Intra-industry trade –
An in-depth study of Swedish pump trade

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Preface

The investigation reported in this publication constitutes a part of a doctoral dissertation to be published in october 1992 (Jordan, forthcoming). Since some readers may be interested in the specific issue of intra-industry trade, but less concerned with the conditions for global industrial restructuring, the part dealing with the former issue is hereby published separately.

The English of this manuscript has not been corrected, except through my own humble efforts. Please be indulgent with weird sentences and other errors.

I would like to express my deeply felt gratitude to all the people who have offered their precious time to discuss pumps with me (not always a core interest), especially my advisor Claes-Göran Alvstam, professor Risto Laulajainen, Peter de Souza, Sten Lorentzon, professor Åke Forsström and Mario Zejan (Dept. of Economics, Gothenburg), and all the competent and service-minded librarians at the University Library. A large number of pump industry professionals have generously and patiently explained very basic circumstances to me. I hope I did not misunderstand too much.

Many advices were given, of which too few were given due attention by me. May therefore no shadow from this study fall on anyone but me.

Göteborg, June 1992,

Thomas Jordan

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1. Intra-industry trade – the field of inquiry

Intra-industry trade - a challenge to established theory

In the 1960's a number of economists "discovered" intra-industry trade (IIT), the simultaneous exportation and importation of commodities classified in the same industry. Exploratory studies found that IIT was a wide-spread phenomenon in international trade. From a theoretical point of view this discovery was somewhat disturbing, as IIT fits uneasily into the traditional neoclassical trade theory, the Heckscher-Ohlin-Samuelson (H-O-S) theory. The H-O-S theory assumes that the main cause of international trade is that countries have different mixes of resource endowments. A country specializes in the production of the commodities for which it has favourable resource endowments, compared to other countries. These commodities will be exported, while other commodities, produced by different factor proportions, will be imported from countries whose resource endowment are suitable for that kind of production. In other words, the factor proportions of export and import products will differ. However, if the commodities exported and imported to a particular country are very similar, the H-O-S theory is hard pressed to give an explanation.

This "mismatch" between theory and observed facts has generated a substantial body of studies, both empirical and theoretical. One approach has been to try to reconcile H-O-S theory with IIT, either by arguing that IIT is only a product of heterogeneous items in the commodity classification systems used in official trade statistics, or by constructing models which permit IIT within the H-O-S paradigm. Another approach has been to develop a new trade theory through relaxing some of the more restrictive assumptions of the H-O-S theory, such as constant returns to scale, homogeneous products within industries and perfect competition.

Scholarly occupation with the IIT phenomenon

The occurrence of simultaneous exports and imports in one industry was mentioned in the literature before World War II (Hilgerdt, 1935; Ohlin, 1933; see Grubel & Lloyd, 1975, p. 12f.), but it did not catch wider attention until the 1960's. The establishment of the European Economic Community was based on the argument that market integration would lead to increasing intensity of competition and increasing efficiency because each country in the customs union would specialize according to its comparative advantages. Economists predicted that trade liberalization would lead to increasing

inter-industry specialization. However, empirical surveys discovered increasing intra-industry trade (e.g. Drèze, 1961; Verdoorn, 1960; Balassa, 1965). The results of these early studies attracted some attention among scholars. A number of exploratory studies followed to document the phenomenon in various settings.

It was also noted that foreign trade among high-income countries grew rapidly in the post-war era. The influential study by Linder (1961) discussed the role of similar product composition of demand in countries with similar income levels as an important explanation of the geographical foreign trade patterns.

In 1975 the seminal study by Grubel and Lloyd was published, a comprehensive study of empirical, methodological and theoretical aspects of IIT. Grubel and Lloyd also introduced the Grubel-Lloyd-index (the GL-index, see below), which is still the most employed formula for measurement of IIT. In the 15 years since the Grubel and Lloyd study considerable efforts have been devoted to the study of the IIT phenomenon *[1]*. Greenaway & Milner (1987b) identify four distinct areas of research: theory, measurement (method), empirical evidence and policy implications.

Since several recent literature surveys are available (see e.g. Tharakan, 1983; Greenaway & Milner, 1986, 1987a and 1987b; Gray, 1988; Hansson, 1989; Lloyd, 1989) this section will only deal with issues relevant for the present study.

The research paradigm

Empirical research on IIT is totally dominated by one particular research strategy. This strategy, a variant of the deductive method, is firmly based in the imagined world of theoretical models *[2]*. Logical stringency is considered to be of paramount importance, which means that scholars try to construct models which resemble the real world, while at the same time the variables and the structure are kept simple enough to be analyzed by logical deduction. When a particular problem is to be analyzed, the researcher conceives a hypothesis which might explain the problem, usually in the form of an equation. Then the theoretical variables which are candidates for explanation are translated into operational variables, i.e. real-world information are sought for which might correspond to the theoretical variables. The first choice is to sift official trade and industry statistics for data which might pass as reasonably good indicators of the theoretical variables. The next step is to test the formalized hypothesis on the set of data. The result is that the initial

[1] Among recent research two Scandinavian theses deserve attention, the doctoral thesis by Pär Hansson (1989) and the licentiate thesis by Marja-Liisa Parjanne (1990).

[2] "Imagined" is not used in a pejorative sense here.

hypothesis is rejected, accepted or that the test was inconclusive.

This strategy has some important advantages. The process relies heavily on logic, which means that studies can be checked for consistency and can easily be replicated by other researchers. Data are collected from official sources, conveniently accessible to everyone. If the basic assumptions and the data are accepted as valid, and if no mistakes have been made, the results must be accepted as valid. The method is consequently characterized by a high level of *transparency*. Furthermore, the researcher can exercise control over the model, e.g. by changing the specifications to test for alternative hypotheses. This gives the researcher a valuable opportunity to *experiment* with different possibilities.

There are, however, also some drawbacks. To maintain control the model-world must remain simple. The simplifications may, of course, in the worst case render the models meaningless, as they lose all resemblance to reality (Gray, 1988). Sometimes this problem can be handled by adding new variables, but increasing complexity also reduces the chances of achieving unambiguous results. There are also other problems. The main thrust of development in a field dominated by deductive methods comes from the ingenuity of the researchers' imaginations. New ideas or hypotheses on causal relations are generated by, I would maintain, largely intuitive mental processes. Deductive models do not incorporate a comprehensive and explicit mechanism for *generating* relevant and creative hypotheses. Furthermore, as the “home” of the researcher is in the imagined model-world, and expeditions into the real world are only short excursions while testing specific hypotheses, the strategy exposes very small parts of the model-world to reality at a time. Consequently, it might take a very long time to discover and remedy elements in the model-world which are either *too* outright false or exceedingly simplified to be meaningful.

From this background I would suggest that the existing body of research on IIT could benefit from contributions based on methods which are geared towards *the generation of hypotheses*. The most powerful among these methods is the case study. Among the advantages of the case study is its ability to correct misconceptions on the part of the researcher and the wealth of detailed, perhaps unexpected, information which surfaces. The main disadvantage is the restricted potential for generalization from one particular case to other cases.

The measurement of IIT

Even though alternative conceptions exist *[3]*, the Grubel-Lloyd index

[3] For a discussion, see Parjanne, 1989.

(GL-index) is accepted by most researchers as a relevant way of measuring the share of IIT in industry *i* for a given country:

$$(1) \qquad IIT_i = 1 - \frac{|X_i - M_i|}{X_i + M_i}$$

This GL-index measures the share of IIT in total trade in industry *i.* It can take any value between 0 and 1 *[4].* If the value is 1, all trade is IIT, if it is 0, no trade is IIT.

If the industry is disaggregated into several items, the composite GL-index is calculated for aggregation level *a* according to the following formula:

$$(2) \qquad IIT_a = 1 - \frac{\sum_{i=1}^{n_a} |X_i - M_i|}{\sum_{i=1}^{n_a} (X_i + M_i)}$$

Similar formulas can be constructed for the analysis of IIT disaggregated according to trade partners (see Grubel and Lloyd, 1975, ch. 2). In this study country disaggregation will not be considered.

An example may illustrate how the two GL-indices defined above relates to each other. Imagine the country "Diligentia", which employs a foreign trade commodity nomenclature of which one item is called *123 Liquid pumps* at the 3-digit aggregation level. A further subdivision of the item is provided by the nomenclature, namely: *123.1 Rotary pumps, 123.2 Reciprocating pumps* and *123.3 Centrifugal pumps.* For a given year, Diligentia reports the following foreign trade transactions:

Commodity items	*Exports*	*Imports*
123 Liquid pumps	150	100
123.1 Rotary pumps	10	40
123.2 Reciprocating pumps	5	50
123.3 Centrifugal pumps	135	10

In this case the IIT_i index for "123 Liquid pumps" would be:

$$IIT_i = 1 - \frac{|150 - 100|}{150 + 100} = 1 - \frac{50}{250} = 0.8$$

This particular example yielded a high share of IIT. If the IIT_a formula is applied at the 4-digit level of aggregation, the calculation of the index is as follows:

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[4] However, Grubel and Lloyd multiplied the index with 100 to yield percentages of total trade in their seminal study (Grubel & Lloyd, 1975, ch. 2). Their index consequently varied between 0 and 100.

$$IIT_a = 1 - \frac{|10-40|+|5-50|+|135-10|}{10+40+5+50+135+10} = 1 - \frac{200}{250} = 0.2$$

The composite GL index displays a considerably lower level of IIT than the GL-index calculated at a higher level of aggregation although the same volume of trade is considered. In this case we can conclude that the share of IIT is highly dependent on the level of aggregation. The calculation of the IIT_i index at the 4-digit level gives the following values: rotary pumps: 0.4; reciprocating pumps: 0.18; and centrifugal pumps: 0.14.

The GL-index measures the proportion of IIT in total trade at the chosen aggregation level, but it takes no account of the absolute level of trade flows. This means that it should be applied cautiously, as some items are traded in insignificant quantities. The statistical properties of alternative measures of IIT are discussed elsewhere (Parjanne, 1989; Kol, 1988).

Two practical problems have attracted considerable attention in the literature. The first concerns the distortions of the GL-index due to imbalances in the total balance of payments of a country. Various ways to "correct" the GL-index for trade imbalance have been constructed (e.g. the "Aquino correction", Aquino, 1978). The other problem is of greater significance in the present study: the problem of categorical aggregation. The IIT phenomenon is a result of comparisons of trade statistics, which means that the structure and levels of IIT are critically dependent on the design of the commodity nomenclatures employed in official publications.

Theories of IIT

If the industry definitions of official commodity nomenclatures are accepted, how can IIT be explained? Two main approaches can be identified. The first, the conservative position, is that IIT can be explained within the framework of the H-O-S trade theory. The second, the innovative position, is that "new" trade theory, focusing on scale economies, diversified preferences and imperfect competition yields more satisfying explanations to IIT than the theory based on country-specific factor endowments.

The *conservative* position argues that IIT mainly results from heterogeneity of statistical items. This was the initial reaction of many economists to the phenomenon of IIT. If products within an industry are produced with different factor intensities, IIT is compatible with the H-O-S theory. Some products in a particular industry may be produced by labour-intensive technologies, while other products may require capital-intensive or skill-intensive manufacturing. The products may even be substitutes in demand,

only differentiated by the level of quality: high quality products manufactured by more capital-intensive technologies, low quality products by labour-intensive technologies (Falvey, 1981. See also the discussion and the references in Lloyd, 1989).

A special case of IIT, which is also consistent with the H-O-S theory, is the result of the spatial disintegration of manufacturing processes. For example, labour-intensive operations may be carried out in low-wage countries while other parts of the production process remain located in the home-country. If components are first shipped abroad for assembly or other processing then reimported both exports and imports may be reported under the same statistical heading.

The factor proportions approach to international trade tries to explain the directions and commodity composition of trade *by country-specific factors*. Given sufficient knowledge of various characteristics of a country (notably factor endowment), and of the factor proportions of the commodities traded, we should be able to predict the pattern of foreign trade.

Other explanations of IIT which do not violate the conservative standpoint include border trade, periodic trade and entrepôt trade. Border trade occurs when a supplier on the other side of a national border can offer a lower price or other advantages due to proximity, cultural affinity or other circumstances. Periodic trade may explain IIT in cases when commodities are available only periodically. During one period country A exports domestically produced commodities to country B, while in the next period the flow is reversed (e.g. due to harvesting seasons). Entrepôt trade occurs when commodities are reported as imports and exports during transits thorugh a country to the final destination. However, normally commodities in transit are not reported in foreign trade statistics. Scholars seem to agree that while examples can be found of border, periodic and entrepôt trade, these explanations affect only small portions of the IIT reported (Hansson, 1989, p. 32).

The central argument of the *innovative* position is that the main part of IIT is related to product differentiation in response to diverse consumer preferences. If increasing returns to scale are present, firms cannot supply an infinite range of product varieties. Firms in one country will then export product varieties to other countries which are not produced domestically, to cater to the preferences of certain customers, while competitors of other countries will supply other product varieties to their domestic market, as well as to foreign markets (Krugman, 1979; 1980; Dixit & Norman, 1980; Lancaster, 1980; Helpman, 1981; Lawrence & Spiller, 1983; Helpman & Krugman, 1985).

In new trade theory the explanations of foreign trade are mainly based on *product-specific factors*. This implies that the theory cannot predict *where* certain products are manufactured or the *spatial* patterns of trade, except under some very restrictive assumptions (Greenaway & Milner, 1987a, p. 19f;

Krugman, 1990, p. 2). Consideration of scale economies and differentiation of demand can explain why particular products are not produced in every country, but cannot explain the actual patterns of the international division of labour *[5]*.

While most observers agree that consideration of product differentiation is important in analyzing foreign trade, the concept seems to elude stringent definition in a theoretical framework (see further discussion in a later section). IIT scholars operate with *horizontal* and *vertical* differentiation, the former indicating products of similar quality but different mixtures of characteristics, the latter indicating quality (and price) differences. The concept *national* product differentiation has been used in some studies, reflecting the assumption that consumers would prefer products from a particular country to products from other countries (Hansson, 1989, p. 34).

In a somewhat different frame of reference it has been argued that IIT can occur because of reciprocal dumping in oligopolistic industries. Under certain conditions firms may follow different price strategies in the domestic market and in foreign markets. The reciprocal dumping in foreign markets may lead to two-way flows in identical goods (Brander, 1981; Brander & Krugman, 1983).

In fig. 1.1 the most important explanations of IIT found in the literature are listed. The first two are compatible with the H-O-S theory of trade. Items 3 to 5 are considered to be applicable only for marginal shares of total IIT volumes. Items 6 and 7 are the main explanations advanced by the 'new' trade theory, while the last item is something of an attempt to incorporate behavioural factors.

1. Varying factor intensities in the manufacturing of different products within industries.
2. Vertical disintegration of the manufacturing of individual products into processes with different factor intensities.
3. Border trade
4. Periodic trade
5. Entrepôt trade
6. Scale economies and vertical product differentiation
7. Scale economies and horizontal product differentiation
8. Reciprocal dumping

Figure 1.1 *Explanations of IIT in formalized trade theory*

[5] An integration of the country-specific and the product-specific perspective on the international division of labour is attempted by Porter (1990). However, the complexity of Porter's framework does not allow stringent model-building.

In a radical departure from the deductive strategy Peter H. Gray (1988) proposes the development of a “paradigm” for analysis of the IIT phenomenon, as a complement to formal models. Gray argues that IIT is too complex a phenomenon to be captured by the conventional models. He proposes a framework whose structure is inspired by Dunning's OLI model for analysing foreign direct investment (see, e.g, Dunning, 1988). This framework, or paradigm, is more or less a list of factors relevant for the analysis of IIT.

Gray's framework emphasizes the proliferation of product types and varieties demanded. This vast number of different products cannot be supplied by domestic manufacturers in a particular country due to impediments to produce all product varieties demanded. Scale economies in manufacturing and in R&D activities, and proprietary technology are mentioned by Gray as such impediments. Gray also stresses the role of similarities between trading partners in generating IIT (following Linder, 1961). Similar demand structures and similar factor cost structures promote IIT.

Undoubtedly Gray's framework incorporates many important factors influencing IIT. However, this framework has not yet (to my knowledge) been employed in empirical studies. Therefore, it might be too early to construct conceptual systems. A number of case studies into IIT would probably yield new insights which could contribute to an empirically founded framework for IIT analysis.

I. Factors necessary for IIT
- a. Preference diversity for final goods
- b. Similarity of tastes
- c. Similarity of absolute and relative prices of generic factors of production
- d. Absence of substantial impediments to trade (including both transportation costs and commercial policies
- e. Geographically diffuse possession of proprietary product (and process) technology
- f. Afterbusiness

II. Factors promoting IIT
- a. A wide range of horizontal differentiation of final goods
- b. Vertical or gradient differentiation
- c. Large home market
- d. Diseconomies of proliferation

III. Factors impeding IIT
- a. Barriers to entry for marketing and distribution activities in foreign markets
- b. Small absolute economies of scale
- c. Public acceptance of a “basic” product
- d. Unequal selling costs in different markets

IV. Factors ambivalent towards IIT
- a. Multiproduct firms
- b. Foreign direct investment and multinational corporations
- c. Firm-specific process technology
- d. Oligopolistic industry structure

Source: Gray, 1988, p. 224-225.

Figure 1.2 *Gray's "paradigm” for the analysis of IIT*

The “industry” concept

A fundamental conceptual problem is the definition of intra-industry trade. The key word is, of course, “industry”. In orthodox trade theory the industry is defined as “. . . an agglomeration of firms which produce a perfectly homogeneous commodity such as 'cloth' or 'wheat'” (Grubel and Lloyd, 1975, p. 2). This definition is convenient for the purposes of the model-builder, but unappropriate for empirical studies. Clearly, the extent of IIT is highly dependent on how broad or narrow the definitions of “industry” are. In traditional trade theory an industry is comprised by products which have identical production functions (i.e. they are produced with the same mix of production factors) and/or infinite elasticities of demand (Hansson, 1989, p. 9), in other words products which are substitutes in production and/or in demand *[6]*. This definition does not make very much sense in the real

world. However, to the orthodox economist simultaneous exports and imports of products which have similar production functions is puzzling, as it defies explanation by the factor proportions theory.

Recent trade theory has to relax these assumptions as product differentiation is seen as a major explanation of IIT. A weaker definition has to be accepted, e.g. that ". . . the elasticity of substitution in demand between products produced within the same industry is larger than the elasticity of substitution in demand between products produced in different industries" (Hansson, 1989, p. 9f). These theoretical definitions may be employed in formalized models, but they have little practical relevance for empirical studies. Almost all studies on IIT are based on official trade statistics, which leaves the researcher little choice. He or she can choose between different levels of aggregation in the commodity classification used in official trade publications (SITC, CCCN / HS, and national classifications), or perhaps regroup the items according to some more or less ingenious principle. In fact, this problem was given a straightforward formulation by Grubel and Lloyd:

> We decided that it serves the purposes of our study best if we cease the search for an unambiguous definition of an industry at some level of aggregation and instead call each statistical class of internationally traded goods, regardless of the level of aggregation, an 'industry'. (Grubel and Lloyd, 1975, p. 4)

The lack of theoretical underpinnings of the industry concept used in empirical studies opens the door for various types of criticism. Some critics argued that in reality (i.e. according to a theoretically satisfying definition of "industry") there is no IIT. All (or almost all) observed IIT is due to the lumping together of separate industries in the commodity classification nomenclatures ("the aggregation problem", Finger, 1975; Lipsey, 1976; *[7]*).

In the following I will make a distinction between "apparent IIT", i.e. the IIT which can be observed in comparing trade statistics, and "true IIT", i.e. the simultaneous exports and imports of similar products which directly compete for the same application. The latter is not a theoretically satisfying definition, but perhaps one of the more reasonable for practical purposes. I do not believe that unequivocal delimitations of "industries" can be made, except in a few particular cases. Two examples may illustrate the difficulties. Products belonging to a particular industry should be close substitutes according to traditional theory ("infinite elasticity of substitution in demand"). Consider a manufacturer of centrifugal pumps. Pumps are supplied

[6] For a more comprehensive discussion of the "industry" concepts in theories of IIT, see Gray, 1979, appendix B, and Lloyd, 1989, p. 19ff.

[7] See also the discussion and references in Lloyd, 1989, p. 15ff.

in different designs which are adapted to particular applications. However, each design type is provided in a large number of sizes, as the energy efficiency is very sensitive to the fit between pump dimensions and the actual duties. This means that for a particular application a large pump cannot be substituted by one or several small pumps even if the design is exactly the same. Nevertheless I think all would agree that the large pump and the small one belong to the same industry, even though they are not substitutes in demand. On the other hand the assumption of similarity of production functions may also be challenged. For certain duties pumps of radically different construction principles may directly compete with each other, e.g. an eccentric screw pump with a lobe rotor pump. Should they be defined as separate industries or not? This decision cannot rest on some absolute principle and still be reasonable for all purposes.

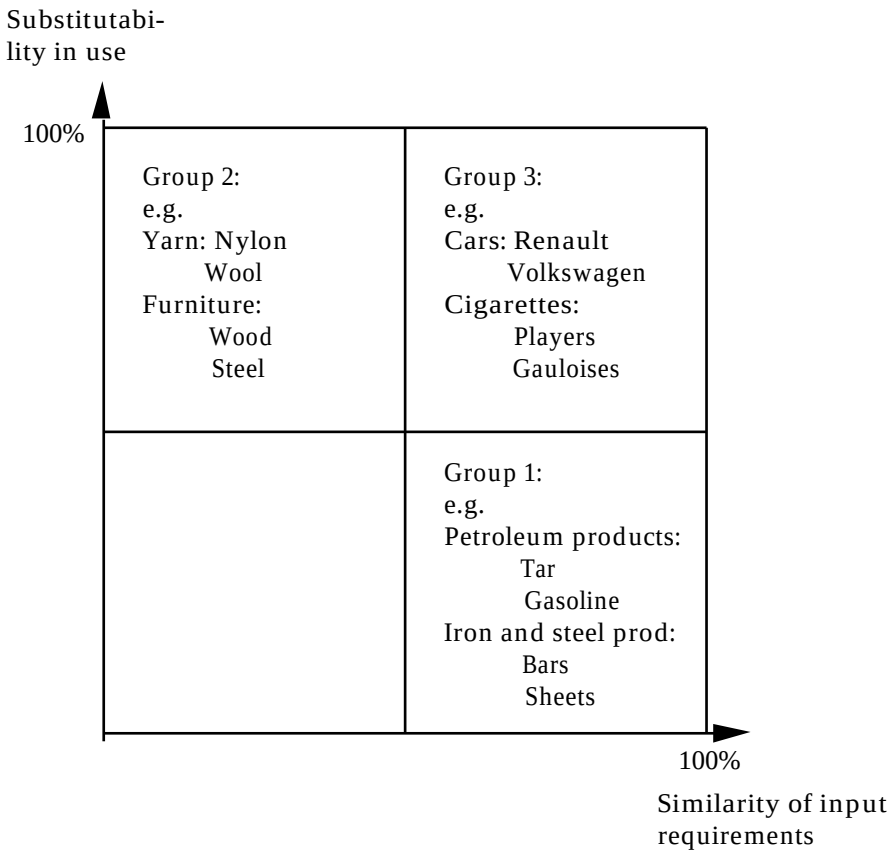
The definition of "product differentiation"

Grubel and Lloyd (1975, pp. 86f.) identified three types of differentiated products by combining high vs. low substitutability in production and demand for various *product groups* (fig. 1.3) *[8].*

The first group is commodities with similar input requirements, but low substitutability in use. Typical examples for this type of product groups are found in the primary and intermediate commodity industries: metal fabricating, petrochemical industry. Grubel and Lloyd divides this group into two subsets: (a) products which are distinct, but are produced in fixed proportions due to technical conditions (e.g.refinery products); and (b) products which are made from similar materials and "frequently in the same plant and machine" (ibid, p. 88), such as bars, rods, beams, sheets, wires of steel in varying dimensions and quality. To the examples provided by Grubel and Lloyd could be added such products as machine tools, which are manufactured for a wide variety of purposes and capacities. The second group is commodities with high substitutability in use, but low similarity of input requirements. Here we find products with similar functions but dissimilar production processes, such as chairs of wood, steel or plastic, or textiles made from different types of fibres. The third group is commodities which are substitutes in demand *and* have similar input requirements. This is the typical case of product differentiation: cars, cigarettes, television sets, etc.

Grubel and Lloyd states that of the groups defined above, the second is least interesting in this context, since IIT in trade with such products can be

8 Grubel and LLoyd considered the nature of the commodities within 3-digit SITC items, i.e. the products which are grouped into the same statistical item, thus constituting an "industry" in their terminology.



Source: after Grubel and Lloyd, 1975, p. 86.

Figure 1.3 *Groups of differentiated products (Grubel and Lloyd)*

explained with the H-O-S model. In the discussion of group 1 and 3, Grubel and Lloyd proceeds to analyze the role of scale economies and product differentiation. Two basic types of product differentiation are recognized, style differentiation and quality differentiation (ibid, p. 95):

> In the real world these analytical classes tend to overlap, but basically quality differentiation is based on measurable performance characteristics of products while style differentiation is based on product appearance and marginal performance characteristics . . .

The analysis of Grubel and Lloyd seems to be modelled on conditions valid mainly for consumer goods, although they state that:

> Quality and style differentiation in consumer goods have their analogue in intermediate raw materials such as steel in various shapes and qualities, and fixed capital goods such as lathes and presses. (ibid, p. 100)

This implies that the concept of quality differentiation includes differences

between products which implies that they are not substitutes in demand (group 1b above). This way of conceiving product differentiation is quite different from the usual definition of product differentiation in economic theory, following Lancaster (1979). Lancaster describes his approach to product differentiation as follows:

> In this approach, goods are perceived as bundles of the characteristics (demand-relevant properties) they possess, consumers buying the goods because of these characteristics and regarding goods with the same characteristics in closely similar quantities as *highly substitutable*. A goods group is defined by a set of common characteristics, some or all of which can be varied. The variation in the relative amounts of various characteristics [...] differentiates the products within the well-defined group. (Lancaster, 1987. Emphasis added)

The approach of Lancaster reflects, I believe, the intuitive perception of product differentiation, i.e. variations within a group of products which are more or less close substitutes in demand. It might be convenient to retain this definition, and coin a separate concept for products which have similar input requirements and are manufactured with similar technologies, but are not substitutes in demand (group 1b in terms of the Grubel and Lloyd framework). Provisionally, this type of product variety will be called *intra-industry product proliferation* here, in the hope that a more convenient label will surface elsewhere.

Purposes and approach

The mainstream approach to empirical studies of IIT is to formulate hypotheses on the basis of formalized economic theory, and to test these hypotheses on official trade and industry statistics *[9]*. The central idea of this study is to explore if additional insights into the analysis and explanation of IIT can be gained from a case study based on interview and questionnaire techniques, employing the industrial organization perspective. The case study approach allows a detailed investigation into the 'aggregation problem', may provide a rich empirical material to elucidate causes of IIT and may give a practical perspective on key concepts used in the theoretical literature, such as 'product differentiation', 'substitutes in demand' and 'industry'.

Considering the methodological and theoretical issues involved, this study has several purposes:

[9] Previous studies of IIT in the mainstream tradition concerning Sweden have been made by Lars Lundberg and Lars Gavelin (e.g. Lundberg 1982, 1988, and Gavelin & Lundberg, 1983) and Pär Hansson (1989).

(i) to explore the advantages and disadvantages of using official foreign trade statistics in studies of IIT and international specialization. This task will be initiated in chapter 2, as a general methodological survey. In the following chapters the general considerations will be elaborated in the specific framework of an empirical case study.
(ii) to explore, by means of a case study, if "true" IIT exists or if IIT is merely a consequence of "categorical aggregation". This issue will be entangled progressively in chapters 3 and 4.
(iii) to generate new hypotheses on the causes of IIT. Chapter 5 is devoted to a systematic review of the hypotheses generated by the empirical study.
(iv) to make a contribution to the development of a conceptual framework for studying international specialization. Some tentative formulations regarding this issue are given in chapter 6.

The study will start by presenting the pattern of apparent IIT in Sweden's foreign trade in pumps as it is recorded in the official foreign trade statistics (chapter 3). In order to separate concealed inter-industry trade (= international specialization) from "true" IIT, Sweden's pump trade will be disaggregated as far as allowed by foreign trade nomenclatures (including the use of partner statistics) (see fig. 1.4). It will be shown that a substantial amount of IIT still appears at the most disaggregated level permitted by the commodity classification systems. In order to reach further disaggregation an attempt is made to use interviews and a questionnaire in a case study to extract a deeper knowledge about the structure and causes of IIT (chapter 4). Finally, various causes of "true" IIT and international specialization are discussed separately (chapters 5 and 6 respectively).

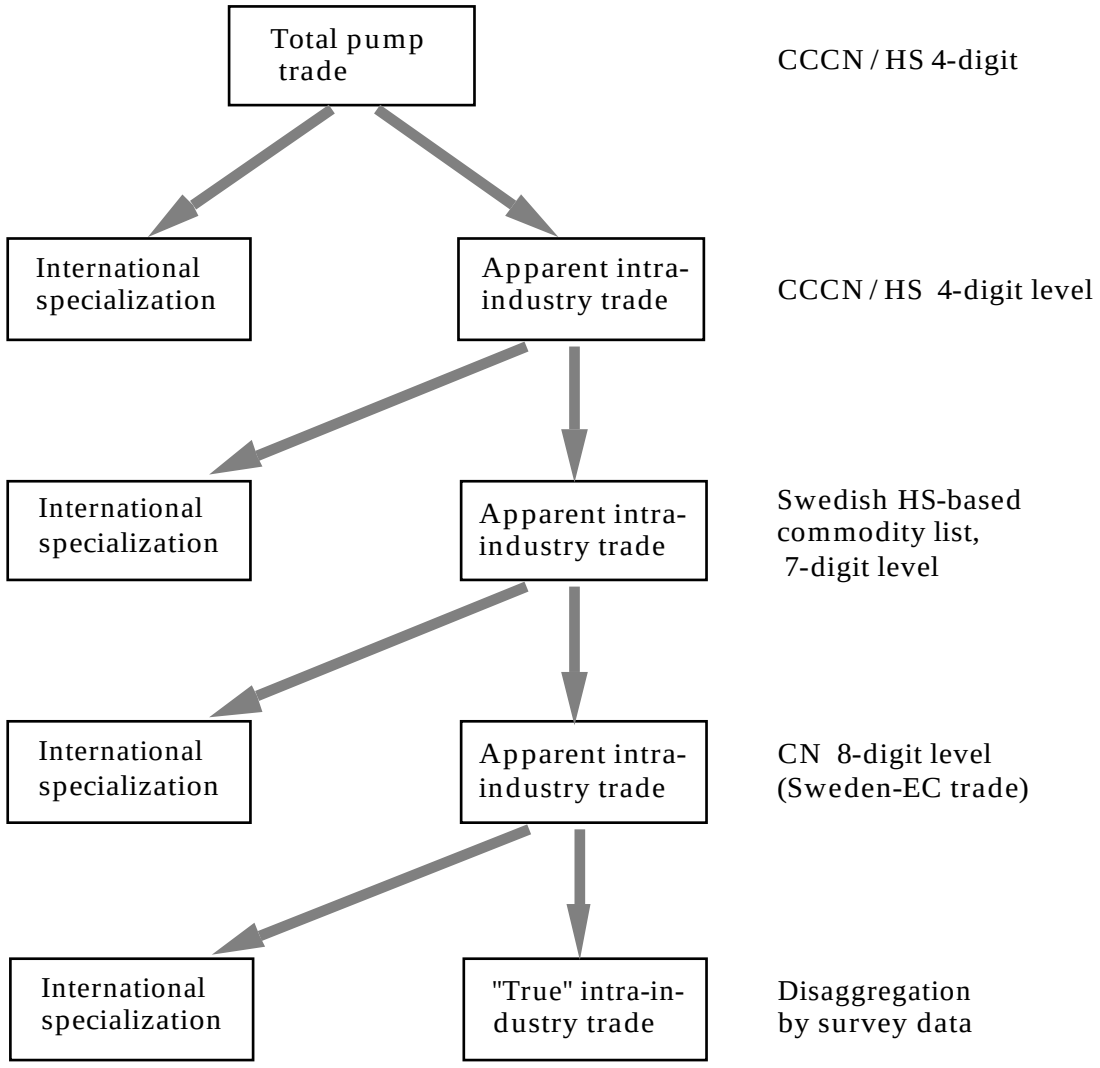


Figure 1.4 *Method: Stepwise decomposition of apparent IIT*

2. Sources of information – a critical survey

Potential sources of empirical data

The nature of the research issues formulated in chapter 1 requires different types of information. The study employs an unorthodox method for the analysis of intra-industry trade and international specialization. The voluminous literature reporting empirical studies on intra-industry trade invariably employ official foreign trade statistics as the principal data source. The breach with tradition which is perpetrated in this study motivates the rather detailed examination made in this chapter of the methodological problems involved in the choice of sources.

In the framework of the present study, the following types of sources have been identified as relevant *[10]*:

1. *Interviews.* There is a broad range of people who can provide valuable information. Employees of manufacturing, distributing, supplying or procuring firms are obviously a first choice. Other categories include securities analysts, employees in governmental authorities, officials of industry associations, specialized journalists and pensioners.
2. *Questionnaires.* The primary sources are the same as above, but the information is usually more standardized.
3. *Official foreign trade, industry and other statistics.*
4. *Published academic studies.*
5. *Business press.* Valuable information can often be found in general business press, such as *Financial Times, Economist* and *Business Week,* as well as in specialized periodicals.
6. *Technical literature.* E.g. manuals, technical periodicals and text-books.
7. *Company publications and brochures.* Most important are the annual reports, which are available for large companies listed on the stock exchange.
8. *Reports from consulting firms.* These may be valuable, but also very expensive.
9. *Product directories and the like.*

Extremely little has been written on the pump industry by academic scholars or others *[11]*. Various data-bases and bibliographies have been consulted,

10 A survey of potential sources is provided by Porter, 1980, in appendix B.

11 A case study of the internationalization of the Swedish-American pump company Flygt is included in a study for the Swedish Government on the effects of foreign direct investments (Forsgren & Larsson, 1981). However, this study was not relevant in the context of the

but the results were meagre. No periodical focused on industry conditions exists (apart from World Pumps, which mostly contains articles of a technical nature), and the pump industry is very seldom mentioned in international business periodicals such as Financial Times, The Economist, Business Week or Fortune. Some consulting firms produce reports on the pump industry regularly, e.g. Frost & Sullivan and Predicast. The main task of these reports is to forecast the market development. However, they may also provide an overview of salient features of the industry. I have not been able to employ reports from consulting firms in a consistent way, although I have had the occasion to form a general impression of their contents.

In the case of the pump industry, the major sources of information available to the researcher are, consequently, interviews and questionnaires on the one hand, and official statistics on the other hand. In the ensuing sections these sources will be subjected to a critical survey. The emphasis is laid on the examination of official trade and production statistics, because I feel that the methodological problems involved in their use have been underestimated in many studies.

On official trade and industry statistics

The overwhelming majority of empirical studies on intra-industry trade are based on official trade statistics. Studies seeking explanations of intra-industry trade usually try to measure industry characteristics and/or country characteristics by various manipulations of official industry-related statistics. However, there is usually no analysis whatsoever of the *quality* of the data employed, nor a discussion of the limitations of this *type* of information. This section is devoted to a critical discussion of foreign trade statistics, and to some extent production statistics, as sources of information for studies of international industrial change and foreign trade. The discussion will start with very practical problems, such as the quality of the data, and proceed to more intricate issues, such as conceptual problems and the scope of accessible information *[12]*. However, a basic knowledge about the bewildering systems of commodity classification used in foreign trade statistics is needed as a background.

Commodity nomenclatures in foreign trade statistics

For the present, foreign trade statistics are available in internationally stan-

present study.

[12] A detailed survey of the methodological problems of trade statistics can be found in Alvstam, 1979.

dardized commodity nomenclatures according to three systems: the *Harmonized System* (HS), the *Standard International Trade Classification* (SITC), and the *International Standard Industrial Classification of All Economic Activities* (ISIC). *[13]*

The HS is a modern development of the Brussels Trade Nomenclature (BTN) which was created in the beginning of the 20th century for the needs of the customs authorities. In 1976 the BTN was renamed CCCN, the Customs Cooperation Council Nomenclature. Several revisions of the nomenclature were made, the last one, implemented in 1988, leading to the present HS. The structure of the HS is determined by the function of the nomenclature as a basis for determination tariff levels. The interests of the academic consumers of statistics have not been taken into consideration. The HS is the most detailed foreign trade nomenclature in use on a global scale. However, within the HS, each country may create its own statistical items at the lowest level of disaggregation. The EC has developed a standardized expanded version of the HS, the *Combined Nomenclature* (CN), which is used by the EC member countries and in Eurostat publications.

The SITC was developed in the UN system in the end of the 1940's as a standardized foreign trade nomenclature adapted to the needs of researchers and planners. SITC has been revised three times (SITC Rev., SITC Rev. 2, SITC Rev. 3). The SITC is less detailed than the HS. However, all UN members supply foreign trade data according to SITC, which means that studies covering diverse countries usually are based on SITC figures.

The ISIC was developed by the UN for use in industrial statistics. It is considerably less detailed than the HS and the SITC. Foreign trade classified according to the ISIC are used when there is a need to relate foreign trade statistics with industrial statistics.

A survey of methodological problems of foreign trade statistics

Six distinct issues will be discussed below. They concern (i) the quality problems associated with *misclassification;* (ii) the difficulties of correct *valuation;* (iii) the definition of *parts and components;* (iv) the existence of *reexports and reimports;* (v) the theoretical problem of the *unit of analysis;* and finally (vi) the *scope of information* accessible through the analysis of official statistics. In the section following this survey, empirical evidence on some of these issues will be discussed.

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13 The main source for the description of the commodity nomenclatures is Alvstam, 1978.

Misclassification

The original source of trade statistics is the customs clearance formulars filled in by exporting and importing firms. The employee of the firm assigns a code number from the commodity classification system to the products to be exported or imported, and reports the value (and weight) of the shipment. This process is probably seen as a bureaucratic measure which is only a burden to the firm. The incentives for correct classification are very small. In the Swedish case, the exporter/importer can call the customs authority if there is doubt about how to classify a particular product. However, the customs official has no nomenclature more detailed than the official commodity classification systems. If there is no obviously correct statistical item, the customs employee will assign the product the item he or she deems most appropriate. This means that product classifications in many cases probably are inconsistent. Two firms exporting the same type of product may report it in different statistical categories. In most cases, however, the classification is probably correct, especially when firms export products within one or a few statistical items.

A discouraging example was discovered during this study. Consider the figures given in table 2.1. The ratio of exports to production for centrifugal pumps 1989 was 2.3 – exports exceeding production by more than 500 mill. SEK. On the other hand the production of "other pumps" shows an astonishing 674.5 mill. SEK for an item which, all things considered, should be quite small *[14]*. An informed guess would be that most submersible centrifugal pumps have been classified as "other pumps" in the industrial production statistics, but not in the export statistics. In this case the misclassification did not affect trade statistics, but there is no reason why it could not have been the other way round.

Table 2.1 *Selected statistics on Swedish pump production and trade 1989 (mill SEK)*

Statistical item (HS nomenclature)	*Production*	*Exports*	*Imports*
84.13.700 Centrifugal pumps, n.e.s.	384.4	889.6	294.0
84.13.810 Other pumps, n.e.s.	674.5	81.7	110.7

Source: Utrikeshandel 1990; Industri 1989. Statistiska Centralbyrån

[14] All pump types used in large volumes are included in the items centrifugal pumps, rotary positive displacement pumps and reciprocating positive displacement pumps. There are no large domestic producers of pumps which would classify in the "other pumps" item.

In particular cases there may be strong incentives for intentional misclassification. Non-tariff-barriers to imports or tariffs on certain commodities may cause a company to classify a product in a category where barriers or tariffs are non-existent or low.

Valuation

The quality of the valuation of exported commodities is an even more disturbing problem than misclassification. A very large proportion of international trade is intra-firm trade, i.e. trade between firms linked by ownership but located in different countries. Intra-firm trade is often trade in parts and components to be assembled or processed in the receiving firm. The valuation of commodities exported is then a strategic decision. The assignment of a high value means that more capital is transferred to the exporting firm than if a low value is assigned. By means of such so-called *transfer prices* capital can be transferred to countries with low tax rates or other favourable circumstances. The possibility of transfer pricing obviously introduces a considerable element of arbitrariness into the calculation of IIT measures. Unfortunately very little is known about the true levels of either intra-firm trade or transfer pricing *[15]*. In the framework of the case study reported below, this issue will be further discussed.

Intentional undervaluation of exported commodities may also be motivated by tariff evasion. The extent of such activities are largely unknown (see next section).

Parts and components

For industrial machinery, the borderline between final product and components is often blurred. Pumps are usually exported without motor and/or some other standard parts, such as base plate, cover and legs. This ambiguity probably is a minor problem for the quality of trade statistics. In some cases trade statistics could be distorted for products which are incorporated in larger systems. Pumps are used in large numbers in industrial washing and cleaning equipment, food processing equipment, chemical plants, etc. These types of equipment may be exported in sets to be assembled at the final destination. Now, a pump exported as a part of an industrial cleaning machine, should it be classified as a pump or as a part of a cleaning machine? Furthermore, large numbers of industrial equipment are exported

[15] For an interesting case study of transfer pricing in the aluminium industry, see Bauer et al., 1989. A theoretical study of transfer pricing is provided by Nieckels, 1976.

in connection with plant construction. If a process plant contractor builds, say, a food processing plant in a foreign country it will send all types of components and equipment to the construction site. It could easily be imagined that no excessive efforts are made to classify each item correctly. Probably most products are classified in items like SITC 727.29, *parts for food-processing machinery, not elsewhere specified.*

This means that a pump could be classified as a pump, as parts of pumps (if it is incomplete) or as parts of other machinery. The distortion should decrease at higher levels of aggregation, although it will not disappear completely.

Reexports and reimports

Most hypotheses on intra-industry trade implicitly or explicitly assume that it is an expression of international specialization *[16].* Many studies search for correlations between various country and industry characteristics and the levels of intra-industry trade. However, a substantial part of the exports of a country may have been imported from other countries previously. There are several explanations for reexports, and my study has revealed a non-negligible share of reexports in total exports. This issue will be treated in the framework of the case study.

The unit of analysis

It may be argued that the intra-industry trade phenomenon is an artifact of the structure of available trade statistics. Trade statistics are collected at international borders. Countries as units of analysis are given to us by the statistical authorities, and we have little choice but to accept them as relevant. However, are there really theoretically satisfying reasons for adopting the countries as units of analysis? Of course the answer depends on the problem. Now, in the case of intra-industry trade, the problem is posed by an empirical phenomenon which is dependent on the structure of official statistics (see chapter 1). If our main problem was to analyze the structure of spatial specialization we would probably find the country to be too arbitrary a unit of analysis to be of much value. In this case trade statistics would be regarded as a source which is readily accessible, but of limited value. It would be natural to explore other sources of information which could provide a more suitable structure of information.

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16 One exception is the reciprocal dumping model, see Brander & Krugman, 1983.

The scope of information

Trade statistics contain a restricted amount of information. Without consulting other sources of information we cannot know anything about the actual composition of particular statistical items. The traditional approach is to supplement trade statistics with industry statistics which are collected according to the same statistical nomenclature. In this way we can know something about the industries manufacturing particular commodities, such as level of R&D, energy consumption, wage levels, composition of labour force, etc. The traditional approach has been to erect hypotheses on causal links between certain industry characteristics and the level of intra-industry trade, to conceive variables which represent explanatory factors, and to make econometric tests on the statistical material available. This deductive approach emphasizes the human capacity to conceive theories, which are then tested for rejection or acceptance. The problem is that neat theoretical models may be too simplified to catch some essential explanations (Gray, 1988). Interviews may reveal unexpected, but important, insights into causal relations which are not revealed by the analysis of trade statistics or which do not fit into the unavoidable simplifications of formalized theory.

The quality of trade statistics - empirical evidence

During the last two decades two larger studies on the reliability of Swedish foreign trade statistics have been conducted, an official report from the Ministry of Economics, based on 1975 data, and a study on economic crime in foreign trade from the National Council of Crime Prevention, based on 1983/84 data. Both studies were based on a detailed investigation into a sample of statistical items. Efforts were made to ascertain the extent of misclassification and errors in reported values and weights.

In the 1975 investigation (SOU, 1977) it was found that items representing a value of about 35% of the total value of imports, and about 65% of the total value of exports were incorrect in some respect. Export items representing about 17% of the total value of exports were reported at values which deviated more than 5% from the actual value (SOU, 1977, p. 119). Items representing almost 5% of the total export value were reported at values which deviated more than 25% from the actual value. The corresponding figures for imports were 4% and 1% respectively.

The *value* of items which were assigned the wrong CCCN number was 17% in the case of exports and 10% in the case of imports *[17]*. If the *number* of items is considered, 32% of all items were reported with some type of fault in the assignment of CCCN number. Errors were not restricted

[17] The foreign trade nomenclatures are discussed in the first section of chapter 11.

to the lowest level of disaggregation. 4% of the value of imports and 5.5% of the value of exports were incorrect at the 2-digit level CCCN level, 3% and 5% respectively at the 4-digit level, 3.5% and 3% respectively at the 6-digit level and 2% and 3% respectively at the 7-digit level (SOU, 1977, p. 28ff).

Errors concerning country of origin and country of destination were restricted to between 1% and 2% in exports as well as in imports, according to the investigation. However, the method employed could not be expected to uncover all errors concerning country of origin and destination.

The investigation by a researcher at the National Council for Crime Prevention (Magnusson, 1987) was focused on identifying economic crime in imports to Sweden. 3,300 consignments were examined, divided into 4 samples. The sum of (i) the value of consignments which were misclassified or assigned the wrong country of origin, and (ii) the value of the differences between declared value and the correct value, were estimated to 16.5% of total Swedish imports (excl. oil) in 1984. It was also estimated that intentional errors in customs declarations affected 12% of all consignments (Magnusson, 1987, p. 8ff.). Between 16% and 31% of the consignments in the four samples were assigned the wrong CCCN number, and about 20% of the consignments were assigned an incorrect value. Very few consignments were found to be assigned with the wrong country of origin, 1-2.5% (Magnusson, 1987, p. 44). However, such errors are very difficult to detect, which implies that real levels of error may be substantially higher.

These investigations suggest that the margins of error of the official foreign trade statistics are substantial, especially on the lowest level of disaggregation.

A simple exercise can demonstrate the dangers of employing trade statistics uncritically. In trade statistics a test of reliability can be made through the comparison of partner statistics. Each trade flow, e.g. the flow of centrifugal pumps from Sweden to Switzerland, is recorded twice in official trade statistics. It occurs in Swedish data as exports to Switzerland and in Swiss data as imports from Sweden. Exports are reported fob (free on board), i.e. excluding costs for transportation and insurance, while imports are reported cif (including cost, insurance, freight). Import data should consequently display somewhat higher values than export data. However, there are also other sources of error, e.g. the periodization of consignments which are shipped close to the end of the year and may be reported as imports in the next year.

From table 2.2 we can conclude that the choice of source country is strategically important to the results of the analysis, at least if separate trade flows are to be analyzed. In the case of Italy partner trade data diverges by a factor of 28 for Swedish exports and 14 for imports! When studying trade flows scholars recommend the use of import data, as it is more likely that the

country of destination can identify the country of origin than the other way round (Alvstam, 1979, p. 29). There are several conceivable explanations to the deviations illustrated above. Commodities may be reexported from the country reported as destination in Swedish statistics, e.g. because of the location of sales companies, agents or whole-salers with international fields of operation. The classification of the commodities traded may be different in the country of origin and in the country of destination, due to different practices, arbitrary decisions or carelessness. Finally, the collection of statistics may be inefficient in some countries, leading to substantial under-reporting of foreign trade.

This example should inspire a considerable amount of caution about the reliability of trade statistics. Conclusions which directly depend on the analysis of foreign trade data should ideally be supported by complementary data from other sources.

Table 2.2 *Swedish centrifugal pump trade with selected countries 1990, '000 USD*

	Swedish exports *as reported by*		***Swedish imports*** *as reported by*		***Ratio of partner data to Swedish data***	
Partner	*Sweden*	*Partner*	*Sweden*	*Partner*	*Exports*	*Imports*
Germany	17851	13348	17470	19028	0.75	1.09
Denmark	4067	1062	13220	9407	0.26	0.71
Italy	15073	534	9403	667	0.04	0.07
Finland	3099	1222	4921	5563	0.39	1.13
USA	25430	24963	4301	1756	0.98	0.41
Spain	7617	7025	2123	2659	0.92	1.25
UK	11796	10035	1685	2004	0.85	1.19
France	19288	20252	1300	1091	1.05	0.84
Japan	1478	995	584	891	0.67	1.53
Switzerland	2587	2089	627	334	0.81	0.53
Austria	2999	545	798	1047	0.18	1.31
Belgium/Lux.	1553	282	220	177	0.18	0.80
Netherlands	3571	1825	940	970	0.51	1.03
Norway	5128	2187	142	465	0.43	3.27
Canada	6413	787	84	88	0.12	1.05
Australia	4109	1130	0	1	0.28	–

Source: OECD Annual Foreign Trade Statistics by Commodity

Limitations to interview- and questionnaire-based information

The exclusive use of official statistics is considered inappropriate for the purposes of this study. As have been demonstrated, trade and industry statistics have a low level of reliability. Furthermore, they do not provide the disaggregation needed to penetrate the structure and causes of intra-industry trade. Neither do they provide sufficient information to draw conclusions about the underlying causes of the observed patterns. In the following study, the trade and industry statistics are used as a starting point of an investigation into trade patterns. Two types of material has been collected to supplement official statistics. In order to pursue the disaggregation of commodity items further than trade nomenclatures allow, detailed trade data for the Swedish centrifugal pump trade 1990 has been collected through a questionnaire and through interviews. In-depth interviews with various industry officials were conducted to explore the causes of observed patterns.

Interviews have many limitations as a source of information for this type of studies *[18]*. Two aspects loom large. The first concerns the type of information which can be gained from interviewees. It is very difficult to collect reliable quantitative information by means of interviews. Interviewees may be reluctant to provide figures which might be sensitive in relation to competitors. Often the data assembled by firms for internal use are not structured in a way which suits the needs of the researcher, and the effort required to rearrange data is often considered too great. The time available for interviews is usually restricted to a few hours, which means that the interviewer has to focus on questions which can be answered directly. Very often internal statistics are kept in different departments by different employees.

The other major aspect concerns the time horizon. Information concerning the situation more than a few years back is usually too confused and unreliable to be used as evidence in an academic study. This implies that longitudinal studies present difficult methodological problems. The results of an interview-based study may be very vulnerable to exceptional circumstances in the period of investigation.

Information gained in interviews inevitably has a subjective character. Answers to questions of causality will be biased by the conceptual structures of the respondents. Their perception of the reasons for existing structures may be rationalizations which hide important circumstances which are not perceived. On the other hand interviews may generate a comprehensive list of explanations and interrelationships which would be inaccessible through other methods.

My strategy in this study is to explore whether a case study of intra-industry trade can generate new hypotheses, and, as a side-effect, to investigate

[18] A comprehensive discussion of advantages and disadvantages of the interview method can be found in Schoenberger, 1991.

some methodological problems of employing official statistics.

Conclusions

The survey of sources of empirical information made in this chapter indicates that different types of sources have their own peculiar advantages and disadvantages.

It was indicated above that a number of factors reduces the reliability and value of official trade statistics (misclassification, valuation, definitional problems and reexports). Furthermore, these statistics are poor in terms of information contained and inflexible in terms of the units of analysis. Consequently, methods based exclusively on the use of official statistics are weak in generating new hypotheses. On the other hand the use of official statistics is convenient in terms of the effort required and allows for high levels of transparency, replicability and stringency.

The information given by interviews and questionnaires is less transparent, considering the restricted possibilities for replicating the material, and the restrictions posed by the confidential nature of some information. The stringency may suffer because of the type of empirical data used. Case studies usually imply extensive interpretation on the part of the researcher, a process which might be more difficult to follow for the uninitiated than if formal modelling is used. Other disadvantages include the difficulties of conducting longitudinal studies on the basis of interviews and questionnaires. The advantages are the richness of detail, and the high potential for unexpected discoveries. Interviewing (and, to a lesser extent, questionnaires) offers a high level of flexibility. Misconceptions on the part of the researcher can be corrected rapidly, hypotheses can be given a preliminary test through discussions with industry experts and questions can be asked on virtually anything.

Evidently there are no ideal sources of information for studying intra-industry trade. An interesting research strategy would therefore be to combine the use of official trade and industry statistics with other types of information, taking advantage of the different characters of these methods rather than seeing them as competing methods. In this study official statistics will be used primarily for giving a background to the case study. In chapter 3 it will be demonstrated, stepwise, how far an investigation of statistics can take us in analyzing intra-industry trade patterns. However, this will be done without an effort to squeeze the foreign trade data for all information it could provide by using the instruments of econometrics. In that respect the present study does not follow the strategy outlined above of combining radically different research strategies. It was considered more productive at this stage to focus the investigation on pursuing the rather

unexplored potential of case studies in this area of research.

3. Sweden's foreign trade in pumps according to official statistics

The classification of pumps in Swedish foreign trade statistics

Data on Swedish foreign trade in liquid pumps are reported in official statistics according to three nomenclatures. Of the three, one (SNI) is primarily used for industry statistics, the other two are foreign trade nomenclatures. SNI (Svensk standard för näringsgrensindelning) is a slightly modified version of ISIC (International Standard Industrial Classification of All Economic Activites), which is a system developed by the United Nations. In the case of pumps, SNI provides one item at the lowest level of aggregation (6-digit level). The relevant SNI item is 382992, *Manufacturing of liquid pumps*. The SNI nomenclature does not provide information which is not available in the two other nomenclatures. Therefore, SNI-based statistics will not be further discussed in the present study.

Over the last few decades Swedish foreign trade statistics have been published according to two nomenclatures, the BTN/CCCN/HS and SITC *[19]*. Both have been repeatedly revised. A detailed survey of all the changes implemented in the revisions is not necessary here. The two nomenclatures, the HS and SITC Rev. 3, have been harmonized in the latest revision. However, each country may modify the HS system at the finest level of disaggregation according to national needs. The EC countries have developed a standardized expanded version of the HS, the Combined Nomenclature, CN. Sweden will probably introduce the CN within a few years time. At present, Sweden has not exercised the possibility of further addition of items in the case of pumps. The items of the HS (84 13 110-920) and of the SITC Rev. 3 (742.11-95) in Swedish trade statistics are nearly identical. The only difference is that hand pumps are separately reported in the HS nomenclature. However, SITC Rev. 3 and HS were introduced in Sweden in 1988. Earlier versions allowed disaggregation of liquid pumps into 5 pump types (excluding parts): *reciprocating, centrifugal, rotary, fuel & lubricant* and *other* pumps (incl. liquid elevators). Longitudinal studies of Swedish data and multicountry studies based on UN or OECD data are consequently restricted to the analysis of these five items.

The Combined Nomenclature of the EC provides a much more disaggregated nomenclature. Centrifugal pumps are disaggregated into 12 items. Swedish trade with the EC may be disaggregated accordingly for recent years, which may provide some additional insights. However, for some countries (e.g. Italy) the quality of the EC data seem to be deficient. A few countries,

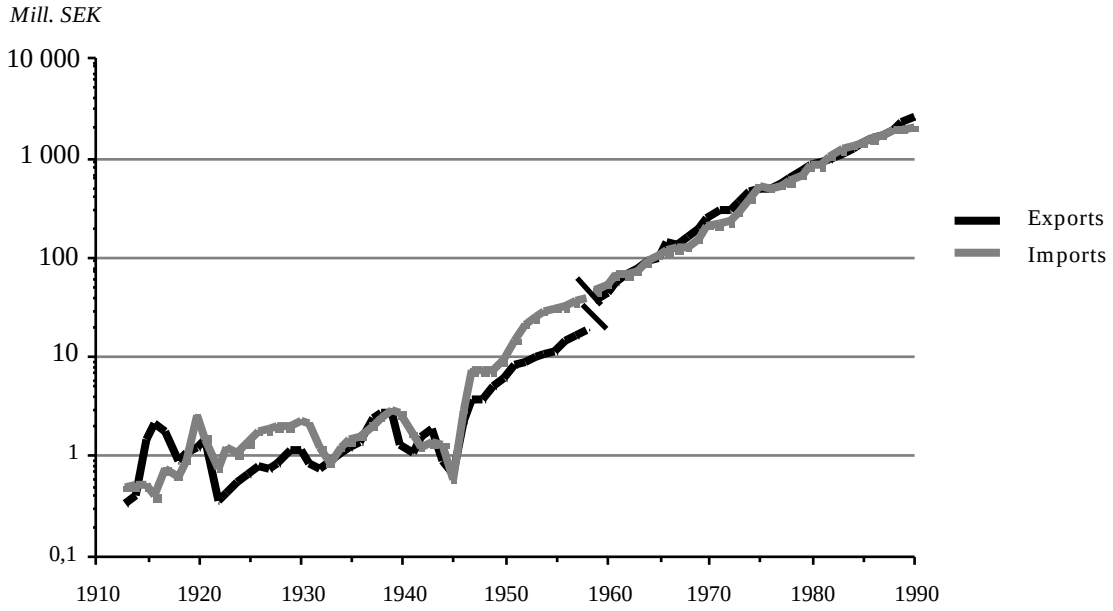
[19] For explanations, see chapter 2.

notably Germany and Denmark, have used finely disaggregated nomenclatures for decades. In these few cases a historical analysis of IIT is feasible. Through analysis of partner statistics the trade between Sweden and these countries can be analyzed on a more detailed level of aggregation than Swedish statistics allow.

Sweden's pump trade

The 4-digit CCCN/HS level

Liquid pumps is a minor item in Swedish foreign trade. Liquid pumps and parts constituted about 0.7% of exports and about 0.6% of imports in 1990. The historical development of Swedish pump trade is presented in figure 3.1. The post-war period is characterized by a strikingly regular pattern. Exports and imports followed each other at similar quantities and growth rates throughout the period. The graphs are based on current prices, which disguises a slight weakening of growth rates from the mid-1970's.



Note: A new statistical nomenclature was introduced in 1959. Evidently this change affected the classification of pump exports slightly.
Source: Handel and Utrikeshandel, Statistiska Centralbyrån

Figure 3.1 *Swedish imports and exports of liquid pumps 1913-1990, current prices (log. scale)*

In table 3.1 the recent Swedish pump trade is disaggregated by pump type. Exports are dominated by centrifugal pumps, rotary positive displacement pumps and reciprocating positive displacement pumps. In imports, however, the largest item is pumps for internal combustion engines (e.g. fuel injection pumps for passenger cars).

Table 3.1 *Pump trade of Sweden by pump type, aggregated 1988-90 (mill. SEK and %, HS 84.13.110-820).*

8413-		Exp.	Imp.	Exp. %	Imp. %
	Pumps fitted or designed to be fitted with a measuring device:				
-110	- pumps for dispensing fuel or lubricants, of the type used in filling stations or in garages	200	85	4.1	1.9
-190	- other	43	34	0.9	0.8
-200	hand pumps	46	40	0.9	0.9
-300	fuel, lubricating or cooling medium pumps for internal combustion piston engines	224	1873	4.6	42.7
-400	concrete pumps	26	21	0.5	0.5
-500	reciprocating positive displacement pumps, n.e.s.	918	658	18.8	15.0
-600	rotary positive displacement pumps, n.e.s.	503	471	10.3	10.7
-700	centrifugal pumps, n.e.s.	2690	899	55.0	20.5
	Pumps; liquid elevators, n.e.s:				
-810	- pumps	240	300	4.9	6.8
-820	- liquid elevators	3	5	0.1	0.1
Total		*4893*	*4386*	*100.1*	*99.9*

Source: Utrikeshandel, Statistiska Centralbyrån

In table 3.2 Swedish pump imports are disaggregated by country. The overwhelming majority of Swedish imports originates in Western Europe, with Germany accounting for more than 50%. The only significant source of Swedish pump imports apart from European countries is North America. It can be concluded from these figures that Japan and the newly industrializing countries in the Far East play a marginal role in the Swedish pump market.

Table 3.2 *Pump imports of Sweden by country/region, 1988-90, % (SITC 742).*

OECD Europe		85.5
Germany	*52.0*	
Denmark	*7.6*	
Italy	*5.5*	
UK	*5.2*	
North America		11.2
Japan		1.8
Eastern Europe		0.8
Far East (excl. Japan)		0.2
Other		0.5
Σ		*100*

Source: Foreign Trade by Country, OECD.

As could be expected from the fact that most countries use pumps, while the pump manufacturers are concentrated to the industrialized countries, Swedish pump exports are more dispersed than imports (table 3.3). However, Western Europe accounts for almost two thirds of Swedish pump exports. North America is an important market, importing 15% of Swedish pump exports. Developing countries in Asia and Latin America account for a further 10%.

Table 3.3 *Pump exports of Sweden by country/region 1988-90, % (SITC 742).*

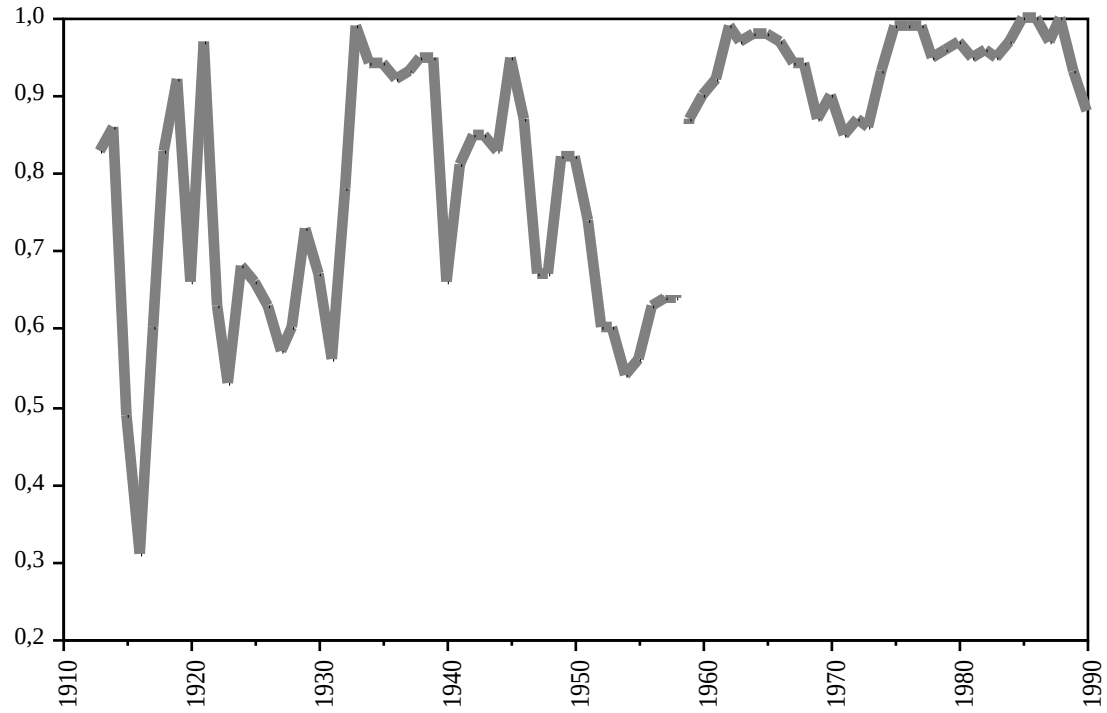
	All liquid pumps	***Centrifugal pumps***
OECD Europe	64.3	58.4
Germany	*10.3*	*9.4*
France	*8.9*	*11.2*
UK	*8.0*	*7.8*
Norway	*7.5*	*3.7*
Italy	*6.1*	*9.0*
Finland	*5.2*	*2.2*
Denmark	*4.5*	*2.8*
North America	15.2	18.5
Japan	1.8	1.1
Eastern Europe	2.9	4.1
Far East (excl. Japan)	5.0	6.7
Middle East	3.3	3.7
Latin America	1.8	1.4
Other	5.7	6.1
Σ	*100*	*100*

Source: Foreign Trade by Country, OECD.

Since Swedish pump exports are dominated by centrifugal pumps, a separate column for these are provided in table 3.3. The structure of centrifugal pump exports is similar to the aggregate pattern. The share of Western Europe is smaller, while the shares of North America and developing countries are larger.

Intra-industry trade in Swedish pump trade

Figure 3.2 gives the GL index (IIT_i for "liquid pumps") for Swedish pump trade from 1913 to 1990 *[20]*. Very high levels of IIT are recorded for the last few decades (table 3.4).



Note: "Pumps" 1913-1958; "Liquid pumps" 1959-. A new statistical nomenclature was introduced in 1959. Evidently this change affected the classification of pump exports slightly, (see fig 3.1).
Source: Swedish official trade statistics.

Figure 3.2 *GL-index for Swedish trade in liquid pumps 1913-1990*

[20] Peterson, 1984, provides a comprehensive study of the history of IIT in Swedish foreign trade.

Table 3.4 *GL-index of Swedish pump trade (CCCN 84.10, HS 84.13), recent years*

	GL-index		GL-index
1970	0.90	1980	0.97
1971	0.85	1981	0.95
1972	0.87	1982	0.96
1973	0.86	1983	0.95
1974	0.93	1984	0.97
1975	0.99	1985	1.00
1976	0.99	1986	1.00
1977	0.99	1987	0.97
1978	0.95	1988	1.00
1979	0.96	1989	0.93
		1990	0.88

Source: Utrikeshandel, Statistiska Centralbyrån

At this level of aggregation (4-digit CCCN / HS = 3-digit SITC) *all* trade is intra-industry trade for some years. This is obviously an interesting starting-point for an investigation into the causes of IIT. Can these high levels of IIT be ascribed to the "aggregation problem", i.e. the lumping together of products from separate industries into a heterogeneous statistical category? Is it possible to separate the "true" IIT from apparent IIT?

The 7-digit Swedish HS-based commodity list

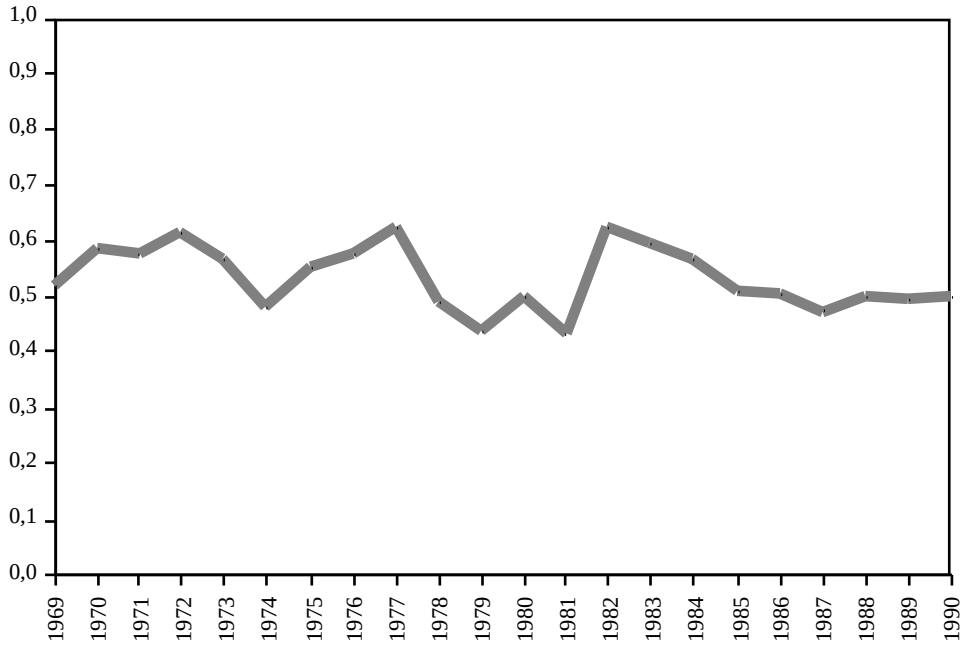
A disaggregation of Sweden's foreign trade in pumps to the finest level allowed by the national expansion of the Harmonized System reveals a substantial international specialization within the pump industry (see table 3.5).

At this level of disaggregation the share of IIT in total trade is substantially lower. Still, almost two thirds of Swedish foreign trade in pumps is IIT at the most disaggregated level allowed in Swedish official trade statistics. If parts are excluded Swedish pump trade may be disaggregated into 10 different types of pumps. However, only a few of these make up the bulk of foreign trade. In 1988-90 almost 85% of Swedish pump exports (excluding parts) were reported in three statistical items: centrifugal pumps, reciprocating positive displacement pumps and rotary positive displacement pumps (table 3.1). Imports were concentrated into four items, pumps for internal combustion engines and the same three which dominated exports. The single most important item in Swedish pump trade is centrifugal pumps. For this item the GL-index hovers around 0.5 (see table 3.5 and fig 3.3).

Table 3.5 *GL-index of Swedish pump trade at the 7-digit level of the Swedish commodity list*

8413-		**1988**	**1989**	**1990**
	Pumps fitted or designed to be fitted with a measuring device			
-110	- pumps for dispensing fuel or lubricants, of the type used in filling stations or in garages	0.56	0.60	0.62
-190	- other	0.83	0.69	0.91
-200	hand pumps	0.61	0.90	0.63
-300	fuel, lubricating or cooling medium pumps for internal combustion piston engines	0.13	0.23	0.28
-400	concrete pumps	0.85	0.93	0.86
-500	reciprocating positive displacement pumps, n.e.s.	0.99	0.78	0.74
-600	rotary positive displacement pumps, n.e.s.	0.95	0.97	0.91
-700	centrifugal pumps, n.e.s.	0.51	0.50	0.50
	pumps; liquid elevators, n.e.s.			
-810	- pumps	0.88	0.85	0.94
-820	- liquid elevators	0.70	0.85	0.22
	parts			
-910	- of pumps	0.91	0.88	0.88
-920	- of liquid elevators	0.27	0.27	0.43
84.13.110-920 (IIT_a)		0.64	0.64	0.65

Source: Calculated from Utrikeshandel, Statistiska Centralbyrån



Note: The statistical nomenclature was changed from 1988. The consequences for this particular item are, however, negligible.
Source: Utrikeshandel, Statistiska Centralbyrån.

Figure 3.3 *GL-index for Swedish centrifugal pump trade 1969-90*

The further investigation will be focused on IIT in centrifugal pumps. This item is the largest single item composing trade in liquid pumps. Methodological problems made a total survey impractical. In the items rotary and reciprocating positive displacement pumps a substantial amount of trade concerns hydraulic devices, which could not be analyzed in the framework of the pump industry. Pumps for internal combustion engines also represent a very peculiar case as most of the trade results from subcontracting relationships between car manufacturers and specialized subcontractors.

Partner statistics

Some indications on the effects on IIT of further disaggregation can be found by employing partner statistics. Recently the European Community adopted the Combined Nomenclature (CN), based on the HS. The CN offers a considerably more disaggregated nomenclature as compared to the HS. In our case the use of EC foreign trade statistics is highly relevant, since a considerable share of Swedish foreign trade in centrifugal pumps is conducted with the EC (79% of imports and 48% of exports in 1988-90). However, as can be seen in table 3.6, the level of IIT for centrifugal pumps

Table 3.6 *Swedish centrifugal pump trade with the EC, according to EC trade statistics, 1990 (thousand SEK).*

CN 84.13.70 Centrifugal pumps	**Imports from the EC**	**Exports to the EC**	**GL**
10 For civil aircraft	640	75	0.21
21 Submersible, single stage	18770	153379	0.22
29 Submersible, multi-stage	18627	111084	0.29
30 Circulation pumps	44714	3624	0.15
40 Centrifugal pumps, outlet <15mm	2155	407	0.32
50 Liquid ring and side channel pumps, n.e.s.	15025	8251	0.71
61 Radial, single stage, single inlet, monobloc, n.e.s.	14792	4792	0.49
69 Radial, single stage, single inlet, excl. monobloc, n.e.s.	14370	1763	0.22
70 Radial, single stage, double inlet, n.e.s.	399	264	0.80
80 Radial, multi-stage, n.e.s.	26916	3112	0.21
91 Single stage, n.e.s.	53658	16630	0.47
99 Multi-stage, n.e.s.	8771	28340	0.47
Σ	218837	331722	
84.13.70.10-99 (IIT_a)			0.31
84.13.70 (IIT_i)			0.79

Source: Calculated from Eurostat data.

(HS 84.13.70) is higher for Swedish trade with the EC (0.77) than for Swedish trade with all countries (0.50, see table 3.5).
The disaggregation of centrifugal pump trade between Sweden and the EC according to the Combined Nomenclature reduces levels of IIT from 0.79 to 0.31 (see table 3.6). The lowest GL value is 0.15. The EC trade statistics unveils a heavy concentration of Swedish exports to the EC to the two submersible pump items. For these items, GL indices are relatively low but far from zero. Swedish imports from the EC are dispersed among the items.

The CN is the most disaggregated trade nomenclature in use in official trade statistics. However, in addition to the EC-wide CN, each EC member has the opportunity to disaggregate CN items according to national needs by adding subdivision to the most disaggregated level. Consequently, there is a possibility that a further disaggregation of the trade patterns might be achieved by consulting national foreign trade statistics. In general, Germany is the country which has the most detailed foreign trade nomenclature. In the case of centrifugal pumps, however, the German addition to the EC-wide CN is restricted to the division of one single item (84.13.70.91) into two items, based on the dimensions of the outlet. This further elaboration does not add to the explanatory value of an IIT analysis of Sweden's foreign trade with centrifugal pumps. Hence we have reached the limit of official foreign trade statistics. Further disaggregation through official sources is not possible.

4. Sweden's centrifugal pump trade: survey data

The survey: method and implementation

In order to obtain more detailed information about Sweden's foreign trade in pumps an attempt was made to use interviews and a questionnaire to assemble an alternative set of data on the patterns of imports and exports of centrifugal pumps. The main question asked concerned the import and export values of various types of pumps. The questionnaire included a nomenclature of pump types developed to mirror the main segments of the centrifugal pump industry, but the respondents were instructed to use their own designations if they found my nomenclature inappropriate (see appendix II). The nomenclature was developed on the basis of extensive interviews probing for the relevant way of identifying segments of competition (see appendix I).

The information gained from the interviews and the questionnaire complements statistical data in several ways: (i) For heterogeneous statistical items an assessment can be made about the main components of exports and import, i.e. a further disaggregation of trade data. (ii) As we have seen, there are several circumstances which indicate that official trade statistics may be erroneous. Industry experts may make an assessment of whether the official figures are plausible. (iii) Through interviews an assessment can be made about the validity of the commodity classifications used in official statistics.

An important limitation of the study is the choice of studying one year only. This means that the structure of imports and exports may well be exceptional in relation to other years. In this industry there are large variations in trade volumes over time for certain items, such as large (and expensive) pumps for power plants or chemical plants. Since the main objective of the survey is to generate hypotheses, it is not important that the results are strictly representative. The study of an extended period would imply a large amount of work with very small prospects for improved results. 1990 was a year when the business cycle peaked, and expectations of a down-turn grew. There are no indications that 1990 was an exceptional year.

The objective was to identify *all* significant actors in Swedish centrifugal pump trade. The domestic pump manufacturers which export centrifugal pumps are few and easily identified through directories and interviews. Considerable efforts were made to identify pump importers. Product directories, telephone directories and various other similar sources were consulted to provide an initial list. However, the main source of information about importers were interviews with industry officials. The questionnaire included a preliminary list of imported pump brands (based on interview

data) and a question about missing companies. Numerous hints were given by respondents over an extended period. The result of this process was some 90 firms, of which about 30 proved to be irrelevant at the final stage of analysis because they had left business or were not at all, or only marginally, involved with centrifugal pumps. Questionnaires were sent to 75 firms in September 1991. A further 12 questionnaires were sent in the following months to firms identified during the survey. 45 written replies were received by mid-December, after reminders. Two replies were collected through personal interviews. 39 replies were collected through telephone calls. No firm declined explicitly to participate in the survey. Two firms did not reply the questionnaire and were excluded from further investigations. In one case the firm was clearly insignificant. In the other case the firm, a mail order company, was marginal to the pump market, and was unlikely to be able to provide accurate data. Finally 60 firms importing centrifugal pumps were identified, of which a substantial part were insignificant in terms of volume. *[21]*

The quality of the replies varied considerably. Some were able to provide accurate figures, while others made more or less accurate estimates. Some firms, e.g. a process plant contractor, did not keep track of pump imports as pumps constituted one of many products imported from the same foreign supplier, e.g. for incorporation in process equipment. In these cases rough estimates were provided. For a number of respondents accurate replies were impossible, or would demand an unreasonable effort, due to the structure of company records. However, reasonably accurate estimates were given by all significant importers.

Misunderstandings on the part of the respondents cannot be excluded. Some respondents may have estimated the value of their imports on the basis of the sales figures. Since the import values are significantly lower than the market values (because of margins), it is possible that some repondents may have overestimated the value of their imports.

The material consequently has many deficiencies as regards quantitative precision. It is, however, reasonable to conclude that the material allows the identification of pump types which are significant in imports and exports.

The products of over 100 foreign centrifugal pump manufacturers were identified in Swedish imports. 8 domestic pump manufacturers exported significant volumes of centrifugal pumps.

Aggregate results: an assessment of data quality

The survey identified imports of centrifugal pumps in 1990 at a value of 340-

[21] Further details are given in appendix III.

350 mill. SEK and exports at about 800 mill. SEK (estimated reexports not included). This can be compared to official Swedish foreign trade statistics, which states that imports 1990 were 344 mill. SEK and exports 1035 mill. SEK. The survey appears to have identified imports satisfactorily. However, it would be reasonable to expect the survey figure for imports to be somewhat higher than the official trade statistics figure because some pump imports probably are classified as parts of other types of industrial equipment rather than as centrifugal pumps. Interviews revealed that centrifugal pumps are imported in conjunction with the projects of foreign process plant contractors in Sweden. An overall assessment indicates, however, that the volume of unidentified imports of centrifugal pumps is small.

In the case of exports the divergence is disturbingly large. A closer correspondence between survey data and official trade statistics was expected because of the small number of firms accounting for the bulk of exports. It is highly unlikely that a major exporter of centrifugal pumps should have remained undetected. The difference is too large to be accounted for by reexports. The most likely explanation is that a part of the exports of Flygt were not included in the reply to the questionnaire. Several organizational units of Flygt are involved in exporting pumps. It proved difficult to determine the exact circumstances. Another possible (but less likely) explanation might be found in the difficulty of assigning values to intra-firm exports, i.e. exports from a Swedish manufacturer to subsidiaries abroad. A high share of Swedish centrifugal pump exports are intra-firm trade. The values assigned to consignments exported are transfer prices to subsidiaries abroad. These values are considerably lower than the market values. The aberration between the survey data and the official export figures might be due to different practices in the internal accounts and in the values reported to the customs authorities. In any case, the “missing” pumps are most certainly submersible pumps of various types. This implies that the implications for the conclusions made later are marginal.

A “test” of the survey data can be made for imports by comparing survey data with official trade statistics country by country. However, because of the sensitivity of some data, the figures must be withheld. Seven countries accounted for over 90% of Swedish centrifugal pump imports in 1990 according to official trade statistics: Germany, Denmark, Italy, Finland, the USA, Spain and the UK. A close correspondence was achieved in the cases of Italy, Spain and the UK. Survey data exceeded official data substantially (=20-25%) in the cases of Germany and Finland, while the reverse was true for Denmark and the USA. These divergences may indicate errors in the survey data, or in the official statistics, as both are unreliable for various reasons. However, it may also be the case that the reporting systems yield illusory differences. Several transnational corporations (e.g. Grundfos) manufacture pumps in more than one country. The actual commodity flows are not

always depicted correctly in the trade statistics, e.g. because products are manufactured in one country, stocked in a second, and sold in a third, or because direct deliveries are invoiced through the financial centre. Pump importers do not always know where a particular pump originally was manufactured.

In the final analysis the quality of the survey data must be labelled poor if the accuracy of each single figure is considered important. However, as indicators of the relative significance of particular pump types in Swedish exports and imports I consider the survey material more than adequate.

Results of the survey

Pump types in Swedish centrifugal pump trade

Swedish centrifugal pump exports by domestic manufacturers is heavily concentrated into a few product categories. However, total exports are more diversified because of reexports. According to survey data more than 85% of the exportation of domestically manufactured pumps were submersible pumps. These can be divided into three distinct groups: submersible sewage pumps; submersible drainage pumps for contractors and mining; and large submersible pumps for infrastructural applications (e.g. tunnel drainage). Other pump types exported in significant quantities are pumps for the pulp and paper industries, slurry pumps and circulation pumps. The small number of firms involved precludes publication of exact figures.

Imports are, predictably, more diversified. Table 4.1 displays approximate shares of selected centrifugal pump types in Swedish imports. Some figures are given as ranges to preserve sensitive information. The largest item is pumps for general industry. A very high share of the pumps in this category is standard type clean water pumps and standard type chemical pumps which can be used for a multitude of purposes. Designs are highly standardized and the potential for differentiation is low.

Table 4.1 *Pump types in Swedish imports 1990*

Centrifugal pumps for industry, water supply and sewage (incl. booster, irrigation pumps, etc; excl. submersible pumps)	25-30%
Circulation pumps	12-15%
Domestic pumps ("jet"- and drainage pumps)	10-12%
Bore-hole pumps	7-8%
Pumps for the pulp and paper industry	6-8%
Pumps for the power generation sector	4%
Sealless pumps (magnetic drive and canned motor)	4%
Pumps for the food industry	3-5%
Submersible sewage pumps	2-4%
Chemical pumps in special materials	2-3%
Internal combustion engine drainage pumps	0,5-1%
Slurry pumps	<0,5%
Σ	***75-95%***
Not specified due to incomplete data:	
Pumps for pressure boosting and tap warm-water in buildings (incl. in pumps for industry)	
Special pumps for washing machines and dish-washers (5-10%)	
Liquid ring pumps (>5%) (partly incl. in pumps for industry)	
Pumps for oil refineries (API pumps) (<3%)	
Σ	***90-110%***

Note: The percentages have been calculated by dividing survey data by the midpoint of the interval of total imports identified, 345 mill. SEK. The figure given by official trade statistics is almost identical: 344 mill. SEK.

Comments on official foreign trade statistics

The survey revealed that in this case at least, the nomenclature used in official foreign trade statistics is inappropriate for the purpose of analyzing IIT. Many commodity items are indeed aggregates of heterogeneous products. Disaggregation can be pursued in a meaningful way for most of the items of the HS or the CN.

The quality of the survey data is not high enough to allow a reliable assessment of the quality of foreign trade statistics. The anomalies between official and survey figures may stem from deficiencies in either material, or from diverging reporting principles. Although no definite conclusions can be made about the reliability of trade statistics, the independent material of the survey should inspire some caution about using official data uncritically. A certain amount of chance seems to be involved about how complicated economic transactions are reported in official statistics. The persons involved in the "production" of trade statistics are often unaware of the true

origins of the products. This is an especially important consideration when transnational corporations are involved.

Estimates of GL-indices from survey data

In table 4.2 estimates of GL-indices have been made from the survey data. The quality of the estimates vary considerably. Since the main source of uncertainty is the extent of reexports, separate estimates of GL-indices excluding and including reexports are provided. It must be emphasized that the estimates of GL-indices including reexports are to be regarded as informed guesses which might be erroneous.

There are several sources of error and imprecision which must be kept in mind in the interpretation of the figures. The *survey data* are influenced by several factors which reduce their reliability. Some respondents were able to give estimates only. However, most of the larger firms were able to give reasonably accurate figures. Misunderstandings cannot be completely excluded. Some respondents who did not have access to written records may have made estimates based on sales values, which are considerably higher than import values. A further source of error concerns the division of aggregate figures into pump types. Some firms were unable to utilize the "nomenclature" provided by me, which in some cases yielded ambiguity. For some pump types, notably process pumps and some types of pumps for the building sector, it was impossible to separate accurate figures from the survey material.

Estimates of *reexports* are included in the calculation of the GL indices. Reasonably accurate data on reexports exist in some cases (hygienic pumps, chemical pumps in special materials, slurry pumps, and sealless pumps). The respondents were asked to give an estimate of the proportion of their imports which were reexported, based on their knowledge about the market and particular customers. These estimates have been used as a basis for estimating total reexports for various types of pumps. Generally speaking, most reexports occur through process plant contractors. This implies that significant volumes of reexports are found among the pump types which are incorporated in process plants in, primarily, the chemical and food industry and effluent treatment: process pumps; chemical pumps in special materials; sealless pumps; hygienic pumps and sewage pumps. It could be expected that levels of reexports are very low for pumps for the households and for pumps used in applications in which Swedish process plant contractors are not active, e.g. oil refineries. However, in several cases the extent of reexportation can only be guessed at, e.g. concerning circulation pumps for central heating and pumps for the power generation sector.

Table 4.2 *Estimated GL-indices for selected types of centrifugal pumps, Sweden 1990.*

Pump type	GL-index excl. reexports	GL-index incl. reexports	Net trade balance
Pumps for the chemical industry in special materials	0	0.4-0.8	-
Pumps for the pulp and paper industry	0.5-0.6	0.5-0.6	+
Hygienic pumps	0	0.4-0.5	-
Circulation pumps	0.3	0.3-0.4	-
Other process pumps	0	0.3-0.5	-
Standard clean water pumps (single & multistage)	0	0.2-0.4	-
Sealless pumps (canned motor and magnetic drive)	0	0.2-0.5	-
Liquid ring pumps	0	0.2-0.4	-
Sewage pumps	0	0.1-0.4	-
Booster pumps for buildings	0	0-0.1	-
Irrigation pumps	0	0-0.1	-
Slurry pumps	0.07	0.08	+
Submersible borehole pumps	0.02	0.05	-
Submersible sewage pumps	0.07	0.07	+
Submersible drainage pumps for contractors and mines	0.01	0.05	+
Chemical DIN norm pumps	0	0.05	-
Pumps for the power generation sector	0	0-0.1	-
Pumps for households (mainly “jet” pumps)	0	~0	-
Pumps for oil refineries, API norms	0	~0	-
Drainage pumps, non-electric	0	~0	-
Submersible drainage pumps for households	0	~0	-

Notes: The GL indices have been calculated from the questionnaire data. The estimates including reexports should be considered as speculative, see the text.
Source: Calculated from survey data.

Only two items have high levels of IIT if reexports are excluded: pumps for the pulp and paper industry and circulation pumps. However, if reexports are included at least eight items have estimated GL-indices over 0.2. The estimated IIT_a index for the most disaggregated level possible, corresponding to “true” IIT, is slightly below 0.1. This implies that in this particular case, most apparent IIT was found to be due to the phenomenon of “categorical aggregation”, i.e. the lumping together of products which in reality should not be considered as belonging to the same industry. However, a closer examination of the individual cases of IIT which could not be eliminated by disaggregation reveals widely diverging circumstances. A short survey of these cases is made below. In the next section a systematic review of the findings in a theoretical perspective will be made.

A high share of the remaining *volume* of IIT at this level of disaggregation is accounted for by four pump industry segments: pumps for the pulp and paper industry; pumps for the chemical industry; circulation pumps; and submersible sewage pumps. High levels of IIT (but small shares of the total volume of trade) are also recorded for chemical pumps in special materials, hygienic pumps, sealless pumps and, possibly, for liquid ring pumps. These cases of "true" IIT represent different types of explanations.

For pumps mainly used in the *chemical industry* and for *hygienic pumps* the main reason for high levels of IIT is reexports. In the former case pumps are reexported through process plant constructors. In the case of hygienic pumps, most IIT is intra-firm trade, i.e. the trade flows mirrors the internal division of labour of a transnational corporation, in this case Alfa Laval. This company happens to have its main centrifugal pump plant in Denmark (in 1982 the Swedish centrifugal pump plant in Lund was closed, and the production was relocated to Denmark). Most pumps produced are incorporated in food industry equipment and plants, which are built by Alfa Laval on a contract basis for customers around the world. Pumps are imported to Sweden from Denmark, only to be reexported in conjunction with other pieces of equipment to be incorporated in food plants.

In the other cases the main component of IIT is simultaneous exports and imports of competing products. In the case of *pumps for the pulp and paper industry*, ABS Scanpumps exports domestically manufactured pumps, mainly to Asia, whereas Finnish Ahlström imports pumps for the Swedish market. The main explanation for this case of IIT is the unwillingness of the customers, the large pulp and paper companies in Sweden, to accept a monopoly for strategic reasons. It is possible that in some cases the choice of the foreign supplier depends on product differentiation. However, both firms supplies a full range of pumps for this particular application.

In the case of *circulation pumps*, Perfecta (a smaller Swedish pump manufacturer, formerly owned by the cooperative movement, now by Wilo, Germany) exports domestically manufactured pumps to countries like Turkey, Greece and Spain. At the same time, circulation pumps are imported from the global market leader Grundfos and from some other companies, notably Kolmeks (Finland), Wilo (Germany) and Interdab (Italy). This state of affairs can be attributed to a combination of factors, such as the entrenched positions in the distribution network, transaction costs and the presence of long-term relations between firms. Circulation pumps are mature products, with highly standardized designs, which means that the incentives to switch supplier are small. Perfecta has been able to survive, in spite of a small scale compared to large foreign competitors, because of traditional linkages to distributors, and the possibility of finding business opportunities abroad which competitors have neglected.

In the case of *submersible sewage pumps* the situation is similar, al-

though the global market leader is Swedish (Flygt). Imports are less than 5% of exports, which implies a low GL-index value. However, as submersible sewage pumps is the largest single item in Swedish pump exports even a low GL value implies a non-negligible volume of IIT.

Product differentiation within the segments is, in this particular industry, not a significant explanation of IIT, even though most segments are constituted by a large number of distinct pump designs. This might be a surprising finding, as new trade theory emphasizes the combination of product differentiation and scale economies as a major explanation of IIT.

5. Explanations of IIT in Sweden's pump trade

A systematic review of the findings: introductory comments

The interpretation of the findings in a theoretical perspective will be made in two stages. In this chapter the implications of the findings for IIT theory will be discussed. The contribution consists of a number of empirically substantiated hypotheses on the causes of IIT, based on the results of the case study.

In the second stage (chapter 6) a reformulation of the research problem is suggested. The concept *international specialization* is given a preliminary definition, and some suggestions are given for directions which further development of this perspective might take.

Apparent and "true" IIT

In the case of Swedish centrifugal pump trade it was found that most apparent IIT could attributed to "categorical aggregation", since heterogeneous products were lumped together in quite arbitrary statistical items. In industries where product differentiation is an important means of competitiveness, it could be expected that the share of "true" IIT is higher. However, it was also found that "true" IIT indeed exists. The circumstances involved indicate that similar results could be expected in other industries as well.

It must be recognized that the concept of *industry* is extremely problematic. Depending on the context, the industry can be defined by the extent to which products are substitutes in demand or in manufacturing. The former definition is nearest to the approach chosen in this study, although it is impossible to impose it rigidly for a number of reasons. In the latter case, however, the same product might be assigned different industries in different segments of the markets. An eccentric screw pump might compete with a lobe rotor pump for certain applications but not in others. I do not believe that this problem can be given a definite solution. IIT is a concept which is dependent on the context, and which must be *defined contextually* (if used at all).

Explanations of "true" IIT in Sweden's pump trade: a systematic review

In the following sections a systematic survey is made of the explanations of

"true" IIT found in the case study of Sweden's pump trade. It is difficult to classify all the alternative explanations in a consistent theoretical framework, because a variety of behavioural, institutional, microeconomic and conceptual elements are involved. Rather than classifying various types of circumstances according to classes of theoretical explanations, the exposition will follow a didactic principle related to the manufacturing-distribution-consumption system (see fig. 5.1 below).

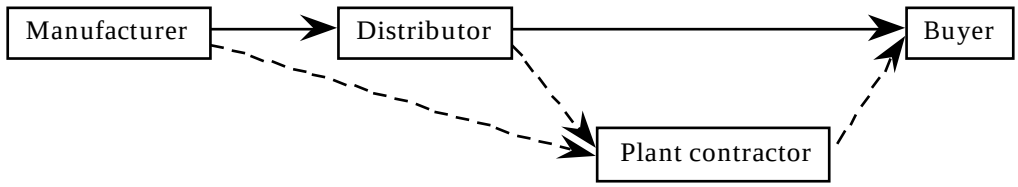


Fig. 5.1 *The manufacturing-distribution-consumption chain*

The case study provided examples of various circumstances leading to IIT. These examples can be related to the stages of the production-distribution chain. The actors in fig 5.1 may be located in different countries in various constellations, which may imply that IIT occurs, within one chain or through the effects of independent chains involved with the same kind of product.

If the entire production-distribution-procurement chain is taken into consideration, it is evident that the role of distributors may be important in explaining IIT. The actual identity of the manufacturer may be of secondary importance to the buyer scanning the market for a suitable supplier (see the example in fig 5.2). The choice of the buyer in fig 5.2 will be reflected in Swedish foreign trade statistics, but it might be impossible to explain the actual transactions by considering the characteristics embodied in the product, or the characteristics of the *manufacturer*. Several examples of how this notion might enhance the understanding of the IIT phenomenon are given in this chapter.

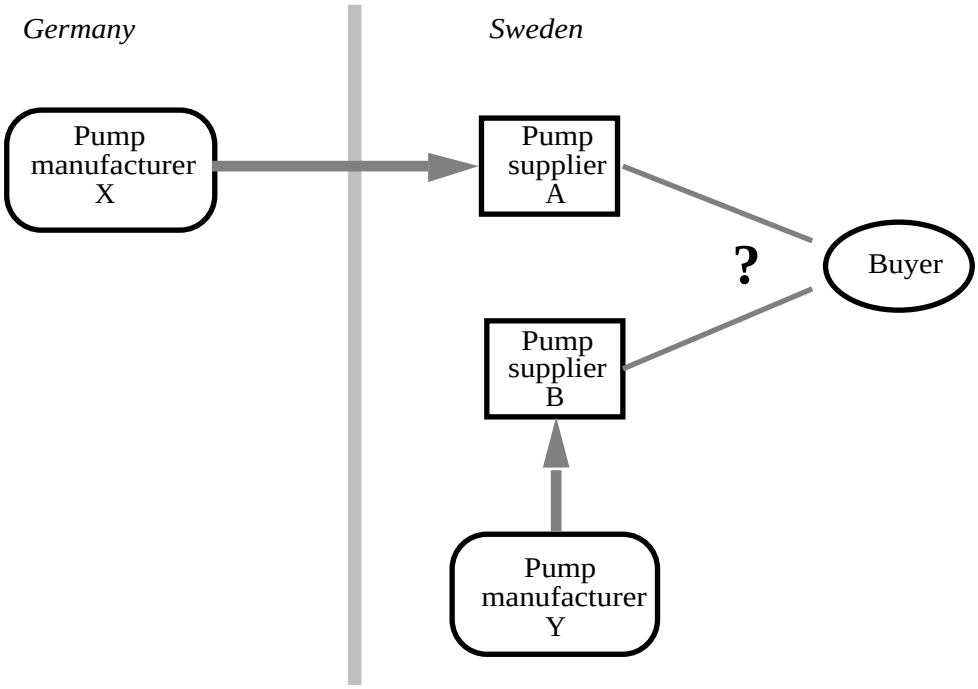


Figure 5.2 *Choice of supplier and foreign trade*

We may speak of two basic types of IIT. The *first* type occurs when *two independent production-consumption chains give rise to trade flows of similar products crossing a national border in opposite directions.* This type will be called *horizontal IIT* here, referring to the exchange of products at similar stages in the manufacturing process. The *second* type occurs when *reexports* are involved, i.e. when the transactions (the arrows in fig 5.1) in different stages of *one* production-distribution chain involves the crossing of a national border in opposite directions. This type of IIT will be referred to as *vertical IIT* below. In the following sections the examples found in the case study will be classified and discussed. Numerous other cases might be imagined, though. The illustrations provided include *examples* of transactions leading to IIT, disregarding all other transactions and actors not involved in causing IIT in order to keep the figures as simple as possible.

Horizontal IIT

The *first* basic type of IIT occurs when a country houses a manufacturing firm involved in the exportation of certain products, while domestic buyers for a variety of reasons procure foreign-made products of the same type

[22]. In fig 5.3 this is the case for country A.

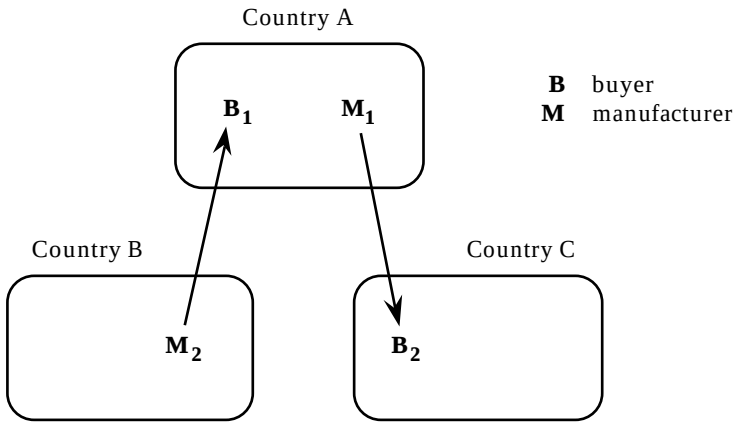


Figure 5.3 *Horizontal IIT*

A large number of circumstances may explain this type of IIT. Most of the examples found in the case study may be related to factors motivating the choice of the buyer. We will therefore start by asking the question: *Which reasons can move a buyer to prefer a foreign-made product when a domestic manufacturer is able to supply similar products?* The M_1–B_2 flow will be taken for granted in the examples provided. However, this trade flow may be explained by the same type of circumstances.

In the case study the following main reasons were identified:

(i) *strategic behaviour of buyers to foster competition among suppliers*
(ii) *industrial network formation and intra-firm division of labour*
(iii) *differentiation of services*
(iv) *afterbusiness*
(v) *personal affections and disaffections*
(vi) *contacts unrelated to the case under study*
(vii) *strategic behaviour of manufacturers*

The following sections explain and exemplify these factors one by one.

[22] Of course the manufacturer may also sell a part of the output to domestic buyers, while buyers procure only a part of their total demand from foreign suppliers. In the illustrations provided in this chapter the foreign actors are placed in different countries, which is the most common case. However, in some (real) cases only two countries are involved.

Strategic behaviour of buyers

Buyers of industrial equipment are often reluctant to become dependent on a single source. By spreading procurements among several suppliers, the competitive pressure can be maintained in the supplier industries, which potentially benefits the buyer in the forms of lower prices, more rapid product development and increased willingness to provide advanced service. One case may illustrate this point. One of the specialities of the Swedish pump industry is pumps for the pulp and paper industry, the latter occupying a central position in the Swedish economy. Until 1982 two Swedish companies dominated the Swedish market, Scanpump (formerly API) and JMW. When JMW was acquired by Scanpump in 1982 the Swedish pulp and paper companies grew uneasy, because they feared being disadvantaged when a single company controlled the bulk of the market. In this situation the pump division of the Finnish firm Ahlström found the Swedish market easy to penetrate. For the present, the Swedish market for pumps for the pulp and paper industry is dominated by ABS Scanpump and Ahlström. Pumps in this segment constitute an important part of Swedish centrifugal pump exports, while they are also represented in imports, mainly from Finland.

There are some interesting twists to this case which indicate that a dynamic approach might be necessary to appreciate all factors relevant for the existence of IIT. When JMW was taken over by Scanpump, the new direction started to rationalize the product range to exploit scale economies. Product lines which catered to the same application were reviewed in order to eliminate duplicating. One criteria for choosing among similar pump types was the pump construction in terms of manufacturing costs. Scanpump chose to cease production of some of the JMW pumps, which had a more complex design. However, some customers preferred the pump types which were discontinued, and felt maltreated when Scanpump refused to supply them. These customers turned to Ahlström in the hope of finding a more “reasonable” supplier.

The role of strategic behaviour on the part of buyers as a cause of IIT could be expected to be significant in industries characterized by oligopsony and oligopoly. A broad range of producer goods industries might display similar dynamics, but the role of this factor might be important in explaining IIT in consumer goods as well. Even though the number of final consumers (the households) may be very large, the critical element is the structure of the distribution chain. The choice of supplier is not a sovereign decision of the final consumer, since the distribution system constitutes a filter which only permits a restricted number of foreign manufacturers to offer their products to the market.

Industrial network formation and intra-firm division of labour

The structure and dynamics of the relations between manufacturers, distributors and buyers proved to be a central issue for understanding IIT patterns in the pump industry. For various reasons manufacturers, distributors and buyers develop long-lasting relationship to each other, forming industrial networks (Axelsson & Easton, 1992; Håkansson, 1982 and 1989). These networks of established relations enable the actors to benefit from a variety of advantages. Most obvious is the potential for *reducing transaction costs* realized through the routinization of contacts. Costs (and efforts) for searching and evaluating alternative suppliers, and for negotiating deals may be avoided by sticking to a satisfactory business partner. Several segments of the pump industry are characterized by a mature technology, a high degree of standardization of the products and a low potential for differentiation in design. In addition, the purchase of a pump is usually a minor investment in terms of the budget of the buyer. In such circumstances the buyer will not spend effort and money on contacting foreign manufacturers not represented in Sweden, or even alternative domestic suppliers. Most ordinary pump users will not evaluate the offers of alternative suppliers if no distinct reasons for dissatisfaction with the customary supplier are present. By employing the established network of business relations established over an extended period of time, the transaction costs can be reduced considerably. This is a rational form of behaviour as long as the products offered by the alternative suppliers are similar in price and quality.

Other advantages of network formation include access to information and know-how in a non-formal way. A pump buyer who is a regular customer of a particular supplier may resolve difficulties by making a phone call to a knowledgeable seller. In the course of time a personal relationship, where *trust* is an important element, often develops which further stabilizes the pattern of economic transactions.

In some cases more intimate forms of networks develop, e.g. when there are advantages to the supplier and the buyer in the mutual adaptation of products, joint product development, exchange of experiences or trial runs.

Apart from network formation among more or less independent actors, the internal division of labour in transnational corporations, or in companies linked by ownership or by other means (e.g. strategic alliances or long-term subcontracting agreements), may lead to substantial amounts of IIT. In the case of strategic alliances the collaborating firms often agree to complement each others range of products to exploit scale economies in manufacturing or design. The economic explanation of this type of IIT is, of course, scale economies. However, the network approach might be necessary to understand the dynamics and geographical patterns of trade flows. Sub-

contracting agreements often concern vertical specialization (Casson, 1986, Dicken, 1991, Donaghu & Barff, 1990). The economic explanation in this case might well be found in the comparative advantage framework, e.g. when labour-intensive operations are subcontracted to firms in low-wage regions. Less clear are the cases of TNC's allocating a specific manufacturing activity to one of its plants (in order to exploit scale or scope economies) which supplies ware-houses, process plant contractors, assembly plants, etc. within the same corporation but located in other countries.

Differentiation of services

Expert advice on the selection of sealing or rotor type may be crucial for the efficient and reliable operation of a pump, especially if operating conditions include unusual liquid properties or environments. In such cases the buyer can gain considerable advantages by turning to a supplier which has special know-how in that particular application. The actual pump supplied may be of a standard type, very similar to pumps included in the product range of competitors. However, the competitor might be unable to provide good advice for this particular application because of wanting know-how. This means that IIT can result from the skill structure of distributors, while the identity and nationality of the manufacturer is of secondary importance (see fig. 5.2). The same type of pumps may be exported and imported simultaneously, but used in different industries.

The IIT literature accords a central importance to product differentiation, of which the differentiation of service may be considered a part. However, it is important to recognize that the differentiation of service may occur in the distribution firms, independently of the original manufacturer. This fact introduces a new element of complexity into the analysis of foreign trade patterns, since it is not clear that the link between a particular manufacturer and a particular distributor is determined by the present competitiveness of the manufacturer relative to other manufacturers. The link may have been established long ago, under different conditions, or through a chance meeting of two individuals.

The general relevance of this element in explaining IIT across the whole range of commodities is, of course, related to the importance of service as a competitive advantage in in each particular industry.

Afterbusiness

Considerable amounts of industrial equipment are exported and imported

through construction projects. Process plant contractors are specialists in the design and construction of manufacturing facilities in industries such as the food processing industry, oil refineries and the chemical industry. These engineering firms usually incorporate in their designs components and machines from their own customary suppliers. The company (e.g. a Swedish chemical company) which operates the completed plant often prefers to replace worn-down equipment with products from the original supplier, even though domestic manufacturers might be able to offer similar products to similar prices and quality. The reason is partly switching costs, such as costs associated with keeping parallel spare part inventories, the adaptation of existing equipment to different dimensions and training of personnel. Other reasons include avoidance of insecurity (if the characteristics and reliability of alternative products are not known) and familiarity with the idiosyncrasies of the original equipment.

Personal relationships

The role of personal relationships in maintaining a diversity of suppliers on the market should not be underrated. In several interviews it was mentioned that certain customers avoid specific suppliers because they do not trust their sales personnel, because they have felt themselves maltreated during previous business contacts, or because they dislike the management. Probably the fear of coming in the position of dependence on a single supplier is wide-spread among buyers, not only for purely economic reasons, but also for emotional reasons. This might be a powerful impediment to the monopolization of industries.

Strategic behaviour of manufacturers

Reciprocal dumping is one explanation advanced in the literature to explain IIT (Brander, 1981; Brander & Krugman, 1983). In the present study some evidence was found for dumping in the markets of competitors. However, this phenomenon cannot be ascribed to purely economic (short-run) considerations, as in the theoretical models. Price-cutting in the home-market of a competitor was pursued for two reasons. The *first* concerns the long-term strategy for entering new markets. In order to establish a foothold on a market dominated by domestic manufacturers, dumping can occur as the only way to find buyers. Losses can be accepted as a part of a long-run strategy to build a sustainable customer-base. The *second* reason concerns prestige, or image-building. Sales in the home-market of a strong competitor is regarded as proof of high quality and skilled personnel. Sweden is the home-

country of one of the world's largest and most successful manufacturers of submersible pumps, ITT Flygt. For foreign manufacturers of submersible pumps, business in Sweden may be a way to prove their competitiveness.

A preliminary assessment of the relevance of this factor for explaining IIT indicates that it is a marginal factor in the pump industry, and probably in most other industries as well.

Vertical IIT

The *second* basic type of IIT, reexports or vertical IIT, is something of a special case, but of considerable importance as an explanation of "true" IIT. Substantial volumes of diverse products are reexported without modification. In this study five different, and relevant, reasons for reexports were identified:

(i) *reexports through process plant contractors*
(ii) *reexports because of completing of product range*
(iii) *reexports because of chance contacts*
(iv) *reexports because of regional warehousing*
(v) *reexports because of "entrepreneurial arbitrage"*

These types of IIT will be discussed below, with an adjoining comment on some other potential causes of IIT through reexports which were not found to be significant factors in the particular case of pumps.

Reexports through process plant contractors

The most common reason for reexports in this case study proved to be the extensive activities of engineering firms, e.g. process plant contractors, selling industrial equipment and turn-key plants abroad (see fig. 5.4).

In a few cases intra-firm trade is involved, as when Alfa Laval Flow Equipment imports pumps from the Alfa Laval pump plant LKM in Denmark for inclusion in food plant projects abroad. However, in most cases the firm constructing, say, a water treatment plant in a foreign country procures most components in the home-country. Pumps may be bought from a Swedish pump supplier who represents a foreign pump manufacturer. The pumps are exported to the site of construction abroad for installation.

A selection of Swedish firms engaged in process plant contracting and in exporting industrial equipment incorporating centrifugal pumps is provided in table 5.1. This list is by no means complete. This kind of activities may

symbolize the increasing complexity of the international economic system, which implies diverse and complicated trade flows.

As a general factor of explanation the role of suppliers of industrial systems, plants and complex pieces of equipment is probably considerable in the industries manufacturing products which are incorporated in such products / projects.

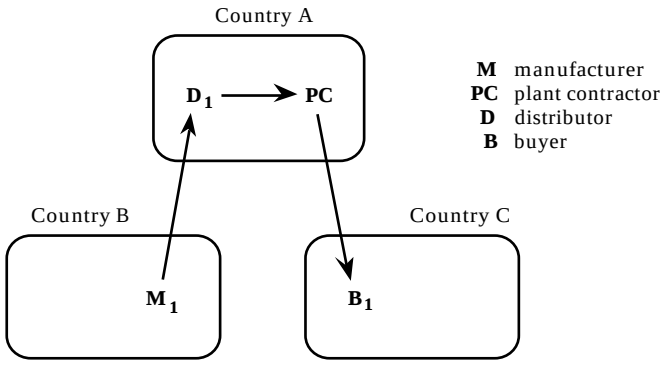


Figure 5.4 *IIT due to the activities of process plant contractors*

Table 5.1 *Selected OEM suppliers and process plant contractors exporting centrifugal pumps (1990)*

Firm	***Product***
ABB Metallurgy	pickling plants for steel works
ABB Transformers	transformers (cooling oil)
ABB Traction	locomotives (hydraulic oil)
Agaria Industri AB	washing eqipment (degreasing)
Alfa Laval	food plants, equipment for fishing-boats
Cellchem	chlorine dioxide plants
EKA Nobel	chemical plants
Electro-Invest	drinking water plants
Electrolux	dish washers for catering
Frigoscandia	washing equipment
Getinge AB	dish washers for hospitals
KMW	equipment for the pulp and paper industry
Malmkvist	cleaning equipment
Nobel Chematur	plants for pharmaceuticals, explosives, chemicals
Pharmacia	plants for pharmaceuticals
Purac	sewage treatment plants
Sunds Defibrator	equipment for the pulp and paper industry
Fläkt	ventilation equipment
Widholms Industri AB	washing equipment for industry, bus companies, etc.

Source: compiled from interviews

Reexports because of completing of product range

Some manufacturing pump companies import pumps to complement their own product range (see fig 5.5). These imported pumps are sometimes sold abroad, often as afterbusiness, or in conjunction with larger orders. In the present study this was the case on a marginal scale for the Swedish submersible pump manufacturers Grindex and Pumpex.

In some other industries anecdotal evidence suggest that this factor might be of a considerable importance in explaining IIT. The basic explanation of this type of IIT is usually scale economies in manufacturing or product development, or proprietary technology or know-how. It appears that the large number of strategic alliances in such industries as cars, semiconductors, computers, etc. partly is motivated by the need of individual firms to complement their product ranges. Even though the basic explanations can be traced to the above-mentioned factors, the organizational elements are essential to a deeper understanding of the actual patterns.

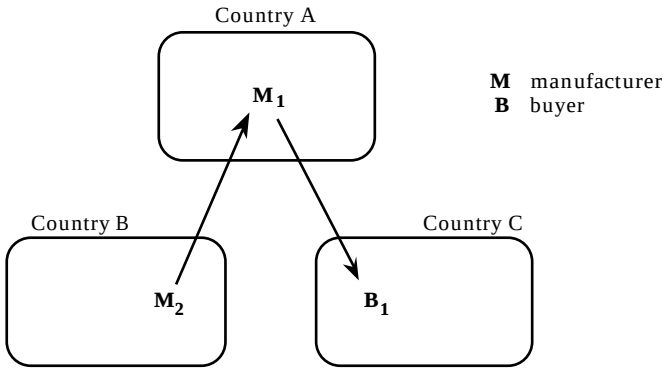


Figure 5.5 *Reexports due to completing of product range*

Reexports because of unrelated contacts

Business contacts may result in reexports simply because buyer and seller happen to be in contact with each other, even though the main reason for the contact is unrelated to pumps. The value of the pumps in this kind of "side-deals" is usually small compared to the main deal, and the products standardized. In such cases search costs are not motivated, even though bargains might be found. This is the case of avoidance of transaction costs

mentioned above.

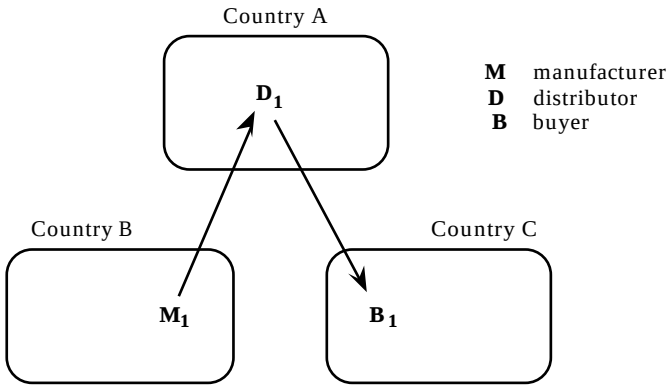


Figure 5.6 *Reexports because of unrelated business and regional ware-housing*

A related circumstance is when a distributor happen to have personal contacts with a foreign buyer. A distributor of foreign products may also sell products to foreign buyers because, say, a process plant contractor or another firm, related to the distributor by common ownership, act as an intermediary. Buyers who procure a certain kind of products infrequently may be reluctant to devote much effort to scan the market. When an opportunity arises to find a satisfactory supplier no further efforts are made.

Reexports due to regional ware-housing and marketing

A domestic company may represent a foreign manufacturer for a regional market, which means that pumps are imported, stocked, and then exported to neighbouring countries. In Sweden, some companies import pumps which are sold in the Nordic market from a Swedish base, e.g. Morgårdshammar. This type of reexports is similar in structure to the previous type in terms of the production-distribution chain (fig 5.6).

The role of the organization of marketing and ware-housing in other industries in explaining IIT patterns is not known, but probably deserves to be included among research hypotheses in future case studies.

Reexports because of "entrepreneurial arbitrage"

Although a minor factor in explaining the occurrence of IIT, this pheno-

menon illustrates the opacity which sometimes characterizes real-world transactions. Several respondents described to me how an entrepreneur can earn a living from exploiting different price levels in different countries. The same pump model may be priced differently depending on the intensity of competition. A pump company distributing their products in many

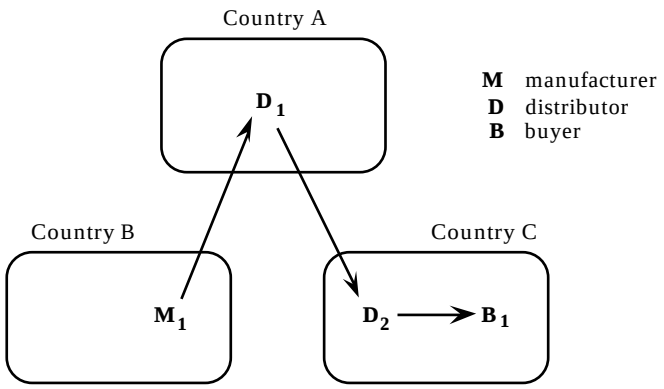


Figure 5.7 *Reexports because of "entrepreneurial arbitrage"*

countries will adapt their pricing strategies to the prevailing market in each country. Where competition is fierce (in this case e.g. in Italy), lower margins must be accepted. However, in countries with less intense competition margins may be considerably higher (e.g. in Sweden). The perceptive small scale entrepreneur, which may operate with low visibility, may procure pumps in one country for reselling in another country. If the pumps were imported to the low-price country originally, IIT will occur. This was not the case in Swedish pump trade, but certainly in the case of Italy. However, the volumes involved are marginal.

Some further comments on reexports

A further type of reexports (not found to be important in the present case study) is trade in used products. Reexports may also be involved when pumps are sold for use aboard ships or off-shore platforms.

Reimports also exist, but probably on a marginal scale. Reexports usually involve three countries, e.g. imports of chemical pumps to Sweden from Germany, which are reexported to a construction project in the Middle East or in Latin America. Reimports would imply imports of products formerly exported from Sweden, which is rather unlikely.

The cases reported above concern the reexportation of centrifugal pumps as separate pieces of equipment (although they might form a part of a

package). Even more important, in terms of volume, is the reexportation of pumps which are built into industrial equipment, such as industrial washing and rinsing machines. However, in these cases they are probably not classified as pumps in the official foreign trade statistics when they are reexported, thus not contributing to the apparent IIT.

What about product differentiation and scale economies?

In the context of the case study, no examples were found of product differentiation as a *major* explanation of IIT. Several respondents were asked if product differentiation is an important competitive advantage. The answer was often in the affirmative, but few examples were given. Such characteristics as reliability and energy efficiency were mentioned, but they seemed to refer to the general level of quality rather than to product varieties. In the cases of IIT recorded, such factors seemed irrelevant. Product differentiation probably contributes to IIT in many cases, but the point here is that other explanations seemed more important.

However, the Swedish case may be exceptional, as exports are concentrated to a small number of segments. It is plausible that high volumes of IIT due to product differentiation exist between, say, Germany, Switzerland and France in such segments as sewage pumps, chemical pumps and large pumps for the power generation sector. In these segments the operating conditions are extremely diverse, and product design may be strategically important.

In the final analysis this case study suggests that the role of product differentiation as the major explanation of IIT might be overrated in new trade theory, at least in the case of producer goods. Further research is called for to explore this issue.

Preliminary conclusions

The explanations of IIT in the Swedish pump industry outlined above may be grouped into:

behavioural factors (strategic behaviour of buyers and manufacturers; personal relationships; chance contacts; personal contact networking; aspects of afterbusiness),

institutional factors (industrial network formation; ownership linkages; the organization of distribution systems),

cost-related factors (avoidance of transaction costs; scale economies in manufacturing, distribution, product development, etc.; diseconomies of product proliferation; switching costs).

However, this framework should not be taken too literally since there is usually a cost aspect on behavioural and institutional factor, a behavioural aspect on cost-related and institutional factors, etc. The case study reported here may indeed serve as an illustration for the "untidyness" of the IIT phenomenon, which Peter Gray (1988) refers to.

The pump industry is representative only for a part of the commodities traded internationally. It is therefore too early to erect a systematic formal framework for the analysis of IIT incorporating the hypotheses generated in this study. A comprehensive framework for the analysis of IIT and international specialization should be developed on the basis of a range of thorough case studies of different types of products.

IIT theory in perspective

IIT theory in the perspective of the case study

The empirical findings reported above provides a background for some comments on the explanations of IIT offered in the (mostly theoretical) literature. Leaving marginal explanations aside, the following explanations seem to be considered the most important in the literature: (i) varying factor intensities within industries (including "categorical aggregation"); (ii) vertical disintegration of production processes by factor intensity; (iii) scale economies and product differentiation; and (iv) reciprocal dumping (see the section *Theories of IIT*).

It was found in the case study that the main part of the observed IIT could be explained through the aggregation of heterogeneous products in the same statistical items, but a disaggregation did not reveal varying factor intensities as a relevant explanation. However, it was also demonstrated that substantial volumes of "true" IIT actually exist. The conclusion is that in this particular case the recourse to explanations based on variants of the factor proportion theory of trade must be largely rejected.

The presence of product differentiation in the sense of product varieties which are substitutes in demand was also considered as a marginal factor for the explanation of IIT patterns. However, the theme of the proliferation of product types within an industry and scale economies in manufacturing and product development is clearly relevant to explain specialization patterns.

Reciprocal dumping seems to exist in a small scale in the pump industry, but accounts for a marginal share of IIT.

Where do these conclusions leave us in evaluating the relevance of current IIT theory? The findings related above suggest that behavioural and organizational perspectives have some important insights to contribute in

explaining IIT. Strategic behaviour on the part of buyers and manufacturers were important sources of IIT in the case studied here. The role of uncertainty and incomplete information also seem to be very important. In a world characterized by limited information, industrial networks are important in reducing the transaction costs associated with the search for suppliers and the evaluation of alternatives. In this particular industry there are important incentives to rely on known alternatives as the costs of not finding the most favourable offer are often smaller than the costs for search and evaluation. The case might be very different in industries which are not characterized by mature and highly standardized products. The theme of networks seem to offer a promising perspective for research into internationalization issues, as is illustrated by the role of process plant contractors, afterbusiness and casual links in the pump industry.

This case study might be seen as an empirical substantiation of Gray's (1988) claim that the IIT phenomenon is to complex for “tidy” models. It is possible that some kind of eclectic framework along the lines proposed by Gray might be helpful in furthering IIT studies. However, the volume of empirical research is still small, and it might be prudent to explore some issues in more depth before developing a general framework. It might also be questioned if the phenomenon of IIT can justify a major research effort in itself. In the following chapter a tentative reformulation of the research issues is made, changing the emphasis of inquiry from IIT towards the more general phenomenon of international specialization.

Implications for the methodology of IIT research

The findings reported above have implications not only for the hypotheses on the causes of IIT, but for the research methodology as well. The significant role of behavioural and institutional aspects in explaining trade patterns in the pump industry suggest that the predominant methodology in IIT research, econometrics, is inadequate to deal with important aspects of the object of research. This does not imply that one methodology should be abandoned in favour of another, but that our knowledge would benefit from a greater range of variation in approaches. The broad range of issues relevant for IIT research outlined in preceding sections suggests that further in-depth case studies would have a good potential for yielding additional insights.

Why international trade? – some comments

In the perspective of the empirical material considered in this study some general comments about formalized trade theory can be made.

In the course of the analysis several examples were given of the complexity of real-world transactions, e.g. the activities of plant contractors, the intra-firm division of labour and the role of the distributors. In the face of this evidence the relevance of neo-classical or even "new" trade theory may be thrown into doubt. The production and circulation of industrial products cannot be represented by models of discrete producers and consumers acting according to simple profit-maximizing principles, without a considerable damage to relevance.

Although recent developments in trade theory assigns a more important role to product differentiation, my general impression is that the role of manufacturing costs and the prices of the products as explanations to trade patterns is exaggerated. The price of a product is only one of many factors considered by the prospective buyer. In the pump industry the price of the pump constitutes something like 5% of the total cost for the pump during its economic life. Obviously even a pure cost analysis of the purchase would focus more on the expected life-time and the maintenance costs (hence quality) than on the price tag. For products which are incorporated in industrial manufacturing processes, the adaptation of a single piece of equipment to very specific operating conditions might be crucial. In this perspective the price of the product is often a very small share of the total values involved, e.g. lost incomes if the manufacturing process operates suboptimally.

For the manufacturer, it is often more profitable to compete by differentiation than by price leadership *[23]*. Consequently a trade theory which focuses on the analysis of manufacturing costs and prices is biased in relation to the real world.

An inductive case study is a limited basis for developing general frameworks, but I would nevertheless like to try to summarize the causes of international trade which have surfaced during the empirical studies. Let us postulate that international trade occurs because of *differences* between products manufactured domestically and abroad, in combination with differentiated preferences and needs on the part of buyers *[24]*. The difference can be constituted by:

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23 See the extensive discussion in Porter, 1980, 1985.

24 The framework presented below is *one* way of discussing causes of foreign trade. The perspective chosen is that of the buyer: we ask what the buyers choice of foreign vs. domestic products. We might approach the problem of foreign trade from the other angle, asking why manufacturers export.

1. Price
2. Product characteristics
3. Service offered
4. The identity of the supplier
5. Delivery conditions
6. Transaction costs
7. Other internalization advantages

Price. This element of explanation is well developed, at least from the static perspective, in various contexts, such as location theory, trade theory, business administration and industrial organization. Cost factors may include varying (i) factor costs, such as the costs for unskilled and skilled labour (including efficiency considerations), energy, capital, land, know-how and information; (ii) economies of scale and scope; (iii) profit margins; (iv) efficiency in the organization of various functions; (v) state of technology in installed facilities; (vi) infrastructure.

Product characteristics. These include technical performance characteristics (including quality considerations), life-time costs (reliability, resistance to wear, energy efficiency, etc.), design differentiation and image. For many consumer goods subjective product characteristics may be important, such as image, uniqueness and minor design details. For producer goods the technical performance and cost factors usually dominate.

The switching costs implied by installed equipment which must be repaired and, in the case of complex systems, replaced, may introduce an important element of inertia in the consumption patterns, leading to after-business.

Services offered. These may include, for example, maintenance, training, information, documentation, spare-part supply agreements. The importance of this dimensions varies widely. For expensive and technically complex products, such as printing presses or jet fighters the service dimension may be crucial.

The identity of the supplier. A professional buyer often prefers to develop long-term relations with suppliers. A long-term relation might yield advantages which are quite independent from the qualities of the supplier. Personal relationships generate a framework for exchange of information of various kinds. Each party becomes important to the other, which means that a certain amount of trust develops in the relationship. But of course there might be particular reasons for preferring one supplier above another. The capacity to give competent advice, accessibility to key persons, long record as a reliable supplier, high-quality image, etc. might be important motives for the choice of supplier. The supplier might be able to develop superior marketing skills, which may or may not imply tangible advantages

for the buyer. It must be recognized that the identity of the *manufacturer* might be of secondary importance to the buyer. The choice of supplier will be reflected in the level of imports in Sweden's foreign trade statistics, but it might be impossible to trace the explanation of the trade flow (or absence of trade flow) to characteristics related to the products themselves or to the manufacturers. The strategically important factor is then how a foreign manufacturer establishes long-term relations with domestic distributors. Again, this might not necessarily involve purely economic circumstances, such as manufacturing costs.

The identity of the supplier might be important for other reasons as well, as was indicated in the case study of IIT in the pump industry. Buyers may strive for the maintenance of a competitive market by spreading procurements among the potential suppliers.

Delivery conditions. This factor might as well be included in the discussion of differentiation. An element of chance might be involved regarding the availability of particular products at the desired point in time and space. However, for many companies the choice of service level, the density of the distribution network, spare capacity, etc., constitute important variables in the competitive strategy. An established record of punctuality and reliability may be a decisive criteria for the choice of supplier in a range of industries. A closely related issue concerns the credit arrangements.

Transaction costs. Each firm has an established network of contacts and personal relations which can be likened to a road system, except that the structure of the network is different for each actor. It is convenient and inexpensive to employ this network, rather than moving through unknown terrain. A node to which a convenient link exists is closer in time and transaction costs than a node which might be closer, or possess some other desirable qualities, but to which no links exist. In the case of networks of contacts, the individual often prefers known alternatives to probing for better alternatives under uncertainty. What might be disturbing to the scholar trying to incorporate this concept into the analysis, is that there is a considerable element of chance in the process of establishing and maintaining the networks, except in the more tangible forms of formalized links between firms (e.g. through ownership, subcontracting agreements or strategic alliances).

Other internalization advantages. Transactions may be internalized into an organization (e.g. a TNC) for a variety of reasons (Dunning, 1988). Ownership of suppliers and distributors may be preferred to arms-length transactions because of concerns related to quality control, control of proprietary technology and know-how, etc. The geographical allocation of activities within such organizations is a complex issue. Single location decisions are not made under direct competitive pressures, which implies that organizational structures may be more important to the decision-makers than

traditional location factors. The international trade flows within firms (intra-firm trade) might consequently be difficult to explain by conventional trade theory.

Evidently it is impossible to integrate all of these elements in a formalized trade theory. The perspective outlined above does not imply that formal trade theory is irrelevant, but that it must be recognized that the aspects which can be formalized are only a part of the picture.

6. International specialization – some suggestions

A reformulation of the research problem

The field of IIT studies is in a sense quite artificial, since apparent IIT is highly dependent on theoretically unfounded definitions of the concept *industry*. However, the significance of the IIT debate is that it poses a problem for the traditional paradigm in economic theory (an *anomaly*, in the language of Kuhn), the approach based on general equilibrium theory and an almost exclusively deductive method. What does IIT signify apart from the opportunity to falsify traditional economic theory? In this study IIT was found to be the result of quite diverse circumstances. IIT can be a starting-point for the analysis of international specialization, but in themselves the structure and dynamics of the GL-indexes are not very informative. I would suggest a reformulation of the questions asked. A central task is to develop methods for documenting and analyzing the causes of international specialization, of which IIT is one expression. On an even more general level there is obviously a need for a more comprehensive and versatile theory (or framework) of foreign trade. The formulations made in this and the following sections are preliminary sketches. The framework which is outlined presents many problems which are not solved here. However, I submit these ideas hoping that they will provoke or stimulate to further elaboration elsewhere.

There is a fair amount of confusion about the concept international specialization. The concept is often used to designate the industries in a particular country which are prominent in exports. Lennart Ohlsson defined international specialization in the following way:

> The concept international specialization is generally used to designate the variations in the differences between domestic production and consumption over a range of commodities a given year. If a country is producing more than it consumes of a particular commodity it can be said to be specialized in the production of this commodity. (Ohlsson, 1976, p. 35, my translation)

Intuitively, the concept of specialization implies that from a range of products demanded, a producer (whether a firm or a territory) chooses (or is forced) to manufacture only a small part, e.g. in order to exploit scale economies. If the unit of analysis is a territory, specialization implies that only a small share of the range of products which are consumed in this particular territory is manufactured there. Hence the need for a definition of inter-

national specialization which can be applied on production (P) as well as consumption (C). The definition of Ohlsson can easily be extended to take account of "negative specialization", i.e. those commodities which are *not* manufactured domestically, or in insufficient quantities in relation to demand. If C/P<1 (Ohlsson's case) we would have *positive specialization,* if C/P>1 we would have *negative specialization*. This definition presupposes that the difference between consumption and production is accounted for by exports (X) and imports (M). However, such a conception is somewhat too crude to be an instrument for analysis of actual international specialization patterns.

Staffan Jacobsson has proposed an alternative way of analyzing international specialization patterns (Jacobsson, 1988). His indicator of intra-industry specialization is defined as *2(min X, M)/P+AC,* where AC stands for "apparent consumption" (P-X+M). This index measures the aggregated level of specialization within an industry for a given country. As an indicator for over-all specialization levels the index of Jacobsson is convenient. However, the index does not allow an analysis of positive vs. negative specialization.

What is needed is a definition which (i) can be used to describe and analyze the aggregate pattern of international specialization, i.e. positive as well as negative specialization; and (ii) is operational. For these purposes the concept international specialization, as applied to a single country, is here given the following definition: *international specialization characterizes a particular group of commodities if a significant share of domestic production is exported and/or a significant share of domestic consumption is imported.* What is meant by a "significant" share is a matter of judgement. This definition allows the identification of several types of specialization by considering the export share of production and import share of consumption for specific products (or groups of products), see fig. 6.1.

In principle it would be possible to assign every single commodity item a position in fig. 6.1, provided we have access to accurate data. With this instrument we would be able to analyze the structure of international specialization for single countries. However, there are some caveats. On the conceptual level, it must be recognized that all international trade can not be attributed to international specialization. In the empirical study reported above, limited access to information and the transaction costs associated with the search for the optimal supplier lead to trade patterns which could not be seen as consequences of international specialization proper. This problem should not prove a serious obstacle, though. There are more acute problems concerning the operationalization and application of the ratios defined in empirical studies. Unfortunately the ratios defined (X/P and M/C) are not restricted to the range 0-1. Values may well exceed 1 if imported commodities are reexported. If domestic production is very small for a particular item, and if imports and reexports are large, the X/P ratio may be

very high. In principle, this problem could be solved by eliminating the volumes reexported from the calculation of the X/P and M/C ratios. However, this is a realistic option only in the framework of detailed case studies. Another serious problem is the data on production, consumption, imports and exports, where all the problems of employing official statistics discussed in previous chapters apply: the aggregation problem, the valuation problem and the reliability problem. In fact, here these problems are worse, because production and trade statistics, which are seldom published in consistent forms, should be integrated.

My preliminary assessment, based on the discussion in previous chapters, is that the framework presented here cannot be used for large-scale empirical investigations. In this sense the definition suggested above only partly satisfies the the second requirement mentioned above: operationality. However, as a conceptual tool, and as a framework for case studies it might contribute to important insights.

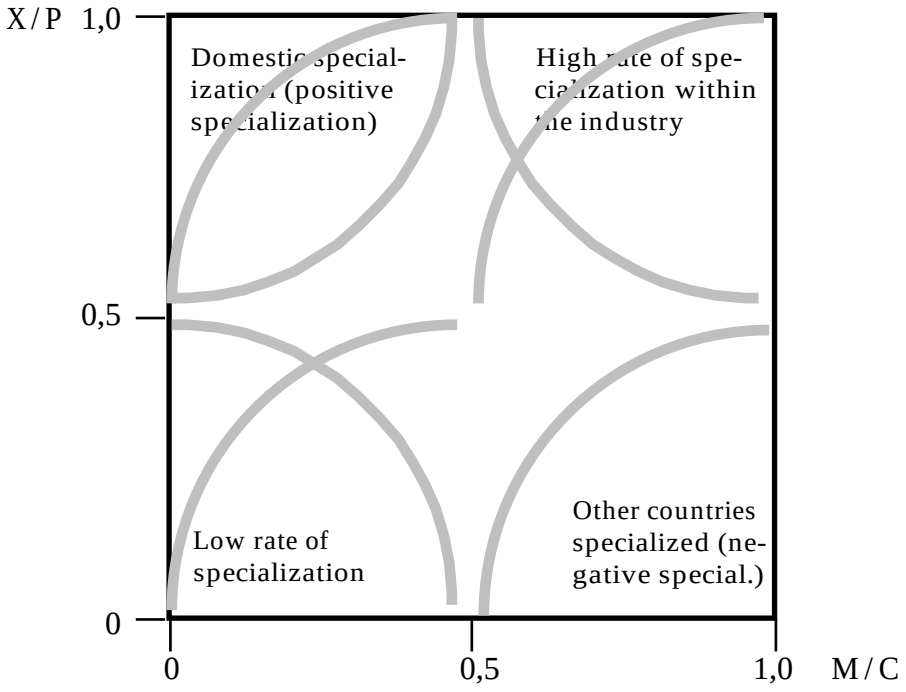


Figure 6.1 *A typology of international specialization*

Horizontal and vertical international specialization

The definition of international specialization made above conceives specialization in terms of a complementary exchange of commodities. This perspective is implicitly built on the assumption that the production process is indivisible in space. It can be stretched to analyze the patterns of international specialization in different stages of a production process, but it is not a good instrument for analyzing what is often denominated vertical international specialization or a vertical division of labour (Laestadius, 1979; Casson, 1986). In order to make a distinction between these two perspectives (which are not mutually exclusive) the *product-focused* perspective will be called *horizontal international specialization* (HIS) and the *process-focused* perspective will be called *vertical international specialization* (VIS). Although they to some extent constitute different aspects of the same phenomena, different frameworks are needed for their analysis.

Horizontal international specialization in the Swedish pump industry

The historical perspective

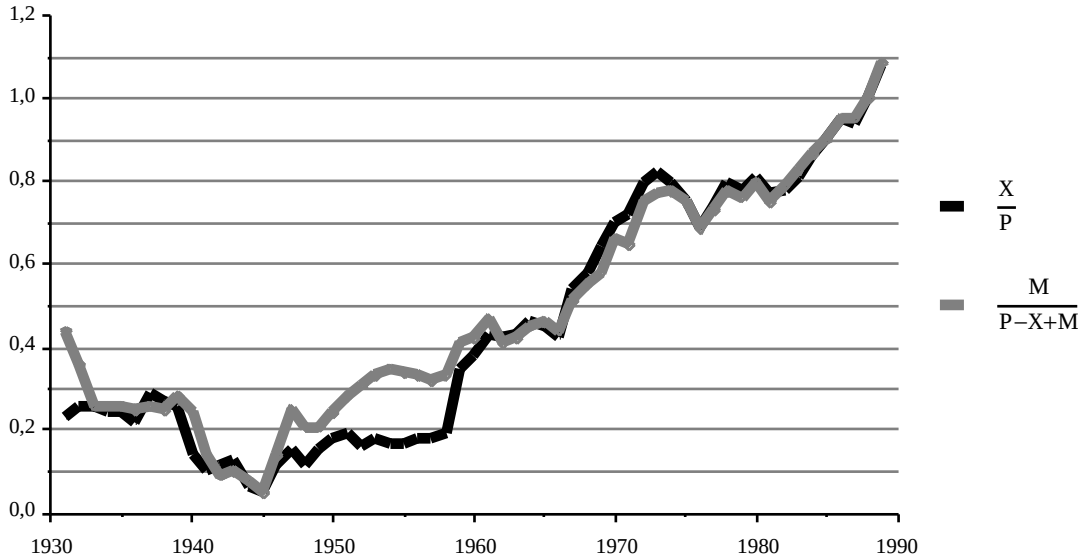
The available trade and production statistics for the Swedish pump industry goes back to 1931. However, it is not possible to disaggregate the item *pumps* for the period 1931 to 1959 *[25]*. The ratios of exports to production and of imports to apparent consumption (M/(P-X+M)) indicate a very rapid pace of internationalization of the Swedish pump industry since the 1960's (fig. 6.2), affecting production as well as consumption. During this dramatic process the levels of IIT were, however, consistently high (see fig. 3.2 in ch. 3).

Notice, though, that for the last few years displayed, exports exceeded domestic production and imports exceeded apparent domestic consumption, as reported in official statistics. This circumstance should inspire a certain amount of caution about the quality of the official statistics. The most reasonable explanations to an exports-to-production quota above 1 are (i) *re-exports* (see chapter 4); and (ii) *undervaluation* of production due to misunderstandings, intentional underreporting, non-reporting, mistakes, etc. On the other hand, exports may be “undervalued” as production is assigned a “sales value”, i.e. market-place values while exported products are given lower values because sales margins in foreign markets are not included in the price. In some cases exports are intra-firm trade, which means that export values are transfer prices within the same firm. These

25 'Centrifugal pumps' were reported separately from 1969 onwards.

transfer prices may be set because of financial reasons, e.g. to avoid taxation or to transfer capital among subsidiaries, and do not necessarily reflect market values *[26]*.

However, misclassification remains a plausible explanation, considering that production statistics are collected separately from trade statistics. The actual assignment of statistical codes is probably often done by different individuals, which reduces consistency.



Note: A new nomenclature was adopted in 1959, which obviously implied a reclassification of some items, boosting exports.
Sources: Industri, Handel and Utrikeshandel, Statistiska Centralbyrån.

Figure 6.2 *Internationalization of the Swedish pump industry 1931-1989*

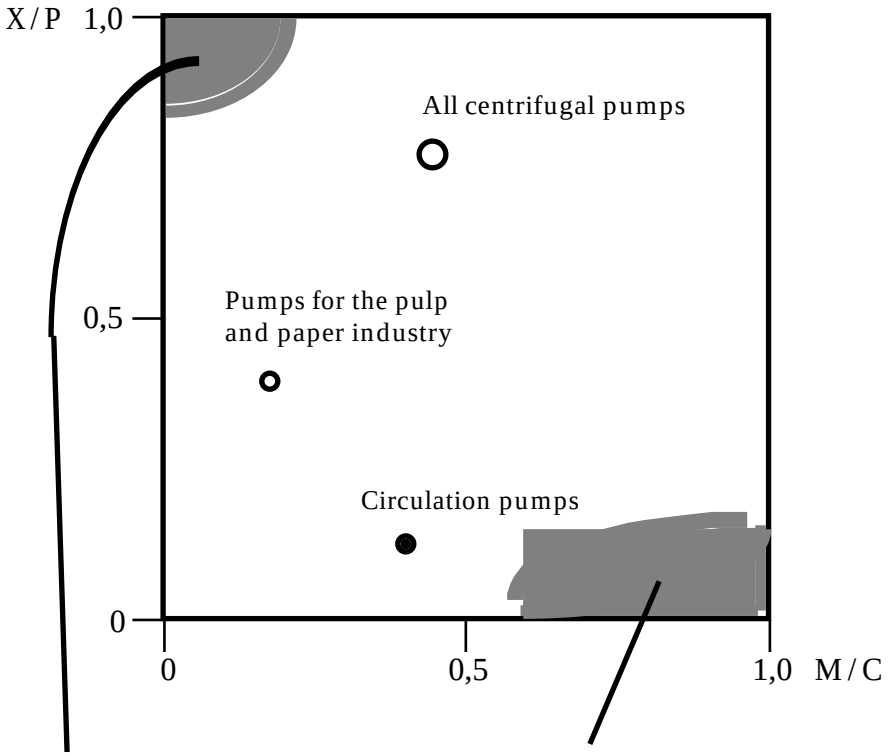
The pattern of specialization in the Swedish centrifugal pump industry

In the case of the centrifugal pump industry, official Swedish production and trade statistics fail to yield meaningful results because of inconsistent classification (see table 2.1). This is symptomatic, I believe. Most countries do not collect production statistics in a detailed and comparable form (Germany and Denmark are exceptions). Neither are the survey data of sufficient quality to permit a calculation of the specialization ratios in precise figures. However, most centrifugal pump types can be classified according to basic type of international specialization. The approximate position of various centrifugal pump types in the case of Sweden are shown in fig. 6.3. Most pump types grouped into two distinct clusters, corresponding to the types positive and negative specialization respectively. However, two pump types,

[26] In the case of intermediate products or firm-specific equipment for internal use market values may not even exist.

pumps for the pulp and paper industry and circulation pumps for central heating systems, fall in between these clusters.

The empirical study was not designed to probe for explanations of the patterns of international specialization in a consistent way. However, the rich information yielded by the interviews provide a good basis for some preliminary conclusions. The Swedish pump industry is specialized in a restricted range of products, which implies that the majority of pump types required in a modern industrial society like Sweden have to be imported. The most important incentive for this specialization is, in my judgement, the costs, efforts and time involved in developing a comprehensive body of knowledge and know-how which is specific for each segment. Know-how in actual manufacturing is an important part in this process, but still more important is the knowledge about specific applications which is indispensable in many segments (especially for industrial applications). An intimate knowledge and experience about operating conditions is necessary if the seller shall be able to give adequate advice on the pump choice. Many factors are involved, such as form and material of the rotor, choice of sealings, pump material and size. Scale economies in manufacturing do play a role, but are far from the only relevant consideration. Over time a range of entry barriers have developed which introduces a considerable element of inertia into the dynamics of competitive relations within the industry (Jordan, 1990). They include the reputation for reliability and competence, the switching costs associated with spare part inventories and installed equipment and the established networks of personal contacts. In this simplified discussion it is impossible to go into the specific details of each segment. Each segment has unique conditions in some way. In some cases scale economies in manufacturing may be decisive, due to specific conditions regarding market size, standardization of the product, and so forth.



Cluster A

Submersible sewage pumps
Submersible drainage pumps for contractors and mines
Large submersible pumps
Slurry pumps

Cluster B

Standard clean water pumps (single & multistage)
Process pumps, n.e.s.
Chemical DIN norm pumps
Submersible borehole pumps
Pumps for households (mainly "jet" pumps)
Booster pumps for buildings
Pumps for the power generation sector
Sewage pumps
Sealless pumps (canned motor and magnetic drive)
Liquid ring pumps
Hygienic pumps
Irrigation pumps
Pumps for the chemical industry in special materials
Pumps for oil refineries, API norms
Drainage pumps, non-electric
Submersible drainage pumps for households

Figure 6.3 *International specialization in the Swedish centrifugal pump industry*

Explanations of international specialization - comments on theories

The case of the pump industry provides an interesting framework for a discussion of explanations of international specialization. Considering the pump industry on a world scale, the variety of conditions has engendered an extremely complex pattern of international specialization.

When discussing international specialization the focus of analysis must shift somewhat in relation to the analysis of "true" IIT. In the case of imports we must ask why these commodities are not produced domestically, and in the case of exports we must ask how the exported commodities can be competitive on foreign markets which often house domestic firms active in the same or closely related industries. The distinction between geographical patterns and industry-specific patterns must be kept in mind. Traditional trade theory (H-O-S) focus the attention on the spatial differentiation of factor endowments and the factor proportions of various types of commodities. Those commodities are produced which have production functions in harmony with the available mix of factors of production. Newer trade theory emphasizes the role of scale economies, product differentiation and varying consumer preferences as explanations to trade. What can be said about these explanations in the light of the case study of the pump industry?

Factor costs

Nationally differentiated factor costs seem to be a very weak explanation to specialization patterns in the pump industry. Manufacturing costs are constituted by inputs, machining, R&D, administration, marketing and service. Inputs are castings, steel rods, sealing rings, ball bearings and the like. Machining costs are composed by capital costs for the equipment and labour compensation. Within the pump industry, the variation in the composition of manufacturing costs is limited. There are some types of complicated pumps which require extensive engineering and service, thus demanding a higher proportion of skilled labour than the average. However, when trying to analyze specialization patterns within Western Europe, especially among such countries as Germany, France, Switzerland, UK and Sweden, the patterns of factor proportions in manufacturing and in country endowment is far too blunt an instrument.

There are of course some cases of factor-based specialization. Several large pump companies have established manufacturing subsidiaries in Spain (Ingersoll Rand, SIHI, Dresser / Worthington, Dresser / Pleuger, Sulzer). This might be attributed to the lower wages in Spain than in Northern and

Central Europe. However, in the case of Sweden imports from Spain constitute a marginal share of total pump imports.

The main reason for the restricted explanatory value of the factor proportions theory of trade in the case of pumps seem to be that quality considerations are more important than the procurement price of the pump. Pumps can be produced at lower costs in low-wage countries, but quality and / or image generally suffers. Consequently, most trade in pumps is trade between advanced industrialized countries. If the wage component constituted a larger share of manufacturing costs the pump companies probably would invest more effort in transferring skills to low-wage regions.

Scale economies in manufacturing and product differentiation

In the pump industry little IIT could be attributed to product differentiation in the usual sense of the concept. Styling, special product features, different price / quality, etc. are simply not as important in this industry as these factors may be in consumer goods industries and in some other producer goods industries. However, the pump industry is fragmented into a large number of specialized subindustries which manufacture products which are not mutual technical substitutes. The fragmentation of the industry into segments which have a relatively small global market volume, in combination with increasing returns to scale in manufacturing implies that the number of manufacturing units in each subindustry in the world market must remain restricted. In some cases there is only room for a handful of plants in the world. The larger segments (e.g. standard water pumps), however, may permit the coexistence of hundreds of plants. In the more specialized segments a theoretical analysis of optimal scale in relation to the volume of demand postulates that international specialization must result, as manufacturing must be concentrated to a smaller number of countries than demand. However, an analysis of production functions and market volumes does not provide any indication of in which part of the world plants would be expected. Either we have to postulate a random element in the development of the actual pattern of international specialization, or we must take recourse to auxiliary arguments. In the 1990 study of Porter and associates some suggestions are given to the treatment of this problem. The process of international specialization seems not to develop completely at random. Porter and associates found that the development of regionally concentrated competitive firms in specific industries or product segments were related to (i) nationally differentiated patterns of demand; (ii) factor conditions, especially the development of knowledge and skills; (iii) the presence of important and competitive related and supporting industries; and (iv) the “fit” between the requirements of the particular industry

considered and the national (or regional) environment in terms of business culture, values, financial system, etc.

Scale economies in product development

Scale economies in other functions than manufacturing may influence the pattern of international specialization as well. Scale economies in product development, which is perhaps the most important of those, must be considered in relation to the absolute volume of demand in the market segment considered. A very small firm with proprietary technology and know-how may enjoy the protection of scale economies in product development because a potential competitor finds the costs for developing this particular product too large in relation to the potential market (which might be very small even internationally). Scale economies in product development may, consequently, act as an entry barrier protecting established manufacturers from new competition. This implies that the concentration of manufacturing to a few countries may be a result of entry barriers into the segment, rather than forced by scale economies in manufacturing.

Proprietary technology and know-how

The nature of the proprietary technology and know-how which is important is conceptually elusive. Patents and distinct proprietary product or process innovations seem to be less important than the complex body of know-how and knowledge about manufacturing processes and applications.

Judging from the case of the pump industry, one of the main hypotheses deserving further elaboration and testing is that a main cause of international specialization is the accumulated knowledge about specific applications, which enables a manufacturer to develop superior products and to serve their customers in a superior way.

Conclusions

The spatial division of labour on an international or global scale seems to be a rather unexplored field, in spite of its obvious importance. In this chapter some suggestions were given on paths into this complex of issues. It was emphasized that “positive” as well as “negative” specialization should be considered.

In the light of the discussion in the last few chapters, I conclude that

international specialization cannot be studied by an exclusive analysis of trade and production statistics without a serious risk for partial and biased conclusions. The combination of a broad range of case studies and statistical research seems to be the most promising approach, since it permits the consideration of economic, behavioural and institutional elements.

A basic proposition for further studies should be that the pattern of international specialization which can be observed empirically (apparent HIS) may be of two rather different types: (a) international specialization proper, which arises because of territorialized competitive advantages of various kinds; and (b) trade flows resulting from various kinds of uncertainty, especially incomplete information. The restricted access to information divides the business environment of an actor into a known and an unknown part. In order to cope, actors in the market develop linkages and networks (informal or formalized) to lower transaction costs and to reap the benefits of cooperative relations. This kind of trade flows may be impossible to explain by identifying cost or differentiation advantages embodied in the product.

The role of these two types of explanations to apparent HIS patterns may vary considerably from case to case. An intimate knowledge about the circumstances involved in each particular case is probably indispensable for a satisfying explanation.

7. Conclusions

Empirical results

This study is the first, to my knowledge, in-depth case study of IIT going beyond official trade statistics. In the case of Swedish trade in centrifugal pumps, it was shown that most IIT could be attributed to "categorical aggregation", i.e. the lumping together of heterogeneous products in the items of the statistical nomenclatures used for recording foreign trade. However, a rest remained which could not be explained as categorical aggregation. This trade, here called "true" IIT, proved to be the result of varying circumstances. A considerable share of the "true" IIT was found to be reexports.

The investigation gave many examples of the difficulties in achieving clear and unambiguous definitions of "industry" and "product" in many cases.

Hypotheses generated

At least twelve different causes of IIT were identified in the course of the study. There is nothing to suggest that any of them is peculiar to the pump industry, but some circumstances are only relevant for producer goods. IIT may result from (see ch. 13):

HORIZONTAL IIT (independent trade flows)

(i) *strategic behaviour of buyers to foster competition among suppliers*
(ii) *industrial network formation and intra-firm division of labour*
(iii) *differentiation of services*
(iv) *afterbusiness*
(v) *personal affections and disaffections*
(vi) *contacts unrelated to the case under study*
(vii) *strategic behaviour of manufacturers*

VERTICAL IIT (reexports)

(i) *reexports through process plant contractors*
(ii) *reexports because of completing of product range*
(iii) *reexports because of chance contacts*
(iv) *reexports because of regional warehousing*
(v) *reexports because of "entrepreneurial arbitrage"*

Product differentiation in combination with scale economies was not found to be an important explanation to IIT in this particular case.

Methodological aspects

In the survey of sources for IIT studies it was concluded that foreign trade statistics suffer from serious problems of reliability, validity and scope of information. The extent of errors in data collection seems to be significant. The case study demonstrated that the statistical items of the foreign trade nomenclatures may have little relation to relevant product definitions in real life. An exclusive reliance on this type of data risks producing unreliable and partial results. On the other hand, data generated by interviews and questionnaires suffer from serious methodological problems as well. From this point of view, it is advisable to allow the use of different types of methodologies and sources.

If the hypotheses on the causes of IIT generated by the case study are taken seriously (which they deserve), the implications for the methodology are far-reaching. It would probably be very difficult to find a way to test these hypotheses by conventional econometric methods. Further case studies are needed to test the relevance of the findings reported here.

Theoretical aspects

The case study indicates that the conventional theories of IIT must be complemented on a range of issues. The prevailing focus on costs seem to exaggerate the role of price as a competitive advantage. Behavioural and institutional aspects seem to have an important explanatory value which deserve to be taken into consideration. In this respect, this study supports Gray's (1988) statement that IIT is an “untidy” phenomenon, requiring an eclectic framework for analysis.

Moreover, it can be argued that IIT is a highly artificial phenomenon, since it is defined by the structure of trade nomenclatures. The significance of the IIT phenomenon is that it constitutes an anomaly in relation to neo-classical trade theory. However, this study indicates that it is not sufficient to extend trade theory into a consideration of scale economies and product differentiation. What is called for is something of a paradigm shift, or at least a shift of emphasis, away from pure micro-economics, towards an incorporation of behavioural and institutional perspectives.

In the long run the concept of *international specialization* seems more

promising than that of IIT. In this study some tentative steps were taken towards a reformulation of the research problem. However, major methodological and theoretical problems remain to be resolved.

On a more practical level, the case study illustrates the severe difficulties of defining some central concepts stringently, such as “industry” and “product differentiation”. These difficulties should not, in my view, be handled through further refinements of formal theory. The problems of defining these concepts stem from the lack of “tidyness” in the real world. A thorough understanding of international specialization and intra-industry trade is, I think, possible only if it is recognized that important insights into the nature of these phenomena can only be found in the complex context of particular cases.

Unresolved issues and suggestions for further research

This study has generated a number of hypotheses on explanations to IIT. It remains to investigate the relevance of these hypotheses in other cases. The scope for further case studies yielding interesting results seems wide. Probably an in-depth study of a consumer goods industry would yield a different picture.

However, in the final analysis the relevance of the IIT concept must be called in question. The present study indicates that the issue of *international specialization* deserves a major research effort. Little has been done so far, which means that the potential is enormous. The core issue seems to be the dynamics and structure of the spatial division of labour. The present convention of using the country as the main unit of analysis is, in the long run, unfortunate (though convenient). The patterns of spatial specialization can be studied from several angles: (i) a place, region, country, continent; (ii) a relation between two or more spatial units; (iii) the industry-specific pattern; (iv) the long-run changes in specialization patterns; etc. However, the conceptual framework and a range of methodological problems is in great need of development.

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International Trade Statistics Yearbook, UN, various years.

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List of interviews

Face-to-face interviews

Ahlzén, Percy, marketing planning manager, ITT Flygt AB, 12.5.89.
Blomdahl, Hans, Rima AB, sales officer, 28.8.89.
Bolander, Stefan, product manager, Ahlsell Industri/Kommunalteknik, 20.2.90.
Callin, Björn, managing director, Grindex AB, 21.2.90.
Flodin, Ulf, secretary, Svenska Pumpleverantörers Förening, 12.5.89.
Fohlstedt, Nils, retired, formerly by Zander & Ingeström AB, 12.5.89, 23.2.90.
Günther-Hansen, Hans, retired, formerly by Scanpump, 25.9.90.
Holmén, Göran, marketing manager, Grindex AB, 24.4.89.
Jobson, Robert, marketing manager, Grundfos AB, 17.2.89.
Johnsson, Olle, marketing manager, Johnson Pump AB, 17.1.90.
Jägrén, Per-Åke, marketing manager, AKA, 24.10.89.
Karlström, Bertil, senior sales manager, ITT Flygt AB, 12.5.89.
Lidman, Gunnar, marketing manager AKA, 21.2.90.
Lindahl, Bengt, sales director Sweden, Scanpump, 11.9.91.
Ljungholm, Bertil, senior sales officer, Raydar AB, 13.2.90.
Mattson, Bo, senior sales officer, AXAB, 25.10.89.
Meyer, Lars, managing director, Pumpteknik AB, 15.2.89, 8.2.90.
Mörck, Carl-Fredrik, managing director, KSB Mörck AB, 30.8.89.
Stråhle, Anders, market analysis director, IMO AB, 25.4.89.
Svensk, Bo, marketing manager, Scanpump AB, 14.4.89, 9.10.89.
Torell, Jan, managing director, Torell Pump AB, 25.10.89.
Wennerström, Rolf, marketing manager, Svenska Rheinhütte AB, 24.10.89.
Wikander, Nils, retired, former manager by Alfa Laval AB, 19.10.89.
Wåtz, Roland, marketing manager, Zander & Ingeström AB, 26.10.89.

Telephone interviews (short inquiries not included)

Björk, Ingemar, sales officer, Scanpump Jönköping, 26.9.90.
Bolander, Stefan, managing director, Sprinklerteknik AB, 3.10.91.
Dahlgren, Hans, sales director, Grundfos Sweden, 24.1.92.
Enström, Bo, sales officer, Atlas Copco Borrcenter, 17.9.91.
Hydén, Ingvar, sales officer, Volvo Hydraulik AB, 25.9.89.
Kvist, Hans, sales officer, Debe-pumpar, 10.12.91.
Lundgren, Lars-Magnus, managing director, Lundgrens Gjuteri, 8.10.90.

Lövgren, Malte, sales officer, Pumpex (Scanpump), 26.9.90.
Mörck, Carl-Fredrik, managing director, KSB Mörck AB, 21.11.89.
Nord, Bruno, sales director, Osby Armatur, 28.9.90.
Sandman, Ralf, sales director, Ahlström Machinery (Sweden), 5.3.92.
Spännare, Jan-Erik, sales director, Morgårdshammar AB, 8.11.91.
Stein, Frank, maintenance engineer, Scanraff (oil refinery), 12.9.91.
Svensson, Bertil, chief engineer, service dept., Ringhalsverket (nuclear power plant), 11.9.91.

APPENDIX I: Core questions asked at interviews

Segmentation

1. How do you define your segment(-s)?
2. Do you have any comments to my segmentation?
3. Is there any pronounced specialization within your segment(-s)?

Segment description/Entry barriers

1. What impediments face a potential entrant into the segment (say, a Japanese pump company)?
   (The answer to this question was usually followed by more precise questions regarding the importance of various types of entry barriers, e.g. scale economies in manufacturing, R&D, marketing, distribution, selling organization, purchasing; proprietary technology; specialized know-how; brand loyalty; patterns of differentiation; switching costs; capital requirements; nationally differentiated technical standards and preferences; profitability.)
2. Rate of growth?
3. Inter-segment competition?
4. Potential for differentiation?
5. The volume of the market compared to Minimum Efficient Scale?

Corporate structure

1. Which are the important firms in this segment?
2. Which firms are important competitors from your point of view?
3. Have there been any significant mergers, acquisitions or coalitions?
4. Which are the most important competitive advantages?

The company

1. Sales?
2. Value of pump production?
3. What is the proportion of exports to production?
4. Do you have foreign manufacturing facilities?
7. What are your main products?

Trade

1. Which types of pumps are exported from Sweden?
2. Which types of pumps are imported into Sweden?
3. Who imports pumps, and how much?
4. Do you know of any cases of reexports or reimports?

Distribution

1. How are your products distributed?
2. Are there any alternatives?
3. Which costs are important in distribution?

Manufacturing

1. Which manufacturing operations are undertaken in-house?
2. Has NC/CAD/CAM-technology influenced the company?
3. Which components are imported?

Other questions

1. Are there scale economies in purchasing?
2. Is service organized in-house or through independent firms?
3. How important is R&D in the segment?
4. In what areas are innovations made?
5. Which technical standards/preferences influence your segment?

APPENDIX II: The questionnaire (translation from Swedish)

QUESTIONNAIRE ON SWEDISH
CENTRIFUGAL PUMP EXPORTS AND IMPORTS

Purpose of the questionnaire

I am presently engaged in a comprehensive study on Swedish foreign trade in centrifugal pumps. This study is a continuation of a previous study which you may have encountered, *"Global shifts in the manufacturing industry - A case study of the liquid pump industry"*.

The purpose of the study is partly to develop methods for studying the very complex pattern of international specialization which has evolved among the industrialized countries, partly to survey various types of causes of international specialization. I need, among other things, to be able to make an assessment of the share of centrifugal pump imports which compete with domestic production. The result will be reported in a doctoral dissertation.

Background

The project is completely independent of commercial organizations, and is financed exclusively by the School of Economics and Commercial Law, University of Gothenburg.

In order to create a detailed picture of Sweden's centrifugal pump trade, official trade statistics are inadequate. I am therefore obliged to turn to competent industry professionals in order to chart the imports and exports of pumps by interviewing and this questionnaire. The questionnaire contains a few questions which concern the foreign trade of your company, and what you know about other companies. It is sent to some 50 Swedish manufacturers and importers of pumps.

Confidentiality

You might be hesitant about divulging figures which you do not want your competitors informed about. I therefore want to assure you that no figures about individual companies will be published, or in any other way be divulged. I need the figures partly in order to make an assessment about

the importance of each pump type in Swedish foreign trade, partly to assess the share of imports and exports covered by this survey. If you are unwilling (or unable) to provide exact figures, I would be grateful for approximate figures, e.g. <1 mill., 3-5 mill., 10-12 mill., etc.

Practical details

Try to estimate export and import values at the border, i.e. exclude the value of motors, base plates and other parts which are assembled here, and margins, if you are making estimates from your sales volumes. If any questions arise, my telephone number is 031-631421.

The results

All who send me the completed questionnaire, or replies by phone calls, will receive a copy of the final report, which probably will contain interesting material. If you do not have access to the previous study on the conditions of international competition in the pump industry, please contact me.

In conclusion

I am eagerly awaiting the answers on my questions, and hope that my study will contribute insights for the pump industry as well as for my academic colleagues.

Yours sincerely,

Thomas Jordan

Responding company:
Respondent:
Telephone number:

Please start by reviewing the enclosed chart of Swedish imports of centrifugal pumps, in order to get an impression of what kind of information I need. Use preferably the classification of pump types/segments supplied on page XX. If it is impossible to use my classification, report your imports/exports according to the items you find relevant yourself.

Imports

1. How much did your company import in 1990? (Including imports from your own facilities abroad, if any) Remember that large companies, such as Wilo, KSB and others have manufacturing facilities in several countries.

Make and country of origin	Pump type/segment	Value of imports 1990
.....	.....	.....
.....	.....	.....
.....	.....	.....
.....	.....	.....
.....	.....	.....
.....	.....	.....

2. Which are your competitors in the Swedish market?

Pump type/segment	Manufacturer/country	Swedish distributor
.....	.....	.....
.....	.....	.....
.....	.....	.....
.....	.....	.....
.....	.....	.....
.....	.....	.....

3. Are any important (>0,5 mill. SEK) pump companies missing in the chart of Sweden's imports of centrifugal pumps enclosed? (Remember that large pump companies may have manufacturing facilities in several countries)
I miss data about the pump imports from Spain. Do you have any ideas?

Pump type/segment Manufacturer/country Swedish distributor
.....
.....
.....
.....
.....
.....

4. Estimate the share of your imports which is *reexported:*
a) as pumps (e.g. through the foreign construction projects of Swedish firms):
.....
b) built into other types of equipment (e.g. industrial cleaning equipment):
.....

Comments:.....
.....
.....
.....
.....
.....

Production and exports (for those who work in manufacturing firms)

5. Manufacturing of centrifugal pumps in Sweden:

Pump type/segment Sales value 1990 (SEK)
.....
.....
.....
.....
.....

6. Exports:

Pump type / segment	Export value 1990 (SEK)
.....	
.....	
.....	
.....	
.....	

PUMP TYPES/SEGMENT (most important types only)

CENTRIFUGAL PUMPS IN STANDARDIZED DESIGNS

Non-submersible, single stage

Circulation pumps for central heating
Other pumps for the building sector (pressure booster pumps, etc.)
Household pumps (so called “jet” pumps, automatic pumps, etc.)
Water pumps according to DIN specifications
Other clean water pumps
Chemical pumps according to DIN specifications
Other process pumps
Sewage pumps
Food pumps
Slurry pumps
Pumps for marine applications
Petrochemical pumps (according to API / ANSI specifications)
Pumps for the power generation sector
Drainage pumps, non-electric
Sealless pumps (canned motor, magnetic drive)
Liquid ring pumps and similar types
Pumps for incorporation in machines (e.g. dish-washers or machine tools)

Non-submersible, multi-stage

Normal multi-stage pumps
Multi-stage pumps for process industries
Multi-stage pumps for the power generation sector

Submersible pumps

Bore hole pumps
Submersible drainage pumps for ground water
Submersible drainage pumps for contractors and mining
Submersible sewage pumps
Other submersible pumps

CENTRIFUGAL PUMPS IN SPECIAL DESIGNS (not mass-produced)

Chemical pumps in special materials
Pumps for the power generation sector
Large submersible pumps

SVERIGES IMPORT AV CENTRIFUGALPUMPAR 1990 (tis 8 okt 1991)

		Agent	Import 1990	%
Tyskland			103,4	30
KSB	kraftverkspumpar, industripumpar, kemipumpar, VA-pumpar.	KSB Mörck		
SIHI (inkl. Halberg)	enstegs och flerstegsp. f. industri och bevattning			
	vätskering och kombipumpar.	ABS Scanpump		
	mavap. (Balcke-Dürr?)	Torell		
Allweiler:	kraftverkspumpar, industrip.,			
	keminormpumpar	Torell		
Wilo	VVS-pumpar	Scanpump, Robota		
ABS	dränkbara VA-pumpar.	Rima / Scanpump		
Wernert	plastpumpar för kemiind.	Lyma Kemiteknik.		
Emu	borrhålspumpar	ABS Scanpump		
Dresser-Pleuger	undervattenspumpar	Torell		
Grundfos	VVS-pumpar	Grundfos		
Sulzer	kraftverkspumpar o likn.	Friatec		
Rheinhütte	kemipumpar i speciella material	Friatec		
Ritz	VA- och tryckstegringspumpar	Processpumpar		
Hermetic Pumpen	en- & flerstegs spaltrörmotor- & magnetpumpar	Chemoinvest		
Fristam	pumpar f livsmedelsind.			
Edur Pumpen	flerstegspumpar f. bevattning			
Ruhr-Pumpen	raffinaderipumpar (API-standard)	Euromekanik		
Hannibal	avloppspumpar	Processpumpar		
Sero	vätskeringp. f. kemiind.	Processpumpar		
Hilge	livsmedelsind (marginellt)			
Dickow	industri, mavapumpar,			
	kombipumpar f. bensin & olja			
	magnetpumpar	Swedenborg		
Speck	vätskeringp., standardvattenpumpar	Pumpteknik		
Hanning & Kahl	vattenpumpar för diskmaskiner o.likn.	Electrolux		
	dränkbara pumpar	Grindex		
Siemens	vattenringpumpar f. process- & cellulosaind.	Siemens		
Löwe	Kombipumpar (vätskering+centrif.) för pumpning av bensin och olja			
Eheim	specialpumpar för fotoind. och			
	laboratorier, akvariepumpar,	Rima		
	dialyspumpar			
Klaus Union	magnetkopplade pumpar	Tekno-Gran		
Sondermann	magnetkopplade plastpumpar	Tekno-Gran		
Homa	dränkbara avloppspumpar	Täljepump		
Klöckner-Humboldt (?)		flerstegs gruvpumpar i specialstål		
Dresser / Worthington		marinpumpar		
Weller	mavapumpar	Kemostål		

Danmark			78,2	23
Grundfos	VVS-pumpar	Grundfos		
LKM	livsmedelspumpar (mejeri, m.fl.)	Alfa Laval		
Pasilac (APV)	livsmedelspumpar			
DeSmitske Fabriker	självsugande; fartygspumpar	PL Teknik		
Thrige Pumper	cirkulationspumpar	Kemostål		
Italien			55,6	16
Interdab	VVS-pumpar (cirkulationsp., pump-automater, länspumpar, tryckstegringsp.)	AKA		
Robuschi	keminormpumpar	Pumpteknik		
Dresser / Worthington	raffinaderipumpar (API-standard)	Gotec		
Calpeda	vattennormpumpar, flerstegsp. f. bevattning	Raydar		
Varisco	vattennormpumpar, pumpar för förorenat vatten	Raydar		
FBM / Pompe Vergani	vätskeringpumpar	Kemostål / Z&I		
Lowara	industri- & kemip, hushållspumpar	KSB Mörck		
Pedrollo	hushållspumpar	Pumpteknik		
Osip	dränkbara grundvattenpumpar	Pumpteknik		
Jacuzzi	djupbrunnspumpar (?)			
Caprari	en- och flerstegs normpumpar,	Tykoflex		
Ebara Italia	hushållspumpar	EMS Teknik		
Askoll	pumpar f diskmaskiner	Electrolux		
Plaset	pumpar f diskmaskiner	Electrolux		
Sole (Electrolux)	pumpar f diskmaskiner	Electrolux		
Flera mindre företag (Redwood, Pentax, m.fl.)	hushållspumpar	EMS Teknik		
Barbera	vertikala plastp.	Lyma Kemiteknik		
CDR	tätningslösa magnetdrivna	Temag		
Castner	magnetdrivna pumpar	Telfa		
Nuovo Pignone	petrokemipumpar ???			
Biraghi	vattenpumpar f. industri, (högtryck, marg.)	Raydar		
Finland			29,1	8
Ahlström (inkl. Serlachius, Karhula)	pumpar t. massa- och pappersind, kemipumpar, VA-pumpar, slurrypumpar.	Ahlström		
Kolmeks	VVS-pumpar	Flygt		
Sarlin	dränkbara pumpar (marginellt)	Pumpteknik		
USA			25,4	7
Red Jacket	djupbrunnspumpar	Robota		
Goulds	djupbrunnspumpar	Atlas Copco		
Dresser / Worthington	pumpar f. petrokemisk ind.	Gotec		
Byron Jackson	API-pumpar f. raffinaderier, kärnkraftsverkpumpar	direktfsg.		
Chesterton	processind.pumpar	Järn & Maskin		
Ingersoll-Rand	pumpar f. gruvor, kemiind, cellulosaind.	via norsk agent		
Filterpump	tätningslösa vertikala pumpar	Temag		
Rotojet	specialpumpar	ABS Scanpump		

Gorman-Rupp	avloppspumpar	Ifako		
	tätningslösa	Titan		
Lawrence	propellerpumpar (vissa år)	ABS Scanpump	vissa år	
Spanien			12,6	4
Itur	cellulosa-, kemipumpar			
Licar	virvelhjulspumpar			
Ideal (mkt små)				
Ingersoll Rand?				
Pleuger?				
SIHI?				
Worthington?				
Storbritannien			10,0	3
Dresser / Worthington?	pumpar f petrokemi	Gotec		
HMD	magnetkopplade pumpar	Pamac		
SPP	vanliga centrifugalp.	Pumpteknik		
Warman UK	slurrypumpar	Warman Oy (FI)		
Girdlestone	speciella pumpar för ångkonden-			
	sat och cellulosaind. (små)	AXAB		
APV	livsmedelspumpar			
Vanton	tätningslösa vertikala pumpar	Temag		
JNS (Scanpump)	spaltrörmotorpumpar	Gotec		
Frankrike			7,7	2
KSB-Guinard	vattenpumpar för inbyggnad, normp., flerstegsp.	Ahlsell / Sprinklert.		
Pompes Salmson (Wilo)	cirkulationsp, flerstegsp.	AKA		
Sundstrand	högvarviga pumpar	Z&I		
Scanpump / LEFI	magnetkopplade; spaltrörmotorpumpar	ABS Scanpump		
Wilo-Droir	små cirkulationsp.	Perfecta?		
Dresser	raffinaderipumpar (API-standard)	Gotec		
Nederländerna			5,6	2
Stork	vattenpumpar, självsugande pumpar			
	för VA-sektorn	Nks		
	vattennormp., keminormp., marinp.,			
	magnetkopplade p.	Kemostål		
Sulzer Delta (?)	petrokemipumpar			
Nijhuis	självsugande pumpar.			
Byron Jackson	raffinaderipumpar (API-standard)			
	större dränkbara pumpar	Kemostål		
Duijvelaar Pompen	kopior av Grundfos			
	tryckstegringspumpar	Robota		
Robot	dränkbara avloppspumpar	WEDA		
Österrike			4,7	1
Ochsner	pumpar f. kemi-, process-, petroleum-, kraftind.	Processpumpar		
Vogel	borrhålspumpsr, standardvattenp. tryckstegringsp.	Garvens (nu Ahlsell)		

Andritz	processindpumpar, cellulosap. (tillv. av Vogel)	Östbo		
Schweiz			3,7	1
Egger	virvelpumpar (avloppsvatten)	Pumpkonsult, Brevik		
Sulzer	kraftverkspumpar			
Rütschi	keminormpumpar, små spaltrörmotorp.			
Hidrostal	pumpar för avloppsvatten	Pumpteknik		
HUS	avloppspumpar (för tjockt slam)	JL Pump & Co		
CT Pumpen	teflonbelagda & titanmagnetpumpar	Lyma Kemiteknik		
Japan			3,5	1
Iwaki	magnetkopplade pumpar			
Nikkiso	spaltrörmotorpumpar	Friatec		
Texel	magnetkopplade pumpar	Lyma Kemiteknik		
Seiko	magnetkopplade pumpar			
Koso	tätningslösa pumpar f. bl.a. fotoind.	Johnsson Pump		
Honda	bensinmotordrivna länspumpar	Berema		
Teikoku	tätningslösa f. kemi- och petroleumind.	Processpumpar		
Sanso	vattenringpumpar	Täljepump		
Tsurumi	små länspumpar för hushåll			
Jap. handelshus	dränkbara länspumpar f. bygg. & gruvsektorerna	Grindex		
Summa			*339,5*	*98*
Total import			**344,1**	**100**

Anm. Länder med mer än 1% av importen

APPENDIX III: The survey - participating firms

Firm	*Written reply*	*Telephone*	*Note*
ABS Rima AB	X		
ABS Scanpump AB	interview		
Ahlström Machinery	X		
AKA Industriprodukter	X		
Alfa Laval Flow Equipment AB	X		
Almenco Engineering Co		X	
Atlas Copco Borrcenter		X	
AXAB Pumpar AB		X	centr. pump sales ceased
Berema Sverige AB	X		
Ulf Bergsten AB		X	
BML AB		X	
Cellwood Grubbens AB	X		
Chemo-Invest AB	X		
Christian Berner AB	X		
Clas Ohlsson AB			no reply
Debepumpar AB	X		
Dymatic AB		X	
EMS Teknik AB		X	
Electrolux Major Appliances	interview		
Epox Maskin AB			no reply
Euromekanik AB		X	
Exergon AB, Sv.			firm has closed down
Flygt AB	X		
G. Fagerberg AB	X		no centrifugal pumps
Foke AB		X	
Friatec Sverige AB	X		
Garden Motor AB	X		
Gotec AB	X		
Grindex AB	X		
Grundfos AB		X	
Ifako Pumpteknik AB	X		
JCE Produkter AB		X	
JL Pump & Co AB		X	
Johnsson Pump AB	X		
Jonsered Motor AB		X	
Järn & Maskin Lindberg Co AB	X		
Kemostål AB	X		
KSB Mörck AB	X		
Leijons Brunns-Service AB		X	no imports
Leroy Somer		X	ceased pump imports
Limo Linatex Molystria AB	X		
LTA Food System AB		X	
Löwener Vacuumservice AB	X		
Myson International Ltd		X	

Runbolagen AB		X	
Lorentzen & Wettre		X	no pumps
Lyma Kemiteknik AB		X	
Löwener Maskin AB	X		
Morgårdshammar AB		X	
Netab Vattenreglering AB		X	not involved in foreign trade
Nks-Kemipumpar AB	X		
Osby Armatur AB	X		
Pamac AB		X	
Perfecta Pump AB		X	
PL Teknik	X		
PM Pumpmaterial AB		X	
Processpumpar AB	X		
Pumpex AB	X		
Pumpkonsult K Brevik AB	X		
Pumpteknik AB	X		
Raydar AB		X	
Regol AB	X		no pumps
RE Thermoprodukter AB	X		
Rinkaby Motorverkstad AB	X		
Robota AB		X	
Rox Maskin AB	X		
Sala International AB	X		
Scansigma AB	X		
Siemens AB		X	
Spirax Sarco AB	X		
Sprinklerteknik AB	X		
Stanco AB		X	
Stibab-Geda		X	
Swedenborg, ing. firma AB		X	
Tekno-Grahn AB		X	
Telfa Pump AB		X	
Temag Pumpar AB	X		
Thrysin Konstruktioner AB	X		no centr. pumps
Titan AB	X		
Torell Pump AB	X		
Transaco Machine Co AB		X	
Tykoflex AB	X		
Täljepump AB	X		
Unimec AB		X	
USENTA Europe		X	
Weda Pump AB	X		
Wemak Pumpindustri AB		X	no centr. pumps
Zander & Ingeström		X	
Östbo AB, Bertil		X	
∑ (n=89)	45+2*	39	

*: 2 interviews

SWEDISH CENTRIFUGAL PUMP IMPORTERS

Importer	*Manufacturer (nationality)*
ABS Scanpump	SIHI (DE / CH) ABS (DE) Wilo (DE) Emu (DE) Scanpump / LEFI (FR / SE) Rotojet (Baker Hughes, US) Lawrence (US)
ABS Rima	ABS (DE / SE) Edur Pumpen (DE) Eheim (DE) Stuart Turner (GB)
Ahlsell	Vogel (AT)
Ahlström Machinery	Ahlström (inkl. Karhula) (FI)
AKA AKA / Dymatic	Iwaki (JP) Interdab (IT)
Alfa Laval	LKM (Alfa Laval) (DK / SE)
Almenco	Schmalenberger (DE)
Atlas Copco	Goulds / Lowara (IT / US)
Berema	Honda (JP)
Berner, Christian	Fristam (DE)
Chemoinvest	Hermetic Pumpen (DE)
Debe-Pump	Jung (DE) Lowara (IT) Eurosip (IT)
Electrolux	Hanning & Kahl (DE) Sole (Electrolux) (IT / SE) Askoll (IT) Plaset (IT) Tanaka (via Jonsered Motor) (JP)
EMS Teknik	Pentax (IT) Stork Pompe (IT)
Euromekanik	Ruhr-Pumpen (DE)
Flygt	Loewe (DE) Kolmeks (FI) Lowara (IT / US)

Friatec	Rheinhütte (DE) Sulzer (DE / CH) Nikkiso (JP)
Garden Motor	Gardena (DE)
Gotec	Dresser / Worthington (IT, FR, AT, / US)
Grindex	Hanning & Kahl (DE)
Grundfos	Grundfos (DK)
Ifako	Gorman-Rupp (US)
JL Pump & Co	HUS (CH)
Johnsson Pump	Dickow (DE) Inoxpa (ES) Koso (JP)
Järn & Maskin	Chesterton (US)
Kemostål	Thrige Pumper (DK) FBM / Pompe Vergani (IT) Stork (NL)
KSB Mörck	KSB (DE) KSB-Guinard (FR / DE) Lowara (IT / US)
Limo Linatex Molystria	Linatex (GB)
LTA Food Systems	APV (DK / GB)
Lyma Kemiteknik	Wernert (DE) Barbera (IT) Texel (JP) Teikoku (JP) CT Pumpen (CH)
Löwener Vacuumservice	Hilge (DE)
Morgårdshammar	Ash Gallagher (US)
Myson	Myson (GB)
Nks Kemipumpar	Stork (NL)
Osby Armatur	Pentax (IT)
Pamac	HMD (IT)
Perfecta	Kessel (DE) Speroni (IT)

	Thrige Pumper (DK)
PL Teknik	DeSmitske Fabriker (DK) SAER (IT)
PM Pumpmateriel	Sta-Rite (US)
Processpumpar	Ritz (DE) Ochsner (AT) Hannibal (DE) Sero (DE)
Pumpkonsult	Egger (CH)
Pumpteknik	Speck (DE) Pedrollo (IT) Robuschi (IT) Eurosip (IT) Hidrostal (AT) Sarlin (FI) SPP (GB)
Raydar	Stübbe (DE) Calpeda (IT) Varisco (IT) Biraghi (IT)
RE Thermoprodukter	Deutsche Vortex (DE)
Rinkaby Motorverkstad	Rovatti (IT)
Robota	Wilo (DE) Ebara / Novax (IT) Red Jacket (US) Little Giant (US) Duijvelaar (NL) Koshin (JP)
Siemens	Siemens (DE)
Sprinklerteknik (Ahlsell)	KSB-Guinard (FR / DE)
Stibab-Geda	Tsurumi (JP)
Svenska Stanley	Stanley (US)
Swedenborg	Dickow (DE) Beresford (GB)
Tekno-Gran	Klaus Union (DE) Sondermann (DE)
Telfa	Caster (IT)
Temag	CDR (IT) Vanton (GB) Filterpump (US)

Titan	Gorman-Rupp (US)
Torell Pump	Allweiler (DE) Dresser (Pleuger) (DE / US)
Tykoflex	Caprari (IT
Täljepump	Homa (DE) Sanso (JP)
WEDA	Robot (NL)
Zander & Ingeström	FBM / Pompe Vergani (IT) Sundstrand (US / FR)

Land codes:

AT	Austria
CH	Switzerland
DK	Denmark
ES	Spain
FR	France
GB	Great Britain
IT	Italy
JP	Japan
NL	Netherlands
SE	Sweden
US	USA