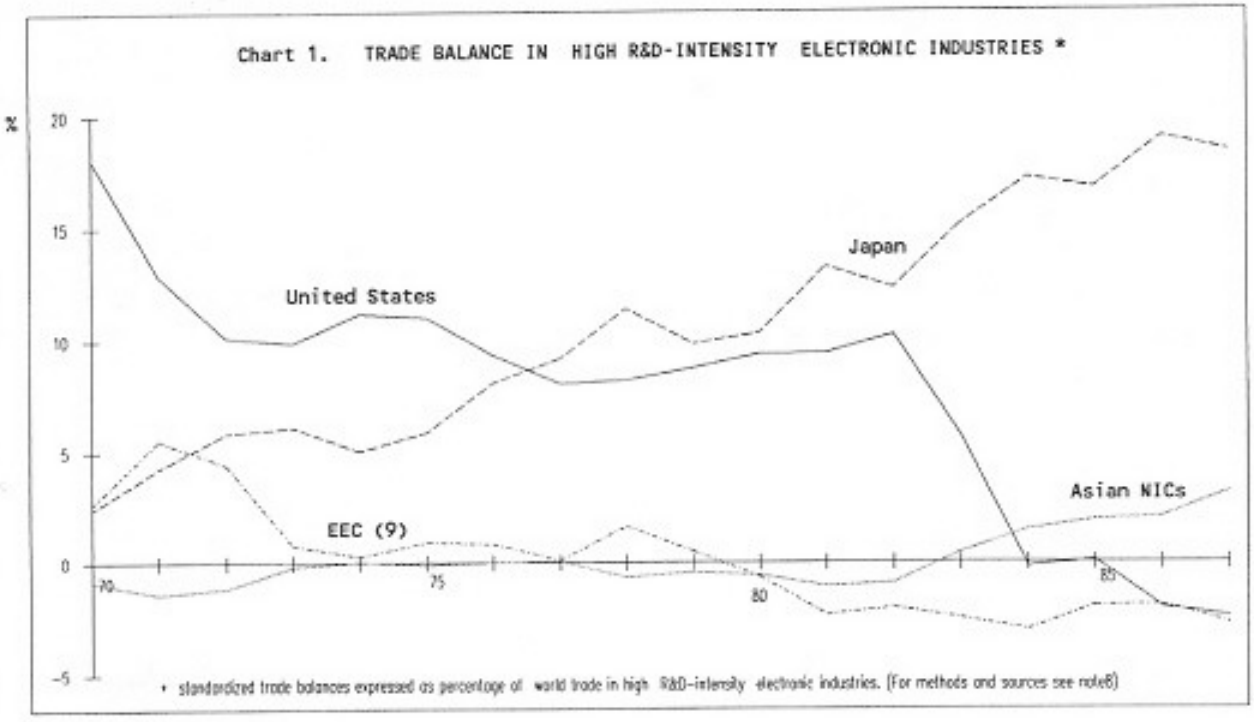
(comparative advantages) of the Japanese industry's specialization pattern (see Figure 1). But since the mid-1970s and throughout the 1980s, profound changes took place. Following a deep industrial restructuring process, with unprecedented intensity and quality in the advanced countries, positive contributions to trade balance strongly increased: (i) in the case of the R&D-intensity sectors (science-based), by a quadruplication of their indicator ICTB (+ 12 percentage points); (ii) for the specialized-supplier sectors, by a doubling of their ICTB (+5.7 percentage points).

The strengthening of Japanese specialization in high R&D-intensity products (science-based) may be largely attributed to the notable gains of Japanese industry in electronics, and particularly in those sectors with the highest technological content (12). In the latter sectors, such as data processing systems, electronic components, telecommunications, the increase in market shares since the early 1970s was impressive such that by 1986-87 Japan became the world largest exporter of electronic products (see Table 11). In terms of trade balance, Japanese performance was even more successful, with huge and increasing trade surpluses, which confirmed its supremacy, quite sharply in most electronic sectors, with respect to other partner countries (see Chart 1).

The adoption of the most advanced product and process innovations, mostly imported by the US, the lower costs linked to large scale production processes, the aggressive industrial and trade policies have all contributed to the rapid rise of Japanese electronic industry in international markets, which severely penalized, as shown below, most of the US and European productions.

The use of new electronic technologies, on the other hand, also sustained the strengthening of Japanese specialization in specialized-supplier sectors (Figure 1), and particularly in industrial machinery, such as numerically controlled machine-tools.

Together with the increase in comparative advantage in science-based and specialized-suppliers, the evolution of



* The R&D intensity electronic industries are those sectors in the electronics that are characterized by a relatively high R&D spending in relation to output and are therefore included in the Science Based group (see Appendix)

Japanese specialization patterns reveals that the scale-intensive sectors significantly decreased their contribution to trade balance since the second half of the 1970s (-14.8 percentage points), even though its value is still the highest in absolute terms (see Figure 1).

A new element has been the great reduction in the role of traditional sectors, which registered negative values of the ICTB indicator in the second half of the 1980s, following a decrease of over 19 percentage points since the early 1970s (Figure 1). Also the share of exports of traditional goods in total Japanese manufacturing exports has significatively declined in the last two decades, to less than half, while there has been a symmetrical doubling of the share of the R&D-intensity group, see Table 13 (13).

Thus, the evolution of Japan's trade specialization pattern has been characterized by a dynamic reallocation of the productive resources, oriented towards a sharply strengthening of the special-supplier and science-based sectors in the 1980s. Given that technological progress is increasingly dependent, as already noted, on the quality and intensity of interaction between innovative and user sectors (Lundvall, 1988), in the case of Japan these intersectoral transmission mechanisms of innovation functioned properly and to a large degree explain the strengthening of the Japanese competitive position in the period considered.

To sum up, Japan's performance seems to show very clear-cut patterns: a rapid growth of manufactures exports strongly concentrated in a restricted number of sectors (14) and a substantial shift in specialization patterns, both based on high and growing technological capability in terms of high intersectoral dynamics of the generation and dissemination of innovations, have led the Japanese industry to achieve the best results of the most advanced countries with respect to nearly all the indicators.

In recent years, however, Japan has had to face both the revaluation of the yen and growing protectionist barriers. The first reaction has been a significant increase of manufactures

imports and especially an upsurge of direct investments abroad, particularly into US market. Hence Japan is now undergoing a changing growth pattern, bound also to modify its domestic economic structure. But it is too early for any sound forecast in this regard.

4. The emergence of the Asian NICs as new competitors

In addition to Japan, it is important to note the remarkable performances of South-East Asian countries - Hong Kong, Singapore, South Korea and Taiwan (Asian NICs) - over the entire period (1970-87), in terms of both rapidly increasing market shares and trade surpluses in manufacturing activity. In the early 1970s Asian NICs market shares accounted for a little more than two percentage points of world manufactures exports. By the late 1970s this figure had doubled and throughout the 1980s increased so much that by the end of the period under consideration it was four times higher than it had been initially (see Table 1).

The CMSA reveals that this export market share increase was largely attributable to a positive 'competitiveness' effect; however, 'structural' effects associated with a favourable market and commodity export composition also greatly contributed, particularly in the 1980s, to the Asian NICs upsurge in world market (see Table 12).

Even in terms of trade balances, Asian NICs achieved substantial gains in the period under consideration. From trade deficits in the 1970s they shifted to increasing surpluses in the 1980s, registering an overall increase in the period 1970-87 almost equal to that in Japan (2.7 percentage points of total world trade in manufactures (Table 2) (15).

Such remarkable trade performance may be connected with the export-led growth strategies followed by Asian NICs countries since the end of the 1960s. A massive allocation of productive resources in those industrial sectors with highest export

potential was the main goal of these strategies. To this end either state interventions or incentive and subsidy policies were used on a large scale and in different forms (Bradford and Branson, 1987).

The industrial development of Asian NICs has thus been initially supported by production and export of consumer goods requiring large amounts of unskilled labor, for which they benefitted by the highest comparative (and absolute) advantages. The specialization pattern clearly shows the key role played in the past and even today by traditional industrial sectors for export growth of Asian NICs (see Figure 2). Of the various sectoral groups, only traditional industries maintained consistently positive and relatively high values of comparative advantage indicators (ICTB) over the entire period under consideration. However, the contribution of traditional goods to the trade balance, after increasing consistently until the end of the 1970s, has shown a significantly decreasing trend throughout the 1980s (-6.14 percentage points) (16).

This trend stems from the diversification process of manufacturing output that Asian NICs have been carrying out since the second half of the 1970s, greatly decreasing their import dependence on science-based and scale-intensive sectors, as shown by substantial improvements of trade balance contribution indicators of these two sectoral groups (see Figure 2). In specialized-suppliers sectors, conversely, Asian NICs still registered notable comparative disadvantage in the 1980s (Figure 2).

Further evidence of Asian NICs position in world trade can be drawn from their competitive patterns, measured, as has been done in the preceding section, by the share of world exports and standardized trade balance in various sectoral groups.

Competitiveness indicators show a sharp strengthening of NICs traditional industries on international markets both in terms of a rapidly rising share in world exports (from 6.1 per cent in 1970 to 17 per cent in 1987) (Table 9) and significantly increasing trade surplus (in 1987 equal to 10,3 percentage points of total world trade in traditional goods) (Table 10). This

continued export success of the four Asian NICs, concentrated in sectors such as textiles, clothing, leather and footwear, severely penalized the industries of most European countries and of Japan in the 1970s, while in the 1980s the US industry in particular suffered the most severe losses.

In addition, the four Asian NICs were also able to improve their competitive position in scale-intensive sectors (iron and steel, shipbuilding and petrochemicals) and most of all in science-based sectors (electronics) (17), in both cases considerably increasing their share of world exports and shifting their trade balance from a deficit to a moderate but significant surplus (Tables 3-4, 7-8).

Such gains confirm that the development strategies of the Asian NICs, based initially on poles of competitiveness comprising labor-intensive consumer good exports, gradually put into effect a process of diversification of industrial structure leading toward a strengthening of higher capital-intensive and most of all technology-intensive productions.

In this respect, the achievements of the Asian NICs in electronics are emblematic. In the first half of the 1970s, they succeeded in expanding their share of world export and trade surplus in consumer electronics. Such advances were later used to develop up-stream more technologically sophisticated electronic sectors, such as electronic components and telecommunications, through an import substitution process (most of all in South Korea) that was both complementary to the export-led growth path followed and centered on an 'à la filière' approach which turned out highly effective. This is demonstrated by the increasing trend in the 1980s of world export share and positive trade balances of the East Asia NICs - particularly South Korea - in data processing machines, telecommunications and electronic components (Table 11, Chart 1). Their standardized trade surplus increased considerably in the last decade, surpassed only by the huge Japanese one (18).

Finally, in specialized-supplier sectors, and particularly in mechanical engineering (i.e., machinery for specialized indusries), Asian NICs rising share (Table 5) was not followed by

an improvement of trade balances, which, on the contrary, were negative and quite high throughout the entire period under consideration (Table 6), confirming that the Asian NICs diversification process of industrial structure required increasing imports in these sectors.

To sum up, the pattern of international trade specialization of the Asian NICs was characterized by profound and rapid changes in the period under consideration. It initially centered on labor-intensive consumer products (traditional sectors) and intensively diversified towards both scale-intensive sectors and most of all the electronic industry, with a sharp strengthening in the latter in recent years.

Clearly these countries can no longer be considered only export platforms connected with the redeployment strategies of multinational firms of the major industrial countries. The Asian NICs are at present a sound productive reality and are going to play an increasingly relevant role in world trade in the 1990s.

5. The deterioration of the US competitive position

Against the rise of the Asian countries, there was a relative decline in the US international competitive position throughout the period under consideration. The evolution of aggregate trade flows shows a changing pattern of the US industry's competitiveness, especially since the late 1970s, diametrically opposed to the one characterizing Japan.

The US share in world manufactures exports experienced a sharp decline from 1970 to 1987, which is ditributed over the entire period (see Table 1). The results of CMSA (Table 12) show that this decrease is wholly attributable to a loss of US industry competitiveness both in the 1970s and 1980s since structural effects, comprising a positive commodity effect and a negative market one, on the whole played only a marginal role.

Further evidence that the US trade performance in the last two decades was anything but positive stems from trade balance

patterns, showing a persistent deficit since the mid-1970s which has grown enormously in the last decade, mostly a consequence of the increasingly large trade deficit in manufactured products (Table 2). After the first oil shock, the US economy, unlike all other more advanced economies, was not able to counterbalance growing oil deficits, however moderated by positive net exports in food products, through adequate trade surpluses in manufactures. Despite the depreciation of the dollar in the second half of the 1970s, the manufacturing trade balance only partially improved, while an appreciation of the exchange rate until 1985 led to an enormous increase in the US deficit (9.4 percentage points of world manufactures trade) only partially decreased in the most recent years (19).

This overall deterioration is confirmed by the evolution of US competitiveness in various sectoral groups, though it has followed quite different patterns.

The most negative results have been those in specialized-supplier sectors (mechanical engineering, i.e. machine tools), in which the US industry sharply declined either in the 1970s or in the 1980s, accumulating a large decrease in its share in world exports (from 22.8 per cent in 1970 to 11.0 in 1987) (Table 5) and a huge increase in its trade deficit (-19.7 point in percentage of total world trade of this sectoral group) (Table 6) (20). The CMSA results demonstrated that these losses can be mostly attributed to a strong deterioration in the competitiveness of US mechanical engineering sectors (specialized suppliers) (see Table 12), to the advantage of Japan and European (German and Italian) industries.

In traditional sectors the US economy also experienced a declining market share and a growing trade deficit, primarily in the last decade (see Tables 9-10) (21), while in scale-intensive industries the losses were equal to those registered by the manufacturing sector as a whole (Tables 7-8).

Only in science-based sectors the US industry maintained a positive trade balance even in the 1980s, but also in this case manifested a sharp decrease either of its share in world exports (from 29.2 per cent in 1970 to 19.8 per cent in 1987) or of its

surpluses in the last two decades (see Tables 3-4). In this respect, it is in the electronic sectors of science-based groups that the American firms suffered the heaviest losses, as a consequence of the rapid and strong rise first of Japanese firms and then of Asian NICS ones.

In the early 1970s, US industry enjoyed a position of relative strength and supremacy in most areas of electronics. Over the last two decades, however, in successive periods of decline affecting first electronic office products, then electronic components and , most recently, data processing equipment, the US registered a marked deterioration in its competitive position. The notable decrease in market shares, particularly when considered together with the strong decline in trade balances over the last decade, is a clear evidence of the significant loss of competitiveness of US electronic industries as a group (see Table 11, Chart 1)(22). Therefore, although US firms continue to hold a strong competitive position in certain key sectors of electronics (e.g. information technologies), figures for the period considered here clearly demonstrate that there has been a distinct shift in relative strength in favor of the Japanese industry for the electronics complex as a whole.

Two sets of contrasting interpretations have emerged to account for this overall negative performance of US industry: (i) a rather optimistic view attributing the decline in competitiveness to cyclical factors, particularly the 1980s appreciation of the dollar; (ii) a more negative view, which sees the decline as the result of long-term and pervasive ills of the US industry due to structural factors (23).

The first of these interpretations is supported by the negative US export performance in the first half of the 1980s, which may also be attributed to adverse cyclical trends (e.g. the strong and prolonged appreciation of the dollar and the negative domestic growth differentials), and which may partly account for the rise in the US trade deficit in this period.

But the current difficulties of US industries cannot be explained solely by these relatively recent events. As has been shown above, in many cases indicators reveal negative trends

dating from the second half of the 1970s. Similarly, the sharp decrease in the market shares of US industries, as indicated by CSMA results, is largely attributable in all the sectoral groups to a loss of competitiveness of US productions over the course of the entire period considered here, rather than to negative effects of product and market composition (see Table 12).

The foregoing leads to the conclusion that the relative decline of the US competitive position also derives, as the second more negative set of interpretations maintained, from structural disadvantages that should not be easy to neutralize, even in the presence of a significant reversal of trends in the exchange rate of the dollar, as has been the case. The major structural problems associated with the competitiveness of US firms include (Cohen and Zysman, 1987; Teece 1987; Dertouzos et al., 1989): a decline in many sectors of a formerly uncontested technological leadership; a trend toward decreasing productivity; an inadequate development of process innovations, particularly in the incremental type; the gradual obsolescence of management and organizational models for production. These are multi-faced problems requiring complex solutions, the results of which will only become evident in the medium-long term.

Indirect evidence of the above lies in the evolution of the trade specialization pattern of US industry (see Figure 3). US comparative advantages have been and are increasingly concentrated in R&D-intensity product groups (science-based), most of which are characterized by high growth rates in world demand (24). The weight of science-based exports with respect to total US manufactures exports is also very high and has been rising in recent years (Table, 13) (25).

The other strong point of US specialization is food items and industries, as is demonstrated by its comparative advantage in this area until the firts half of the 1980s, despite a slight decrease in recent years (see Figure 3).

In the scale-intensive industries (particularly automobiles) and traditional industries (especially textiles and clothing) on the other hand, there has been a consolidation of a relative despecialization of the US industry in the last two decades.

Following sharp fluctuations including a period of recovery in the 1970s, and a subsequent phase of deterioration of equal magnitude in the 1980s, comparative disadvantages in both these sectors at the end of the period were virtually equal to those at the beginning of the 1970s.

The new element in the evolution of the US pattern of specialization is the sharp decrease in the positive contribution to trade balance (ICTB) of the specialized-supplier sectors such as mechanical engineering (-9.4 percentage points), although they maintained a slight comparative advantage by the mid-1980s (see Figure 3). These sectors also experienced a significant decline in terms of their share in the US total manufactures exports (26).

This trend is indicative of increasing difficulties of US industry in transforming high-level scientific research that continues to be generated in the US into innovative activities and products with significant commercial value in the other manufacturing sectors. The inverse correlation existing between the strenghtening of US specialization in R&D-intensive products and the overall negative trade (industrial) performance indirectly demonstrates that the availability of sources of 'primary' innovation (high-tech sectors) certainly constitues a competitive advantage for a country, but it is not a sufficient condition to assure the technological progress of its industry as a whole. Intersectoral technological links play an increasing role in the process of development and diffusion of 'primary' innovation throughout the economy and in the case of US they did not function properly, impeding a positive technological adjustment in many 'user' sectors, such as the specialized-suppliers.

To sum up, the patterns of US trade performance and specialization analyzed here demonstrate that it is the combination of adverse cyclical macroeconomic factors and long-standing competitive disadvantages of a structural type which accounts for the relative deterioration in the international standing of the US economy. While it is true that the US still maintains a position of relative strength in terms of industrial

structure in science-based sectors, its specialization appears increasingly threatened by the rise of Japan and other Asian countries in many important industries, such as electronics and mechanical engineering.

More recently, with the strong depreciation of the dollar, trade performance, especially in terms of export growth, of US industry has improved. However, the production restructuring necessary to bridge the competitive gaps generated by adverse trends in the past sill appears to be a long and difficult process to accomplish.

6. The European Community's international competitiveness: widely differing patterns

Unlike the relatively well-defined trends emerging from indicators of trade performance in Japan and in the United States, the pattern generated for the European Community (EC) is more complex and not as clearly delineated. The market shares of EC countries as a group with respect to world manufactures exports registered a relative decrease from the early 1970s to the second half of the 1980s (-7.4 per cent), with greater losses (-14.5 per cent) if intra-Community trade is not taken into account (Table 1). This decrease, however, occcurred almost entirely within the first half of the 1980s, and losses have been partly reabsorbed since 1985.

Trends in the Community's trade balance appear more satisfactory. In fact, manufactures trade balance was highly positive throughout the entire period, despite notable fluctuations (see Table 2). A high surplus was maintained until the end of the 1970s, largely as a result of the significant positive net exports with respect to developing countries. In the 1980s, the net decrease in imports of manufactures by developing countries, resulted in a marked reduction in the European surplus in manufactures trade, which was only partially compensated by the positive trade balance with respect to the US, while the

deficit towards Japan has recently increased considerably (27).

This general evolution in European competitiveness has been sharply differentiated with respect to both the performance of its individual member states and trends in various sectoral groups.

First, competitiveness of EC countries in specialized-supplier sectors (mechanical engineering) was very strong in the past and had maintained high levels in the 1980s, with market shares only slightly decreasing and highly positive trade balances (see Tables 5-6). This was the result of the positive performance, on the one hand, of the Federal Republic of Germany, which had maintained a highly competitive position in terms of market shares and trade surpluses, which were the highest of all major industrialized countries; and, on the other hand, of Italy, the only European country which increased both its world market shares (+22.8 per cent) and its positive trade balances (+1.8 points in percentage of world trade of this product group). On the contrary, the competitiveness of France and particularly of the United Kingdom deteriorated sharply, especially with regard to extra-Community trade.

The EC competitive position has also remained firm in scale-intensive industries, despite a slight decrease in market shares (see Tables 7-8). Once again, this may be attributed to the highly differentiated performance of the major EC countries. Germany, in particular, continued to be highly competitive in these sectors, as demonstrated by its increase in market shares following a drop in the early 1980s and by a recent net gain in what had already been a high surplus. France also maintained a trade surplus during much of the period considered here, but it registered a declining trend over the last decade. The competitiveness of Great Britain and Italy, on the other hand, clearly deteriorated, with a considerable increase in their trade deficits in scale-intensive industries.

In traditional products, there was a notable decrease in EC market shares, particularly in intra-Community trade in the 1980s and mostly to the advantage of the newly industrializing Asian countries (see Table 9). It may be attributed to

significant deterioration in competitiveness in United Kingdom, France, and, to a considerably lesser extent, of Germany (Table 10). Italy was the only major country in the Community that did not folllow this trend, as it had strengthened its competitive position in traditional industries during the 1970s and was able to maintain its advantage in this area during the last decade, though with some difficulty in recent years (28).

Finally, in science-based sectors EC countries registered a more uniform performance (Table 3-4). The EC competitive position, which was relatively strong in the early 1970s, experienced a net deterioration in the 1980s. EC normalized trade balance maintained positive and high values by the late 1970s but sharply declined in the 1980s (29). This negative performance affected all EC countries, including Germany. It must be underlined, however, that this negative performance is attributable almost entirely to the significant deterioration of the EC competitive position in all electronic sectors of science-based group. In effect, in data processing systems, in electronic office equipment and electronic components, EC countries registered significant reductions in their market shares and increasing trade deficits to the advantage primarily of Japan and, to a lesser extent, of Asian NICs (30)(Table 11, Chart 1). In the other sectors of science-based group, on the other hand, European industries maintained or strengthened their competitiveness (31).

These trends in the competitive position of EC countries are fully confirmed by their patterns of specialization over the period considered here (see Figure 4). The European industry maintained sound comparative advantages in many chemical and mechanical sectors of specialized-supplier and scale-intensive groups. In fact there was a strengthening of EC specialization in chemicals and pharmaceuticals, rubber products, basic metals and mechanical engineering - such as machine tools and machinery for specialized industries - which, it must be recalled, are vital investment goods for many manufacturing industries. Food items and the food industry constitute a special case as they increased their positive contribution to EC trade balance in virtue of a

highly protectionist Community agricultural policy.

In contrast to these areas of relative strength, EC specialization patterns reveal a declining trend in traditional sectors and above all in science-based electronic industries, particularly those in the 'information technology' area (32). This latter weakness must not be underestimated, as electronic products represent vital inputs in manufacturing restructuring currently underway in all major countries.

These overall trends, however, mask the sharp differences that have characterized, as has already been shown, the trade performances of individual EC countries, particularly the four major ones.

Germany retained its position of competitive strength, maintaining stable market shares at the end of the period considered here and reabsorbing the losses suffered in the first half of the 1980s largely thanks to gains on the European internal market at the expense of its EC partners. This positive German performance may be attributed to a relatively stable patterns of specialization, strong points of which have always been scale-intensive industries (especially automobiles, chemicals and pharmaceuticals) and specialized-suppliers (particularly industrial machinery and mechanical components) (see Figure 5) (33). This consolidated 'coherence' of German specialization also favored a rapid diffusion of technical progress into the entire production system through a strong and positive interaction between innovation production sectors and user sectors. The evolution of the competitive position of German industry is thus one of renewed strength with respect to its EC partners. If other more industrialized countries, such as Japan, are also considered, however, the German position appears less strong, because of the relatively poor performance of German exports in sectors of key strategic importance for 'primary' innovation such as electronics.

The United Kingdom, on the other hand, has had a distinctly negative trade performance. The deterioration in competitiveness that has characterized the position of British industry on international markets over the last two decades (34) is clearly

reflected in its decidedly unfavorable specialization pattern in the same period (see Figure 6). Comparative advantage indicators registered considerable decreases in all four groups of industrial products (35), while there were increases only in agricultural products and foodstuffs, and especially in the energy sector. A slight reversal in trends in the last few years has not modified these overall negative results of UK trade performance.

French industry, unlike German, is characterized by generally low levels of trade specialization, though there have been significant qualitative and quantitative changes in the structure of its comparative advantages over the last two decades (see Figure 7). High R&D-intensity industries (science-based) have emerged as new strong points, while there has been a relative despecialization in the traditional sectors (36). At the same time, recent years have seen a weak specialization position of France in specialized-supplier sectors, as in the early seventies. These changes are still at work and have not yet yielded the expected results, in terms of replacing old comparative advantages with the new ones, thus mostly accounting for the overall negative trade performance of French industry in the last decade (37).

Finally, Italy distinguishes its position in the world economy by the increasing heterogeneity of its specialization pattern with respect to other more advanced countries (see Figure 8). The trade performance of Italian industry has been decidedly positive over the last two decades (38) and is attributable not only to the the strong competitive position of Italian firms in traditional industries but also to the strengthening in specialization and competitiveness in the sectors of mechanical engineering (specialized-suppliers), such as industrial machinery (machine-tools). This was the result of the process of extensive restructuring in Italian industry beginning in the mid-1970s, based largely on application and diffusion of mostly imported technology, which also allowed some so-called mature sectors to be revitalised. In this respect, the case of Italy shows that the concept of maturity of sectors should be treated with extreme

caution, since technological change may remove the ageing symptoms of the more traditional industries.

In the case of Italy, this external acquisition of technological input, however, also resulted in increased deficits and despecialization in many science-based sectors and in certain scale-intensive product groups (such as chemicals), with disturbing implications for the future position of Italian industry in world economy.

In sum, the figures in the previous analysis are indicative of complex trends in the EC, which cannnot be unequivocally interpreted. In an effort to compensate for the relative loss of competitiveness experienced particularly in high-tech sectors in the early 1980s, the EC initiated moves toward the 1992 Single Market in an attempt to eliminate excessive rigidities and constraints on their economies. The renewed growth and recovery in investments in Europe in the last two years are indicative of the beginning of an economic revival of European countries, which seems destined to be reinforced by the new opportunities for integration offered by Eastern European countries. It must be emphasized, however, that the major EC countries have been characterized by significant different patterns of specialization and competitiveness in the past decade, and these differences are bound to be of particular importance once the 1992 internal market is completed.

7. Concluding remarks

The rapid development of world trade in the last two decades was accompanied by profound changes in the product and market patterns of trade flows. The new shape of the international trade environment, together with the new technological opportunities stemming from accelerated growth of product and process innovations, affected all the major countries and speeded up structural adjustments in their industries.

This paper concentrated on relative trade performance of different countries and on their trade (industrial) specialization, that is, on the degree to which their structural changes were consistent with the international competitive environment. In effect, trade performance and specialization provide a relatively objective and convenient test of comparative efficiency in each industry for each country.

Most world trade in manufactures products is today composed of a two-way exchange of fairly similar goods at sectoral level (intra-industry trade) between countries which are increasingly similar in their 'classical' factor endowments; however, this has not led toward a convergence in the pattern of international trade of the industries of the most advanced countries, quite the contrary. As this paper has demonstrated, the process of trade (industrial) adjustment followed different patterns in the major economies and most of all it met with very different success. Each major country presents a different structure of trade specialization and comparative advantages and these national differences increased rather than diminished in the last two decades, bringing about major changes in countries' relative competitive positions.

Among the major countries, Japan undeniably achieved the best trade performance in the last two decades, as all indicators used here demonstrate. This notable progress on international markets may be attributed to the profound changes in the patterns of Japan's trade specialization in the last two decades. It has adapted to the changing dynamic and commodity composition of world demand much more and better than have the specializations

of the other major countries, sharply strengthening both specialized-supplier and high R&D-intensity sectors (science-based), particularly electronics. The case of Japan shows that factors of a technological order deeply influence the competitive position of a country in world market, mostly through the proper functioning of the intersectoral network of generation and dissemination of innovation at the level of the industry as a whole.

Together with the notable rise of Japan, the emergence of the South-east Asian countries as new strong competitors on international markets should be underlined. As has been shown by using the new data base on world trade, the continued export success of the Asian NICs, based initially on products with a high content of unskilled labor, was subsequently the results of more capital-intensive and most of all technology-intensive products, such as electronic goods and equipment. The Asian NICs thus now hold a prominent position on international markets and they seem destined to play a first-rate role together with other major industrialized areas in the 1990s.

The rising competition of Asian countries has increasingly affected the other advanced countries, and primarily the US and European area.

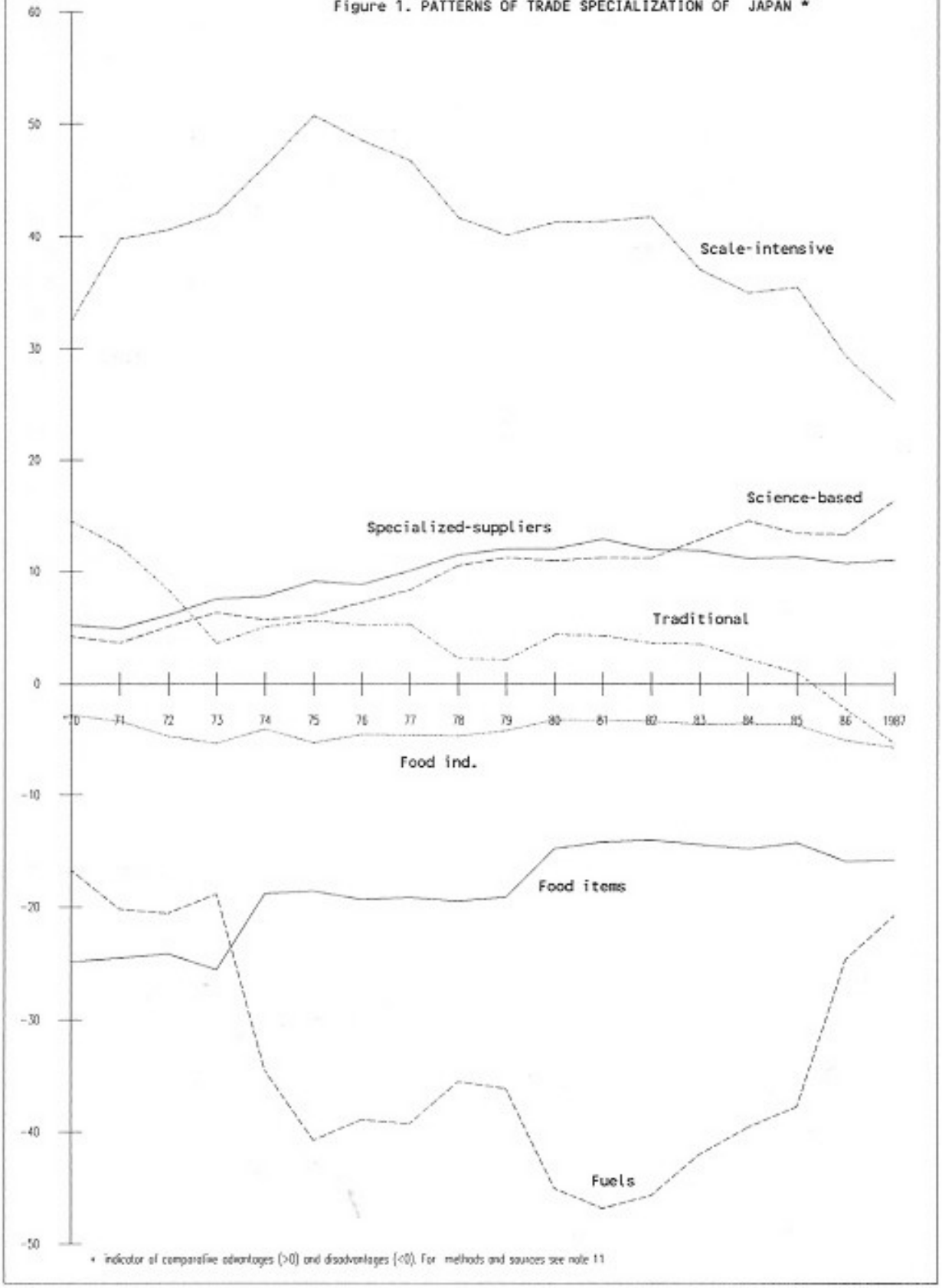
The United States suffered a marked deterioration of its international competitive position on the whole. Almost all the indicators provide unequivocal signs of this competitive decline, which may be attributed not only to cyclical factors, but mostly to long-term structural competitive disadvantages that will not be easy to neutralize. The US still enjoys oustanding comparative advantages in R&D-intensity product groups, but it has been increasingly difficult to transform its high-level research capability into competitive industrial products, as evidenced by negative trends in many other manufacturing sectors. The US case shows that technological capability of a country is a difficult concept to define and quantify. This stems from the fact that each country has a very different pattern of technological and trade competitive advantages and no general common pattern exists. A sound competitive position in sources of 'primary'

innovation, such as high-tech (science-based) sectors, as in the case of the US, is not a sufficient condition for assuring a given country a positive trade performance. The dynamism of the innovation process increasingly depends on the intensity and the quality of the interaction between innovation production sectors and user sectors, which has been anything but positive in the US case in the last decade.

The patterns of trade performance and specialization of the EC countries was more complex and do not provide clear-cut indications. On one hand, the competitiveness of EC countries was very sound in the past and strengthened in the 1980s in specialized-supplier and scale-intensive industries; in traditional product and, above all, in science-based electronic sectors, on the other hand, the EC registered rather negative results on the whole. It should be underlined, however, that these general trends have been sharply differentiated with respect to individual member states. The rather positive trade performances of Germany and Italy, that are both due, although in different manner, to a favorable intersectoral dynamics of the dissemination and application of innovations, contrast with the more uncertain outcomes in the case of France and, especially, with the negative trade patterns of the United Kingdom.

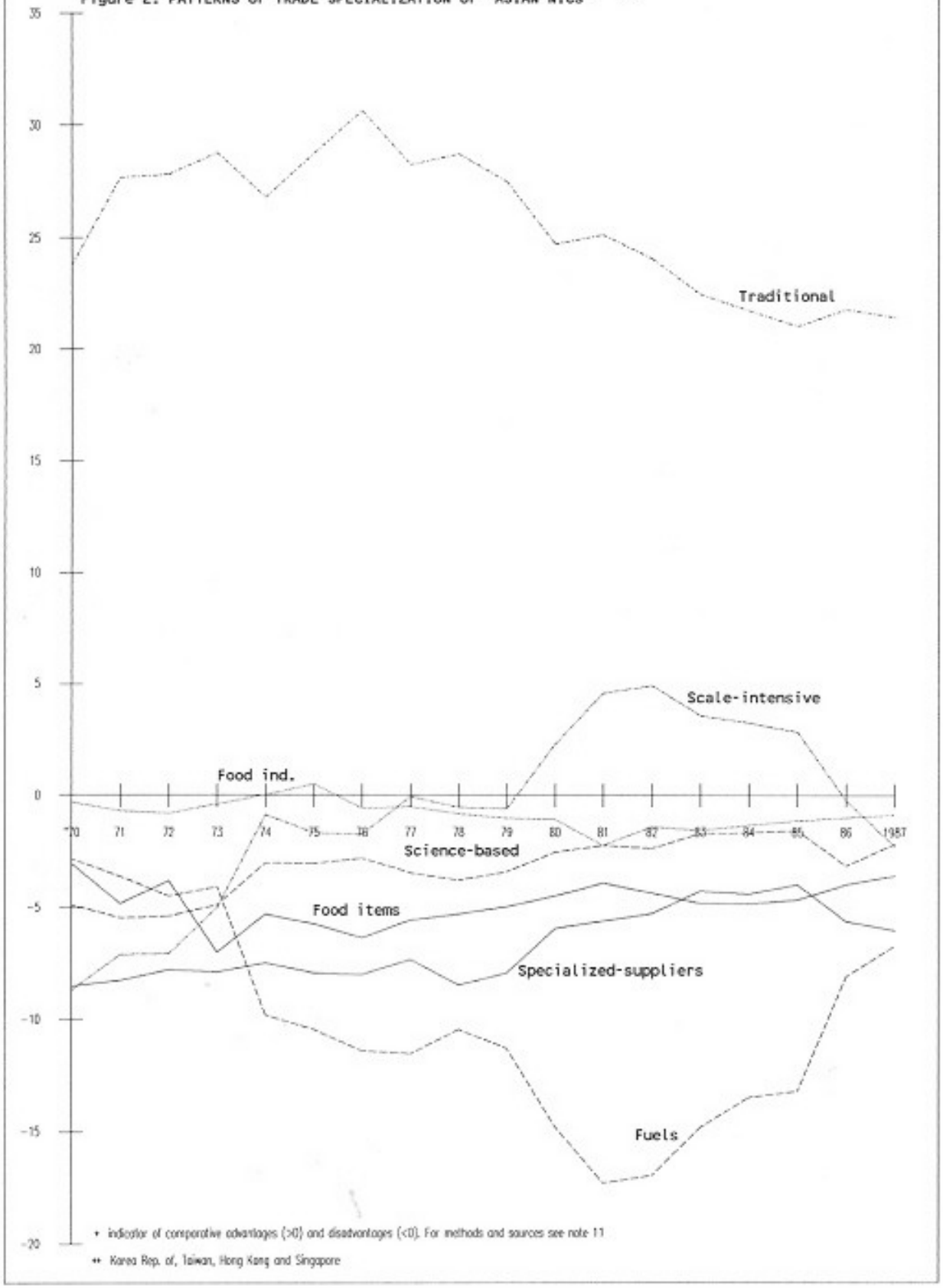
In an effort to compensate for the relative loss of competitiveness experienced particularly in the high-tech sectors, the EC launched the 1992 Single Market initiative. The renewed growth and recovery in investment in Europe in recent years could be indicative of the beginning of a long-run economic revival of European countries; however, it will depend, among other things, on the Europe's ability to overcome its competitive weakness in electronics.

Figure 1. PATTERNS OF TRADE SPECIALIZATION OF JAPAN *



* indicator of comparative advantages (>0) and disadvantages (<0). For methods and sources see note 11

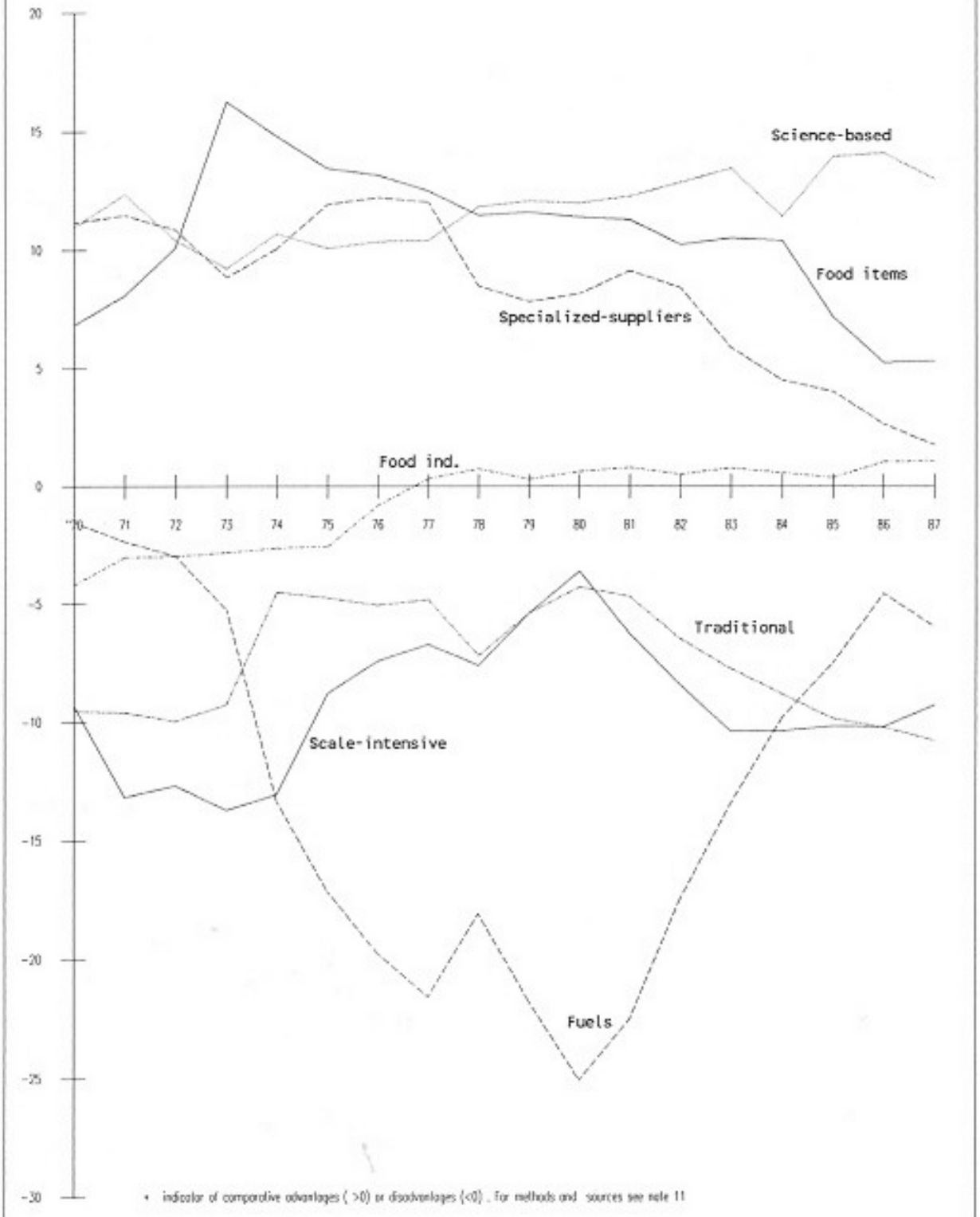
Figure 2. PATTERNS OF TRADE SPECIALIZATION OF ASIAN NICs * **



* indicator of comparative advantages (>0) and disadvantages (<0). For methods and sources see note 11

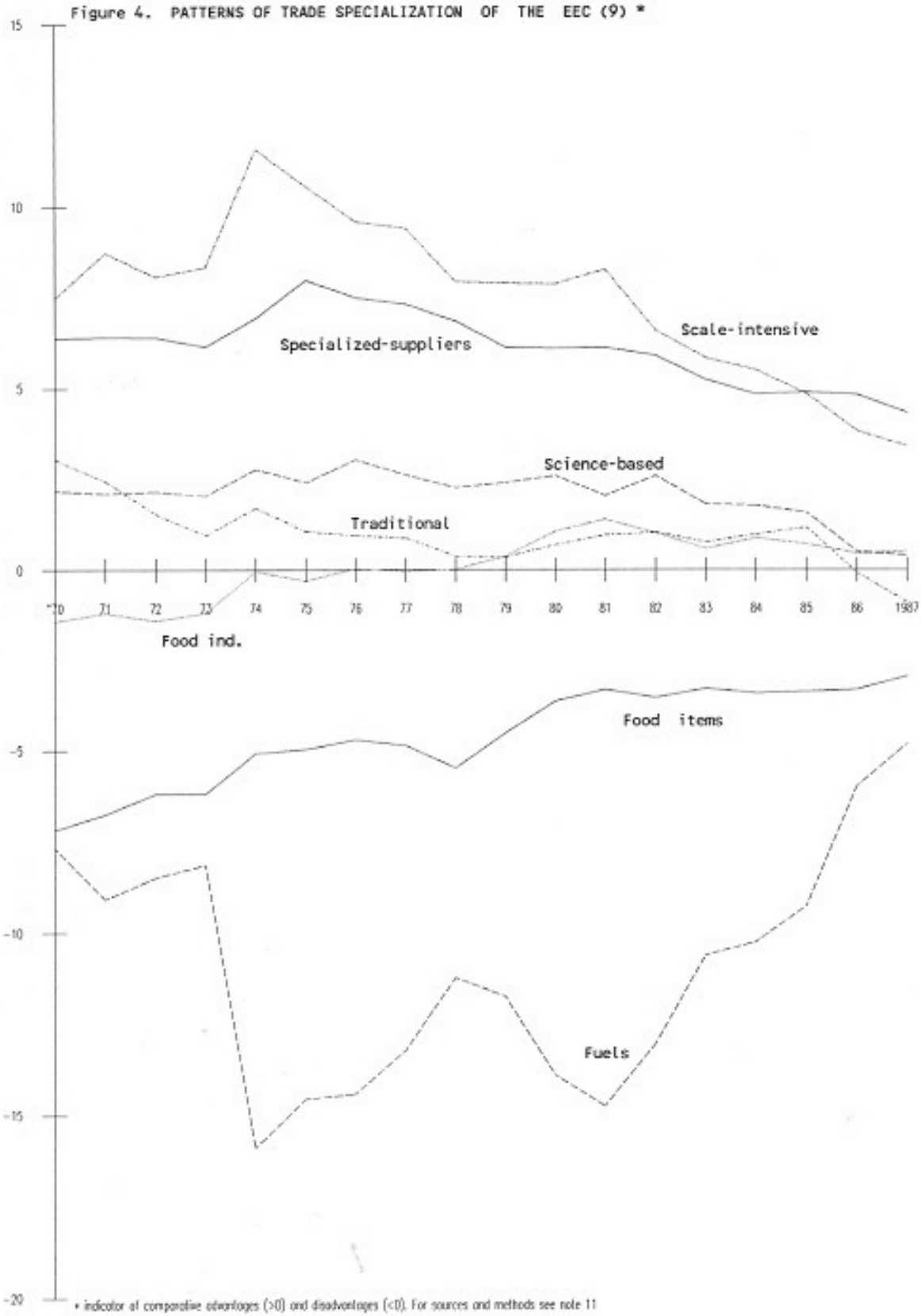
** Korea Rep. of, Taiwan, Hong Kong and Singapore

Figure 3. PATTERNS OF TRADE SPECIALIZATION OF THE UNITED STATES*



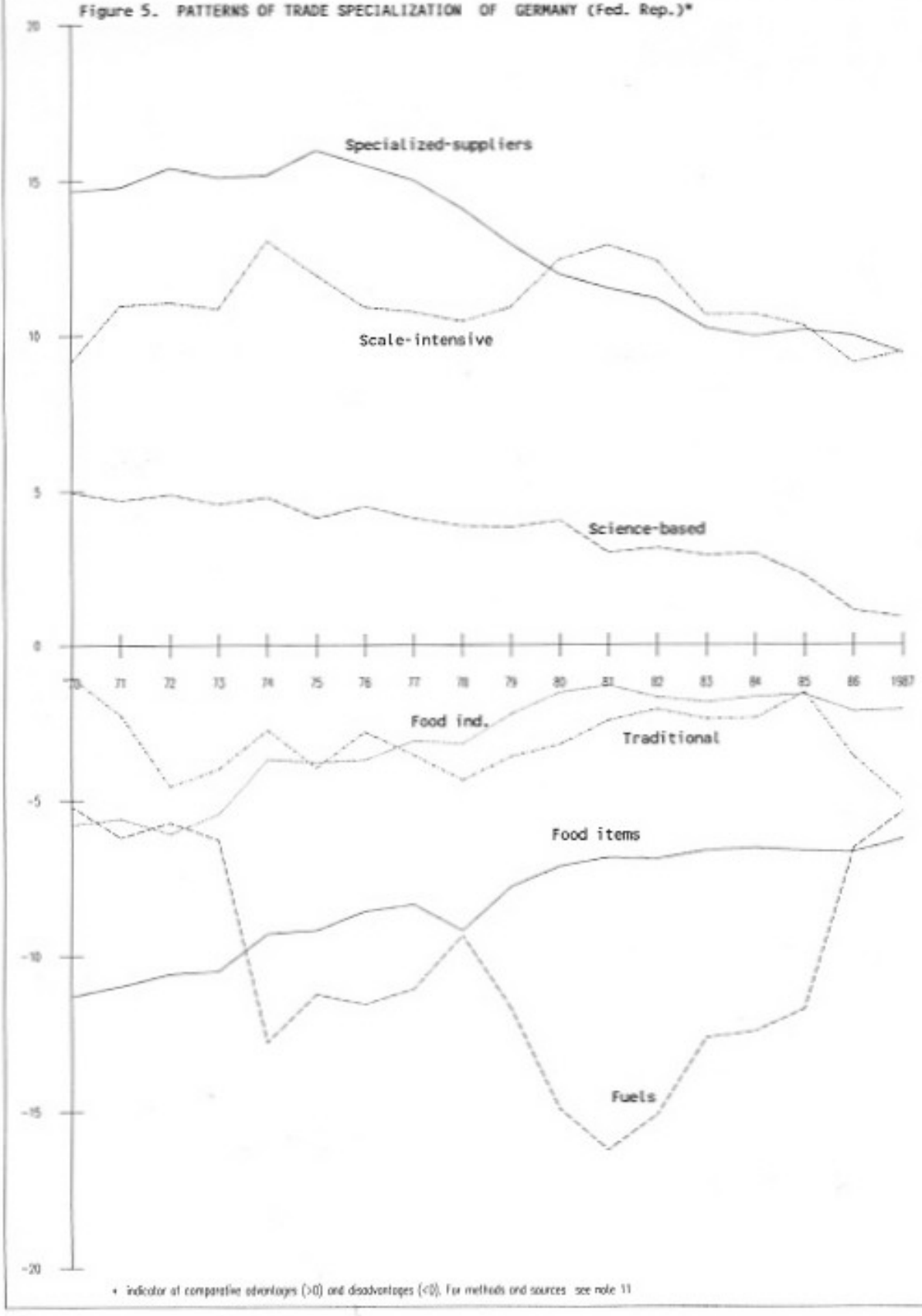
* indicator of comparative advantages (>0) or disadvantages (<0) . For methods and sources see note 11

Figure 4. PATTERNS OF TRADE SPECIALIZATION OF THE EEC (9) *



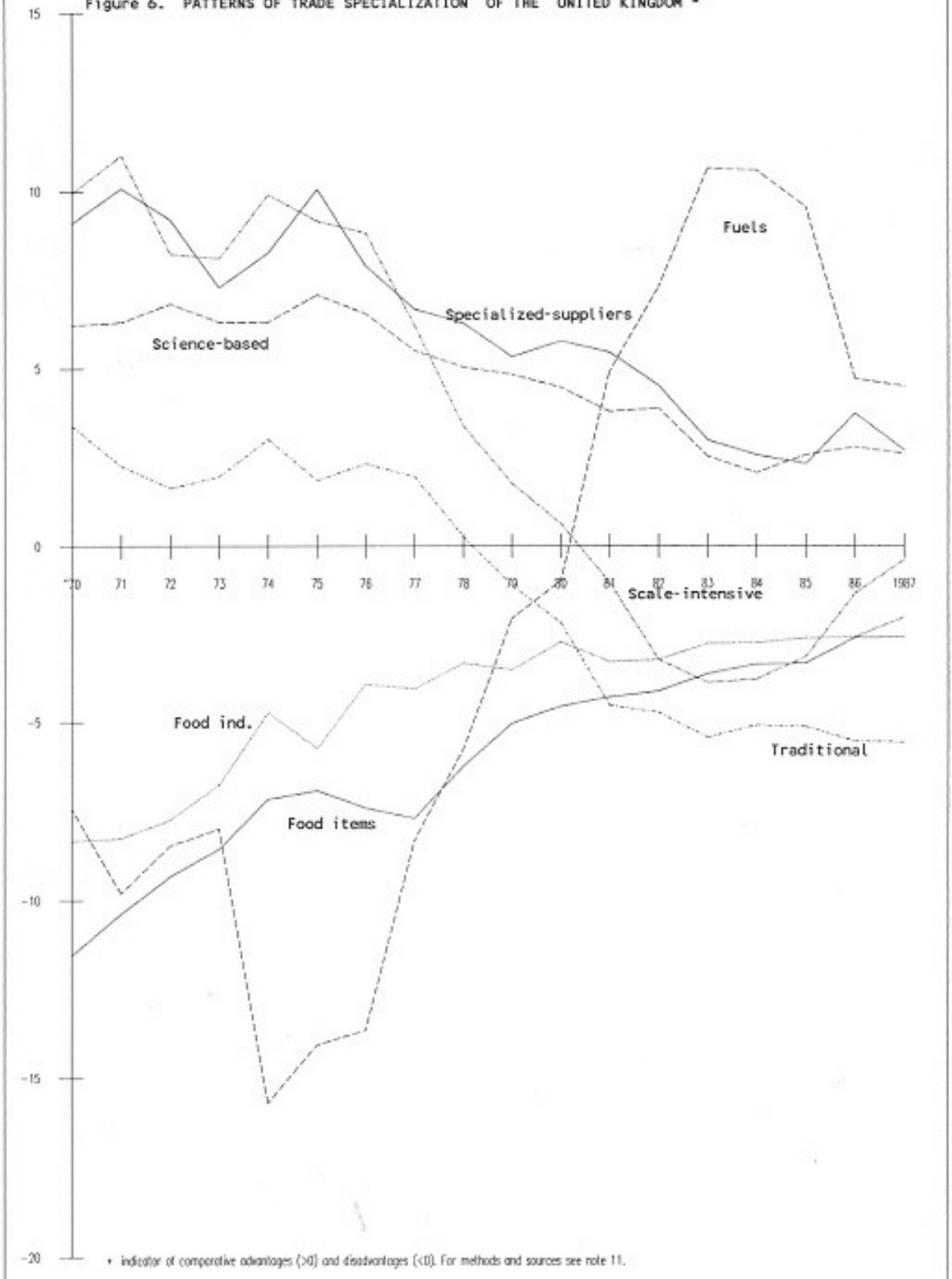
* indicator of comparative advantages (>0) and disadvantages (<0). For sources and methods see note 11

Figure 5. PATTERNS OF TRADE SPECIALIZATION OF GERMANY (Fed. Rep.)*



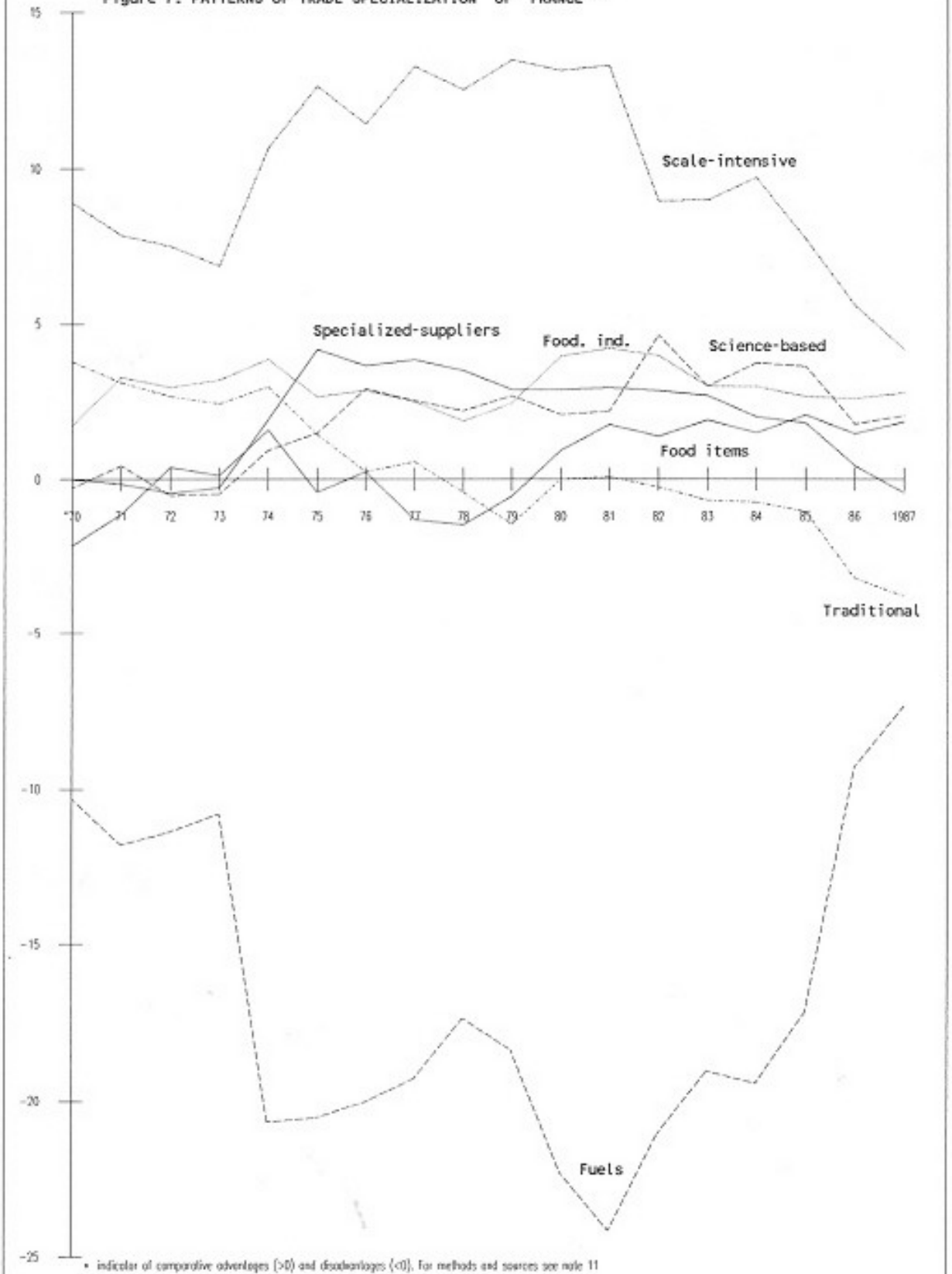
* indicator of comparative advantages (>0) and disadvantages (<0). For methods and sources see note 11

Figure 6. PATTERNS OF TRADE SPECIALIZATION OF THE UNITED KINGDOM *



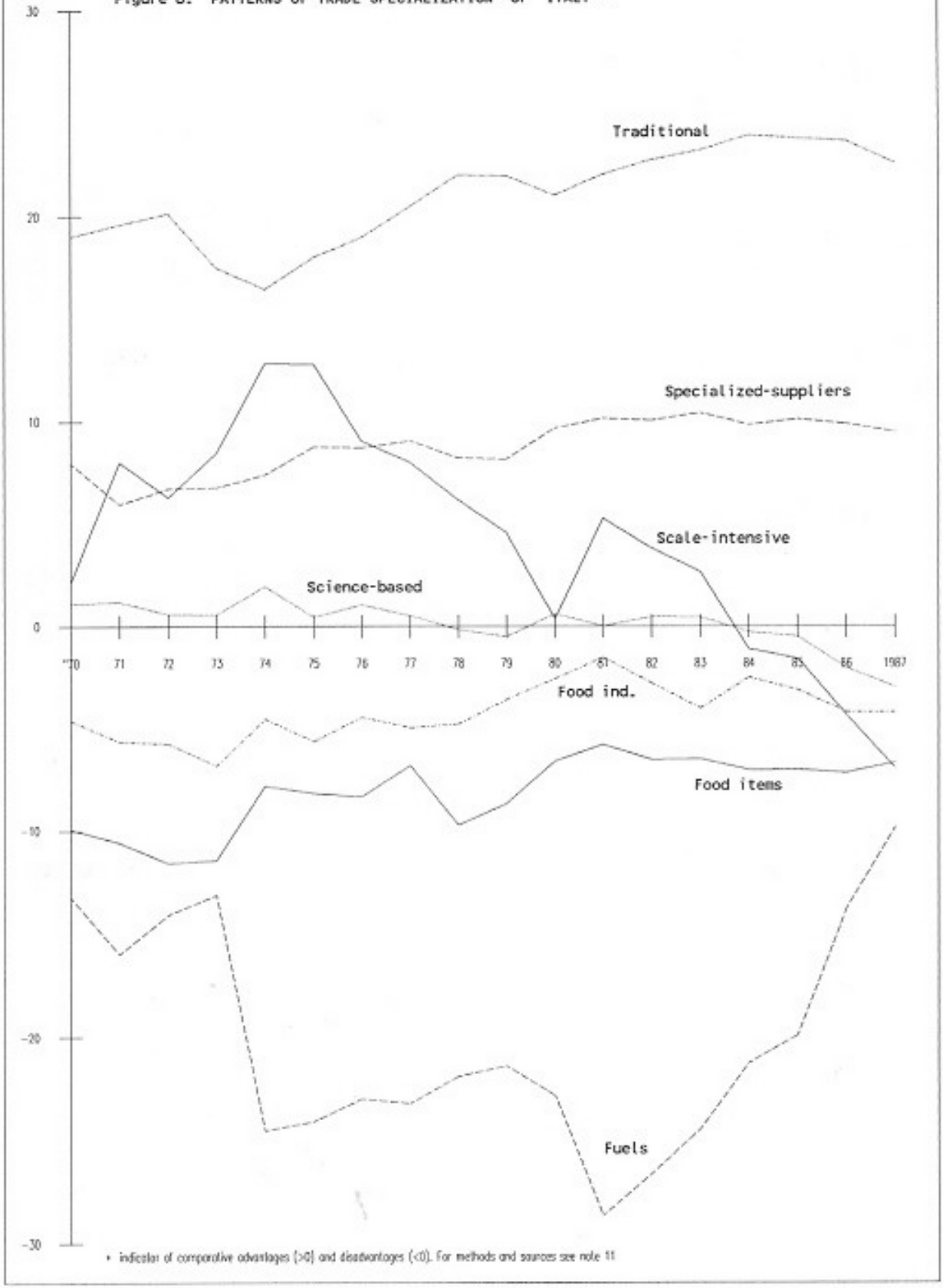
* indicator of comparative advantages (>0) and disadvantages (<0). For methods and sources see note 11.

Figure 7. PATTERNS OF TRADE SPECIALIZATION OF FRANCE *



* indicator of comparative advantages (>0) and disadvantages (<0). For methods and sources see note 11

Figure 8. PATTERNS OF TRADE SPECIALIZATION OF ITALY *



* indicator of comparative advantages (>0) and disadvantages (<0). For methods and sources see note 11

Table 1. SHARES OF SELECTED COUNTRIES AND AREAS IN WORLD TRADE IN TOTAL MANUFACTURERS *

(Percentage shares in values)

	1970	1973	1976	1979	1982	1985	1987
OECD	85.91	84.49	84.27	82.29	80.32	79.06	79.59
United States	15.64	12.62	13.22	11.88	13.01	12.18	10.78
Canada	5.46	4.34	4.01	3.53	3.81	4.65	3.77
Japan	8.37	8.79	10.14	9.04	11.06	12.48	11.75
EEC (9)	46.02	47.21	45.96	47.11	42.11	39.52	42.62
Germany	14.51	15.78	14.93	14.67	13.56	12.69	14.55
France	7.05	7.61	7.62	7.99	6.76	6.28	6.64
United Kingdom	8.12	7.06	6.67	7.15	6.16	5.71	5.81
Italy	5.46	5.11	5.31	6.15	5.67	5.41	5.79
Other EEC (9)	10.88	11.65	11.45	11.14	9.96	9.42	9.94
Greece, Port., Spain	1.41	1.72	1.69	1.96	2.04	2.21	2.25
EFTA	8.16	8.08	7.94	7.62	7.01	6.78	7.41
Non-OECD Countries	13.33	14.71	15.51	16.76	19.19	20.46	19.91
MIDDLE EAST	0.81	0.78	1.06	1.05	1.12	1.27	1.11
NICs in ASIA	2.25	3.35	3.95	4.61	6.05	7.48	8.42
China	0.38	0.59	0.47	0.62	1.03	1.19	1.61
OTHER ASIAN C.	1.38	1.64	1.94	2.17	2.29	2.58	2.58
NORTH AFRICA	0.31	0.31	0.29	0.35	0.61	0.59	0.51
LATIN AMERICA	3.39	3.56	3.35	3.55	3.98	3.67	2.84
NICs in Latin America	1.17	1.72	1.32	1.54	1.76	2.31	1.93
COMECON	2.34	2.41	2.54	2.51	2.32	2.09	1.71
Soviet Union	0.74	0.82	0.96	1.02	1.07	0.91	0.66
Comecon Europe	1.49	1.51	1.51	1.44	1.21	1.16	1.03

(*) Ratio of national exports to world exports (percentage)

Source: SIE-World Trade data base

Table 2. TRADE BALANCE OF SELECTED AREAS AND COUNTRIES IN TOTAL MANUFACTURERS *

	1970	1973	1976	1979	1982	1985	1987	87-70
United States	0.41	-1.42	0.45	-1.24	-1.81	-9.43	-8.01	-8.42
Canada	0.25	-0.63	-0.79	-0.38	0.18	-0.21	-0.24	-0.49
Japan	4.73	4.71	6.88	5.34	7.46	8.72	7.36	2.63
EEC (9)	7.51	7.67	8.77	7.26	7.07	5.87	4.96	-2.55
Germany, Fed. Rep.	4.59	5.71	5.21	4.15	4.56	4.03	4.81	0.22
France	0.76	0.78	0.91	1.21	0.21	0.52	-0.25	-1.01
United Kingdom	1.08	-0.19	0.51	-0.21	-0.35	-0.86	-1.21	-2.29
Italy	1.01	0.54	1.36	1.81	1.52	1.15	0.83	-0.18
Greece,Port.,Spain	-1.35	-1.08	-0.86	-0.26	-0.21	0.23	-0.71	0.64
EFTA	-0.81	-0.38	-0.29	-0.11	0.03	0.16	-0.23	0.58
NICs in Asia	-0.71	-0.07	0.49	0.34	1.04	2.05	2.01	2.72
NICs in Latin America	-1.47	-0.89	-1.15	-0.85	-0.32	0.66	0.31	1.78

* Standardized trade balances expressed as percentage of world trade in total manufacturers (For methods see note 8)

Source: SIE-World Trade data base

Table 3. SHARES OF SELECTED COUNTRIES AND AREAS IN WORLD TRADE IN SCIENCE-BASED SECTORS*

(Percentage shares in values)

	1970	1973	1976	1979	1982	1985	1987
OECD	96.25	94.63	92.3	88.63	87.33	85.03	83.81
United States	29.25	25.39	24.41	22.46	25.17	23.87	19.86
Canada	4.87	3.63	3.09	2.06	2.39	2.53	2.15
Japan	7.81	9.07	9.61	10.37	11.6	14.75	16.16
EEC (9)	44.61	46.66	46.15	45.69	41.15	37.14	38.15
(a)	31.62	32.49	32.67	31.45	27.83	24.58	23.83
Germany, Fed. Rep.	15.85	17.33	16.19	15.37	13.83	12.04	13.13
(a)	11.08	12.04	11.28	10.01	8.82	7.62	8.21
France	6.81	7.31	8.61	8.67	7.76	6.73	7.01
(a)	4.41	4.65	6.39	6.15	5.79	4.81	4.58
United Kingdom	9.87	9.48	8.74	9.72	8.93	8.09	7.23
(a)	8.61	8.16	7.23	8.15	7.17	6.01	5.28
Italy	4.61	4.07	4.05	3.81	3.69	3.55	3.55
(a)	2.95	2.89	2.97	2.73	2.72	2.58	2.16
Other EEC (9)	7.48	8.47	8.56	8.12	6.94	6.72	7.22
Greece, Port., Spain	0.41	0.58	0.63	0.73	0.88	0.92	0.97
EFTA	9.12	8.91	8.17	7.09	5.88	5.58	6.26
Non-OECD Countries	3.29	4.91	7.26	9.52	11.35	13.35	15.43
MIDDLE EAST	0.21	0.27	0.42	0.44	0.78	0.79	0.68
NICs in ASIA	1.04	2.32	3.75	4.76	5.42	7.61	9.29
China	0.04	0.07	0.11	0.11	0.16	0.24	0.47
OTHER ASIAN C.	0.22	0.31	0.72	1.25	1.61	1.72	2.15
NORTH AFRICA	0.01	0.03	0.02	0.03	0.07	0.06	0.05
NICs in LATIN AMERICA	0.44	0.59	0.57	0.66	0.82	1.58	1.69
COMECON	0.74	0.76	0.98	1.25	0.64	0.47	0.47

(*) Ratio of national exports to world exports (percentage)
(a) excluding intra-Community trade

Source: SIE-World Trade data base

Table 4. TRADE BALANCE OF SELECTED AREAS AND COUNTRIES IN SCIENCE-BASED SECTORS*

	1970	1973	1976	1979	1982	1985	1987	87-70
United States	18.87	13.79	13.85	10.99	10.91	3.62	1.38	-17.49
Canada	-2.35	-3.47	-2.47	-2.48	-2.19	-2.58	-1.89	0.46
Japan	3.28	4.74	6.19	7.02	8.05	10.99	12.61	9.33
EEC (9)	8.27	8.35	10.63	7.02	6.42	3.72	2.06	-6.21
Germany, Fed. Rep.	7.82	8.65	7.22	5.01	4.15	3.11	3.53	-4.29
France	-0.66	-0.67	1.01	1.01	0.81	0.86	0.15	0.81
United Kingdom	4.03	2.66	2.75	1.83	1.71	0.46	-0.21	-4.24
Italy	0.06	-0.68	-0.07	-0.42	-0.32	-0.61	-1.15	-1.21
Greece,Port.,Spain	-2.89	-3.29	-2.47	-1.54	-1.45	-1.13	-1.81	1.08
EFTA	0.49	0.64	0.43	0.13	-0.17	-0.33	-0.28	-0.77
NICs in Asia	-2.14	-2.32	-1.47	-2.02	-1.51	0.08	0.45	2.59
NICs in Latin America	-3.52	-3.54	-2.96	-2.12	-1.69	-0.48	-0.45	3.07

* Standardized trade balances expressed as percentage of total world trade in science-based sectors (For methods, see note 8)

Source: SIE-World Trade data base

Table 5. SHARES OF SELECTED COUNTRIES AND AREAS IN WORLD TRADE IN SPECIALIZED-SUPP.SECTORS*

(Percentage shares in values)

	1970	1973	1976	1979	1982	1985	1987
OECD	96.74	95.47	95.34	94.54	91.41	91.37	91.21
United States	22.79	19.17	21.06	16.67	19.06	15.26	11.01
Canada	2.21	1.83	1.85	1.99	2.07	2.09	1.68
Japan	6.36	7.45	8.15	10.29	12.35	15.61	14.6
EEC (9)	55.31	56.25	53.51	53.61	46.62	46.53	50.65
(a)	42.65	43.41	42.72	41.88	36.28	35.46	37.91
Germany, Fed. Rep.	24.01	26.55	23.81	22.96	19.02	19.31	22.19
(a)	17.78	20.59	19.31	18.62	14.84	15.02	17.06
France	6.83	7.44	7.99	7.81	6.49	6.14	5.94
(a)	5.15	5.54	6.53	6.19	5.25	4.73	4.33
United Kingdom	10.54	8.63	8.22	8.32	7.71	6.98	6.67
(a)	9.79	8.02	7.34	7.09	6.69	5.94	5.51
Italy	7.14	6.28	6.23	7.24	7.22	7.72	8.77
(a)	5.99	5.14	5.23	5.81	5.91	6.09	6.98
Other EEC (9)	6.78	7.35	7.25	7.27	6.19	6.38	7.08
Greece, Port., Spain	0.67	0.82	0.96	1.34	1.28	1.23	1.39
EFTA	9.09	9.51	9.47	10.31	9.64	10.11	11.25
Non-OECD Countries	3.24	4.51	4.58	5.33	8.43	8.37	8.52
MIDDLE EAST	0.08	0.09	0.12	0.16	0.26	0.32	0.28
NICs in ASIA	0.77	1.52	1.22	1.62	2.44	3.71	4.02
China	0.05	0.07	0.08	0.11	0.21	0.18	0.28
OTHER ASIAN C.	0.21	0.39	0.48	0.49	0.58	0.84	0.87
NORTH AFRICA	0.02	0.02	0.01	0.02	0.03	0.03	0.04
NICs in LATIN AMERICA	0.32	0.48	0.58	0.82	0.88	1.21	1.35
COMECON	1.31	1.41	1.38	1.28	1.12	0.96	0.81

(*) Ratio of national exports to world exports (percentage)
(a) excluding intra-Community trade

Source: SIE-World Trade data base

Table 6. TRADE BALANCE OF SELECTED AREAS AND COUNTRIES IN SPECIALIZED-SUPPLIER SECTORS*

	1970	1973	1976	1979	1982	1985	1987	87-70
United States	14.97	11.13	14.11	7.59	8.99	-1.86	-4.73	-19.7
Canada	-4.34	-3.99	-3.81	-3.34	-2.61	-3.68	-3.09	1.25
Japan	3.14	4.85	6.34	8.35	10.41	13.36	12.43	9.29
EEC (9)	20.52	22.34	24.44	22.87	20.37	18.2	17.44	-3.08
Germany, Fed. Rep.	16.45	19.93	17.79	15.92	13.11	12.67	14.23	-2.22
France	-0.46	-0.47	1.24	1.41	0.44	0.57	-0.89	-0.43
United Kingdom	4.71	2.78	2.96	2.66	2.58	1.01	0.57	-4.14
Italy	2.68	1.81	2.97	3.95	4.24	4.57	4.47	1.79
Greece,Port.,Spain	-3.06	-3.59	-2.34	-1.58	-1.61	-1.09	-2.48	0.58
EFTA	-0.21	0.74	1.45	2.49	2.24	2.18	1.81	2.02
NICs in Asia	-2.64	-2.86	-2.77	-3.72	-3.06	-2.12	-3.18	-0.54
NICs in Latin America	-4.12	-4.09	-3.93	-3.55	-3.21	-1.87	-1.43	2.69

* Standardized trade balances expressed as percentage of total world trade in specialized-supplier sectors (For methods see note 8)

Source: SIE-World Trade data base

Table 7. SHARES OF SELECTED COUNTRIES AND AREAS IN WORLD TRADE IN SCALE-INTENSIVE SECTORS*

(Percentage shares in values)

	1970	1973	1976	1979	1982	1985	1987
OECD	86.31	86.51	85.51	83.51	80.81	79.97	82.84
United States	13.21	10.66	10.85	9.77	9.83	9.35	8.47
Canada	8.34	6.42	5.97	5.17	5.71	7.19	6.09
Japan	10.23	12.05	14.18	11.9	14.62	15.71	14.61
EEC (9)	43.94	46.26	43.89	46.29	40.44	37.31	42.43
(a)	28.56	29.5	27.61	28.63	24.79	22.38	25.48
Germany, Fed. Rep.	14.29	16.11	14.38	14.95	13.69	12.77	15.71
(a)	10.09	11.41	10.24	10.32	9.36	8.63	10.47
France	7.13	7.56	7.53	8.51	6.65	6.21	6.94
(a)	4.23	4.43	4.71	5.21	4.26	3.83	4.21
United Kingdom	7.14	6.01	5.62	5.92	5.15	4.77	5.42
(a)	6.54	5.33	4.48	4.43	3.66	3.18	3.84
Italy	4.42	4.53	4.54	5.21	4.52	3.92	4.16
(a)	2.98	3.11	3.31	3.92	3.44	2.85	2.76
Other EEC (9)	10.97	12.05	11.83	11.71	10.42	9.64	10.21
Greece, Port., Spain	1.04	1.43	1.44	1.85	2.08	2.42	2.36
EFTA	8.46	8.39	7.99	7.77	7.15	6.95	7.89
Non-OECD Countries	13.35	13.17	14.29	16.12	18.72	19.63	16.57
MIDDLE EAST	1.06	0.91	1.54	1.5	1.57	1.86	1.59
NICs in ASIA	1.11	1.89	2.39	2.96	4.59	5.46	5.38
China	0.15	0.21	0.19	0.32	0.68	0.62	0.74
OTHER ASIAN C.	0.96	0.85	1.01	1.1	0.96	1.2	1.03
NORTH AFRICA	0.14	0.22	0.28	0.47	1.09	1.09	0.78
NICs in LATIN AMERICA	0.61	0.86	0.71	1.01	1.59	2.29	1.76
COMECON	2.51	2.67	2.91	3.34	3.51	3.19	2.46

(*) Ratio of national exports to world exports (percentage)
(a) excluding intra-Community trade

Source: SIE-World Trade data base

Table 8. TRADE BALANCE OF SELECTED AREAS AND COUNTRIES IN SCALE-INTENSIVE SECTORS*

	1970	1973	1976	1979	1982	1985	1987	87-70
United States	-2.92	-5.28	-3.88	-4.89	-6.21	-13.44	-11.58	-8.66
Canada	3.33	1.22	1.17	1.13	2.23	1.78	1.46	-1.87
Japan	6.39	8.63	11.1	8.21	10.92	11.9	10.24	3.85
EEC (9)	7.14	9.25	8.88	7.71	5.91	4.71	5.03	-2.11
Germany, Fed. Rep.	4.58	6.48	5.25	4.72	5.22	4.47	6.34	1.76
France	1.21	1.13	1.32	2.21	0.27	0.72	0.14	-1.07
United Kingdom	1.27	0.17	0.47	-0.42	-0.72	-0.94	-1.04	-2.31
Italy	-0.25	0.21	0.61	0.48	-0.04	-0.71	-1.27	-1.02
Greece,Port.,Spain	-1.85	-1.15	-1.22	-0.59	-0.31	0.31	-0.81	1.04
EFTA	-0.91	-0.64	-0.58	-0.27	-0.01	0.52	0.33	1.24
NICs in Asia	-1.26	-0.87	-0.42	-0.48	0.41	0.97	0.33	1.59
NICs in Latin America	-2.17	-1.97	-1.94	-1.64	-0.53	0.62	0.08	2.25

* Standardized trade balances expressed as percentage of total world trade in scale-intensive sectors (For methods see note 8)

Source: SIE-World Trade data base

Table 9. SHARES OF SELECTED COUNTRIES AND AREAS IN WORLD TRADE IN TRADITIONAL SECTORS*

(Percentage shares in values)

	1970	1973	1976	1979	1982	1985	1987
OECD	79.81	74.41	73.84	71.61	68.6	65.1	62.25
United States	7.43	6.66	7.33	6.43	6.71	5.21	4.42
Canada	3.09	3.25	2.51	2.63	2.31	2.91	2.41
Japan	9.29	6.33	6.23	4.63	6.03	5.53	4.01
EEC (9)	48.42	46.22	45.34	45.69	40.94	38.96	39.19
(a)	30.62	27.38	26.41	26.77	24.09	23.41	22.21
Germany, Fed. Rep.	12.06	12.04	12.07	11.07	10.51	10.12	10.69
(a)	7.83	7.59	7.39	6.84	6.52	6.38	6.59
France	7.06	7.27	6.55	6.27	5.74	5.34	5.17
(a)	4.41	4.08	3.94	3.62	3.58	3.28	3.02
United Kingdom	8.51	7.63	7.06	7.76	5.14	4.62	4.39
(a)	7.98	7.07	6.08	6.48	3.89	3.39	2.98
Italy	9.01	7.68	8.81	10.81	10.63	10.51	10.33
(a)	5.65	4.34	4.79	6.03	6.46	6.53	5.91
Other EEC (9)	11.79	11.59	10.85	9.79	8.92	8.38	8.62
Greece, Port., Spain	2.48	2.89	3.11	3.25	3.49	3.52	3.62
EFTA	8.54	8.34	8.61	8.34	7.95	7.41	7.27
Non-OECD Countries	18.24	23.35	25.95	25.77	30.5	33.97	36.82
MIDDLE EAST	1.27	1.48	1.37	1.41	1.29	1.25	1.28
NICs in ASIA	6.13	8.67	10.7	10.64	13.8	15.86	17.01
China	1.11	1.71	1.34	1.69	2.92	3.86	4.97
OTHER ASIAN C.	2.74	3.76	3.97	4.41	4.81	5.72	6.49
NORTH AFRICA	0.57	0.46	0.51	0.46	0.45	0.45	0.76
NICs in LATIN AMERICA	1.02	1.81	1.41	1.53	1.34	1.92	1.68
COMECON	2.82	2.81	3.26	2.58	2.23	2.01	2.01

(*) Ratio of national exports to world exports (percentage)
(a) excluding intra-Community trade

Source: SIE-World Trade data base

Table 10. TRADE BALANCE OF SELECTED AREAS AND COUNTRIES IN 'TRADITIONAL' SECTORS*

	1970	1973	1976	1979	1982	1985	1987	87-70
United States	-8.46	-7.56	-5.66	-6.99	-8.98	-19.07	-15.57	-7.11
Canada	-1.46	-0.63	-1.85	-0.48	-0.78	-0.78	-0.58	0.88
Japan	6.62	1.39	3.05	0.75	2.48	2.04	-0.61	-7.23
EEC (9)	6.53	1.54	0.43	-1.01	1.37	2.69	-0.79	-7.32
Germany, Fed. Rep.	0.82	-0.31	-0.35	-1.68	-0.16	0.45	-0.47	-1.29
France	1.21	0.77	-0.88	-1.27	-1.56	-1.01	-2.03	-3.24
United Kingdom	0.66	-1.18	-0.45	-1.53	-2.24	-2.59	-2.95	-3.61
Italy	5.51	3.94	5.38	7.13	7.16	7.12	6.47	0.96
Greece,Port.,Spain	0.73	1.25	1.51	1.82	1.84	2.08	1.39	0.66
EFTA	-1.66	-0.82	-1.17	-1.18	-1.01	-1.13	-2.13	-0.47
NICs in Asia	2.21	4.65	6.88	6.57	8.24	9.81	10.3	8.09
NICs in Latin America	-0.18	0.91	0.66	0.69	0.47	1.16	0.97	1.15

* Standardized trade balances expressed as percentage of total world trade in 'traditional' sectors (For methods see note 8)

Source: SIE-World Trade data base

Table 11. SHARES OF SELECTED COUNTRIES AND AREAS IN WORLD TRADE IN HIGH R&D-INTENSITY ELECTRONIC INDUSTRIES

(Percentage shares in values)

	1970	1973	1976	1979	1982	1985	1987
United States	35.4	29.3	27.2	29.7	34.5	28.2	22.8
Japan	11.1	15.4	16.1	17.4	19.3	23.8	26.1
Asian NICs	2.1	5.4	8.7	9.3	9.1	12.3	15.8
EEC (9)	31.1	30.4	29.1	26.6	20.9	19.8	19.1

(*) Ratio of national exports to world exports (percentage), excluding intra-Community trade

Source: SIE-World Trade data base

Table 12. Results of the Constant-Market-Shares-Analysis of the exports in single group of sectors (*) 1970-1987 (percentage values)

	Market share changes (c) = (d) + (e)	Effect competi-tiveness (d)	Structural Total (e) = (f)+(g)+ (h)	Structural Market Effect (f)	Structural Commo-dity Effect (g)	Effect Specif. Effect (h)
UNITED STATES, 1970-87:						
Total	-4.86	-4.31	-0.55	-1.12	1.02	-0.45
Food Ind.	-0.72	-1.2	0.48	0.7	0.23	-0.45
Traditionals	-3.01	-1.87	-1.14	-0.77	-0.25	-0.11
Scale intensive	-4.74	-4.02	-0.71	-0.52	0.5	-0.7
Specialized suppliers	-11.77	-8.25	-3.52	-2.55	-0.66	-0.32
Science based	-9.39	-6.25	-3.14	-3.48	0.01	0.34
JAPAN, 1970-87:						
Total	3.38	1.07	2.31	1.97	0.55	-0.21
Food Ind.	-0.93	-1.29	0.37	0.14	0.18	0.05
Traditionals	-5.29	-4.77	-0.51	0.68	-0.82	-0.37
Scale intensive	4.38	2.08	2.31	1.6	1.01	-0.28
Specialized suppliers	8.23	4.29	3.94	3.47	0.21	0.27
Science based	8.36	5.52	2.84	3.57	-0.55	-0.18
ASIAN NICs, 1970-87:						
Total	6.17	3.85	2.32	0.93	1.04	0.35
Food Ind.	1.74	0.88	0.87	0.06	0.3	0.5
Traditionals	10.87	5.26	5.61	2.58	2.71	0.32
Scale intensive	4.27	4.05	0.22	0.1	-0.4	0.52
Specialized suppliers	3.25	2.22	1.03	0.81	0.3	-0.08
Science based	8.25	2.03	6.22	2.1	4.77	-0.65
GERMANY (Fed.Rep.), 1970-87:						
Total	0.04	-0.23	0.27	-0.56	0.22	0.61
Food Ind.	5.6	3.32	2.28	0.95	0.36	0.97
Traditionals	-1.37	-0.29	-1.08	-1.01	-0.41	0.33
Scale intensive	1.42	-0.29	1.72	-0.06	1.32	0.46
Specialized suppliers	-1.82	-1.32	-0.5	-1.01	0.43	0.07
Science based	-2.72	-0.57	-2.15	-1.83	-2.24	1.92
FRANCE, 1970-87:						
Total	-0.41	-0.07	-0.34	-0.72	0.01	0.37
Food Ind.	2.59	0.78	1.81	0.6	0.2	1.01
Traditionals	-1.89	-1.15	-0.74	-0.81	-0.22	0.3
Scale intensive	-0.19	-0.32	0.13	-0.5	0.5	0.13
Specialized suppliers	-0.89	-0.09	-0.8	-0.86	0.17	-0.11
Science based	0.21	1.55	-1.35	-0.82	-0.7	0.17
UNITED KINGDOM, 1970-87:						
Total	-2.32	-2.25	-0.07	-0.32	0.24	0.01
Food Ind.	0.42	-0.44	0.86	0.51	0.23	0.12
Traditionals	-4.11	-3.7	-0.41	-0.74	-0.02	0.35
Scale intensive	-1.72	-1.82	0.1	-0.25	0.33	0.01
Specialized suppliers	-3.87	-3.32	-0.56	-0.16	-0.28	-0.12
Science based	-2.65	-1.35	-1.3	-0.62	-0.36	-0.32
ITALY, 1970-87:						
Total	0.33	-0.05	0.38	-0.26	0.34	0.3
Food Ind.	1.56	1.32	0.25	-0.04	0.29	0.01
Traditionals	1.32	0.66	0.66	-0.1	0.68	0.08
Scale intensive	-0.26	-1.08	0.82	-0.22	0.53	0.51
Specialized suppliers	1.62	1.87	-0.25	-0.45	0.13	-0.07
Science based	-1.05	-0.27	-0.78	-0.53	-0.66	0.42

(*) The CMSA was carried out within each single group of sectors

Source: Guerrieri-Milana (1990)

Table 13. WEIGHTS OF THE SECTORAL GROUPS IN TOTAL EXPORTS BY MANUFACTURING INDUSTRY *

Country	Food Ind.		Traditional		Spec. Suppl.		Scale-intens.		Science-based	
	70-73	84-87	70-73	84-87	70-73	84-87	70-73	84-87	70-73	84-87**
United States	6.2	5.6	10.2	8.5	22.1	14.2	37.8	34.3	23.6	37.4
Japan	1.7	0.6	18.2	7.5	11.1	15.1	57.6	53.1	11.3	23.9
EEC (9)	8.5	8.6	20.4	18.5	17.3	14.5	42.4	41.2	11.4	17.1
Germany,Fed.Rep.	3.1	4.6	15.9	14.9	24.1	18.7	44.1	44.4	12.7	17.4
France	11.9	10.7	19.4	15.7	13.9	11.2	43.6	42.7	11.1	19.6
United Kingdom	6.1	6.6	21.1	14.8	18.8	15.1	38.5	38.6	15.3	24.8
Italy	4.7	4.9	31.2	35.8	17.6	17.6	37.1	30.1	9.4	11.6
NICs in Asia	6.8	3.1	56.2	41.5	5.9	5.9	24.2	29.1	6.7	20.3
World	9.6	6.9	20.1	19.5	14.5	12.3	43.9	42.4	11.8	18.8

* (the sum of the five sectoral groups = 100)
** average value in each sub-period

Source: SIE-World Trade data base

NOTES

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(1) For a survey of this kind of literature see Greenaway and Milner (1986), Grimwade (1989).

(2) Extensive surveys of this literature on innovation and technical change can be found among the others in Freeman (1982), Rosenberg (1982), Scherer (1986), Dosi (1988)

(3) For such kind of studies using sectoral taxonomies of the traditional type referred above see OECD (1985), Kremp and Larroumets (1985), Koekkoek (1987)

(4) Therefore, the important role played by science-base industries in manufacturing system does not rely so much on their technological content, since this latter is also high in other sectoral groups using different means to generate innovations; rather it depends on the fact that their products represent sources of 'primary' innovation to many other sectors and produce important intersectoral effects.

(5) These five classes of products have been formed from the 400 product groups comprised in the database SIE-World Trade (see Appendix)

(6) The three broad economic categories are the followings: food items and agricultural raw materials, fuels, other raw materials.

(7) Export market share of country (j) in total world exports with respect to a given group of products (i) is worked out as follows:

$$MS = \frac{jXi}{wXi}$$

jXi = total exports of country (j) in product group (i)
wXi = total world exports of product group (i)

(8) The standardized trade balance or the indicator of relative competitive position (IRCP) highlights the international distribution over time of trade surpluses and deficits among countries in each group of products. Trade surpluses and deficits are normalized by total world trade in the same group of products (CEPII 1983, CEPII 1989). The evolution of trade balance distribution permits to highlight competitiveness patterns of various countries in a certain group of products. For each country (j) the indicator is given by:

$$IRCP = \frac{Xi - Mi}{WTi}$$

Xi = total exports of country (j) in the product group (i)
Mi = total imports of country (j) in the product group (i)
WTi = total world trade in the product group (i).

(9) The Constant-market-shares-analysis (CMSA) is an accounting method for decomposing a country's export share (or aggregate export) change in world trade into various effects: 'structural change' effects and 'competitiveness' effects. Its usefulness is effectively summarized by Magee (1975, p.221): 'The technique reveals that, even if a country maintains its share of every product in every market, it can still have a decrease in its aggregate market share if it exports to markets that grow more slowly than the world average and/or if it exports products for which demand is growing more slowly than average'.
The CMSA has been here reformulated in a more convenient way in order to overcome the well known methodological limits linked to the traditional applications of this technique. The version of the CMSA applied in this paper decomposes a country's export share change into the following four effects:
a) competitiveness effect: it measures the change of a country's export share due only to competitiveness factors assuming that its trade structure (market and commodity) is constant
b) market effect: it represents the influence of the geographic composition of trade flows upon the aggregate export share of a country. It is positive (negative) if a country concentrate its exports on market that grow faster (more slowly) than the world average
c) commodity effect: it represents the influence of the product composition of trade flows upon the aggregate export share of a country. It is positive (negative) if a country concentrates its exports on products for which demand is growing faster (more slowly) than the world average
d) specific market-commodity effect: it represents the influence on the aggregate export share of a country stemming from specific composition product-markets more (or less) favourable.
The sum of b), c) and d) effects represents the overall 'structural effect', which measures those changes in aggregate export share of a country due only to changes in commodity-market structure in world trade.
For further details on the methodologies of CMSA here used see Milana (1988) and Guerrieri-Milana (1990).

(10) See, among the others, Bremond [1987], Freeman [1987], Saucier [1987].

(11) The indicator of the contribution to trade balance (ICTB) of a country (j) with respect to a given group of products (i) is the following:

$$ICSi = \frac{(Xi - Mi)}{(X + M) / 2} * 100 - \frac{(X - M)}{(X + M) / 2} * \frac{(Xi + Mi)}{(X + M)} * 100$$

Xi = total exports of country (j) in the product group (i)
Mi = total imports of country (j) in the product group (i)
X = total exports of country (j)
M = total imports of country (j)

If the contribution (positive or negative) of each group of products to trade balance is proportionally equivalent to its weight in total trade (import plus export), then the values of the ICTB indicator for that group of products is equal to zero. Hence, positive ICTB values indicate those product groups whose positive contribution to trade balance is greater than their weight in total trade. Simmetrical considerations are associated with negative ICS values.

The sum of the indicators with respect to the various product groups (i) in which the total trade of a country is disaggregated, is equal to zero (see CEPII, 1983).
This indicator has been here worked out with respect to the 9 groups of products in which total trade has been disaggregated for each country.

(12) For a study on world trade patterns in these R&D-intensity electronic products see Guerrieri-Milana (1989)

(12) The share of Japanese traditional exports in total manufacturing exports decreased from 18,2 per cent in the early 1970s to 7,5 per cent in the late 1980s, while the share of science-based exports increased from 11,3 per cent to 23,9 per cent in the same period, see Table 13.

(14) The increase in market share and trade surplus has been mostly concentrated in three sectors: automobiles, machinery for specialized industries, data processing systems.

(15) The Asian NICs registered the highest trade surplus with respect to the US, which also represented the most important outlet for their exports. Slight trade surplus has been registered by Asian NICs also toward EC countries, while high deficits characterized their trade relations with Japan.

(16) The share of traditional goods in Asian NICs total manufactures exports has also significantly decreased over the last decade, though it is still quite high (41,5%), see Table 13.

(17) The CMSA reveals that the gains achieved by Asian NICs in science-based sectors can be mostly attributed to positive structural effects, particularly to a favorable export commodity composition, while increase in market share in scale-intensive industries largely derive from positive competitiveness effects, (Table 12).

(18) The strategies for strenghtening the electronix complex sharply differed for each Asian country, particularly as regard to foreign partecipation in developing the domestic industrial base in these sectors, see Guerrieri-Milana (1990)

(19) Almost all countries partners took advantage from the huge US trade deficit; however, Japan and the Asian NICs were able to reap the highest benefits.

(20) In the case of machine-tools and other machinery for specialized industries, the most negative results have been those in export performance of the US industry in the 1980s, which to a large degree explain the increase in trade deficit in these sectors.

(21) In the textile and clothing industries the US firms were able to maintain their position in international markets in the 1970s; in the first half of the 1980s, with the appreciation of the dollar, the competitive position of US firms sharply deteriorated, with a strong increase in foreign penetration of the US domestic market, particularly by the Asian NICs.

(22) The deterioration in the US competitive position is almost entirely attributable to the rise of Japanese and, more recently, Southeast Asian industries in the US domestic market as well as in other major areas. In telecommunications and electronic office

equipment, the US deficit was largely a result of trade exchanges with Japan, while 70 per cent of the deficit in electronic components originated from the Asian NICs. There is clearly a complementary relationship between the rise of Japan and the Asian NICs in electronic sectors, which has strengthened the capacity of both these producers to penetrate the US market in particular, and the international market in general.

(23) For the first set of interpretations see among the others Bergsten (1988), Lawrence (1984); for the second wiew see Cohen and Zysman (1987), Dertouzos, Lester and Solow (1989).

(24) Among the R&D-intensity sectors, the US has the highest specialization in aerospace industries, which is characterized, as well known, by high public procurements.

(25) The weight of science based (R&D-intensity) exports in total US exports in manufactures was equal to 37,4 per cent in 1987 (23,6 per cent in 1970) and it is the highest of the most advanced countries.

(26) Their weight declined from 22,1 per cent in 1970 to 14,2 per cent in 1987, see Table 13.

(27) Japan is the only country with respect to which the EEC had registered a trade deficit since the early 1970s

(28) In traditional sectors the strong competitive position of Italian industry is confirmed by its positive trade balance patterns (standardized by total world trade in traditional sectors), which reveals an increasing trend despite cyclical fluctuations. Its value by the end of the period considered was higher than it had been in the early seventies. The evolution of Italian export share in world exports in traditional sectors was also very positive, with notable increase in the 1970s (+20 per cent form 1970 to 1979) and a slight decrease in the 1980s (-4.4 per cent)(Table 9).

(29) By the late 1970s, EC trade surplus in science-based sectors was almost equal to that of Japan; by the mid-1980s it felt to one third of the latter (Table 4).

(30) In trade in electronic products, EC registered huge and increasing deficits with respect to both Japan and the US, in the latter case despite the advantage stemming from the appreciation of the dollar in the first half of the 1980. By the mid-1980s even the Asian NICs accumulated significant surpluses with respect to the EC countries in all major sectors of electronics.

(31) The sectoral indicators reveal a positive evolution and a maintenance of the competitive position of European industry in many science-based (R&D-intensity) product groups over the 1980s, such as chemical-pharmaceuticals, electrical machinery, engineering instruments and more recently aerospace, see Guerrieri-Milana (1990)

(32) This is confirmed by increasing negative values of comparative advantage indicators either in data processing systems or in telecommunications and in electronic components.

(33) The scale-intensive and specialized-supplier industries gave positive and almost equal contributions to German trade balance by the mid-1980s (+9,4 percentage points).

(34) The U.K. registered the highest decrease in market share of the four EC major countries (-29,4%), with losses spread over the entire period (Table 1). Its magnitude is able to explain most of that overall deterioration of EC countries market share noted above.

(35) It is mostly in the scale-intensive sectors that U.K. industry registered the major change in its competitive position: its high specialization in the early 1970s (+9,9 percentage point) shifted into a notable despecialization by the mid-1980s (-3,1 percentage point), with only a slight improvement in recent years. In this respect, had been the huge loss in the automobile industry (-13,6 percentage point) emblematic and the main cause of this pattern.

(36) As to science-based industries, the indicator of their contribution to French trade balance registered a positive and notable increase (+2,8 percentage point form 1970 to 1987). The role of traditional sectors, on the other hand, suffered a great reduction since the early 1970s, when they represented a strong point of French specialization. The indicator of the contribution to trade balance of all traditional sectors diminished more than 7 percentage point and registered increasing negative values in recent years.

(37) France registered an overall slight loss in market share over the entire period here considered; however, it was the result of highly differentiated patterns in the last two decades, with a notable increase in market share in the 1970s and a sharp decrease in the 1980s (Table 1).

(38) The Italian share in world manufactures exports registered a significant increase in the second half of the 1970s, suffering a loss of equal size in the first half of the 1980s, followed by a partial recovery form 1985 to 1987, such that at the end of the period its level was slightly higher than it had been in the early 1970s (+5,1 per cent) (Table 1). The Italian trade performance may be evaluated rather positive on the whole with respect, on one hand, to those of other major european countries, and if one considers, on the other hand, the huge rise in international markets of Japan and the Asian NICs in that period.

APPENDIX : SIE-World Trade Data Base

The world foreign trade statistics used for the analysis in this paper stem from the SIE-World Trade data base.
The network of trade data worked out by the SIE (Servizi Informativi per l'Estero) provides detailed information on export and import of 83 countries with respect to 400 product groups, 98 sectors, 25 broad commodity groups and 5 main product categories. The data base includes trade statistics with respect to the 24 OECD countries, the newly industrializing countries (NICs), the other developing countries and the Comecon countries, and makes it possible to examine and analyze the entire world trade matrix. The source for the basic trade statistics of the SIE-World Trade is the publications of the OECD and the United Nations provided on magnetic tapes.
The SIE data-base is organized in different product group classification at various levels of disaggregation (400 product groups, 98 sectors, 25 categories, 5 branchs) according to the two Standard International Trade Classifications (SITC), Revised and Revision 2, defined by the Statistical Office of the UN (1961, 1975) as to the periods 1961-75, 1978-87.

The broad product groups classification used in this paper is based on the 400 product groups of the SIE-World Trade. A summary list of the product groups included in each of the nine classes of products is below provided:

1) Food items and Agricultural raw materials (41 product groups)

Food - Live animals - Animal oil and fats - Natural rubber - Vegetable and animal textile fibres - Cork and Wood - Skins

2) Fuels (4 product groups)

Coal - Petroleum oil - Gas

3) Other raw materials (17 product groups)

Iron ore - Ores of base metals - Other crude minerals

4) Food industry (36 product groups)

Meat and meat preparations - Dairy products - Vegetables and fruit preparations - Cereal preparations - Sugar preparations - Other edible products

5) Science Based (59 product groups)

Synthetic organic dyestuffs - Radio-active and associated materials - Polymerization and copolimeryzation products - Antibiotics and other pharmaceutical products - Nuclear reactors - Automatic data processing machines & Units - Telecommunications equipment - Semiconductor devices - Electronic microcircuits - Electronic measuring instruments - Electric power machinery and apparatus - Internal combustion piston engines - Aircraft & associated equipment - Medical instruments - Optical instruments- Photografic apparatus and equipment

6) Scale Intensive (106 product groups)

Paper and paperboard - Organic chemicals - Inorganic chemical products - Other chemical materials and products - Medicinal and pharmaceutical products - Petroleum products - Rubber manufactures - Non metallic mineral manufactures - Iron and steel - Non-ferrous metal products - Television, radio, other image-sound recorder and reproducers - Household type electrical equipment - Ships and boats - Railway vehicles & equipment - Road vehicles

7) Specialized Suppliers (43 product groups)

Agricultural machinery - Machine tools for working metals - Metal working machinery - Other machine tools for specialized particular industries - Construction and mining machinery - Textile and leather machinery - Paper and paperboard machinery - Other machinery for specialized particular industries - Other general industrial machinery & equipment - Electrical equipment and components - Measuring, checking, analysing instruments - Optical goods - Other miscellaneous products

8) Traditionals or Supplier dominated (76 product groups)

Textile products - Articles of apparel and clothing accessories - Leather manufactures - Footwear - Wood manufactures - Furniture - Paper and printed products - Article of ceramic materials - Glass products - Miscellaneous manufactures of metal (structures, tools, cutlery and other articles) - Jewellery, goldsmiths - Imitation jewellery - Musical instruments - Sporting goods - Toys & games - Other miscellaneous products

9) Residuals (18 product groups)

Other product groups n.e.s.

A complete list of the products included in each group could be provided on request by the author.

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