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Trademarks Statistics as Innovation Indicator? - A Micro Study

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Keywords: Indicators, Trademarks, Innovation, Industrial dynamics

Trademark Statistics as Innovation Indicator ? – A Micro Study

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Abstract

This study explores the possibility of using trademark statistics as an indicator of new-to-the-firm innovation. It compares registrations of trademarks and the launch of new-to-the-firm products for a number of Swedish companies in the electromechanical, automotive and pharmaceutical industries. The results show considerable differences between these sectors. For the studied companies in the electromechanical and automotive industries, trademarks are generally unreliable as an indicator of new products. However, the results from the pharmaceutical industry are different. A comparison between trademarks and the number of new products show that a high and fairly stable percentage of the new products have been trademarked. The number of trademarks is also mutually co-integrated with the number of registered (approved) new drugs over the time period 1935-1996. Short term variations are not correlated, possibly due to the extreme uncertainty of the development process in the pharmaceutical industry, where many projects fail even in the final testing, as well as the often lengthy registration process. A comparison between the number of trademarks and patents nevertheless suggests that the trademark statistics carries information about product development activities prior to registration. The study also suggests that the use of trademarks as an indicator of new-to-the-firm innovation is likely to be most successful in industries with frequent use of trademarks and with products targeting consumers or professional end-users, but with less uncertain development process than the pharmaceutical industry's.

1. Introduction

The question how inventions are created and transformed into economic activities is central to both the area of economic growth and innovation studies. Investigations of quantitative linkages between innovation and economic growth make use of a number of different indicators of innovation. R&D expenditure and patents are the most commonly used, where the former is often used as a measure of input to the innovation process and the latter output. Other indicators are based upon results from innovation surveys or on product announcements in newspapers and magazines. All of these different indicators

have turned out to have limitations. Patents are not always used by firms, e.g. for software, and when they are the patent count tend to reflect incremental improvements rather than the key inventions. Also, patents are not capturing the commercial side of the innovation process even if there has been some progress in estimating their value by using the citations each patent receives from later patents (Jaffe and Trajtenberg 2002:25-49, Harhoff *et al.* 2003). Survey results rely on subjective self-assessments of respondents which may affect their reliability. Overall, there is no single indicator which can fully reflect innovative activity and its results. To use of a combination of different indicators, each providing a particular aspect of innovation, therefore appears promising. In this situation, any new indicators, especially if they have been recorded consistently over longer time periods, should be welcome. Two recent articles have been encouraging the use of trademark statistics as a new innovation indicator (Schmoch 2003, Mendonça *et al*. 2004).

This study is an initial and exploratory investigation at the detailed firm level of trademark statistics as an indicator of new-to-the-firm innovations, i.e. new products.[1] Previous studies have not been done at this micro level. It includes the use of trademarks for some categories of consumer goods as well as intermediate goods since the latter are of special importance for the productivity aspect of economic growth. A number of major Swedish engineering companies as well as the entire Swedish pharmaceutical industry have been selected for the study. Statistics for these companies' domestic trademarks and patents have been studied in conjunction with bibliographic information regarding new innovative products, such as business histories and staff journals. The time period studied differs for the different parts of the investigation, but overall it covers a long period from approximately the 1940s to the 1990s. This is another difference from previous studies. The long time perspective has been chosen to investigate the suitability of trademark statistics for studies of long term structural change. The study also compares trademark statistics and patent statistics to ensure that the two measures are not simply providing the same information.

It is clear that a study of individual companies, such as this one, may not be representative for the entire economy or branches. In particular, it does not provide information about small and medium size companies. This study should therefore be regarded as a complement to studies on the macro or branch level. However, by providing information from the firm level the study is intended to contribute to an increased understanding if and how trademarks can be utilized when studying the linkages between innovation and economic growth.

This paper starts with an overview of previous research on the use of trademarks statistics as an indicator. A section on how different academic disciplines view the role of trademarks follows, together with information about the legal framework for trademarks. Against this background it is then discussed why trademark statistics could function as an indicator of innovation. A section on the principles of the study also deals

[1] This is innovation in the sense of the OECD (1992) Oslo manual for collecting innovation data. Other types of innovations are new to a particular market or new to the world.

with some issues regarding the source material. The core of the study looks at some general patterns of trademark statistics in Sweden as well as differences between companies in different industry sectors. A comparison is then made between the trademark registrations of the selected firms and their launches of new products. For the pharmaceutical industry, the comparison is also extended in time and econometric methods are used. Finally, the conclusions are summarized.

2. Trademark research

There has been an increased interest in the use of trademarks as indicator for different purposes in the last couple of years. Studies of trademark statistics have been used to gain insights in various questions such as differences in trademark usage between countries (Baroncelli *et al.* (2004a), trade specialization (Fink *et al.* (2003) and the use of trademarks as hidden measures of protectionism (Baroncelli et al (2004b).

However, closer to the subject of innovation are the two themes of a) the patterns of firm's usage of trademarks in relation to their innovation activities and new products, and b) trademarks relations to firm's economic performance. In the former category it is often found that trademarks are more represented in the consumer goods sector than in the intermediate goods sector (Greenhalgh *et al.* 2001a, Mainwaring et al 2004). A number of studies have also noted that the amount of trademarks related to services (service marks) have been growing rapidly during the last decade (Schmoch 2003, Jensen and Webster 2004, Loundes and Rogers 2003, Greenhalgh *et al.* 2001a). It seems that there are important differences in the use of trademarks between different industries in a similar way as is well known for patents (Scherer 1983).

The results regarding the size of the firms using trademarks most extensively are not entirely comparable with each other and slightly contradictory. Allegrezza and Guard-Rauchs (1999) found in their study of Benelux firms, that trademark usage increases with firm size, but that the effect disappears when only the most recent applying firms are investigated. Greenhalgh *et al.* (2001a) found that smaller firms in the UK were proportionally more active in seeking intellectual property protection, including trademarks. Another study found that the trademark count increased with firm size, but only up to 101-250 employees (Mainwaring *et al.* 2004).

Comparisons with the European Community Innovation Survey (CIS 3), show that innovative firms use trademarks more than less innovative ones and that trademarks are used more than patents among the innovative firms (Mendonça *et al.* 2004). Schmoch (2003) find similar results using German survey data, but notes differences between different sectors in the use of trademarks and patents. Trademarks have rarely been used in connection with studies of economic growth. An exception is Yorukogly (2000), who uses US trademark statistics 1903-1997 to calibrate the number of product varieties in an economic model of the interaction and balanced growth path for (endogenous) product innovation and (exogenous) process innovation.

3. Trademarks and their use

3.1 The role of trademarks

Trademarks have been used for a very long time. Manufacturers, but also merchants, applied marks on their products already during Roman times.[2] But the major breakthrough coincides with the era of industrialization and mass-production (Melin 1997: 10-16, Heiding 1946: 11). Trademarks are primarily intended to identify products (goods or services) of one seller and to differentiate them from those of competitors (Kotler 2000: 404). They are legally protected through registration at national or international registration bodies, but in some countries, like Sweden, they are equally well protected by having become publicly known in connection to a certain product through earlier active use. The word brand is closely related to trademarks, but is often used to cover the entire commercial use of trademarks, which is more encompassing than the mark itself. There is a vast literature within the field of business administration on the use of trademarks and how to successfully establish and build brands. Trademark research within business administration is broadly performed either from the perspective of the trademark holder, often called *brand management*, or from the perspective of the consumer in trying to understand the consumers behaviour in relation to trademarks.

In this line of research, three main actors are involved in the processes in which trademarks are used. These are the firm holding a trademark, the consumer and competing firms. An additional fourth actor is the legislator. Trademarks fulfill different roles for the first three actors. (Melin 1997: 25-34). Simplistically expressed, the holder of a trademark tries to establish an ’invisible contract’ with as many customers as possible. This ‘contract’ provides customer loyalty in return for e.g. consistent product quality. Competitors want to break existing such ‘contracts’ and establish new ones between the consumers and themselves.

For trademark holder, the trademark (brand) is a carrier of information about a product in the communication with consumers. It may also be used as a vehicle in conveying an emotional identity for the product and can help in positioning the product for different consumer groups. In addition, it is a way to bypass the retailers in the communication with consumers and is therefore a competitive tool in the distribution chain. For the trademark holder, a trademark represents an abstract value which may be further exploited by expanding the brand to new products or through licensing. This value is often referred to as *brand equity*.

For the consumers, trademarks make the choice between similar products easier. It reduces the need for repeated evaluations of products from different manufacturers since the one preferred from a previous evaluation can be repeatedly selected without further evaluation. The trademark then works as a guarantee for the product quality and reduces the risk of the purchase. Trademarks also fulfil a social role as an image creator and may reduce the social risk of a purchase.

[2] This was merely a practice; Roman Law did not include intellectual property rights (Bernitz *et al.* (1983: 11).

Finally, from the competitors' perspective the trademark provides information when trying to decode the 'invisible contract' in order to break it. But it is also an entry barrier for the competitors whose new products may look like bleak copies when challenging a well established brand.

While business administration research takes the views of the three main actors involved and law studies the view of the legislator, examples of the economists' more societal view are rare. However, Economides (1987) provide an account of the economics of trademarks. Here, the primary reasons for trademark protection are a) facilitate consumer decisions b) create incentives for firms to produce products of desirable qualities even if not observable before purchase (a case of *asymmetric information).* Trademarks facilitate consumer choice among *experience goods* (frequently bought goods; consumers gain experience from first uses and subsequently applies this knowledge) and transmit quality signals for infrequently bought goods *(search goods).* Trademarks also encourage firms to maintain consistent quality and variety standards and supply a spectrum of variety and quality.

But trademarks also create anti-competitive effects and distortions; they allow firms to tie in mental images with the advertised goods and compete in *perception advertising.* This may result in suboptimal number of brands, loss of scale economies, allocation distortions through persuasive perception advertising, wasted advertising efforts. Firms may potentially also derive market power from securing the most appropriate symbol or word for a given product area. However, according to Economides (1987), this power is likely to be small and temporary. Most of the value is created by its association with the product.

For experience goods, a trademark's success is a function of a) consumers ability to recall the mark and associated features b) inability for others to use a confusingly similar mark and c) reluctance of firms to change variety and quality features of the trademarked product

For search goods, trademarks may indirectly signal quality standard to entire products categories. Consumers of electronics may not buy a particular kind of product very often, but she may quite frequently buy other products within the electronics category. A satisfactory purchase of an electronic product may therefore create positive notions about other electronic products of the same brand.

Trademarks may also be used to extend protection after the patents related to the product have expired (Hurwitz and Caves 1988, Rujas 1999). Trademarks are especially important for firms with patented drugs. If they can establish their brand during the period of patent protection, the trademark enables some further possibility to enjoy market power after the patents expiry.

3.2 Legal frameworks

The roots of the legal trademark frameworks can be traced back to guild regulations in late medieval and early modern times. However, the laws regulating the use of trademarks in a more modern sense were typically introduced in the 19th century. The

Swedish trademark law, the result of a co-operation with Denmark and Norway, is from 1884 (Heiding 1946: 11-19).

In legal terms, both trademarks and patents are industrial intellectual properties. However, while patents are protecting intellectual achievements in the form of technical inventions, trademarks are protecting distinguishing marks for products, firms etc. The requirements for an invention to be granted a patent include that it technically has to be new to the world, that is solves a practical technical problem and that it is more technically advanced than what a specialist in the particular field would easily think of. (Reiland 1984: 19-22). The requirements for a trademark to be registered are instead related to the capability of distinguishing the label from others for the same kind of products. Trademarks are therefore registered for specified product types to enable similar trademarks to be used for entirely different types of products. This is achieved by assigning the trademarks to one or more classes according to an international classification system. This system includes 34 goods classes and 11 classes for services. (PRV 2005a). These classes are quite broad, though, and do not enable a detailed identification of the trademarked products. The classification has been used in Sweden from and including 1961. Earlier, the specification of the product types to be covered was made verbally and could consist of a description ranging from a single product type to a full printed page of potential products (Svensk Varumärkestidning 1945-60).

Trademarks can consist of a word, e.g. a product name, or a figure, a logotype. Although a well established trademark can be protected in Sweden without registration (*inarbetat varumärke*), this section will focus on the rules regarding registered trademarks. Such trademarks are valid in perpetuity, given that the renewal fees are paid every ten years. However, it may be revoked if it is left unused. It should, for instance, not be possible to accumulate a portfolio of unused trademarks in order to prevent their use by competitors. A patent, on the other hand, is a time limited right. In Sweden, a patent currently has a maximum validity of 20 years provided that the annual fees are paid. Before 1978, the maximum validity was 17 years. It could also be noted that it was not possible to patent drugs as products in Sweden before 1978. Instead, the production process was patented. Pharmaceutical products may also be granted up to five years additional protection since 1994/95 (Bernitz *et al*. 1998: 116,130).

Both trademarks and patents have a limited geographical validity. They were originally only valid in the country were they had been registered. The need for ways of expanding the area of protection to other countries was perceived early, and international agreements were established. In the trademark area, the Madrid Agreement of 1891 enabled the applicant to file one international application for registration in multiple countries (International Registration or IR). However, the agreement only included 45 countries and none of the Nordic countries. In Sweden, International Registrations became possible in 1996, when Sweden joined the Madrid Protocol, an additional agreement from 1989. In 1996, it also became possible to register a so-called Community Trademark which covers the entire European Union. This trademark is administrated by the Office for Harmonization of the Internal Market (OHIM). The European trademark law does not include any provisions for allowing protection for trademarks through established use

(*inarbetning*); a registration is necessary. In the patent field, the Paris Convention from 1883 of which most industrial countries are members, include rules regarding applications in additional countries. A cooperation agreement (PCT) in 1978 makes it possible to file only one application when applying for a patent in several of the included countries world-wide. A European patent convention (EPC) of 1977 led to the establishment of a European Patent Office (EPO). European patents are valid in the EU countries selected by the applicant, and are regulated by national patent laws in each country. The national laws have, however, gradually been harmonized with EPC. (Bernitz *et al.* 1998: 108-112, 162-163).

The registration fee for a Swedish trademark registration is approximately € 140 for one class and € 65 for each additional class. The renewal fee every ten years is about € 150 plus € 75 for additional classes. The fees for International Registrations are the same as for the national registrations. (PRV 2005a).[3]

Overall, the administrative costs for trademarks are lower than for patents[4], especially when considering the consultancy and translation costs associated with the latter. In the case of trademarks the large investments are not related to the registrations but to the subsequent commercial establishment of a brand through advertising etc.

4. Why an innovation indicator?

To understand how trademarks may potentially function as an indicator of new-to-the-firm innovation, it is useful to compare trademarks with patents. Patent statistics have been used as an indicator of innovation in economic studies for a long time since the pioneering work by Schmookler (1966). A well known problem is that the propensity to patent inventions differs between industries. Not all inventions are patented and some industries use other means of protection, e.g. trade secrecy. The properties of the technology in different industries also influence the amount of patents. (Griliches 1990, Scherer 1983). Aggregation of patent statistics from different industries may therefore give misleading results.

To be granted a patent, an invention must be new and have a certain technical height. This clearly makes patents an unquestionable indicator of that at least some technical advance has taken place, even if it may not be a major invention. Trademarks do not have such a property. The trademark itself is just a distinguishing mark and the legal prerequisites are focusing on the uniqueness of the mark *per se*, not the underlying

[3] The European Community Trademarks are handled by the Office for Harmonization in the Internal Market (OHIM). The fee for application and registration of a trademark valid within the EU, including up to three classes, is € 1085 with additional € 400 per extra class. The ten yearly renewal fees are € 2500 plus € 500 per extra class. (OHIM 2005).

[4] Patents typically have an initial and an annual fee. The fee for a Swedish national patent is approximately € 430, but the patent consultant normally required to file the application will cost considerably more than this. The yearly fee is ramping up from € 20 in the first year to about €480 in the 20th year. (PRV 2005a). For European patents filed at the European Patent Office (EPO), the fees for application and grant is € 805 and the annual fees are ramping up from € 380 in the third year to € 1020 for the tenth and subsequent years. Consultancy and translation fees add to the total cost. (EPO 2005).

product. The rationale for using trademarks as an indicator in innovation studies must therefore be based on something else.

Mendonça *et al*. (2004) argue that the threshold created by the registration fees makes the registration of a trademark an economic decision. The net present value of the sum of registration and renewal fees must be higher than the expected discounted returns from the trademarked product. A firm would therefore only trademark products which are expected to give a reasonable profit. While this is clearly true, the fees for trademarks are generally lower than for patents, especially including the consultancy fees typically incurred for filing the patent application. On one hand, this means that the threshold is lower for trademark than for patents. On the other hand, it increases the probability that firms actually register their trademarks.

There are, however, additional reasons why trademarks could indicate the launch of new products. As was mentioned earlier, trademarks have a role as carrier of product information both for the trademark holder and the consumer. At the same time, trademarks works as a guarantor of stable product quality. Therefore, it seems reasonable to assume that firms will register trademark for their new products, and possibly when they launch major upgrades in the form of new generations of products, in order to inform potential customers about the novelty. But they should be less likely to register trademarks for minor enhancements of existing products since they then run the risk of triggering existing customers to perform an evaluation of other manufacturer's products rather than just be sticking to the brand they used to prefer. Since trademarks may also be utilized as a way to extent protection beyond the expiry of any patents, it is also likely that firms will register trademarks for products that are the result of more substantial investments in research and development. Firms are furthermore unlikely to register trademarks without any intention to utilize it since this is a reason for revocation according to the trademark laws. Combined, the arguments above make it credible to hypothesize that the presence of trademark registrations indicate the introduction of products which are new to the firm or major upgrades. Minor and incremental improvements of existing products would not be trademarked. As was mentioned before, the value of established trademarks can be further exploited by expanding the use of it to other products. This was especially valid for search goods. In this case, it is necessary that the firm registers additional trademarks for the individual products for the hypothesis to hold. This does not seem to be entirely unreasonable, though.

Finally, it should be noted that the correspondence between new products and trademarks does not necessarily need to be exactly one-to-one. As long as there is a reasonably stable ratio (smaller or grater than one) between the number of new products and the number of trademarks, i.e. they are correlated, the latter may still serve as an *indicator* since it reflects the variations of new product introductions.

However, all of the discussion above is hypothetical and the only way to really find out if trademarks can be used as an indicator is through empirical verification. And that is the main objective of this study.

5. The study and its sources

5.1 Description of the study

For trademark counts to be useable as an indicator of firm's new products in the way that was suggested in the previous section, it is necessary that firms use trademarks actively as part of their operations. Also, trademark protection should be employed for products (goods or services) rather than be what we for simplicity could call *general brands*, i.e. company names, firm logotypes and slogans.[5] Most important, though, is that a company actually will register trademarks when it launches new products. It may register more than one trademark for a product (e.g. a name and a figure mark), in which case the relation will not be one-to-one, but still correlated. However, if it does not register trademarks at all when it launches new products, there is of course no possibility to use trademark counts as an indicator or new products.

This study will begin with a review of the first two properties, the active use and the general brands, for the selected companies. It will continue in a more detailed way by investigating these companies' trademark registrations for the period 1945-60 and comparing them with the records of new product launches as they can be found in business histories, staff magazines etc. This material is not exhaustive, but will still provide an indication of the degree of correspondence between new product introductions and trademarks. The material is used to try to falsify the hypothesis that trademarks do reflect new products. This falsification method has the advantage that it can be used not only for individual new products but for wider new product areas. A new product area would by necessity include new products and the absence of trademark registrations by a firm entering a new product area would falsify the hypothesis. The study will also make comparisons with the companies' patent counts to check that trademark and patent statistics are not providing the same information. In that case only one of the two would be necessary and given the more rigorous evaluation before grant and closer tie to an underlying invention, patents would clearly be the prime candidate.

Previous studies have indicated that trademarks are more frequently used for consumer goods than for intermediate goods and the present study will include both types of products. The companies represent two main industry sectors; the engineering and pharmaceutical sectors. Within engineering, three companies in the electro-mechanical industry are studied; the telecommunications company Ericsson, the consumer durables producer Electrolux and AGA, a diversified but very innovative technology company during the period. The automotive sector is also represented in the engineering sector through the car, bus and truck producing company Volvo, and Scania-Vabis, which only produced the latter two types of vehicles. The pharmaceutical sector is studied in its entirety, i.e. the 13 Swedish companies of significance. These partly merged over time (see Appendix 2).

[5] It will be shown later that it is often possible to filter out the general brands if they are mixed with product trademarks. However, the share of general brands must be low for a raw, unfiltered, trademark count to be usable.

To make most efficient use of available source material, a two-stage approach is used. First, the hypothesis is tested against qualitative and quantitative historical information. For the companies showing encouraging results in fulfilling the hypothesis, longer time series is excerpted to enable econometric studies of the correlation between trademarks and new products. This step is not done in cases were the results of the initial test indicate that trademarks are unsuitable as innovation indicator.

The main hypothesis to be tested consists of two parts:

(A) A company will register trademarks when they enter for them new product areas or when they launch significantly upgraded products in existing areas,
(B) otherwise not.

The definition of new products used here is focusing on the market application rather than the technology used. It is therefore not necessary that the technology is new as such. Imitation or re-use of a firms existing technology for a new market application is equally valid as a novelty according to this definition. The hypotheses also allow for excessive use of trademarks for new products, i.e. more than mark per new product, but not for trademarking of minor upgrades.

5.2 Sources

The trademark statistics before 1961 and all patent statistics have been excerpted from printed sources (Svensk Varumärkestidning and Patent, respectively) provided by the Swedish patent office (PRV). Only new registrations and grants have been counted and no renewals. Trademark counts from 1961 have been taken from PRV's on-line database *PRVLink*. Before 1961, the trademarks were not classified according to the trademark classes previously described. There was instead a verbal description of the different product areas which the trademark should cover. This limits the possibilities to make statistical studies of trademark registrations in different classes for earlier time periods.
The study only concerns national registrations. International registrations of trademarks are included in the PRV database, but there are no such registrations present for the companies and time period studied. The registrations only became possible in the final year of the pharmaceutical industry study (1996), which was the year when the Madrid Protocol took effect in Sweden. However, European patents were introduced already in 1978 (although they only gained pace a couple of years later) and such patents are handled by the European Patent Office (EPO). They would consequently not show up in the Swedish statistics. Only taking national patents into account may therefore lead to an underestimation of the patenting from the early 1980s an onwards. This only affects the study of the pharmaceutical industry. However, this industry had an increasing national

patenting in the 1990s, which indicates that they had not abandoned national patenting in favour of European patents.[6]

The information regarding the firms and their products has been collected from business histories, doctoral theses, staff magazines, annual reports etc. The material available has been of different level of detail and the investigation has been tailored to make best possible use of it for the different companies. For the pharmaceutical industry, information regarding drug registrations with the Swedish drug registration authority (Läkemedelsverket) has also been used.

The study of the pharmaceutical industry encompasses the Swedish companies Pharmacia, Astra, Hässle, Draco. Tika, Ferring, Ferrosan, Kabi, Leo, Vitrum, Recip, ACO and Bofors (Norgren 1989: 33, SOU 1969:36 Tabell 3:5 p.35)[7] The data covers over 4000 trademark registrations and over 1000 granted patents during the time period 1935-1996. Subsidiary companies in other fields than the pharmaceutical have been excluded. In the long time period (1935-96) which the pharmaceutical industry has been studied, it underwent considerable concentration. This is shown in graphical form in Appendix 2. This causes a problem for the years when the database has been used for the trademark registrations. The entry for a company in the database reflects the latest owner of the trademark, rather than the original applicant. This fact together with the concentration makes it less valuable to study the registrations of individual firms and therefore the entire industry has been aggregated. In this way, trademarks which have been transferred to the new parent firms as part of an acquisition are captured. However, trademarks which are sold off to other firms (e.g. abroad) are lost. On the other hand are trademarks which have been purchased from other firms included. The former issue is quantified for one of the pharmaceutical companies in a later section and is at least for this company at a manageable level. The latter is merely a form of outsourced R&D and is reasonable to include.

6 Patterns of trademark usage

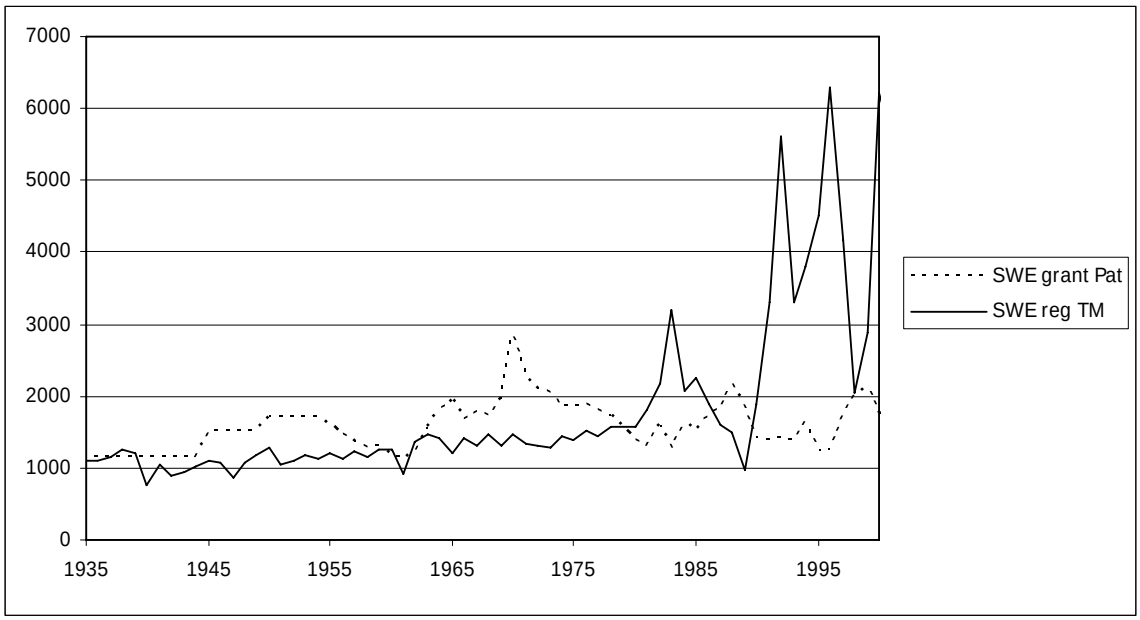
The total annual number of registered trademarks and granted patents for Swedish applicants in the period 1935-1996 is shown in Figure 1. The number of patents peaked around 1970 and has in particular declined during the 1990s. This is likely to be an effect of increased use of European patents. The number of trademarks shows a different pattern. After having risen at a slow pace from the 1940s, it started to increase considerably around 1980. A breakdown into different classes of trademarks suggests that this is largely due to increases in registrations for electronic products and various

[6] Also, the conclusions reached later in the study would only be further strengthened if additional EPO patents were included.

[7] For Bofors, which also produced arms etc, only trademarks in trademark class 5 and 10 (drugs etc., medical equipment etc.) have been counted as well as patent classes 30 and 12 (chemicals and hygiene, medical treatment). General brands for Bofors have been excluded. For Ferrosan, which also had activities in Denmark, only the Swedish company's (Ferrosan AB) registrations have been included.

services.[8] The registrations for other types of products also increased, but less, and often returned to lower levels after 2000.

Figure 1. Annual number of registered national trademarks and granted national patents with Swedish applicants 1935-2000.



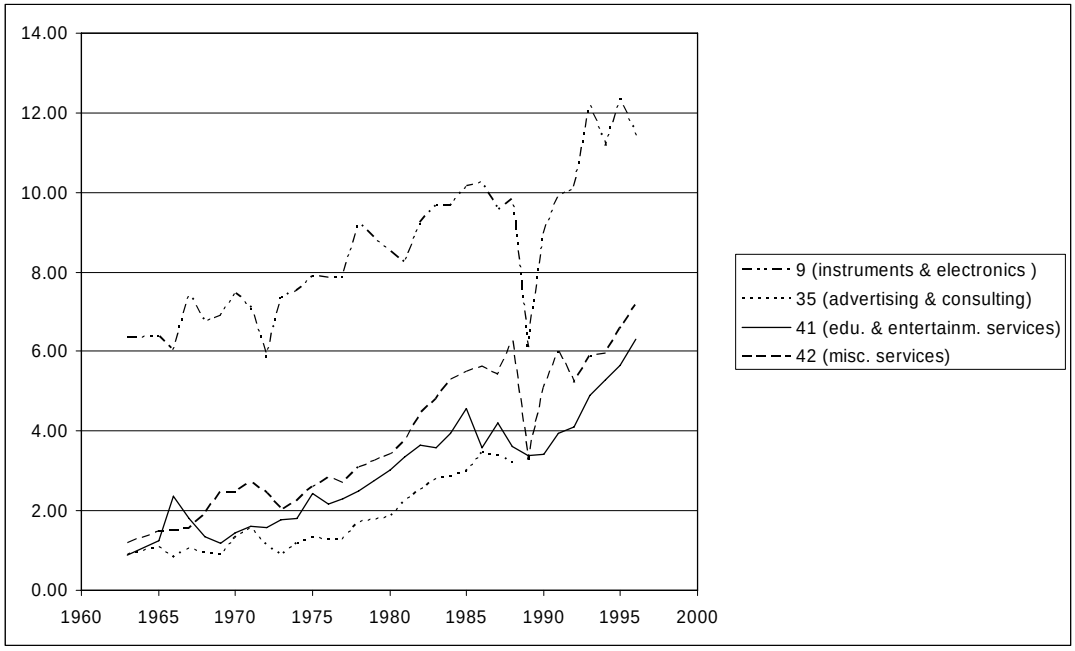
Sources: PRV Årsberättelser 1965-1976, PRV2005b, PRV 2005a.

The electronics class and services were also increasing in relative terms (Figure 2), while others like metal products, machinery and chemical products were declining (Figure 3). The pharmaceutical trademarks had a falling share but recovered later. Typically, the respective rise and decline of the different classes in Figure 2 and 3 becomes pronounced around the mid 1970s. It appears that this is a watershed for the relative position of trademarks belonging to older industries and newer advancing ones. This pattern largely agrees with evidence of the structural change in the economy starting in this period (Schön 2000: 468-517). The trends in relative position for these classes are also generally in agreement with what has been found for Australian trademarks in the second half of the 1990s (Loundes and Rogers 2003).

The substantial swings in the yearly number of registered trademarks (Figure 1) which can be seen in the 1980s and 1990s are partly due to administrative problems at PRV, like the introduction of new computer systems and office moves. This is clearly an issue which needs to be taken into account when using Swedish trademark registrations for indicator purposes. Detailed studies of applications versus registrations of pharmaceutical trademarks covering this time period have therefore been done to ensure that the distortion introduced by the registration process does not affect the results in a significant way.

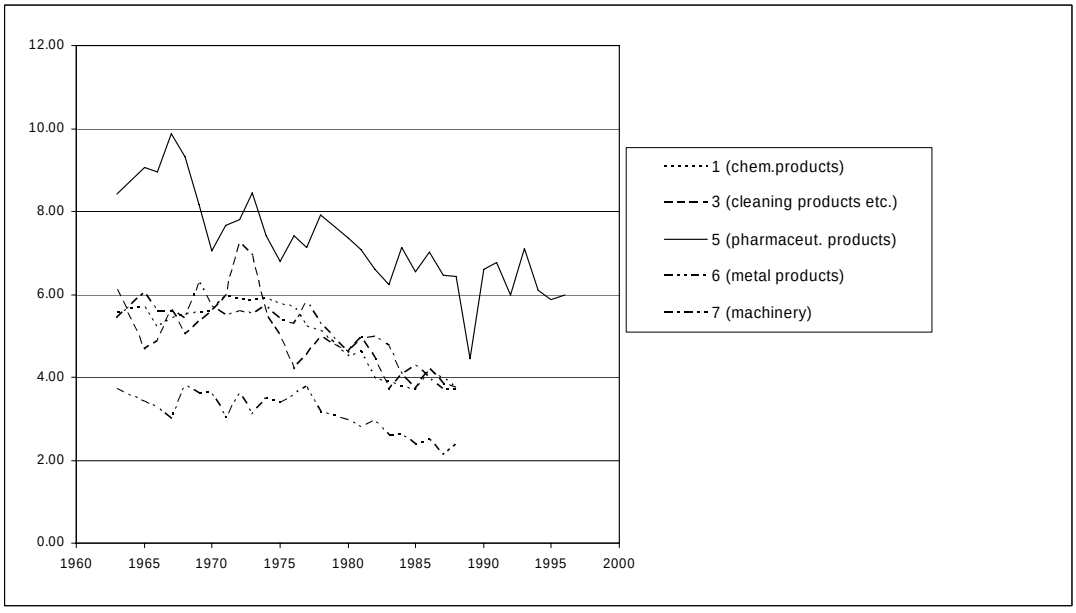
[8] The breakdown was only available for domestic and foreign registrations in Sweden combined.

Figure 2. Percentage of trademark registrations by Swedish and foreign applicants 1963-1996 for examples of trademark classes with rising share of the annual registrations.



Source: Authors compilation based on Bilaga till Svensk Varumärkestidning (1963-1996).

Figure 3. Percentage of trademark registrations by Swedish and foreign applicants 1963-1988/1996 for examples of trademark classes with falling share of the annual registrations.



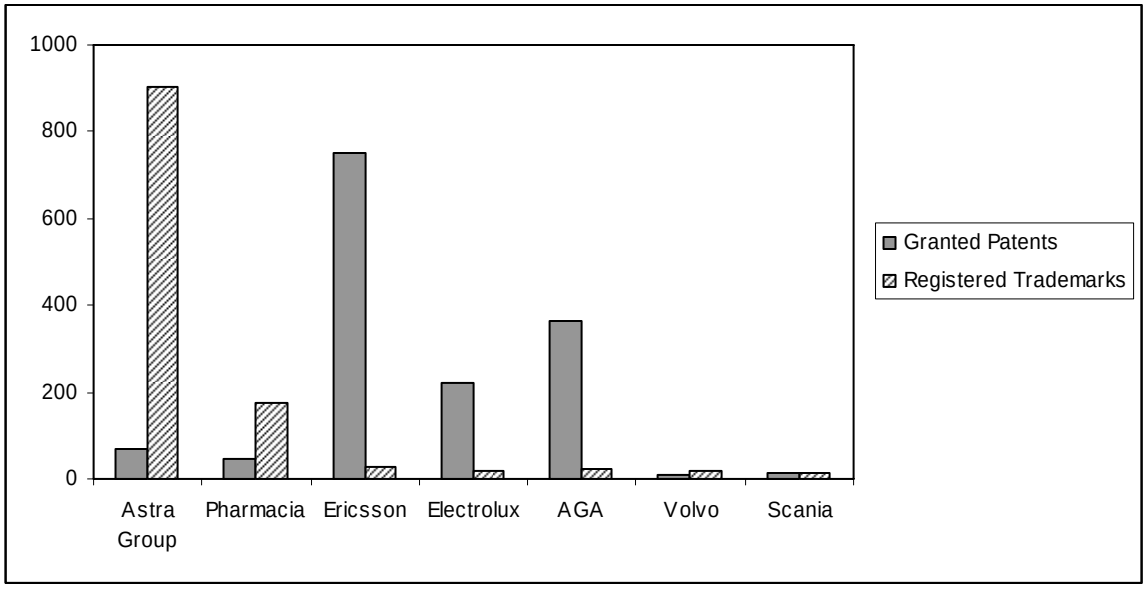
Source: Authors compilation based on Bilaga till Svensk Varumärkestidning (1963-1996).
Note: Some classes have been truncated since they are not included in the list of the five most frequent classes which is the source for the period 1989-1996.

There are no indications that the period 1945-60, the period for the engineering companies in this study, should suffer from this type of distortion, but there is a temporary dip in 1961, most likely caused by the introduction of the trademark classification system. The issue of administrative distortion would of course be eliminated by counting applications that have later received registrations. This, however, is not feasible until 1978 when the trademark database starts to have application dates entered.

The pattern on firm level for the period 1945-60 is shown in Figure 4. The figure reveals three distinct groups of usage pattern. The pharmaceutical companies Astra (including the subsidiaries Hässle, Draco and Tika) and Pharmacia make extensive use of trademarks, while the number of patents is lower. This pattern is reversed for the electro-mechanical companies Ericsson , Electrolux and AGA. The automotive industry, Volvo and Scania-Vabis, have low levels of both trademarks and patents for this period.

The average number of registered trademarks is below two for all of the companies except Astra and Pharmacia. These have on average 56 and 11 trademarks per year, respectively. The difference between the two is to some extent explained by the difference in size. The Astra group had a turnover of 86 MSEK in 1958, while Pharmacia had 20 MSEK (SOU 1960:36: 33).). These companies are at this point in time small compared to the engineering firms, where Ericsson and Volvo had a turnover of just above 1000 MSEK in 1960, Scania ca 500 MSEK, Electrolux had around 200 MSEK for the parent company and closer to 700 for the entire group worldwide. AGA is an exception here with only 133 MSEK in 1960. (AGA 1960, Ericsson 1960, Electrolux 1960, Volvo,1960, Sahlgren 1989: 144).

Figure 4 Total number of registered national trademarks and granted national patents for a Astra, Pharmacia, Ericsson, Electrolux, AGA, Volvo and Scania-Vabis in the period 1945-60.



Source: Svensk Varumärkestidning 1945-60.

The clearly visible differences between companies in different sectors suggest that trademarks may be a better indicator in pharmaceutics than in engineering. This, however, will be investigated further since it may be that the number of new products are fewer (but maybe more complex) in engineering. It may also be the case that there is an over-utilization of trademarks in pharmaceutics. These aspects will be looked at in the following sections which compare trademarks and new products for each company.

Table 1. Percentage general brands (company names, logos, slogans etc.) for AGA Electrolux, Ericsson, Volvo Scania-Vabis, Pharmacia, Astra (incl. Hässle, Draco, Tika), 1945-2000.

Company	Time period	Avg. number of trademarks per year	Approx. Percentage General Brands
AGA[6)]	1945-1960	1.5	5%
	1961-1980	1.5	3%
	1981-2000	4.0	1%
Electrolux	1945-1960	1.3	5%[5)]
	1961-1980	6.4	6%
	1981-2000	6.1	2%
Ericsson	1945-1960	1.6	15%
	1961-1980	1.8	3%
	1981-2000	7.5	5%
Scania-Vabis[1)]	1945-1960	0.8	50%
	1961-1980	0.6	73%
	1981-2000	0.7	29%
Volvo	1945-1960	1.2	26%
	1961-1980	0.8	13%
	1981-2000	5.8	2%
Astra Group[2)]	1945-1960	56.5	NA
	1961-1980	9.0	1%
	1980-2000	23.9	0%
Pharmacia[3)]	1945-1960	11.1	1%[4)]
	1961-1980	22.1	1%
	1981-2000	18.2	1%

Sources: Svensk Varumärkestidning (1945-60), PRVLink (1961-2004).
Notes:
1) Saab-Scania and Scania in their respective time periods.
2) Includes Astra (Astra Zeneca), Hässle, Draco, Tika.
3) Includes trademarks taken over as part of acquisitions in Appendix 2.
4) For the period 1945-56.
5) Excludes some uncertain trademarks that are discussed in the Electrolux section.
6) AGA changes character from the 1970s increasingly focusing on its gas business.

Another potential complication is the use of trademarks in a more general way like company names, firm logos and slogans ("ideas for life", "make yourself heard" etc.). Such trademarks will be called *general brands* in this study for simplicity. If the percentage of general brands is low, a firm's trademark count may be used without pre-processing. But if it is high, a filtering may be required to eliminate them to avoid too distorted statistics. Luckily, filtering is possible for Swedish trademarks after 1960. Product related trademarks are typically registered in one, two or maybe three classes.

General brands typically have a large number of classes, often more than five.[9] The number or registration classes can consequently be used as a criterion for filtering. Table 1 shows the percentage general brands for the investigated companies in different time periods. The pharmaceutical companies Astra and Pharmacia stand out as having low percentages of general brands both in the period 1945-60 as well as in more recent times. The automotive industry, on the other hand, has a quite high level in the earlier period. The comparability in the table suffers from companies' mergers and changing business character. Nevertheless, it seems often to be the case that the percentage of general brands has been decreasing from the 1945-60 period as compared to more recent times. At the same time the yearly number of trademarks have often been increasing, which indicates an increased use of trademarks for products. (The pharmaceutical companies' registrations are increasingly affected by mergers, but have declined somewhat over time).

7 Trademarks and new products in engineering companies

This section compares the hypotheses (A) and (B) in Section 5.1 with information regarding new products launches taken from business histories etc. The comprehensiveness and depth of the information varies from company to company, and the method for evaluating the hypotheses has therefore been adapted to the possibilities in each case.

7.1 Ericsson Trademarks 1945-60

Ericsson was founded in 1876 as a workshop manufacturing telephones sets. The activities were soon expanded to telephone switches, an area which has been very important for the company ever since. Other types of telecommunication product were added later, such as transmission equipment and cables, radio/TV, mobile communications and military equipment.

The business histories for Ericsson include more detailed accounts of different new products and their degree of innovativeness compared to the histories of the other studied companies. The descriptions of new-to-the-firm products in different product areas were matched as far as possible to Ericsson's trademark registrations for the period 1945-1960.[10] The specification of Ericsson's product areas were based on the business history of Jacobaeus *et al.* (1977) and for the identification of new-to-the-firm products Meurling and Jeans (2000) was also used.

[9] This is the criterion used when distinguishing the number of general brands in Table 1. Before 1961, visual inspection of the trademarks has been used.

[10] The registrations for all of Ericsson's subsidiary companies were done under the parent company's name, except *Svenska Radioaktiebolaget (SRA)*. The latter has been excluded from the survey since the mapping of different radio equipment models to trademarks turned out to be very difficult to make with any degree of accuracy.

Although there have been difficulties to identify all trademarks with certainty, it is still possible to see a pattern in the trademarking. Products for end-users, like telephone sets, loud-speaking phones, and electric fencing have much more trademarks than products like public telephones switches, railway signalling systems, microwave links and other products targeting telecom operators, railway operators and the military defence.

In order to quantify this observed pattern and to check the consistency of it, Ericsson's different product areas have been grouped into four groups according to the targeted customers: 1) Infrastructure Operators (equipment for telecoms and railway operators and military defence) 2) Industrial Component Users (the components include capacitors and vacuum tubes etc.) 3) Professional Users (office related equipment, tools etc.) 4) Consumers (telephone sets).

The total number of trademarks in the period was 26. Four of these were general brands (company name, logotype etc.) and three were not possible to identify. However, one of the three seems to be related to consumer products and two to products for professional users.

As was mentioned earlier, the hypothesis to be tested is really two. First, if there is a trademark when a new-to-the-firm product is launched or major upgrades are made, and second, that there are no trademarks when there are no new-to-the-firm products or only minor incremental upgrades. The development and trademarking in the different Product Areas within each Customer Group is compared to these two statements. For the cases were it has been difficult to attribute trademarks to products, a best guess has been made. The details of this comparison are provided in Appendix 1. The results are summarized in Table 2 below.

Table 2. Ericsson trademarks 1945-60, Number of Product Areas in each Consumer Group in agreement with hypotheses (A) (B) and not in agreement (not A) (not B).

	Number of Product Areas in agreement		Number of Product Areas not in agreement	
Area	(A) New products with trademark	(B) No new products and no trademarks	(not A) New products without trademarks	(not B) No new products but with trademarks
Consumer	1 of 1	0 of 1	0 of 1	0 of 1
Professional	3 of 6	2 of 6	1 of 6	0 of 6
Component	1 of 2	0 of 2	1 of 2	0 of 2
Infrastructure	0 of 11	5 of 11	6 of 11	0 of 11

Sources: Own compilation based on Svensk Varumärkestidning 1945-60, Jacobaeus (1977), Meurling & Jeans (2000).
Note: When there are different outcomes within a product area, only a clear majority of fulfilment has been counted in favour of the hypothesis (one case in the Component area).

The *Consumers Group* has only got one product area, telephone sets. In 1947 an updated version of the bakelite telephone of 1931 was launched with some improved technical characteristics. This telephone has not got a trademark. However, in the mid fifties, a radically new phone, the *Ericofon* or *Cobra*, was introduced. It had all it components in one single unit and was seen as a major breakthrough and imitated by

competitors. It utilized advances made in new materials like thermoplastics, light metals and ferromagnetic materials, and had much improved technology for its microphone, receiver and circuitry. This phone has a number of trademarks. The next major product, *Dialog*, came in 1962, i.e. after the period studied, and was also trademarked. Although the sample is extremely small, it seems that trademarks have been used for significantly new products, but not for upgrades. (Jacobaeus *et al.* (1977: 13-56).

The *Professional User Group* is also reasonably well in line with the hypotheses under investigation. This group include six product areas: telephone equipment with a more professional profile (loudspeaker phones, answering/announcing machine), private branch exchanges, intercom phones, telex equipment, mobile radio and other electrical products (electric meters, electric fencing etc.). Ericssson had produced loudspeaking phones since the 1930's, but a radically new one using the novel semiconductor technology was launched in 1959 under the trademark *Ericovox*. In the end 1940's and in the 1950's, answering and announcing machines started to use magnetic tape technology. There is one trademark which seems to be connected to this type of technology, since Ericsson's tape recorders for consumer use only emerged in the 1960s. (Jacobaeus *et al.* (1977: 13-56, Meurling and Jeans 2000:229). Private branch exchanges started to use the so-called crossbar technology during the 1950s following the increasing success of the technology in public telephone switches during the early part of the decade. The trademarks *Ericrossbar* and *Ericross*, registered in 1959 therefore seem more likely to be related to private branch switches than to the public ones. It is possible, though, that it is attributed to the technology as such and not specific product families. (Jacobaeus *et al.* 1977: 244, 102-122). Ericsson had started to market intercom phones in 1942 and in 1948 an incrementally improved version, the so-called F-series, was launched. It became popular and was sold for 10 years. This product did not receive a trademark. The intercom system was gradually improved with exchanges and amplifiers, but a more radically new product was not released until after our period, in 1962, under the trademark *Dirivox*. (Jacobaeus *et al.* 1977: 251-262). The telex equipment area did not see any major product development and was not subject to any trademarking in the 1945-60 period. In the group of miscellaneous products (related to the subsidiary firm Ermex) there was a new electric meter launched in 1945 which has got a trademark. Electric fencing, an odd product for Ericsson during the 1950s, has a trademark in 1954. So far there seems to be a reasonable correspondence with the hypothesis. Trademarks have been registered for new products and in areas with no major developments, there are no trademarks either. However, an exception is found in the area of mobile radio. Here a small radio for mobile communication was introduced in 1954. There is however no trademark for this product. Overall, the use of trademarks in the professional users group is in line with the hypothesis but there is no perfect match. (Jacobaeus *et al.* 1977: 267-270, 361-368, 285-286, Meurling and Jeans 2000).

The product group for users of *Industrial Components* has a less clear match between new products and trademarks. The group has got two main areas, capacitors and vacuum tubes (including early transistors). In the first half of the 1950's, Ericsson's subsidiary company RIFA started producing so-called MP capacitors. This was a German technique

which RIFA had acquired knowledge about through their American connections. After a few years of production, RIFA developed a new and unique encapsulation technique, which they called *Miniprint*. It became very popular and other manufacturers tried to imitate it. The MP capacitors did not receive any trademark, but a trademark for *Miniprint* was registered in 1959. *Miniprint* was also further developed for spark quenching at relay contacts (CR-units). The latter was patented but not trademarked separately. A number of capacitor trademarks registered in 1959 starts with the pre-amble *Tantal-*. These are very likely to be trademarks for tantalum capacitors, which was a very novel technology at the time. Such capacitors were very expensive in the early days and they only got their wider breakthrough during the 1970's. In the end of the 1950s and early 1960s, new types of plastic capacitors were launched by RIFA. The one that falls within the studied period was the polycarbonate capacitor, which did not have a trademark. In the area of capacitors, trademarks seem actually to have been used for products which were new-to-the-market rather than new-to-the-firm. A major deviation is the area of vacuum tubes and transistors, where not a single trademark has been registered. There were, however, new and innovative products in this area. Vacuum tubes were manufactured by Svenska Elektronrör (SER), an Ericsson subsidiary. After 1945 the focus was to improve the technical properties of the tubes. Especially, cathode-alloys giving long life span were pioneered by SER during the 1950's. The term *long-life tubes* was coined, but not trademarked, and the term spread through the tube industry. Swedish-made microwave tubes were used in a trial microwave link in 1946 and from the mid 1950s and 1960s, a range of microwave tubes were produced. During the second half of the 1950s, when the transistor had appeared, SER developed and produced germanium transistors for the parent company to be used in telecom equipment. It was not profitable and was later closed down. Semiconductor work, now using silicon, resumed in the 1960s through license agreements. Overall, trademarking in the *Industrial Component Users group*, albeit partly in line with the hypothesis, cannot be said to fulfil it. (Jacobaeus *et al.* 1977: 345-354, 355-360).

However, the worst fulfilment of the hypothesis is provided by the *infrastructure operators group (*telecoms and railway operators, military defence). The reason is probably that the customers were fewer and the sales process therefore included more personal contacts. In this area, Ericsson to a large extent relied on model numbers, especially the three letter combination used for product families followed by a number combination specifying each particular product within the family. A well known example is the AXE telephone switches. Such model numbers were not trademarked in the period studied here. There are, however, a couple of model numbers registered as trademarks in more recent times. This will be further discussed in a later section. The cases where the hypothesis is fulfilled are in areas were no major developments took place and there is no trademark registrations, i.e. sub-hypothesis (B). These cases are of course of little indicatory value given the scarcity of trademarks when major developments took place.

Although there have been problems mapping trademarks and new products and the exact time of launch has been difficult to establish in some cases, it does not seem too controversial to conclude that the use of trademarks as an indicator of Ericsson new-to-

the-firm products in this period is not very reliable in for the groups of Infrastructure Operators and Industrial Components Users. However, trademarks *may* be a useful indicator for the groups of Consumers and Professional Users. This would require further study. However, this is an indication of that the different propensities to use trademarks which has been noticed between different industries, can also be present *within* companies targeting different customer groups.

When it comes to the question if companies are using trademarks for intermediate goods as well as for consumer goods, it is clear that Ericsson made some use of trademarks for intermediate goods in the time period studied, but that it was considerably less used than for their products targeting consumers and professional users.

7.2 AGA Trademarks 1945-60

AGA was founded in 1904 manufacturing products for acetylene lightning. Lighthouse equipment was especially important and a number of key inventions were made in that area. The company built on its knowledge and continuously expanded into new fields such as welding, navigation systems, medical equipment and electronics. In the 1950s and 60s AGA launched many innovative products, but decided in the 1970s to return to the original business of gas. (Almqvist 1992: 2-5, 32)

The business histories of AGA are less detailed than the ones for Ericsson. Therefore, it has not been possible to do a comparison between products areas and trademarks as detailed as was done for Ericsson. It is, however, quite well documented when AGA entered new product fields. To check if any trademarks exist in these new fields is a criterion that should be less strict than for the narrower product areas in the case of Ericsson. The 'AGA-tree' shows when new fields of activity have been entered. As was mentioned, AGA was very innovative and diversified its product portfolio in the studied period. Nine new product fields were entered: propane/butane combustion gas (after 1945), dictaphones (1948), breathing equipment for divers and fire-fighters (1949), liquid air gas production (1951), electric pin brazing[11] (1951), distance measuring equipment (1953), talking radio beacons (1953) Heart-Lung machines (1954) and TV receivers (1954). (Almqvist 1992, Fig 2, p. 4). Except television sets, there are no products which are exclusively targeting consumers. Propane was used by both professional users and consumers. The breathing equipment was developed for fire-fighters and marine divers, but there were also models intended for sports diving. However, the other fields were related to specialized professional usage.

AGA registered 21 trademarks in the period 1945-60. Nine of these are related to product fields which were introduced before 1945. It has not been possible to verify for all of them if they are connected to new-to-the-firm products in these areas or not. Four are in the field of cutting and welding, an intermediate goods area which AGA entered in the 1910s and mid 1920s. One trademark is in the radio area, which was entered in 1925.

[11] An innovative method for quick and reliable fastening of contact connections to railway lines (Almqvist 1992: 26).

Another four trademarks are in the field of anaesthetics. This area was entered in 1934 with combined breathing and anaesthetics equipment which was based on the technology of a valve used in AGA's lighthouse equipment (Westberg 2002:128, Almqvist 1992:22). Three of the trademarks in this area are approximately coinciding with the launch of corresponding new products; one is registered about a decade after the initial market introduction (AGA 1957: 10).

The four new product fields which actually do have trademarks are combustion gas (propane/butane), dictaphones, diving equipment and the distance measuring equipment *Geodimeter*. The trademark *Agasol* was registered in 1953. Propane and butane had become increasingly popular in the market in the second half of the 1940s competing with AGAs traditional gas product Acetylene. The product field of dictaphones was initially entered in 1948 and the first trademark registrations occurs in 1953 (*Agafon*, *Agaphone*; this is clearly a duplication of the trademark to extend the protection). Although the exact launch date for the product *Agafon* is not known, it was in any case actively being used by 1952 (AGA 1952: 25), and the trademark registrations therefore seems somewhat late in time compared to the product introduction.

The diving equipment area was entered in 1949 with the *AGA Divator* product. However, it was trademarked only in 1955. In that year, there is also a trademark for *AGA Contour*, a container for gas which is likely to be connected to diving equipment. Again, the trademarking is made a number of years after the initial product launch.

However, the matching in time between product introduction and trademark registration is much better for *Geodimeter*, the highly accurate distance measuring equipment for surveying. Its name was protected in the year of the product introduction, 1953, and an additional graphical logotype for it was registered in 1957.

There are five new product fields that lack trademarks: liquid air gas production, electric pin brazing, talking radio beacons, Heart-Lung machines[12], and TV receivers.

Overall, trademarks do not provide a very good indication of AGA's entering into new product fields during the period 1945-60. Only four out of nine new product fields have got trademarks. A number of the trademarks may be connected to new-to-the-firm products in existing product fields, e.g. in the welding & cutting area and in medical breathing support. But this does not substantially alter the negative picture.

7.3 Volvo and Scania-Vabis Trademarks 1945-60

Scania-Vabis is the older of the two companies and was founded in 1911 when the two automotive firms Scania and Vabis merged. They initially produced cars as well as trucks and buses, but after the post-WWI crisis they decided to focus on the two latter product areas. Scania-Vabis merged with Saab in 1968 to form Saab-Scania but is now only called Scania after the sale of the car manufacturing division which Saab had brought into

[12] Three trademarks in breathing support may be connected to the Heart-Lung machine, but are more likely to belong to the anaesthetics field.

the company. Volvo was established in 1926 as a subsidiary company to the Swedish ball-bearing company SKF, which saw automobiles as a major application for its products. Volvo has always been manufacturing cars as well as trucks and buses. (Elsässer 1995:68-78).

Scania-Vabis and Volvo are similar in that they did not start to use trademarks for products until 1953 (Scania-Vabis registered a couple general firm brands in 1951, though). However, while Volvo showed a steady flow of trademarks during the rest of the 1950s, Scania-Vabis only registered a single logotype after 1956.

Volvo registered trademarks for cars and trucks, but not for the buses they also manufactured. For cars and especially buses, they relied to a large extent on model numbers, which were not registered during the period studied. Out of the five new model series for cars in the period (Elsässer 1995, Fig.4:1, p.104), Volvo registered trademarks for only two (*Duett* in 1953 and *Amazon* in 1959).

There are considerably more registrations for trucks, ten trademarks, and this appears slightly counterintuitive given that trucks are bought by professional users and are more relying on technical characteristics than cars and less on image (Elsässer 1995:116). Volvo used trademarks extensively for their new trucks in the 1950s. This was an innovative decade for the product area, especially in engine technology where direct-injected diesels replaced the older Swedish Hesselman engines and turbo charging was pioneered. The truck models introduced just after the war were incrementally upgraded versions of earlier models and named by their model numbers only. But in the 1950s, trademarks for the new truck types *Titan* (introduced in 1951), *Viking* (1953), *Snabbe* (1956), *Starke* (1954) and *Trygge* and *Brage* (1956) all have trademark registrations about one year after the introduction year (Volvo 2005). There are some mismatches though; the trademarks *Joker, Volvo Ekonom*, *Volvo Bjässe* and *Volvo Atle* registered for trucks are not present in Volvo's history of their truck models (Volvo 2005). Also, specialized military vehicles did not have brand names. However, the overall picture of Volvo's trucks in the 1945-60 period is that trademarks actually do reflect the introduction of new products, although there are a number of excessive trademarks (or failed development projects). It must be noted, though, that some of the brand names introduced in the 1950s were kept for substantially improved models during the 1960s, which may lead to that a similar test in that decade could yield a different outcome.

Scania-Vabis' trademark registrations for the studied period are concentrated to four years in the middle of the 1950s. The trucks introduced during the 1940s were identified using model numbers only, and the first truck with a name was the *L51 Drabant* introduced in 1953 (Lindh 1992:135, 146). It was followed the year after by the larger *L71/LS71 Regent*. Both these names were registered as trademarks in 1954. In 1958, a new family of heavier trucks was launched. The trademark *Scania Gigant*, registered in 1956, may have been intended for this series, but it seems too early in time. In any case, it does not seem to have been used in practice (Lindh 1992: 147-149). Neither does the trademark *Dragon*, registered the same year as *Drabant*. It is difficult to escape the impression that Scania-Vabis started to use trademarks for their trucks since the competitor Volvo had done so two years earlier, but that they did not find it worth while

to continue. The low number of trademarks per year in Table 1 as well as the high percentage of general brands point in the same direction.

The two trademarks for buses (*Metropol* registered in 1953 and *Capitol* in 1955) were registered for a novel type of bus with the chassis and body built as one unit. This technique had earlier been used in USA. The other, more conventional, bus types manufactured by Scania-Vabis did not have trademarks. These were often sold as chassis only and the customer had the bodies supplied locally.[13]

With the possible exception of Volvo's trucks and Scania-Vabis's more innovative buses, the trademark count cannot be said to be even close to an indicator of the new-to-the-firm product launches. Instead, there is extensive use of model numbers, which were not trademarked. It is only in the 1980s that Volvo starts to register some model numbers as trademarks (PRV Link 2005). This will be further investigated in section 7.5.

7.4 Electrolux trademarks 1945-60

Electrolux was founded in 1919 through a merger and was initially manufacturing vacuum cleaners. It expanded gradually into other areas of household equipment[14], such as refridgeration in the early 1920s, washing machines in the early 1950s, dishwashers in the late 1950s and electric stoves in early 1960s. (Leidenborg 2002).

Electrolux could be assumed to be a more extensive user of trademarks than the other companies in the electro-mechanical category since its products are largely targeting consumers. That is, however, not the case. Electrolux registered 20 trademarks in the studied period, which is actually slightly less than both Ericsson and AGA.

The area of vacuum cleaners, which was the original product area for Electrolux, is not represented at all. On the other hand, 1945-60 was not a particularly innovative period in the vacuum cleaner area (Leidenborg 2002). Vacuum cleaners were typically identified by model numbers, and the first named one was Electrolux' first vacuum cleaner using plastics. This product was labelled *Luxomati*c and has a trademark registration after our period in 1964, the year of its introduction.

Washing machines, which Electrolux started to manufacture in the early 1950s, were also using model numbers rather than names. But this was definitely an area of new-to-the-firm innovation since Electrolux first domestic washing machine was introduced in the early 1950s.

However, the area in which the most important development during the 1950s took place, fridges and freezers, is comparatively well represented among the trademarks registrations. Electrolux had earlier pioneered the absorption technology, a Swedish invention from the 1920s. But these fridges were too energy consuming as demand for fridges with larger capacity increased. Electrolux therefore gradually changed to the use

[13] This was also often the case for trucks as well. Both companies did this in addition to the manufacturing of complete vehicles. (Lindh 1992: 124-159)

[14] Products were made for both domestic and professional use.

of compressor technology. In 1956, a standalone freezer was launched, and towards the end of the decade a combined fridge/freezer/cooler was introduced. Fridges for caravans were also successful products in the 1950s. (Leidenborg 2002).

The trademarks clearly related products in the fridge/freeze area are *Citybox*, the mentioned standalone freezer (Leidenborg 2002) with the trademark registered in 1957, and a cluster of trademarks which were explicitly registered for this type of products. The latter are *Frilux, Kyllux, Fryslux* and *Eplus* registered in 1958. *Dometic*, registered in 1950s was also a fridge brand, partly used for caravan fridges, at least later during the decade (Electrolux 1980: 8). *Arctic*, also registered in that year, was the name of the fridge company acquired by Electrolux in 1941. However, the name *Arctic* was also used for fridges and freezers in the mid-1950s (*Arctic Freezer 45* (1956) and *Arctic Freezer 100* (1957)). (Electrolux 1994: 66, 21) The focus on fridges and freezers is well reflected in the trademark registrations.

The same could be said for the registration of a trademark for dishwashers (*Maid*) in 1959, the same years as Electrolux first dishwasher was presented. However, in practice it was called D10 and the name *Maid* is not represented in the business histories reviewed. This highlights a reliance on model number for individual products which is also very apparent in listings of various Electrolux products ranging from early products until present time (Tekniska museet 2005).

There are a number of trademarks which are related to various household appliances which not have been possible to identify further and there is a trademark from 1945 referring to a steel storage shelf systems initially introduced in 1940 (Electrolux 1980: 8).

There are also a number of trademarks which may be duplications to further protect the abbreviation *E-lux* which was quite frequently used. These are *Olux* (1955), *Elux* (1956), *Alux* (1957), *Sellux* (1957), *Ilux* (1960) and *Ylux* (1960) They may of course be related to products, but that has not been possible to verify. Another general brand is Electrolux (1956), related to the 1957 change of name in Sweden and Germany from Elektrolux with a ‘k’ (‘c’ had been used in Anglo-Saxon countries earlier).

To conclude, the trademark registrations do correctly highlight that fridges and freezers were areas of new-to-the-firm innovation. This is also true of the dishwasher. The absence of innovations in the vacuum cleaner area is also consistent with a lack of trademarks. The washing machine area is a deviation since Electrolux entered the market for domestic washing machines in the period, but there are no trademarks. The registrations for the miscellaneous products like steel shelves and various household appliances may or may not be related to new products. But out of the four main product fields (vacuum cleaners, washing machines, fridge/freezer and dishwasher), two are in accordance with sub-hypothesis (A) and one with (B). This is a better result than for AGA and the automotive companies, but far from perfect. A more detailed study would definitely be required before claiming that trademarks can be used as innovation indicator for Electrolux.

7.5 Model numbers as trademarks?

The comparison between firm's registrations of trademarks and their new-to-the-firm innovations has not been very encouraging so far, at least not for the period studied. The considerable inconsistencies in the use of trademarks within the companies distort the trademark counts and it is difficult to claim that they would reflect the introduction of new innovative products with accuracy. A key issue is the use of model numbers. If new model number series were registered as trademarks, the situation would be likely to improve substantially. An obvious question is therefore if there has been a change in that direction in more recent times.

However, only one company in the engineering category, Volvo, has more numerous registrations. They started with one trademark in 1982 (*Volvo 760GLE*) and two in 1987 (*Volvo 780 and Volvo 480ES*). In the years 1996 and 1997, they then registered more or less complete number series, e.g. *Volvo C1…9, F1…10, C20…90, V10…90* etc., adding up to 65 trademarks. Some of these are not in practical use (yet). Since the year 2000, they also have had 7 registrations for different truck models.

Ericsson had only one model number trademark before the year 2000, *DRA 1900,* in 1996. Of the six trademarks of this type since then, four are related to mobile phones from the joint venture *Sony-Ericsson,* while the other two are registered by the parent company and appears to be related to telecom infrastructure equipment.

Given that neither Scania-Vabis, nor Electrolux or AGA has got any model number trademarks at all, indicates that this type of trademarks is not the key to trademarks as innovation indicator in the electro-mechanical and automotive industries.

In summary, the comparison between trademarks and new-to-the-firm innovation for the engineering companies has not given results consistently in line with the hypothesis. Some areas of consumer products and products for professional users show better correspondence than intermediate goods, but this is not always the case. A key issue is these firms' reliance on model numbers. This problem seems to largely still remain today. Finally, it should also be mentioned that for none of the engineering companies did the pattern of patenting show any clearly visible similarity with the respective trademark patterns.

8 Trademarks and new products in pharmaceutical companies

As was shown earlier, the picture for the pharmaceutical industry is very different from the companies studied so far. Here, trademarks have been extensively used both in the 1945-60 period and more lately. The chance that trademarks can be used as an indicator for long term studies is therefore higher than for the previously studied companies.

The Swedish pharmaceutical industry grew out of pharmacies during the first decades of the 20th century. Up until the 1930s, the production was focused around a number of standard drugs which were industrially produced in a time when most drugs were prepared by the local pharmacist. Towards the end of the 1930s, the industry slowly

started to develop proprietary original drugs. The interest in original development continued during the 1940s when a number of important products were commercialized, e.g. the tranquilizer *Xylocain* by Astra. After WWII, the industry has expanded their own research and development and also established co-operations with universities which have been an important source of ideas. Since then, pharmaceutical companies founded in Sweden have developed world leading product for the global market.

The pharmaceutical industry is quite tightly regulated. The requirements for tests at the different stages in the development are high to avoid dangerous or harmful side effects. In the early 1960s, the drug Thalidomide (Neurosedyn in Sweden) caused serious damage to babies. This was a breakpoint in the development of medical regulation. After the disaster, the requirements were raised considerably. The Swedish pharmaceutical industry lived under a potential threat of nationalization, first in the 1920s, but also later in the 1960s then due to ideological concerns further fuelled by the Thalidomide-disaster (Norgren 1989: 41-48, Sundling 2003:1, Werkö 2000:322-3).

8.1 Trademarks versus new products

Ideally, a comparison between new products and trademarks similar to the ones performed for the engineering industry should be made also for the pharmaceutical industry. However, it has only been possible to find an exhaustive list of launched products from one company, Draco which is a part of the Astra Group. This list can be checked against the trademark database to see if a new product also has a trademark registration. However, it is not possible to test to what extent the trademarks registered by Draco also has corresponding new products, i.e. test if there are excessive trademark registrations. This is due to the database only having the latest owner entered. Many of the Draco's trademarks were later transferred to the parent company Astra or the sister company Hässle without indications of the original applicant. A smaller number of trademarks, 13%, have also later been sold to companies outside the Swedish pharmaceutical sector. These trademarks would be missed in a raw trademark count derived from the database[15], but have been included in the comparison here. Table 3 shows the number of new products launched by Draco according to their drug registration years.[16] The company Draco was started by Astra in 1956 and its manufacturing was originally supplied with drugs developed in, or licensed by, other parts of the Astra Group. However, they set up their own laboratories and proprietary drugs were launched from the final years of the 1950s. It is clear from Table 3 that they did not use trademark very extensively until after 1965. But after that date the share of new products with trademarks is high and fairly stable between 75% and 100%.[17] The situation when it

[15] See the section on sources for information about the limitations of the database.
[16] For drugs which were 'free-listed' before final registration, the year of 'free-listing' has been used. See the next section for more information about the 'free-listing' system.
[17] Excluding the trademarks later sold to foreign companies distorts the picture somewhat, but not very seriously. Two trademarks would be deducted from the 1966-70 period and one from the 1961-65, 1976-80 and 1986-90, respectively.

comes to timing of trademark registration the situation is less good. Only 70% of the new products have their corresponding trademark registered within 3 years of the drug registration date. The larger deviations may be due to longer than expected drug registration (approval) times. However, the overall picture for Draco is much more in accordance with the hypothesis that new products are trademarked (sub-hypothesis (A)) than it was for the previously studied companies in the engineering industries. Draco's less active use of trademarks before 1965 is likely to be a start-up phenomenon. As was indicated by Table 1, the larger companies in the pharmaceutical sector were using trademarks actively long before Draco did.

Table 3. Number of new products and the number of these with trademark registrations by drug registration date for Draco 1961-1990.

Drug Registration Date	Number of New Products	Number of New Products with Trademark	Percentage New Products with Trademarks
1961-65	14	5	36%
1966-70	15	13	87%
1971-75	5	5	100%
1976-80	6	5	83%
1981-85	8	6	75%
1986-90	9	7	78%

Sources: Larsson 1990: 101-108, PRVLink 2005.

8.2 Trademarks versus registered drugs

Another way of trying to compare the trademark count with new products is to use the registrations (approvals) of new drugs with authorities (*Läkemedelsverket*, previously *Socialstyrelsen*). There are a number of complications with such a comparison. First, the registrations statistics are hampered by changes in the regulatory framework. Second, the companies have registered trademarks for other products than drugs, for instance diagnostics and certain medical equipment. The first issue is mainly due to the regulation change in 1962 following the Thalidomide disaster. Drugs produced by pharmacists (especially their organization ACO) were now obliged to register. Also a number of bacteriological products previously exempt now had to register. In addition, the earlier system whereby drugs were 'free-listed' pending final approval was abolished. The free-listing was typically granted within a year while the final approval could take several years, in some cases over 10 years. The new product groups subject to registration together with the abolished free-listing resulted in a back-log of approvals causing very high numbers of registrations in 1963 and 1964. In 1971 another set of previously exempt older products had to register together with all bacteriological products. This also led to increased registrations in the years 1973-1975. (There was another regulatory change in 1992.) (Berlin 1979, 1981, Norgren 1989:31-35). However, by excluding the turbulent years of 1963-64 and keeping the over-registration in the early 1970s in mind it may still

be useful to make a comparison with trademarks. The second issue can to some extent be dealt with by filtering out the trademarks which have been registered in class 5[18]. This class includes pharmaceutical and veterinary products, diet products for children and ill, plasters and bandages, dental fillings, disinfectants as well as products against vermin etc. The definition of this class is clearly wider than drugs, but is as close as the trademark classification allows. The absolute number of trademarks in other classes than 5 was fairly low and constant in the period for which compiled and reliable drug registration statistics are available (1965-81), and varied between 2 and 18 trademarks. In relative terms, there was an increase from about the 10% level to the 25% level, due to the decrease in the total number of trademarks.

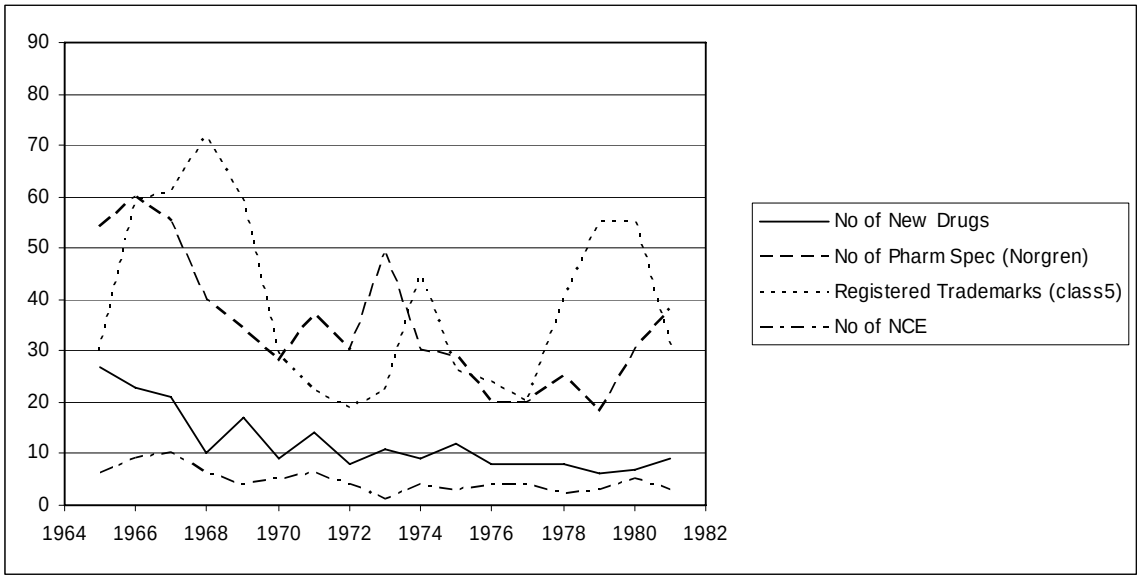
Having corrected for the distortions introduced by regulatory change and having filtered out the class 5 trademarks; there remains the issue of mapping the definitions of the registration to this study's definition of new products. The basic unit of drug registration is the so-called pharmaceutical specialty. However, this includes different forms of preparation and different strengths, i.e. it is a more encompassing definition than the study's. However, Norgren (1989: 33) identified the number of new drugs in the registration listing. This number include both drugs which are original (NCE's, new chemical entities) as well as drugs based on already known active substances. This is a definition which is close to this study's definition of new products. In addition, Berlin (1979, 1981, 1982) has extracted the number of NCE's, i.e. the original drugs developed by the Swedish pharmaceutical industry.

The three types of drug registrations are plotted in Figure 5 together with the number of trademarks in class 5 for the period 1965-81. As can be seen in the diagram, the number of trademarks is much closer to the number of pharmaceutical specialties than to new drugs. There are a number of reasons why this is the case: a) the rather widely defined trademark class 5 could cause the inclusion of products which are not subject for registration, b) different trademarks may be used for different market applications of the same active substance, c) trademarks may have been registered for planned products which development later fails d) there may be an excessive registration of trademarks and e) the number of trademarks and pharmaceutical specialties may both just be symptoms of an increased underlying product development activity. Further and more detailed study of the individual trademarks, specialties and drugs would be required to fully clarify this issue.

The average time for the drug approval and registration process for Swedish NCE's approximately doubled from ca. 1.5 years in the 1960s to almost 3 years in the following decade. However, it was fairly constant at about one year for pharmaceutical specialties. This indicates that the authority's processing capacity could have been limiting the approval pace for NCE's and possible also new drugs. This could affect the comparisons by distorting the yearly number of approvals as well as the timing.

[18] The filtering also excluded trademark figures.

Figure 5. Number of registered (approved) new drugs, pharmaceutical specialties, new chemical entities (NCE's) and trademarks in Class 5 for the Swedish pharmaceutical industry 1965-1981.



Sources: Norgren 1989: 33 (new drugs, pharmaceutical specialties), Berlin 1979, 1981, 1982 (NCE's), PRVLink 2005 (trademarks).
Note: The number of pharmaceutical specialties reported by Berlin is sometimes higher than the number given by Norgren (presented here) most probably due to small firms' registrations and pharmacists'. Norgren is using the same definition of the industry as this study, while Berlin is counting all Swedish registrations. These small firms/pharmacists are not likely to have developed NCE's.

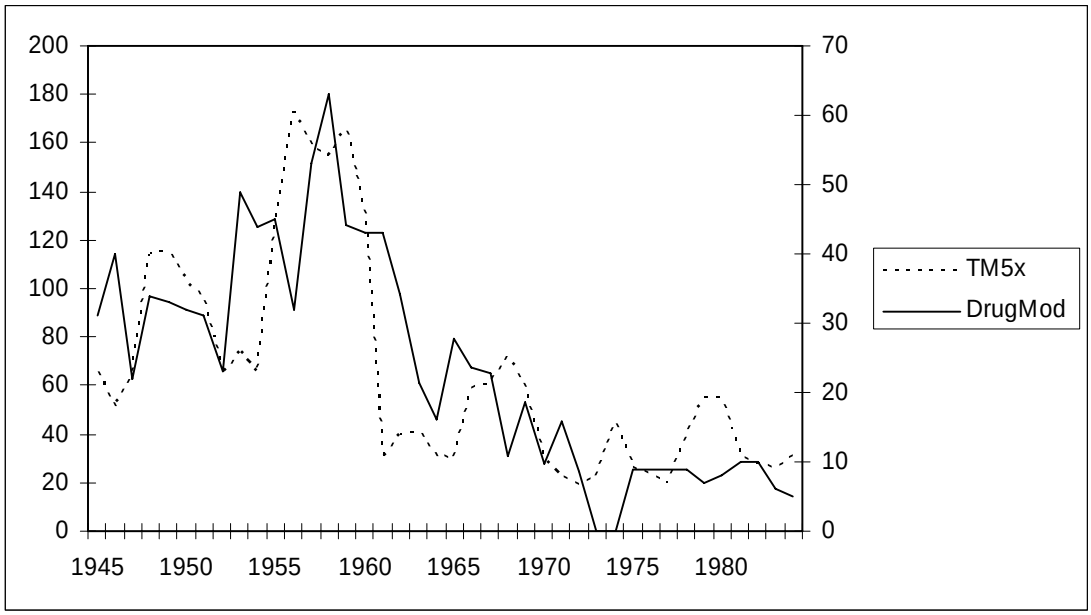
Although the level of the trademark count is much higher than the number of new drugs, it may still be correlated with it. To test this, a longer time series was constructed in order to facilitate a statistical analysis. The number of drugs has peaks in 1963-1964 and 1973-1975 due to the regulatory changes mentioned earlier. A best guess of the excessive drug registrations in these years based on the information provided in Berlin (1979, 1981) and Norgren (1989: 32-33) has therefore been made. The excessive registrations have been removed and distributed over the previous years as an approximation of their true date or origin.[19] In this way a more realistic series for the

[19] The 1964 peak mainly consists of the 64 old and previously exempt pharmaceutical specialties by ACO (Berlin 1981). These have been recalculated to a corresponding estimated number of new drugs using the average ratio between pharmaceutical specialties and new drugs in the years 1962 and 1965 (64/2=32). This number of ACO drugs have been removed from the data and distributed over the period 1939-1963 (1.3 drugs /year), since these drugs may have originated anytime during this period (ACO started in 1939, see Appendix 2). The peak in 1963 mainly consists of a backlog of previously free-listed pharmaceutical specialties and new drugs. The number of drugs in 1963 has been taken to be the mid-point between the 1962 measured value and the estimated value of 1964. The removed drugs have been spread evenly over the previous five year period (6 drugs/year), which is a best guess for the time of their origination. The 1973-1975 peaks are also due to old ACO products and a similar operation as for 1964 has been done. The specialty-to-drug ratio around these years was 3. The number of previously exempt ACO registrations was 88, 30 and 11 for the years 1973, 1974 and 1975, respectively (Berlin 1979). The ratio has been used to estimate the number of drugs to be removed and these have been spread evenly back to 1939 (0.7 drugs/year). For the years 1973 and 1974, the estimated number of drugs was smaller than the actual and the number of drugs was limited to zero. It should also be noted that a number of different ways of

actual number of drugs could be created for the period 1945-1984. The series for the number of trademarks in class 5 was also extended. Trademarks were not classified before 1961 and therefore the total trademark count for the pharmaceutical industry was inserted for the period 1945-1960. The justification for using the total number of trademarks as a proxy for the number of trademarks in class 5 is that the percentage of non-class 5 trademarks was only about 10% in the first years of the 1960s.

The modified and extended series for the number of new drugs and "class 5 trademarks" are not stationary and a bi-variate correlation study must be done using first differences. The result of such a study shows no significant correlation between the variations in the trademark count and number of new drugs. This is also visible in Figure 5 where the short-term variations of the two curves are not coinciding and the variations in the number of drugs tend to be increasingly muted towards the end of the period. The reason for this may be the distorting effect of the drug approval process discussed above.

Figure 6. Pharmaceutical trademarks in Class 5 (TM5x) and registered (approved) new drugs (DrugMod) for the Swedish pharmaceutical industry 1945-1984 (Dual scales).



Sources: Svensk Varumärkestidning 1945-1960, PRVLink 2005, Norgren 1989: 33.
Note: The number of new drugs has been modified to compensate for known anomalies due to regulatory change in the early 1960s and 70s. A filter for class 5 has only been possible to apply 1961-84.

However, in order to investigate if there is a long-term relation between the two variables, a co-integration test was performed. This would show if the two variables are

adjusting the series of new drugs have been tested due to the uncertainties in determining drugs' true date of origination, but the co-integration results are not particularly sensitive to the different versions. The presented version has been regarded as the most likely given the available information.

moving together in the long run. The following regression was run using the extended trademark series (*TM5x*) and the modified number of new drugs (*DrugMod*):

$$TM5x_t = \beta_0 + \beta_1 DrugMod_t + \varepsilon_t \quad (1)$$

The error residuals were tested for stationarity using the Augmented Dickey-Fuller test (ADF). The result using the ADF critical t-statistic for co-integration (Ramanathan 1998: Table 10.10: 540) showed that the error series is stationary at the 1% level. The same result was achieved when exchanging the two variables in equation 1 with each other and repeating the test in the opposite direction. The mutual co-integration indicates that the trademark count actually mirrors the number of new drugs well in the long term, despite not being able to capture the short-term variations and despite being at a too high absolute level. This can also be seen in Figure 6 where the two series are following each other well when it comes to the long term movements.

8.3 Patterns of trademarks and patents

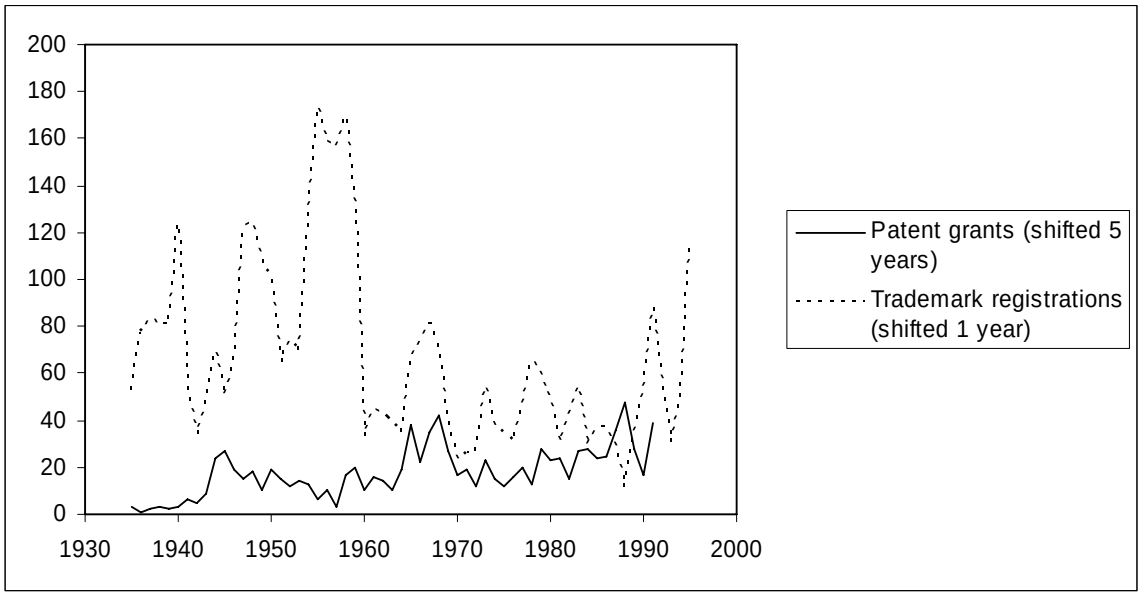
It is also of interest to compare the trademark pattern with the pattern of patenting. First, to see if the two convey the same information, in which case one would be redundant. Second, since it may shed some light on the short-term variations of trademarks. Figure 7 makes such a comparison. Here the curves for trademark registrations and patents grants have been shifted one and five years, respectively. This has been done to compensate for the difference in handling time by the authority (PRV) so that the displayed curves reflect the application dates rather than the dates of registration or grant.[20]

The first observation that can be made is that trend for patenting is rising while it is declining for the trademarks. This could possibly be interpreted as an increased average number of patents per product, i.e. an increased technological content in the products. A second observation is that the patenting exhibits a distinct cyclical pattern around its trend. This pattern has peaks with approximately 20 year intervals. It is tempting to relate this to the patent life-time, which were 17 years until 1978 and 20 years[21] thereafter.

[20] The shifts have been selected based on the mean handling time from application to registration or grant for Astra 1978-98. A detailed comparison between Astra/Hässle/Draco's patent application and grants 1955-97 shows that the granting process does not affect the curve forms substantially. Three year moving averages of the number of application and grants are similar and only shifted in time. The spectral power density is also almost identical. As was noted in the section on Sources, the trademark registration process had some problems after 1988, but seems to work smoothly before that date. A test whereby the peaks and troughs caused by the administrative problems in 1988-95 are manually removed, show very similar spectra for the original and modified curves. To use registrations and grants instead of applications can therefore not be shown to cause problems in this study.

[21] The extended protection for pharmaceutical patent introduced in 1994/95 comes too late to affect this investigation.

Figure 7. Granted patents and registered trademarks (adjusted to mimic application dates) for the Swedish pharmaceutical industry 1935-1996.



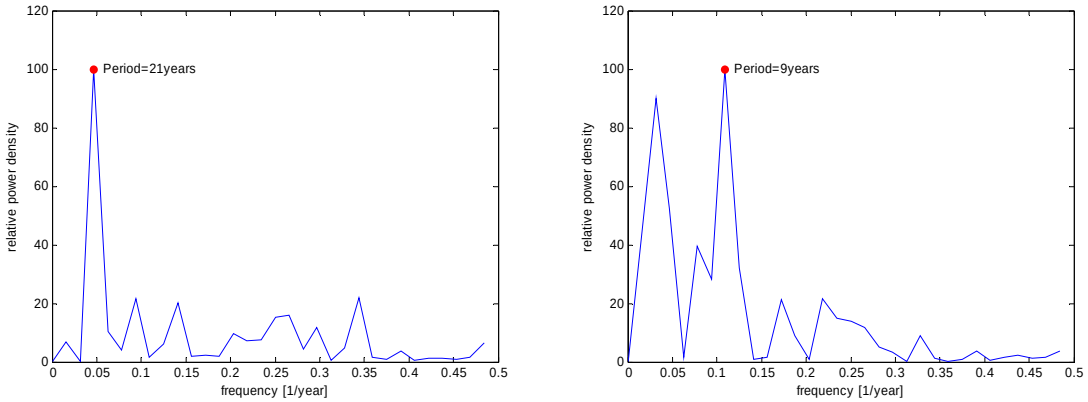
Sources: Patent (1935-1996), Svensk Varumärkestidning (1935-1960), PRVLink 2005.

Cyclic tendencies of investment in innovative activity have been found theoretically when patents lives are of finite length and in the presence of economic growth (Judd 1985). Another potential explanation lies in the major technology shifts in the development of pharmaceutical products (Malerba and Orsenigo 2002). The 1940s mark the emergence of formalized R&D and the use of 'random screening' of a large number of substances for finding new drugs. In the 1970s, a transition to a more 'guided' drug development started, drawing on advances in molecular biochemistry, pharmacology and enzymology. And recently, genetic engineering tools have become more widely used. In this interpretation the patent peaks may indicate the initially high potential of the new techniques. However, to fully explain the cyclic patent pattern is outside the scope of this study. It must also be stressed, that this type of cyclic pattern for patents does not seem to be typical. For instance, a study of the long term patenting of Swedish automotive firms, an industry does not exhibit such cycles (Malmberg 2002) and there are no visual indications in the patenting of the other companies in the present study for the, admittedly short, period 1945-60.

Interestingly enough, the trademark data for the pharmaceutical industry also shows a cyclic behaviour. The trademark count seems to peak just after patents peaks, or coincide with them. But in addition, there are trademark peaks in between the patent peaks. The cyclic patterns are confirmed by spectral analyses of the two curves shown in Figure 8 (Hayes 1996: 18-20). The spectrum for patents has a very distinct spike corresponding to a period time of about 20 years. The trademark spectrum has a spike for roughly half that time, which corresponds to the trademark curve having twice the number of peaks compared to the patent curve. The trademark spectrum also has an additional peak for a period of above 30 years which is caused by the U-shaped appearance of the curve

between 1960 and 1996 and the general increase up to 1960.[22] (It is largely that frequency component the co-integration relation in the previous section tracks.)

Figure 8. Spectral analyses of patent (left) and trademark counts (right) for the Swedish pharmaceutical industry 1935-1996.



Sources: Patent (1935-1996), Svensk Varumärkestidning (1935-1960), PRVLink 2005.
Note: Linear trends have been removed from input data.

The peaks in patenting are roughly in line with when (later) economically important original products were invented. The peak in the mid 1940s coincides with Astra's tranquilizer *Xylocain* which became a very successful product.[23] Its initial patent application was filed in 1943 by university researchers and when Astra had acquired the rights in 1944, they started an intensive work to protect the core patent with protecting ones for alternative production methods (Lindqvist and Sundling 1993:88, 112). (Recall that pharmaceutical product patents were not allowed in Sweden until 1978.) The first half of the 1950s did not see any patent applications for original products which would be of high economic value, which is consistent with a trough in Figure 8. The situation improved with three important products in the second half which left a bump in the patenting curve. The major peak in patenting in the period 1965-70 is in accordance with seven economically important products. But apart from one product in 1975 there were no important products in the 1970s, again in line with a trough in the patenting curve. The increased patenting in the 1980s is to some extent attributable to *Losec*, Astra's commercially very important treatment for gastric ulcer that was launched in 1988, but it is likely to have been more economically important products during the 1980s.[24] The

[22] The resolution of the discrete 64-point Fast Fourier Transform used is more limited for longer period lengths. The possible period times, except zero frequency, are given by 64/n where n=1…63, i.e. 64.0, 32.0, 21.3, 16.0, 12.8, 10.7, 9.1, 8.0 years etc.
[23] The economically important products have been taken from Wallmark and McQueen (1986) who listed all Swedish innovation with a yearly turnover of >20MSEK (1980 prices). The list is limited to products with patent application date in the period 1945-80. *Xylocain* is therefore not included due to its 1943 application, but it did fulfil the economic criterion (Lindqvist and Sundling 1993: 117, 124, 132, 134, 160). Another successful product of the 1940s was Pharmacia's blood plasma substitute *Macrodex* (Pharmacia 1976, turnover of the original product unknown).
[24] This time period is beyond the Wallmark and McQueen (1986) list. However, Losec would definitely be qualified for it selling for 1360 MUSD in 1995 (1995 prices) in USA alone (Östholm *et al.* 1996: 116).

number of new drugs and NCE's in Figure 5 do not capture this pattern of commercially important products particularly well. The reason that the patent statistic captures it better is likely to due to the practice of patenting alternative production methods for protective purposes that was widely used before product patents were allowed. It is likely that protective patenting is used also thereafter but possibly in a different way. Patenting of other products, related to the important invention, may also contribute. Moreover, a study of patent quality 1979-89 using patent citations suggests that the Swedish pharmaceutical industry has a high patent quality in international comparison (Ingenjörsvetenskapsakademien 1993: 44), which improves the accuracy of the patent count as a measure of innovative activity.

The peaks in trademarking in the periods of low patent activity may therefore be interpreted as a sign of product activity not related to original developments, but rather to the commercial use of existing knowledge. This knowledge may have already existed within the company, e.g. new applications of existing active substances, or it may have been brought in by licensing agreements or imitation. The peaks may also include planned products with later failures during the clinical tests.

However, the observation that trademarks have peaks roughly coinciding with patents and successful innovations, while the approvals of new drugs and NCE's do not reflect these innovations well indicate that the short-term variations of the trademark count carries information about successful and original innovations. The approvals do of course by definition provide the number of commercial launches[25], but it does not seem unreasonable to suspect that the trademark statistics is indicating innovative activities taking place before approval, partly including failed projects. Given that the pharmaceutical industry has a very high degree of uncertainty in its development process, this suggests that for other industries that are using trademarks extensively, and that have a more predictable product development process, trademark statistics is likely to be more reliable as an indicator of new-to-the-firm innovation. This would of course require further validation.

9. Conclusions

This study has explored the possibility to use trademark statistics as an indicator of new-to-the-firm innovation. It has compared registration of trademarks and the launch of new-to-the-firm products for a number of Swedish companies. The primary period of comparison has been 1945-60 for the firms in the electromechanical industry (AGA, Ericsson, Electrolux) and the automotive industry (Volvo, Scania-Vabis),. The pharmaceutical industry has been studied in its entirety, i.e. 13 firms concentrating over time, and for a longer time period 1935-1996.

The results indicate that trademarks are generally unreliable as indicator of new products for the studied companies in the electromechanical and automotive industries.

There were a number of other products launched during the 1980s, but there is no consistent evaluation of their economic value available.

[25] At least after free-listing was abolished.

This is the case for both intermediate and consumer goods, although the situation for consumer goods is somewhat better. An important reason is that companies, or departments within companies, are often relying on model numbers to identify their products. These model numbers are seldom registered as trademarks. Although there are scattered signs of an increased registration of model numbers as trademarks in more recent times, this is still far from being a general pattern. The negative conclusion regarding the use of trademark in these companies must therefore be considered valid also today.

The results for the pharmaceutical industry are very different. Trademarks have been used frequently for very long time. A comparison between trademarks and the number of new products for Draco, a subsidiary of Astra, shows that after the firm's start-up period, a high and fairly stable percentage of the new products have been trademarked.

A comparison for the entire industry between trademarks in class 5, the class for drugs etc., and the number of new drug registrations (authority approvals) shows that the number of trademarks is much higher than the number of newly registered drugs. This discrepancy may be due to a number of different reasons: a) that the trademark class 5 also includes various products which do not require drug registration (approvals), b) different trademarks may be used for different market applications of the same active substance, c) trademarks may have been registered for planned products which development later fails d) there may be an excessive registration of trademarks and e) the number of trademarks and pharmaceutical specialties may both just be symptoms of an increased underlying product development activity.

However, the trademark count in class 5 is co-integrated with the number of new drugs with high significance and is following it well in the long term. This indicates that trademarks, it at least in the long term, are reflecting new-to-the firm innovations. The deviations in the short-term may partly be influenced by different times to approval for different drugs which make the flow of products from the firm into the approval process to look different than the flow of approvals.

A study of the patterns of trademark registrations and patent grants for the pharmaceutical industry reveals an interesting cyclical pattern. The patent count peaks with approximately 20 year intervals and the trademarks with approximately 10 year intervals. This creates a pattern were patents and trademarks are sometimes roughly coinciding, but in between these instances there are trademark peaks without the patents peaking. The peaks in the patenting are also approximately in accordance with when commercially successful innovations were patented. The trademark count peaks in these periods as well, which indicates that also the short term variations in the trademark count carries information about innovative activities, at least prior to the approval process. The trademark peaks that are not coinciding with patent peaks could then be interpreted as either periods of product development re-using existing knowledge (proprietary knowledge, licensing or imitation), or periods of planned but failed product developments, or a combination of the two. In any case, it suggests that the combined use of trademarks and patents may be fruitful for innovation studies.

That the trademark count in the pharmaceutical industry contains information about the innovation process both in the long and short run suggests that trademark statistics may be well suited as innovation indicator for other frequently trademarking industries with a less uncertain development process than in pharmaceutics. But the negative results for the electromechanical and automotive companies suggest that the use of trademarks as innovation indicator has to be made selectively, probably on a per industry basis.

The study has also highlighted a couple of issues related to the Swedish source material for trademarks. Studies that intend to make use of Swedish trademark sources would need to take these into account. First, the trademark office had administrative problems in the period 1988-1996 and this caused the number of applications and registrations to deviate substantially. Second, the on-line database *PRVLink* only includes the last owner of each trademark. This means that trademarks can be lost if the trademark rights are sold to another company. This is of special importance when entire companies change hands. It should be noted that these issues have been dealt with in the present study and do not affect the conclusions above.

Appendices

Appendix 1, Ericsson trademarks for different product types and areas.

Appendix 2, Concentration of the Swedish pharmaceutical industry 1935-1999.

Appendix 1, Ericsson trademarks for different product types and areas

Table 1. Products for professional end-users

Product area	Products (introduction year)	New Product or major upgrade	Trademarks (description)	Agreement TM vs. New Products
Telephones	New loud-speaking phone w. semiconductors (1959)	Yes	1959 ERICOVOX (loud-speaking phone)	Yes
	Answering/announcing machines w. magnetic tapes (1950's)	Yes	?1956 BANDINO (tape recording) [tape rec. in Ericsson consumer products came in the 1960's, M&J(2000:229)]	Yes?
Private branch exchanges	Crossbar technology (late 1950's)	Yes	?1959 ERICROSSBAR (telephone exchange) ?1959 ERICROSS (telephone exchange)	Yes?
Intercom phones	*Incrementally* improved model (1948)	No	None	Yes
Telex	No major products in period	No	None	Yes
Mobile Radio	Small mobile radio (1954)	Yes	None	No
Electricity meters & other electrical and meas.products	New electric meter (1945)	Yes	1945 ELMIX (electric meters)	Yes
	El fencing (1950's?)	Yes	1954 ERMEX (locks & electric fencing)	Yes

Sources: Svensk Varumärkestidning (1945-1960), Jacobaeus (1977), Meurling & Jeans (2000).

Table 2. Products for Telecom operators, Military, Railway etc.

Product area	Products (introduction year)	New Product or major upgrade	Trademarks (description)	Agreement TM vs. New Products
Telephone exchanges	Crossbar technology products Early commercial systems 1950-53	Yes	?1959 ERICROSSBAR (telephone exchange) ?1959 ERICROSS (telephone exchange)	No?
Cable and line plants	Polythene insulated cables (ca 1950)	Yes	?1957 SIEVEKON (cable & insulation)	Yes?
	New pressurized cable system (1950's)	Yes		No
Transmission equipment	FM teleprinters (1947)	Yes	None	No
	Facsimile equipment (1950's)	Yes	?1956 ERIFAX (facsimile equipment etc.)	Yes?
	Radio links (1950's)	Yes	None	No
	Multiplexers (1950, 1958)	Yes	None	No
Power supply equipment	No major products	No	None	Yes
Railway telephony	Automatic telephony system for Swedish Rail designed around Ericsson exchanges	Yes	None	No

Military electronics	No major products in period (license production of radar)	No	None	Yes
Space technology	No major products in period	No	None	Yes
Railway signaling	Relay based Centralized Train Control [M&J(2000):240]	Yes	None	No
Road traffic equipment	Magnetic loop traffic control (1949)	Yes	None	No
Other signaling systems	No major products in period	No	None	Yes
Process control	No major products in period	No	None	Yes

Sources: Svensk Varumärkestidning (1945-1960), Jacobaeus (1977), Meurling & Jeans (2000).

Table 3. Industrial Components

Product area	Products (introduction year)	New Product or major upgrade	Trademarks (description)	Agreement TM vs. New Products
Capacitors	MP-capacitor w. unique encapsulation (mid 1950's)	Yes	1959 MINIPRINT (capacitor)	Yes
	Tantalum capacitors (end 1950's?)	Yes	1959 TANTA-LUX (capacitor) 1959 TANTALYT (capacitor) 1959 TANTALAR (capacitor) 1959 TANTALON (capacitor)	Yes
	Polycarbonate capacitors (1959)	Yes	None	No
Electron tubes	Long-life tubes (1950's)	Yes	None	No
	Microwave tubes (2nd half 1950's)	Yes	None	No
	Germanium transistors (2nd half 1950's)	Yes	None	No

Sources: Svensk Varumärkestidning (1945-1960), Jacobaeus (1977), Meurling & Jeans (2000).

Table 4. Consumer Products (excluding SRA)

Product area	Products (introduction year)	New Product or major upgrade	Trademarks (description)	Agreement TM vs. New Products
Telephones	Incrementally improved bakelite telephone (1947)	No	None	Yes
	All-in-one telephone (Ca 1955)	Yes	1955 UNIFON (telephone) 1956 ERICOFON, 1957 ERICOFONE (telephone) 1956 COBRA (telephone) ?1956 STANFON, STANFONE (telephone)	Yes

Sources: Svensk Varumärkestidning (1945-1960), Jacobaeus (1977), Meurling & Jeans (2000).

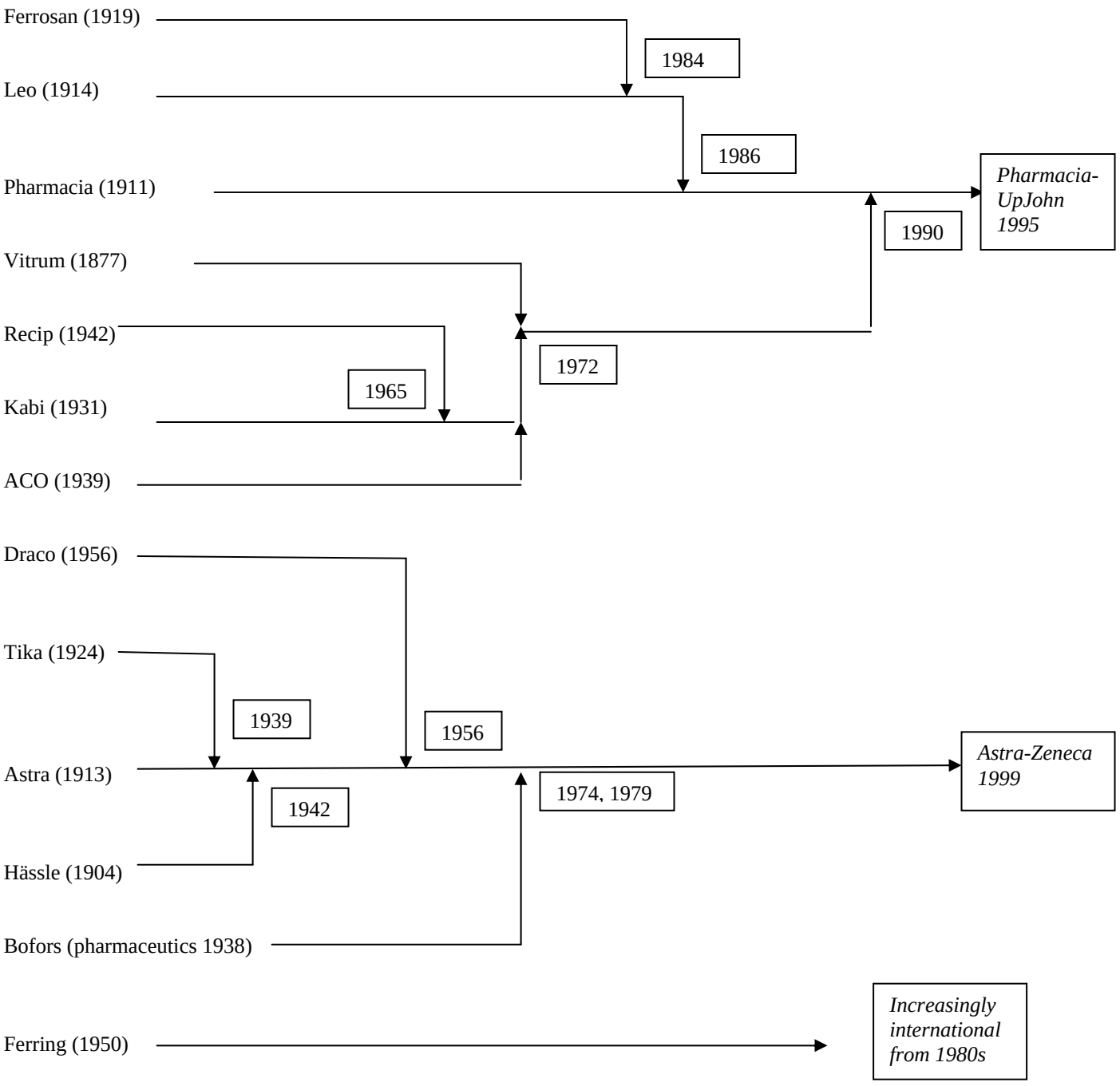
Table 5. General Brands (logotypes etc.) and Unidentified Trademarks

Logotypes etc.	1949 ELLEM (general) 1951 ERMI (el meters & systems) 1951 Kontakten (publication) 1960 LME-logo (cobra telephone and stylized cross connection)
Unidentified Trademarks	?1954 ERIBAND (electric equipment, various uses) ?1960 ERIPRESS (electric wires & contacts) ?1955 ERISET (telephones, telecoms equipm, radio/TV)

Sources: Svensk Varumärkestidning (1945-1960).

Note: Uncertain links between trademark and product have been indicated by "?".

Appendix 2, Concentration of the Swedish Pharmaceutical Industry



Sources: Norgren 1989: 43-47, Sundling 2003: 1-5, Fransson 1996: 174, 263, Ferring (2005), Larsson 1990: 7-9, SoU 1969:36 : 31-48, Ahlin and Lundgren 2002: 279, 297.

Note: The diagram is showing the principles of the concentration only. Companies may have changed name and ultimate owners over time and acquired companies may or may not have continued to use their old names.

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