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# **INTERNATIONALIZATION OF SWEDISH R&D**

**- MOTIVES AND PROBLEMS**

David Salsbäck, 18334  
&  
Klara Halkjaer, 19245

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This thesis examines the development of geographical location of research and development (R&D) in Swedish multinational corporations (MNCs), and the motives and problems associated with locating R&D abroad. A questionnaire-based survey is used in an attempt to map the global location of R&D on a country by country basis, and to evaluate the drivers and obstacles to internationalization. The results on the motives for internationalization show that adaptation of products to local markets and the need of establishing R&D units in conjunction with internationalized production units are the most important motivators for locating abroad. Access to skilled manpower and the cost of labour is also considered important. The motives related to external factors such as technology sourcing and spillover effects from proximity to other companies were rated as far less important. The firms report substantially different problems related to internationalization of R&D when locating in a non-OECD country compared to locating within the OECD-area. Problems related to weak intellectual property rights protection and increased coordination costs and cultural differences are considered to be of particular importance when locating in a non-OECD country. Headquarter proximity received very low scores as a determinant of the location of R&D activities. These results largely confirm earlier studies and suggest that even though the prospect of decreasing the cost of human capital has risen in importance as a motivator for R&D location, the traditional market- and production-related motives still are the primary drivers of internationalization.

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**Tutor: Karolina Ekholm**

**Examinator: Mats Lundahl**

**Presentation: February 21, 2007, 10.15 – 12.00 Room 336**

**Discussants: Sebastian Hybbinette (20756) & Peder Stubert (18730)**

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# 1. Introduction

In recent years, the Swedish debate on economic policy and national competitiveness has largely focused on the impact of globalization on the industrial landscape. As growth in manufacturing jobs seem likelier to occur in low-cost locations rather than in Europe, policy-makers have been trying to formulate a vision for how countries such as Sweden should enhance their international competitiveness.

The conventional answer has been that the ongoing restructuring best can be met by attempting to develop competitiveness in knowledge-intensive sectors. The idea that a country can prosper through strategic investments in knowledge and technology has during recent years been central in the policy debate in Sweden and in other western countries.

In economic theory, the idea that intentional investments in the production of technology can spur growth has been put forward within the endogenous growth theory developed by Romer (1990), Lucas (1988), and Grossman and Helpman (1991). In these models, the stock of knowledge or human capital determines a country's growth rate, implying that countries can benefit from increasing investment in growth-enhancing technology. Insights related to the ideas that underpin endogenous growth theory have lately been at the heart of the industrial policy discussion related to globalization.

The Swedish economy has long been characterised by a high degree of research and development activity. This is often interpreted as proof of the Swedish economy being knowledge-intensive and well-prepared for an international trend where low-skilled manufacturing jobs are to be replaced by knowledge-intensive activities.<sup>1</sup>

R&D has long been seen as an economic activity with low general mobility, and as immune to the risks of being drawn to low-cost locations. When it has moved away from a firm's home base, it has normally moved to another high-cost location. In recent years, however, a number of developing countries, most notably China, have started to attract R&D.

There is some dispute as to how important and sustainable the tendency of increased location of R&D to low-cost locations is. A related topic is whether the location of research activities to

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<sup>1</sup> It has however been argued that the return on Swedish investments in research has been relatively low. This phenomenon – high investments yielding low capitalization is known as the Swedish paradox.

outside the OECD area is driven by a new set of factors (e.g. low cost of human capital), compared to the choice to locate R&D to another high-cost country. Since the latter form has dominated completely in the past, it has naturally also completely dominated the research on drivers and obstacles to internationalization. It is therefore an interesting and potentially policy-relevant topic to investigate;

- 1) Where Swedish corporate R&D is moving;
- 2) and the motives and problems associated with locating R&D abroad.

The Swedish Institute for Growth Policy Studies (ITPS, 2005) published a study on R&D in international companies in 2003. This study includes a survey where 38 large Swedish companies state the most important motives for moving their R&D activities abroad. To our knowledge, this is the only recent survey-based study that focuses on motives for internationalization of R&D in Swedish companies, and the implications of these trends. Our study can provide new insights into this subject by analysing different motives in more detail and also by looking more closely on the problems involved in internationalization of R&D.

## **1.1 Purpose**

The purpose of this study is to shed light on the above questions by performing a questionnaire-based study of 25 of the largest Swedish multinational companies (more on the sample selection in section 2.1). The study aims at mapping the exact location of R&D activities on a country level as well as at examining the drivers and obstacles to internationalization. Regarding the latter, a particular focus is put on the question to what extent drivers and obstacles differ between OECD and non-OECD countries.

## **1.2 Delimitations**

### **1.2.1 Information on location of R&D**

The initial aim of mapping the current location of R&D in Swedish companies on a country by country basis had to be abandoned during the course of the study. It became apparent that it was simply not possible to attain the information needed through the questionnaire-based survey. Hence, this part of the study was excluded and the corresponding part of the questionnaire deleted. Data from the World Investment Report (UNCTAD) and the Swedish Institute for

Growth Policy Studies (ITPS) were instead used to describe the geographic patterns of Swedish industrial R&D.

### **1.2.2 Use of the term “internationalization”**

As defined in UNCTAD World Investment Report (2005) internationalization of corporate R&D can take a number of forms. First, multinational corporations (MNCs) can perform R&D activities at subsidiaries abroad, either established by “greenfield” investments or by the acquisition of existing R&D entities (possibly as part of a larger corporate merger). Second, companies can gain knowledge and access technologies from abroad through international trade, within the company as well as with external parties. Third, R&D activities can be performed within R&D networks involving other multinational companies as well as governments, universities, etc. Finally, companies can employ R&D manpower foreign to the country in question, be it the home or the host country, and thus attain international knowledge and skills.

In this study, the term internationalization will be used in the first form, meaning the location of actual corporate R&D activities abroad. An alternative term to capture this phenomenon would be offshoring of R&D. From this follows that this study deals with *outward R&D*, R&D performed abroad for firms operating in Sweden. Inward R&D, which relates to foreign-owned companies performing R&D in Sweden, is hence not considered.

In the questionnaire, the respondents are not asked to specify if their international R&D is performed in-house or if it is outsourced. The distinction is not relevant within the context of this study, as the interest lies in the general motives for, and problems with, locating R&D abroad. The specifics connected to in-house and outsourcing, respectively, lies beyond the scope of this study. This study works within the framework highlighted in the figure below.

**Figure 1. Internationalization framework.**

		Geographical location of R&D activity	
		In Home Country (domestic)	In foreign country (offshore)
<b>Organiza- tional Location (control)</b>	Inside Company (in-house)	1.Domestic in-house R&D	2. Offshore in-house R&D (by an affiliated company)
	Outside Company (outsourced)	3. Domestic outsourced R&D (by an unaffiliated company)	4.Offshore outsourced R&D (by an unaffiliated company)

*Source: ITPS 2006*

### 1.3 Method

This study is based on a questionnaire<sup>2</sup> that was sent to managers in leading positions in R&D departments of 25 large Swedish and formerly Swedish companies. The questionnaire was developed in collaboration with the Centre for Business and Policy Studies (SNS) in Stockholm and with an Economist Intelligence Unit (EIU) questionnaire as benchmark (2005). The EIU questionnaire had a broader focus than our study but the sections dealing with motives for, and problems with, internationalization of R&D were well suited for our purpose and thus chosen to serve as a benchmarks. Out of the 25 companies contacted, 13 declined to take part in the study. Hence, 12 companies participated, which implies a response rate of 48 percent. But due to the fact that many of the largest R&D spenders choose to respond, the respondents capture a clear majority of Swedish corporate R&D spending in 2004.

### 1.4 Outline

The remaining part of this thesis begins with a discussion on the theoretical framework on R&D internationalization (Chapter 3), followed by an account of the empirics on global R&D location as well as R&D within Swedish multinationals (Chapter 4). Thereafter, there is a brief account of recent studies on R&D internationalization (chapter 5). In Chapter 6, the results of the survey

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<sup>2</sup> See appendix 1

directed at Swedish MNCs are presented. This section is followed by a discussion on the results in the light of previous research and studies (Chapter 7).

## **2. R & D internationalization theory**

Traditionally based in large research facilities in liaison to the firm's home base, R&D has been viewed as an activity characterised by significant economies of scale and agglomeration effects on the firm level. Centralization was argued to facilitate coordination and control of investments in innovation. These factors motivated a need for geographical proximity between innovative activity and head offices and favoured the location of R&D at the same location as the first stages of production (Vernon 1977). The assumption of low mobility of R&D – the so-called stickiness hypothesis (Lall 1979) - was a prominent feature of the early R&D literature.

The stickiness hypothesis received strong support from empirical studies that demonstrated considerably lower mobility in R&D than in other activities within the MNC. During recent years, however, increased mobility of R&D, partly but far from exclusively linked to increased internationalization of production, has been observed. New communications technology has decreased the communicative distances within the firm, enabling achievement of some of the advantages of centralization on a decentralized geographical basis (Howells 1995). This improvement of the network infrastructure of multinationals has lessened the general marginal cost of dispersion, hence facilitating an increased internationalization of activities (Criscuolo & Patel 2003). This has motivated the development of new explanatory models, including theories that focus on internationalization as a mean of knowledge acquisition, and not merely a function to support and serve dispersed production facilities and product markets. The theoretical framework has thus been expanded to include both motives that are internal to the firm and motives that are external, such as knowledge spillover, access to factors of production etc. Below is an account of the theoretical work on the motives for internationalization of R&D. Also included is a section on the more limited literature on challenges associated with the internationalization of R&D.

### **2.1 Motives for internationalizing R&D**

#### **2.1.1 Adaptation**

One of the earliest theories that incorporated R&D location was the product-cycle theory developed by Vernon (1966), also mentioned above. According to this theory it was the location



of production that determined the location of R&D, as the key reason for moving R&D was thought to be supporting foreign production. Dispersion of R&D was merely seen as a side-effect of the dispersion of production, and was thus viewed as driven by factors internal to the firm. In line with this theory, the only R&D that should accompany foreign production was the improvement of existing products and processes – the adaptation stage. The development of new products and processes, on the other hand, should be exported from the home country. Vernon's theory predicted innovative activities to have a rather low degree of mobility.

Fors (1996) summarizes the findings of the extensive adaptation literature that followed the product-cycle theory in three main components. First, foreign production requires foreign R&D to adopt products and processes to local market conditions. Therefore, R&D will be located in connection with foreign production. Second, the market size of the host country and overseas R&D should be positively related as adapting products and processes to local conditions will be considered more worthwhile in a large market than in a small one. Third, the need for foreign adaptive R&D should be predicted to be higher for R&D intensive firms. This third factor has been confirmed in a number of studies (Lall 1980, Zejan 1990) but contested in others (Pearce & Singh 1992).

In short, adaptation motives for allocating R&D resources to a particular location are related to the attractiveness of that location as a consumer market. From an adaptation perspective, shifts in location patterns of R&D can hence be viewed as driven by changes in the importance of consumer markets.

### 2.1.2 Knowledge spillovers

In the early literature on the economics of innovation and technological change, the firm was seen as the spatial unit of analysis when estimating the model of the traditional knowledge production function.<sup>3</sup> Hence, spatial dimensions such as location and geography were left out. However, a number of empirical studies showed that this model was less robust at the level of disaggregated microeconomic units, such as the enterprise, than it was on more aggregated levels, such as industries or countries. These findings indicated that externalities are present and

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<sup>3</sup>  $I_i = \alpha RD_i^\lambda HK_i^\gamma \varepsilon_i$ , where  $I$  is the degree of innovative activity,  $RD$  is R&D inputs, and  $HK$  is human capital inputs (Audretsch and Feldman, 2003). According to this model, innovative output is a function of innovative input.

suggested that spatial units of observation should be considered when analyzing the creation of knowledge. That is, geography should be included in the model. Jaffe (1989) developed a modified version of the traditional knowledge production function. This model was specified for both spatial and product dimensions:

$$I_{si} = \alpha IRD^{\beta_1} * UR_{si}^{\beta_2} * (UR_{si} * GC_{si}^{\beta_3}) * \varepsilon_{si} ,$$

where  $I$  is innovative output,  $IRD$  is private corporate expenditures on R&D,  $UR$  is the research expenditures undertaken at universities, and  $GC$  is the geographical coincidence of university and corporate research. The subscripts  $s$  and  $i$  stand for state and industry, respectively. Jaffe's main concern was to analyse whether patent activity ( $I$ ) as innovative output benefited from geographic coincidence of university and corporate research ( $GC$ ). Using US states as the unit of observation, Jaffe's hypothesis was that "an average dollar of university research will yield more spillovers in Illinois, where both university research and industry labs are concentrated in Chicago, than in Indiana, where the bulk of the university research is in Bloomington and Lafayette, where there are almost no labs" (p. 959). Jaffe, and several following studies, found weak, yet significant, supporting evidence that spillovers are in fact facilitated by the co-location of university and corporate research in a state. This indicates that the output of innovation is a result of innovative inputs in *that specific location* (Audretsch and Feldman 2003). According to this view, geography matters for innovation and might therefore constitute a motive for R&D internationalization.

Parallel to the development of the new spatial knowledge production function was the development of localization theories that argued that spillover effects diminish as they move away from the centre (Audretsch and Feldman 2003). Several scholars offer similar explanations, all emphasizing the fact that integration and exchange of tacit knowledge<sup>4</sup> is facilitated by physical proximity (Jacobs 1969, Von Hippel 1994). Feldman (1994) developed these theories to include the concept of clusters, or agglomeration economies. Specifically, she pointed out that proximity also makes it possible to monitor other firms' advances in knowledge. This implies that foreign affiliates can contribute to their organization's technological knowledge by internalising technological advances in their geographical surrounding. One could counter argue that this technological monitoring could be carried out without having actual R&D operations at the location, but several studies indicate that the R&D spillovers increase if the potential recipient

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<sup>4</sup> Non-codifiable knowledge that cannot be formalized and written down.

undertakes its own R&D in the specific location where the spillovers are generated (Fors 1996, Cohen & Levinthal 1989, Levin 1987). The existence of clusters with localized spillovers would lead companies to concentrate their foreign R&D to centres of excellence in their respective field. This tendency has been observed in the behaviour of Swedish MNCs (Braunerhjelm & Svensson 1996).

The cluster advantages are further enhanced by the synergy effects created by the flow of people and ideas between firms (UNCTAD 2005). Prominent public research institutions and universities in the region can also increase the cluster advantage. Lastly, a factor related not only to clustering, but also to adaptive R&D, is the size of the market. It is often large markets that attract clusters, since these attract more R&D investments and facilitate the use of economies of scale in R&D activity (Braunerhjelm 2001). In short, innovation activities cluster where knowledge spillovers reduce the costs of the innovation process. Once created, “centres of excellence” often retain their lead and survive for a long time due to the cumulative manner in which research skills develop. Whether this is merely a result of path dependence or an underlying characteristic of the location is a debated issue, with considerable industrial policy implications (see section 2.1.3).

In summary, spillovers have a centripetal effect in the sense that they cause concentration. As will be discussed later however, the decreased gap between the levels of human capital in different locations broadens the geographical source of technological development (section 3.1.4). This is in itself a driver of dispersion as it increases the potential number of sources of spillovers, thereby motivating dispersion of R&D activity to capture gains from technology sourcing and monitoring at these new locations. In this sense, spillovers can be said to have a centrifugal effect on a global level, as the number of centres of excellence is increasing.

### **2.1.3 Public policy designed to attract R&D**

The increasing returns to knowledge and the notion that knowledge spillovers are an important growth driver is a central part of endogenous growth theory (Romer 1990, Lucas 1988 Grossman and Helpman 1991). These presumptive externalities are often considered in policy decisions. According to this theory, there is scope for welfare gains through public provision or funding of R&D and knowledge generating activities such as education. The endogenous growth theory might thus motivate public investment in R&D and human capital.

The mechanisms underlying knowledge spillovers might be equally important in generating economic growth and development and might then also be targeted by public policy (Audretsch and Feldmann 2003). The potential benefit of clusters has been demonstrated empirically and there is evidence that a region can make progress through sector-concentrated or spillover-induced growth in a rather short time. Yet, as discussed earlier, the mechanisms underlying knowledge spillovers and clusters are relatively unknown. How and why the knowledge is transmitted has thus far not been established. There is thus no established public policy recipe that can ensure a successful ‘engineering’ of clusters and spillovers.

In the ITPS report “Internationalization of Corporate R&D” Karlsson (2006b) provides an overview of some of the public policies that have been implemented or considered in countries around the world. The overview highlights four different policy categories:

*“Strengthening the national science and technology base”* in order to create innovation systems that attract domestic as well as foreign R&D activities is considered important in many countries. Policies targeting the national innovation systems include measures such as (i) public investment in science and technology, (ii) public investment in education and training in order to ensure the availability of skilled R&D manpower, and (iii) public investment in infrastructure and regulations that support innovative activities and thus the national science and technology base.

*“Foster attractive conditions based on knowledge, production and markets”* includes (i) creating excellent R&D conditions in order to attract multinational companies and thus create “centres of excellence”, (ii) develop advanced production structures that attract production and R&D activities that gain from co-location and interaction, and (iii) creating attractive markets that appeal to multinational companies through their leading and future-oriented approach.

To *“stimulate internationalization and mobility”* a strong national science and technology base as well as attractive R&D conditions should be in place. To further develop internationalization possible policy measures to be implemented include (i) attracting foreign R&D activities through incentive packages and promotion, (ii) internationalizing domestic companies in order to benefit from knowledge and technology developed by foreign companies located abroad, and (iii) attracting foreign skilled manpower and increase manpower mobility.

Finally, on the macro-level, “*maximizing economic benefits*” requires policies that, through the R&D activities, stimulate related activities, such as services and suppliers, in order to create further employment opportunities, while “*minimizing negative effects*” requires policy measures that support the transition for manpower and regions that are faced with unemployment due to internationalization along with other forces.

In conclusion, there is no conclusive or precise way of leading a country through a successful R&D internationalization process to strengthen national competitiveness and ensure long-term economic growth. There is, however, a toolbox including various policy measures and instruments, which can be considered when policymakers are trying to put together an effective combination of measures.

#### **2.1.4 Availability and cost of skilled R&D labour**

Until recent years, the cost of labour was rarely mentioned in surveys regarding the localization of R&D (UNCTAD 2005). And this is very much in correspondence with the observed flows: R&D activity has mainly moved from high-cost OECD countries to other similar countries, rather than to areas characterised by markedly differing factor costs (UNCTAD 2005). There is however some evidence that cost issues are on the rise as a motive for localization of R&D. Due to rising R&D expenditures, R&D departments are experiencing increasing competitive pressure to cut costs and to quickly and continuously bring new products to the market (Balachandra 2005). As a result of sustained economic growth and significant investments in higher education, several important “new” R&D host countries, such as India and China, are now abundant in technical and scientific labour (UNCTAD 2005). In addition, some host country researchers, engineers and managers, which have studied and/or lived abroad, return to their countries with new capital and knowledge (UNCTAD 2005) further increasing this pool of labour. These countries can therefore often offer the MNCs a qualified, low-cost manpower alternative. Several case studies that deal with location of innovative activities to low-cost locations indicate that these location decisions are indeed made principally because of the abundant and low-cost manpower in these nations. (Ernst 2001, Reddy 2000). In conclusion, the human capital gap that earlier largely limited R&D activity to OECD countries, is now decreasing.

## **2.2 Challenges to the internationalization of R&D**

The obstacles to internationalizing R&D can be divided into two main categories: those that are internal to the firm's activities, or organizational, and those external factors that are related to institutional discrepancies between different locations (EIU 2005).

### **2.2.1 Internal/Organizational challenges**

As discussed above, R&D has long been considered an activity with a propensity for geographical concentration due to economies of scale, and to high dispersion costs associated with the need for coordination and control etc. It is mainly factors internal to the firm that has been considered in previous literature. Key concerns in this category are the risks of inefficiencies associated with lack of coordination such as overlapping, duplication, lack of alignment with business strategy etc. (Chiesa, 2000, Gassman and von Zedtwitz 1999).

During recent years, the costs associated with physical dispersion have decreased due to progress in communications technology (more about this in section 4.1) and recent research has therefore focused increasingly on organizational costs, related to cultural distances such as language barriers etc.

### **2.2.2 Institutional quality and intellectual property rights protection**

Research and development could be described as the generation of intellectual property (IP). When assessing the rate of return to an investment in production of IP it is naturally imperative for the firm to design the activity in a manner that facilitates the protection of this output. Concerns over intellectual property rights (IPR) have long been considered to point in favour of concentrated corporate R&D, as the control of the output was thought to be weakened by both increased distance from headquarters to R&D, and by differences in the institutional setting that regulates intellectual property (Lall 1998, UNCTAD, 2005).

More specifically, IPR concerns are stronger when it comes to the location of R&D activity to countries with an institutional climate that varies substantially to that of the home market. One study of FDI's of American firms showed that a vast majority considered the issue a top priority when considering investments in foreign R&D activities, and that perceived improvements in the regulation increased flows of FDI related to R&D (Mansfield 1994).

As R&D activity in developing countries has increased during recent years, and is projected to increase further, avoiding costs related to unsuccessful IP protection presents a vital challenge to the investing MNC's. IPR concerns were also at the top of the respondents listing of concerns in the EIU survey.

### **3. Research and development**

#### **3.1 Corporate R&D**

Innovation is defined as the introduction of new products or processes to the market. OECD guidelines define corporate R&D as corporate activities carried out in order to discover or develop new products or production processes as well as improving existing versions of products and processes (OECD 2002).

R&D includes three generic activities: *basic research*, *applied research and development*. The objective of basic research is to advance scientific knowledge without specific immediate objectives. Applied research aims at advancing scientific knowledge with specific commercial objectives, and development aims at improving existing products and processes. However, in reality it can be difficult to make the distinction between the different activities.

#### **3.2 Global corporate R&D**

Between 1996 and 2002, global R&D spending increased from 576 billion dollars to 677 billion dollars, corresponding to an annual growth rate of 2.8 percent. Considering the geographic concentration of R&D, the growth can be partly explained by increased expenditures by the largest spenders. The ten largest spenders, accounting for more than 86 percent of the total global R&D in 1996 and 2002, consists of nine OECD countries, with the US as the main spender, and China. The R&D expenditures in developing and transition countries in South-East Europe and the CIS<sup>5</sup> are increasing, but from a very low level. Their share of the world total has risen from 2.5 percent in 1991, to 7.7 percent in 1996, to 8.4 percent in 2002. The lion's share of this growth can be accrued to South, East and South-East Asia, whereas the share of most other sub-regions declined during the period.<sup>6</sup>

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<sup>5</sup> Commonwealth of Independent States: Azerbaijan, Armenia, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan, Turkmenistan, Uzbekistan and Ukraine.

<sup>6</sup> This section is based on UNCTAD 2005.

In most countries with significant R&D activity, private enterprises dominate R&D expenditure. The industry share of total R&D has increased steadily over the last twenty years and accounted for 67 percent of total R&D in OECD countries in 2003 (UNCTAD 2005). The remaining one-third of total R&D is performed by governments, educational institutions and non-profit organizations. In a couple of countries, including Sweden, Korea and Japan, the industry share of R&D is significantly higher at around 75 percent (Karlsson 2006).

R&D is not only geographically concentrated, but also concentrated to a relatively limited number of large companies and to a few industry sectors. About one third of world R&D expenditure in 2004 was accounted for by the top 20 R&D-spending companies. This group includes companies such as IBM, Matsushita Electric, Siemens, Ford Motor, DaimlerChrysler, Nokia, Sanofi-Aventis, Pfizer, Intel and Microsoft (Karlsson 2006). Sector-wise, pharmaceuticals, electronics and electrical equipment, and motor vehicles and parts, are responsible for about half of the total corporate R&D investments (Karlsson 2006).

### **3.2.1 Internationalization of global corporate R&D**

Although corporate R&D remains among the least internationalized functions of the MNC, there is evidence that the internationalization is picking up speed. According to von Zedtwitz and Gassman (2002) and UNCTAD (2005), the R&D spending abroad started to increase in the 1980s and accelerated in the 1990s. A study conducted by Kuemmerle (1999) shows that the share of R&D conducted abroad by 32 multinational companies (originating in the US, Japan, Germany, France and the Netherlands) increased from 6.2 percent in 1965 to almost 26 percent in 1995.

Until quite recently, R&D internationalization was performed almost exclusively with developed countries as both home and host countries. If R&D was performed in a developing country, adaptation to local markets was the most common objective. However, these patterns have started to change. UNCTAD (2005) gives an account of the current trends. First, due to offshoring, R&D internationalization is increasing in all key home countries. Second, a number of developing countries currently account for the fastest growth of R&D activity. Third, the motives for internationalization are changing from sole adaptation objectives to more complex processes (see section 5). Fourth, R&D in developing countries has started to evolve from mere



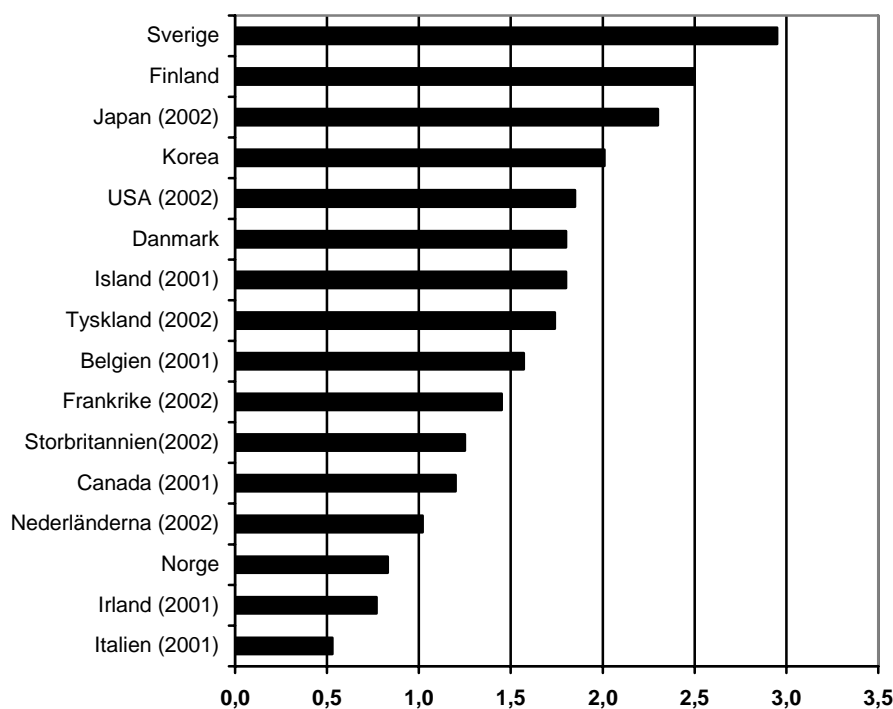
product adaptation to far more complex and knowledge-intensive R&D stages, and fifth, developing countries today are establishing R&D activities abroad.

These changes have been made possible by a number of factors described in Karlsson (2006). First, the development of new information and communication technology has reduced costs of internationalization and facilitated communication across geographical space. Related to these new technologies is digitization and standardized tools that enable R&D activities to be performed in different locations yet easily integrated. Third, the whole production process is becoming more fragmented meaning that different business activities can be performed in different locations. Fourth, the number of possible R&D locations has increased significantly as more countries actively build scientific capabilities, such as training of R&D manpower and development of technological infrastructure. Finally, a general increase in cross-border science and technology activities, such as multinational R&D projects and increasing mobility of R&D manpower, further enable the internationalization of corporate R&D.

### **3.3 Swedish corporate R&D**

During the last decade, Sweden has ranked number one among the OECD countries regarding commitment to R&D when measured as R&D expenditure in relation to GDP (see figure 1). Sweden has the eight highest R&D expenditure in absolute terms, based on a 2002 R&D expenditure of 7.3 billion dollars (Löf 2006).

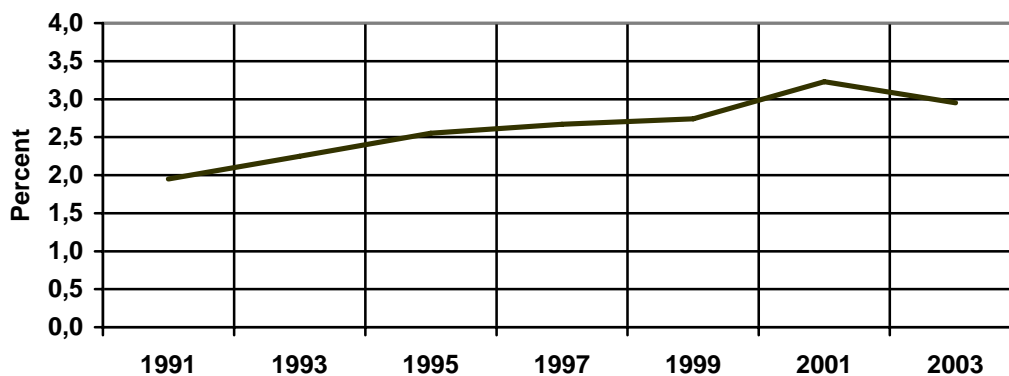
Figure 2. Corporate R&D expenditure in relation to GDP 2003



Source: OECD and Statistics Norway via SCB 2005

Sweden retains this position although R&D expenditure as a percent of GDP decreased from 3.3 in 2001 to 3.0 in 2003. The 2001 level of R&D expenditure as percent of GDP still exceeds the 1999 level of 2.74, as seen in the chart below.

Figure 3. Swedish corporate R&D expenditure as percent of GDP, 1991 - 2003

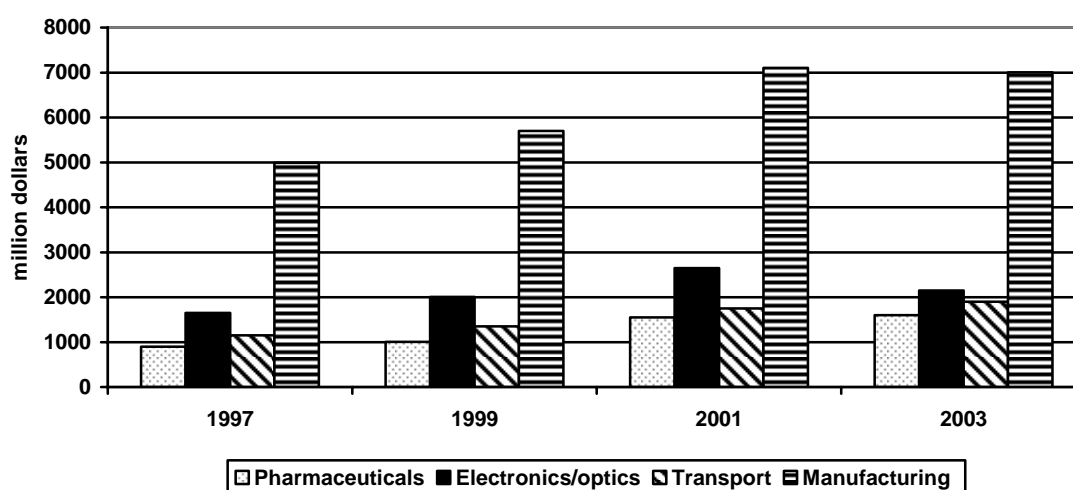


Source: SCB 2005

Between 2001 and 2003 Swedish R&D expenditures decreased with eight percent in real terms (SCB 2005). This decrease can be explained partly by the fact that several Swedish-owned companies were acquired by foreign companies during those years, meaning that a significant amount of R&D expenditures was transformed into foreign R&D expenditures, thus reducing Sweden's corporate R&D figures. Also, the use of consultants in R&D activities rose significantly during the period 1999 to 2001 and later decreased significantly in 2001 to 2003, affecting the R&D expenditure peak seen in the chart above.

The high investment ratio in Sweden can largely be explained by the existence of a few, very large multinational companies. Sweden has long had a remarkable concentration of relatively R&D-intensive MNCs. In 2003, the six largest Swedish companies accounted for 37 percent of R&D expenditures and twenty large Swedish companies accounted for 47.4 billion SEK out of a total corporate R&D expenditure of 72 billion SEK (ITPS 2005). As in global R&D, the concentration is high not only among companies but also among sectors. About 70 percent of the total corporate R&D in 2003 was spent in three industry sectors: electronics/optics (25 percent of total corporate R&D), transport (22 percent) and pharmaceuticals (18 percent) (SCB 2005). All three sectors have increased their R&D investments between 1997 and 2003. However, the electronics sector was faced with a crisis in 2001, which forced companies to reduce all costs. R&D costs in the sector were thus reduced by about 15 percent. This reduction is also one explanation for the sharp decline in R&D expenditures as percent of GDP between 2001 and 2003 (figure 2) (Löf 2006). If the electronics/optics sector is excluded from this chart, the expenditures are almost unchanged since 2001 (SCB 2005).

Figure 4. Swedish R&D expenditure in the manufacturing sector, 1997-2003 (in real terms)



Source: SCB 2005 and ITPS 2006

Regarding different R&D activities, companies in Sweden follow the global trend of spending less on basic and applied research and more on development. In 1997 and 1999, 17 percent of R&D expenditures were spent on research, a number that had decreased to 13 percent in 2001. In 2003, 12 percent was spent on research and the remaining 88 percent on development (SCB 2005). Although the number of R&D full-time equivalents decreased by 3 percent from 2001 to 2003 the number of PhD full-time equivalents increased by 9 percent. This follows a trend that has been observed over the last couple of years – the share of university graduates in R&D is increasing (SCB 2005).

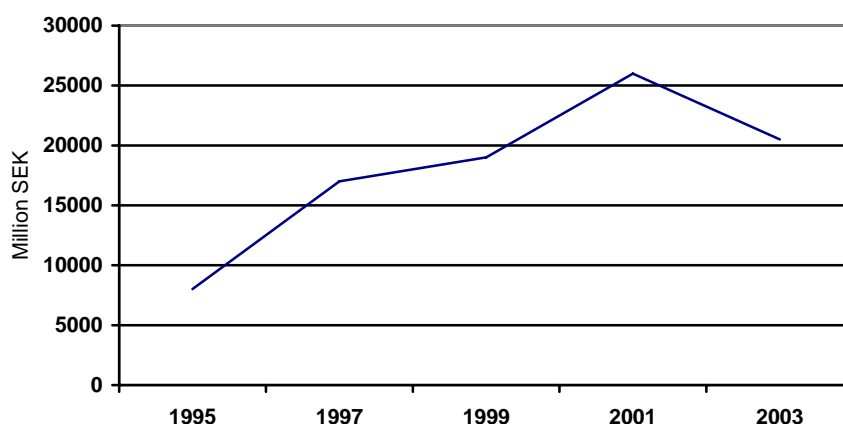
### 3.3.1 Internationalization of Swedish corporate R&D

In 2003, the twenty largest Swedish-owned multinational companies spent about 20 billion SEK on R&D abroad. About 10.7 billion SEK were spent in the EU-15 and about 5.4 billion SEK in the US. As shown in Figure 4 below this is a significant increase since 1995. This increase in R&D performed abroad between 1995 and 2003 represents an increase from 20 percent to 40 percent of their total R&D expenditure (Löf 2006). Regarding R&D in developing countries, the R&D share of the 20 companies increased from 2.7 percent in 1995 to 7.2 percent in 2003 (Karlsson 2006).

In 2003, a group of eight highly internationalized firms among 20 of the largest Swedish companies performed close to 75 percent of their R&D activities abroad, a slight decrease from the 80 percent in 2001. However, these companies are not the ones that spend the most on R&D in absolute terms, constituting 11 percent of the total R&D expenditures in 2003 (9 percent in

2001). The companies with the highest absolute R&D spending performed on average 39 percent of their R&D activities abroad in 2003 as well as in 2001 (ITPS 2005). The firms that have the largest R&D budgets seem to have a stronger relative home country bias than the smaller firms.

**Figure 5. R&D expenditure by Swedish multinationals abroad (in real terms)**



*Source: ITPS 2005*

According to a survey completed by ITPS (2005), 55 percent of the large Swedish multinational companies locate R&D abroad due to organic growth, that is, growth achieved by *internal* investments of the firm. 32 percent of the offshoring is connected to the acquisition of foreign companies and only 13 percent is related to greenfield investments in R&D activities. As for R&D personnel in the 20 largest Swedish companies, in 2003 60 percent were employed in Sweden and over 30 percent in other high-income OECD countries. The number of R&D personnel employed in non-OECD countries remains low at only about 3 percent (Löf 2006).

Research results on industrialized country patterns of internationalization of R&D might differ along country borders. Several studies indicate that firms from smaller countries such as Sweden, Belgium and Canada conduct a larger share of their R&D abroad compared to companies from larger developed countries (Niosi 1999, Edler et al. 2002). This observation seems to be supported by recent developments of Swedish R&D (UNCTAD 2005).

## 4. Earlier studies

There are a large number of studies concentrating on the motives for internationalization of R&D. Most empirical studies based on company surveys are focused on a specific country other than Sweden, a specific industry, a specific internationalization motive or a specific host country. Only a few studies are based on qualitative research of the kind that we conduct. Two relatively

recent studies that are quite similar to our study in aim are Edler (2002) and the Economist Intelligence Unit (2004). Edler conducted a survey in which 209 companies in North America, Western Europe and Japan, with R&D expenditures of \$100 million or more, answered questions on their strategic technology management. Among other things, the respondents were to evaluate nine different motives for internationalizing R&D. The main finding was that no particular motive was dominant across all firms, but some differences between firms originating in the three different regions were found. In the complete sample, most emphasis was put on market-oriented motives, followed by access to foreign skilled manpower and industrial technology. Inappropriate R&D environment in the home country was considered the least important. For European companies alone, the most important motives were “to take advantage of technology developed by foreign companies, to learn from lead markets/customers and to adapt products to local needs”.

The EIU survey pointed to the search for global expertise and the need for market adaptation as the main drivers of internationalization, followed by cost-reductions. The foremost challenge when conducting R&D internationalization was, according to the respondents, to successfully manage differences in IPR regimes, followed by the need to overview and coordinate the corporate R&D carried out in different locations.

Among other recent studies is a study by Ambos (2005) on R&D investments of German multinationals, in which it is concluded that German MNCs gradually internationalize R&D more for resource motives than for market motives. Roberts (2001) conducted a study on strategic technology management applied by companies in Western Europe, North America and Japan, and the top motives were adaptation and learning from foreign lead markets or customers, followed by technology sourcing and skilled manpower access.

To our knowledge, there is only one recent study that focuses on motives for internationalization of R&D in Swedish companies. That is a report published by The Swedish Institute for Growth Policy Studies (2005) on R&D in international companies in 2003. In a survey, 38 large Swedish companies stated the most important motives for moving their R&D activities abroad. The most common motives were the adaptation of products or processes to specific customer/market-demands and that production units require their own R&D capacity. Our study can provide new insights into this subject by analysing different motives in more detail, which facilitates a more

nuanced analysis of the topic. More importantly however, our study looks at the problems involved in internationalization of R&D, a topic not investigated at all in the ITPS study.

Lastly, the comprehensive UNCTAD “World Investment Report” (UNCTAD 2005) pays significant attention to the increase in R&D in low cost locations, and points to the search for cheap and cost-efficient human capital as a rising driver of R&D internationalization.

## **5. The survey**

This study is based on a questionnaire<sup>7</sup> that was sent to managers in leading positions in R&D departments of 25 large Swedish and formerly Swedish companies. This section describes the method used during the course of the study.

### **5.1 The company sample**

The main aim when selecting firms for the sample was to capture the main part of Swedish R&D activity while at the same time keeping the number of firms included to a limited number. A list compiled by the Swedish Institute for Growth Policy Studies (ITPS 2005) was used as basis for our sample. This list includes two groups of companies: (i) the twenty largest companies in Sweden, with regard to the number of employees in foreign countries, on the condition that they perform research, and (ii) eight large foreign-owned companies<sup>8</sup> that have formerly been Swedish and included in group (i). We found no reason to systematically discriminate between the two groups in our study since our focus is on general motives and problems associated with internationalization, and the legal status of the company in question makes no significant difference. Although the domicile of the companies might have consequences for the motives behind decisions to perform R&D activities in Sweden this is of no significant importance for motives behind internationalization. A number of firms were however removed as they had merged into larger foreign entities, making it impossible to compare their locational choices over time, which was one of the aims of this paper. Lastly, two independent Swedish companies were added, also on the basis of their significant R&D expenditures (Ny Teknik 2005).

All of the companies in the sample are manufacturing companies, and several fall into the R&D intensive sectors telecom, pharmaceuticals and transport. Due to the risk of identifying individual companies, more detailed information on the product areas cannot be provided. The 25

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<sup>7</sup> See appendix 1

<sup>8</sup> Companies controlled by one or several foreign owners by the possession of at least fifty percent of the share voting rights

companies in the final sample accounted for approximately 80 percent of Swedish corporate R&D expenditures in 2004.

## **5.2 The questionnaire**

The questionnaire was developed in collaboration with the Centre for Business and Policy Studies (SNS) in Stockholm and with an Economist Intelligence Unit (EIU) questionnaire as benchmark (2005). The EIU questionnaire had a broader focus than our study but the sections dealing with motives for, and problems with, internationalization of R&D were well suited for our purpose and thus chosen to serve as a basis. When the first responses had been collected, it was clear that question number five (see Appendix 1), which dealt with the specific location and scope of the companies' international R&D in 1997 and 2004 respectively, posed a problem for the respondents. Several companies claimed that such information is confidential and others could simply not access the information needed due to fragmented corporate structures. As explained in the introduction, the question was in the end excluded from the questionnaire. This eliminated the possibility to account for the recent changes in location and scope of Swedish companies' international R&D, and to map the location on a country by country basis.

To keep the identity of the individual companies confidential, the questionnaires were coded and the register of codes available only to the authors and the thesis tutor. The information provided by the companies has been treated as confidential and the results have been presented in the form of aggregates and averages so that no individual company can be identified.

## **5.3 Procedure**

In order to get the questionnaires filled out by respondents with adequate knowledge about the companies' R&D activities it was imperative to identify R&D managers at the top of the company hierarchy. The R&D representatives were contacted by phone, informed of the purpose of the study and asked to contribute by submitting a completed questionnaire. If they accepted, the questionnaire was sent either by email or by regular mail. If it was evident that the company would not, or could not, participate in the study, the questionnaire was not sent at all.

## **5.4 Response rate**

Out of the 25 companies contacted, 13 declined to take part in the study. 12 companies participated, implying a response rate of 48 percent. According to both the responses from these



12 companies, and to a listing presented in *Ny Teknik* (Alpman 2005), these firms spent approximately SEK 70 billion on R&D in 2004. This implies that the combined R&D spending of the respondents constitute a clear majority of total Swedish R&D spending. It has however not been possible to calculate the exact percentage that these companies' R&D expenditures make up of total Swedish corporate R&D, due to the difficulty to access accurate and comparable data on the companies' total R&D expenditures in 2004.<sup>9</sup>

Several previous studies have shown that many companies tend to be reluctant to disclose information on R&D activities, as they consider it to be strategically sensitive. This is illustrated by the response rate of 22% obtained by UNCTAD (2005), when asking 319 MNCs to answer a survey regarding their R&D internationalization. Although the scope and size of our study cannot be compared to UNCTAD's, the sought after information is of a similar nature. Even though our response rate is relatively low, the relative size of the R&D expenditure of the responding firms does capture a considerable share of corporate R&D in Swedish-owned MNCs and MNC's that until recently were Swedish owned.

## **6. Results**

### **6.1 Motives for internationalization**

The results from the questionnaire, regarding motives for internationalization of R&D, support the report from ITPS (2004), with adaptation of products to local markets (3.5 average) and the necessity for production units to have their own R&D (3.4 average) being stated as the most important motives on the 1-5 scale. This also reaffirms the relatively large explanatory weight that traditional adaptation- and production-related theory still carries within the field of R&D internationalization. According to previous adaptation literature, summarized by Fors (1996), the growth of a countries consumer market leads to increased adaptive R&D activity in that country. This seems to be consistent with the growth of R&D in India and China, and with the high importance attributed to adaptation motives by the respondents.

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<sup>9</sup> As noted by ITPS (ITPS 2003, ITPS 2005) it is difficult to make relevant comparisons over time as the population of firms vary due to international mergers and acquisitions. As our sample includes a number of firms that until recently were Swedish-owned, but today have a foreign majority ownership (measured in voting rights, ITPS 2005), the SEK 70 billion figure includes R&D spending conducted abroad by firms that no longer are Swedish owned. It is hence hard to estimate the SEK 70 billion spent by our respondents to the total Swedish spending on corporate R&D, which only includes spending by companies with Swedish majority ownership. The latter figure amounted to SEK 72 billion in 2003 and SEK 77 billion in 2005 (ITPS 2005, ITPS 2006). These figures, still indicate that our respondents capture a very important share of R&D spending with ties to Sweden.

With averages of 3.0 for the access to skilled R&D personnel and 2.8 for the lower cost of R&D personnel abroad, human capital motives is the second most important driver for internationalization. This supports the notion that manpower issues and manpower costs are gradually becoming more important as parameters in the location decision regarding R&D units. Notably, the three responding firms with the largest R&D budgets, all responded that access to skilled R&D personnel was the most important motivator, giving it a 5.

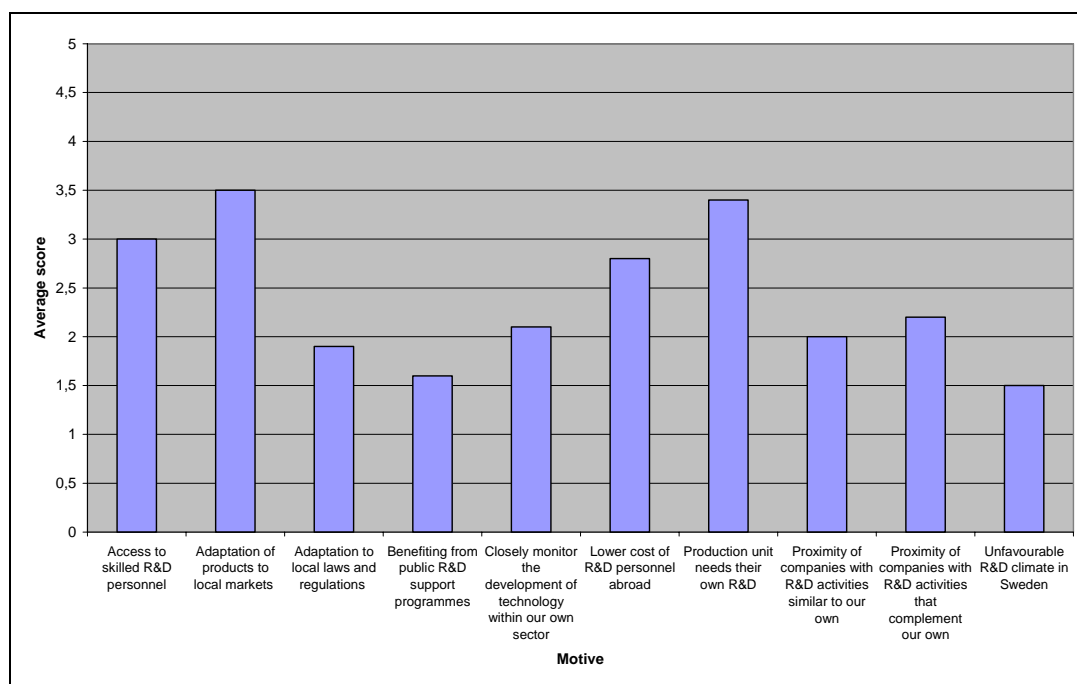
Scoring rather low, the motives related to proximity to other R&D companies is rated as the third most important group of motives. ‘The proximity of companies with R&D activities similar to our own’ got an average of 2.0, ‘closely monitor the development of technology within our own sector’ a 2.1, and ‘the proximity of companies with R&D activities that complement our own’ a 2.2. The relatively low scores of these three spillover related motives possibly reflects the uncertainty that still prevails regarding the mechanisms underlying knowledge spillovers and clusters. With an average of 1.9, the adaptation to laws and regulations (such as technical standards) in the host country, seem to bear importance to a degree similar to the technology sourcing motives.

Least important, with averages of 1.5 and 1.6 respectively, is ‘benefiting from public R&D support programmes’, and ‘unfavourable R&D climate in Sweden’. Given that the Swedish R&D milieu generally is considered quite favourable, and that there, according to economic theory, is no conclusive or precise way of leading a country through a successful R&D internationalization process in order to strengthen national competitiveness and ensure long-term economic growth, these low scores are not particularly remarkable.

In short, the motives for internationalization of R&D, according to our study, are ranked as follows by a population of large Swedish MNC’s:

1. Adaptation of products to local markets and retaining R&D activities close to production units.
2. Access and cost of skilled R&D manpower.
3. Technology sourcing, or spillover effects.
4. R&D climate in home and host countries

Figure 6. Motives for internationalization, average scores

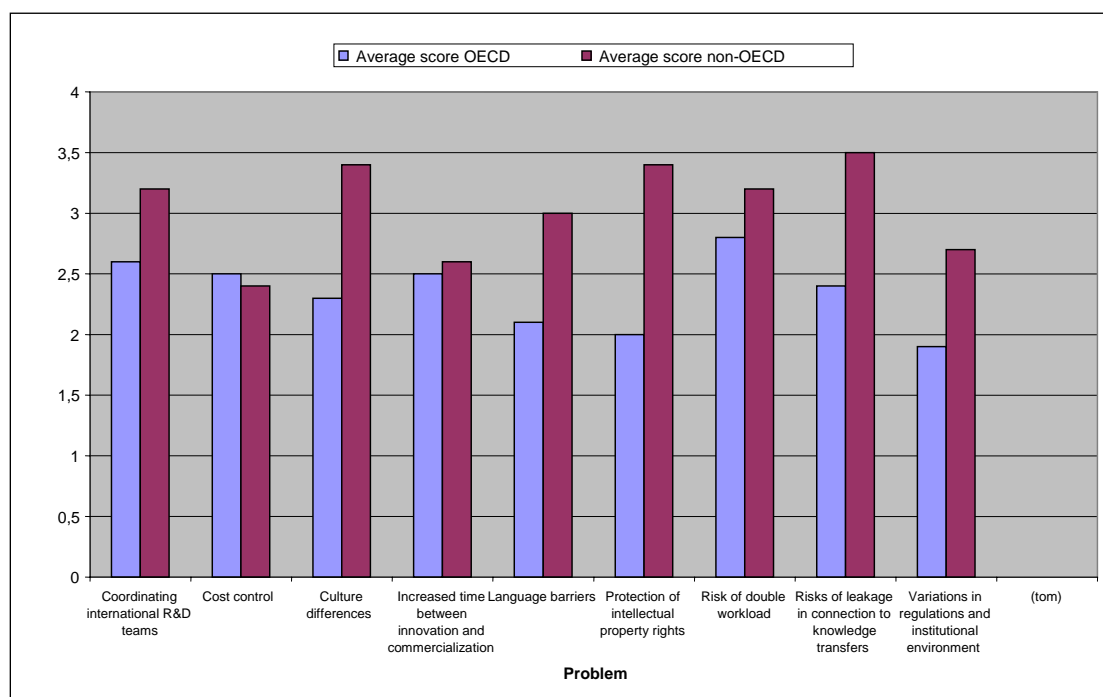


## 6.2 Problems associated with internationalization

The results from the questionnaire regarding problems with internationalization show that there is a significant difference between the companies' views of problems in OECD countries and the views of problems in non-OECD countries. All problems but one, namely cost control, were stated to be greater in non-OECD countries than in OECD countries.

The average estimated importance of the problems in OECD countries is not widely spread. They are all given an average importance of 1.9-2.8 and no specific problem seems to be widely acknowledged as particularly significant. A ranking of the different problems would not provide any meaningful information given that the intervals are insignificant.

**Figure 7. Problems with internationalization, average scores, OECD and non-OECD**



The spreads between the rating of different motives is not very large for the non-OECD countries either, but they are however, considered more significant, averaging at 2.4-3.5. As mentioned before, cost control was regarded less of a problem in non-OECD countries, with an average of only 2.4 (2.5 in OECD countries). This might however be the result of the *relatively* low importance of cost control in non-OECD countries, when compared to other obstacles, rather than of its insignificance in absolute terms. Five problems received an average of between 3.2 and 3.5, meaning that they are considered more problematic than not, given that 3 is the neutral rating. These were ‘protection of intellectual property rights’, ‘coordinating international R&D teams’, ‘risk of double workload’, ‘culture differences - ways of communicating and organizing work’, and ‘risks of leakage in connection to knowledge transfers between countries’, all related to the internal and external problems identified in the literature on R&D internationalization.

As mentioned previously, cost control is regarded to be a larger problem in OECD countries than in non-OECD countries. ‘Increased time between innovation and commercialization’ also displays a very small difference between the two groups, at only 0.1. The largest differences between the two groups are found in factors regarding knowledge management and culture-related aspects. ‘Protection of intellectual property rights’ and ‘risks of leakage in connection to knowledge transfers between countries’ display a difference of 1.3 and 1.1 respectively, while

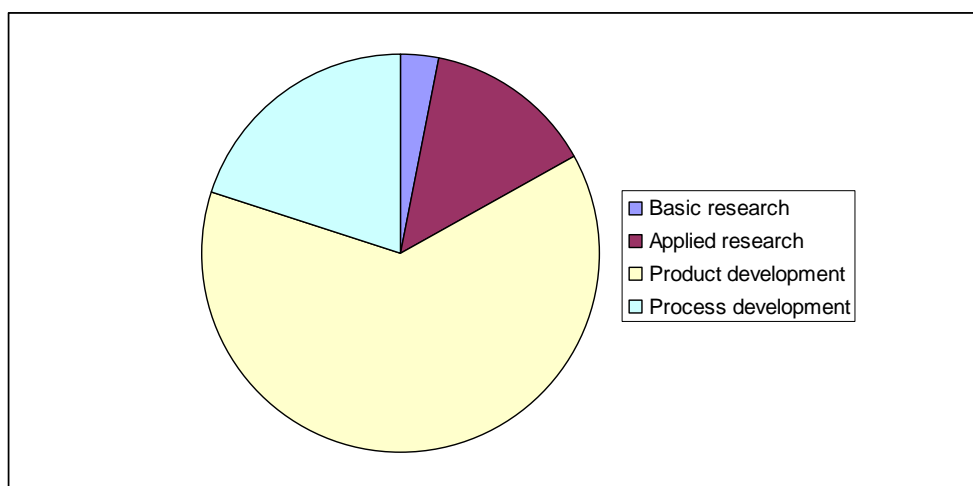
‘culture differences – ways of communicating and organizing work’ and ‘language barriers’ display a difference of 1,2 and 1,0 respectively. It should also be mentioned that three problems were given a five, that is, regarded to be of great importance, in non-OECD countries, while only one was given a five in OECD countries. The three non-OECD problems are, ‘variations in regulations and institutional environment in different countries’, ‘coordinating international R&D teams’, and ‘risks of double workload’ with the last one concerning also OECD countries.

This means that 4.9 percent of the replies regarding non-OECD countries were given a five, while the same applies to only 1.2 percent of the replies regarding OECD countries. Also notable is that the grade four, ‘large importance’, received 33,3 percent of the total replies in the non-OECD group, but only 6.2 percent in the OECD group, a rather significant difference and an implication of the relative weight that these problems carry in non-OECD countries as opposed to in OECD countries.

### **6.3 Categories of R&D activities**

The results in this category are largely consisting of approximations, as several of the responding firms no longer divide their R&D activities strictly along the lines of these categories. The results affirm earlier findings (EIU 2005) that indicate that the growth in investments in development significantly surpass the increase in investments in research, with product development in an unambiguous top position. The responding companies spend, on average, 65 percent of their total R&D budgets on product development and 20 percent on process development. On the research side, applied research accounts for around 15 percent of the R&D budgets, while basic research is only undertaken by 5 companies in the sample, and accounts for only 3.5 percent of the expenditures in this group.

Figure 8. Categories of R&D activities



## 6.4 Headquarter proximity

The results show that keeping R&D activities close to headquarters is generally regarded as unimportant. All four categories of R&D received averages of under 2.0, meaning that the companies attach little, or no, significance to this matter. One company attached greater significance to the matter regarding all types of R&D, which raised the average of all categories. Hence, if one leaves this company out, the scores would be even lower, implying that most companies do not perceive proximity to headquarter to be an important consideration when it comes to situating R&D activities. Several added that they consider a strategic alignment of production and R&D to be far more important than the proximity to the headquarter.

## 7. Discussion

Our results largely confirm previous studies of R&D internationalization in Swedish companies.

Product adaptation and proximity to production units persist as the most important driving forces according to the respondents. The second most important set of factors is the access to manpower. This international search for human capital is not a novel feature, but the increased focus on cost seems to be rising as an increasingly important location determinant as opposed to the intra-OECD relocations seen in previous decades.

Regarding the development of actual R&D location, we have to rely on previous studies (ITPS 2005, ITPS 2006, UNCTAD 2005) as the attempt to collect more detailed data on a country to country basis from Swedish MNCs proved unviable. Even though the exactness of comparisons between different points in time is hampered by changes in the MNC population due to a large

number of mergers and acquisitions involving Swedish MNCs during recent years, it seems safe to say that Swedish R&D activity is becoming increasingly internationalized, and that an increasing fraction is located in low cost locations. R&D internationalization has during recent years been driven by a number of forces such as cross-border ownership and decreased global costs of communication and information. In addition to these general forces, there is also a factor specific to a number of fast-growing emerging economies: namely a rapid increase in skilled labour at low cost (UNCTAD 2005).

One interesting, though not unexpected, feature in our results is the substantial and consistent gap between the difficulties that are perceived depending on whether the MNC chooses to locate R&D in a OECD or non-OECD country. The challenges that seem most accentuated when locating R&D to developing countries are IPR protection and cultural differences. This is in correspondence with earlier findings (EIU 2005 and others).

Our results, even if far from robust, support the picture that the R&D that is located to developing countries mainly is of the development, rather than research, variety. Since product and process development is increasing as a proportion of total R&D, and since the non-OECD share of the total world R&D still is quite limited, this does not significantly hamper the growth potential for R&D in low cost countries.

In the discussion on the effects of outsourcing and off-shoring on western economies, the focus has this far been the loss of jobs in the manufacturing sector. One important issue of policy relevance is whether migration of manufacturing activities is likely to be followed by a move of other more skill-intensive activities such as research and development. The respondents of our survey have rated proximity to production as the second most important factor driving the internationalization of R&D. This supports the concerns of R&D-migration, as Swedish MNCs are growing their production capacity abroad to a great extent.

It seems clear from ours and previous studies, that push-factors associated with adverse characteristics specific to Sweden are considered relatively unimportant by Swedish R&D managers. A number of the respondents stress that they believe that the Swedish proportion of their R&D within the OECD-countries will grow, and Swedish labor costs for R&D personnel are generally lower than in many important competitor countries (USA, Germany etc.) (Braunerhjelm 2001).

One important issue, addressed in section 1, is whether the increased localization of R&D to developing and transition countries is based on “new” internationalization motivators, and if this fundamentally alters the possibilities for a country such as Sweden to attract or retain R&D activity within its borders.

Alarmists are predicting an escalation of the locating of R&D to low cost countries, leading to a significant erosion of the knowledge base of western economies. But this far, there is no evidence that the localization of R&D to low-cost countries is of a fundamentally different nature, or driven by different factors, than earlier internationalization.

When assessing the nature of the shift of R&D activity in low-cost locations, a few points should be considered regarding the impact and the uniqueness of the phenomenon:

First of all, the increase of R&D in low-cost locations is remarkable when contrasted to the corresponding figures 10 years back, but less drastic measured in absolute terms. Even if the increase in the global share of R&D conducted in low-cost countries is notable, it still constitutes a quite modest portion of total spending. In 2002, only 8.4 percent of global R&D spending was allocated outside the OECD. The corresponding figure for the Swedish MNCs was just over seven percent (Karlsson 2006).

Secondly, the surge in R&D has generally coincided with a substantial increase in real wages and in the size of the consumer markets in the same countries. This implies that the wage differential between “cheap” and “expensive” is decreasing quite rapidly. Several studies indicate that the talent search when setting up R&D operations in China is getting increasingly difficult and forecasts continued wage increases of between 15-20 percent yearly (McKinsey Quarterly, 2005).

Thirdly, the increased R&D activity has coincided with a surge in both production and sales in the Chinese and Indian markets. A large portion of the R&D work conducted by MNCs in these countries, does seem to be motivated primarily by adaptation motives rather than lowered labor costs, and hence by the “old” explanatory models.



Given the short history of R&D in low-cost countries, and that an overwhelming share of world R&D still is conducted in OECD countries, there is insufficient evidence to assume that low-cost locations will have an absolute and enduring competitive advantage to countries such as Sweden, regarding the attraction of R&D investments. It is also, as some studies point out (ACM 2006, A.T. Kearney 2004) still too early to evaluate the success of many R&D investments in developing countries.

A study that succeeds where this paper failed, e.g. in mapping the global location of Swedish industrial R&D on a country by country basis, would contribute to the understanding of the drivers of internationalization to low-cost countries and to the possibility of projecting the rate and direction of future R&D investments by Swedish MNCs.

## 8. Summary and conclusion

The effects of globalization on the industrial landscape have been at the centre of the economic policy debate for some time now. Sweden's position as a R&D-intensive country has often been interpreted as a proof of the Swedish economy being knowledge-intensive and well-prepared for an international trend where low-skilled manufacturing jobs are to be replaced by knowledge-intensive activities<sup>10</sup>. However, there is some dispute as to how accurate this is, and also regarding what the drivers of the internationalization of R&D are.

The study is based on a questionnaire<sup>11</sup> that was sent to managers in leading positions in R&D departments in 25 large Swedish and formerly Swedish companies. Out of the 25 companies contacted, 13 chose to not take part of the study. Hence, 12 companies participated, which implies a response rate of 48 percent. But due to the fact that many of the largest R&D spenders choose to respond, the respondents capture a clear majority of Swedish R&D spending in 2004.

The results from the questionnaire, regarding motives for internationalization of R&D, support the report from ITPS (2004), with adaptation of products to local markets and the necessity for production units to have their own R&D being stated as the most important motives. This also implies that the extensive theory on adaptation as a main motive for internationalization is still highly viable and applicable to the current R&D internationalization trends. Access to skilled R&D personnel, and the lower cost of R&D personnel abroad, is the second most important motive for internationalization. This supports the notion that manpower issues are gradually becoming more important as parameters in the location decision regarding R&D units. In short, the motives for internationalization of R&D, according to our study, are ranked as follows:

1. Adaptation of products to local markets and retaining R&D activities close to production units.
2. Access and cost of skilled R&D manpower.
3. Technology sourcing or spillover effects.
4. R&D climate in home and host countries.

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<sup>10</sup> It has however been argued that the return on Swedish investments in research have been rather low. This phenomena – high investments but low capitalization is known as the Swedish paradox.

<sup>11</sup> See appendix 1

Regarding problems with internationalization the questionnaire results show that there is a significant difference between the companies' views of problems in OECD countries and the views of problems in non-OECD countries. All problems but one, namely cost control, was stated to be greater in non-OECD countries than in OECD countries. The average importance of the problems in OECD countries given in the questionnaire is not significantly widely spread. They are all given an average importance of 1.9-2.8 and no specific problem seems to be widely acknowledged as significant. The spread was not significantly large regarding the non-OECD countries either, but they were however, considered more significant in themselves, averaging at numbers higher than in OECD countries. The five problems that were regarded as most problematic in non-OECD countries were 'protection of intellectual property rights', 'coordinating international R&D teams', 'risk of double workload', 'culture differences - ways of communicating and organizing work', and 'risks of leakage in connection to knowledge transfers between countries'.

The results regarding R&D categories reaffirm earlier studies on which categories of R&D that are most prevalent today. Investments in development significantly surpass investments in research, with product development being the main category. Finally, regarding the importance of proximity to headquarters, the results show that keeping R&D activities close to headquarters is generally regarded as unimportant.

In short, our results, even if far from robust, show that Swedish R&D activity is becoming increasingly internationalized, that adaptation remains the main motive for internationalization of R&D activities and that low cost locations are becoming increasingly attractive, although IPR protection and cultural differences still pose a significant problem for locating these activities in non-OECD countries.

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## Appendix: The Questionnaire

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Företag: xx

### Enkät om internationaliseringen av svenska företags forskning och utveckling

Denna enkät behandlar svenska och före detta svenskägda företags lokalisering av forskning och utveckling (FoU). Enkätresultatet kommer att utgöra underlag för en magisteruppsats vid Handelshögskolan i Stockholm och eventuellt för fortsatt forskning vid Studieförbundet Näringsliv och Samhälle (SNS). Magisteruppsatsen avser studera sammansättningen av svenska företags FoU i utlandet samt vilka motiv och problem som är centrala vid internationalisering. Enkäten har skickats ut till 28 storföretag som 2003 stod för en avgörande del av näringslivets investeringar i forskning och utveckling.

Alla uppgifter som lämnas i enkäten kommer att behandlas konfidentiellt. Resultaten kommer att presenteras i form av aggregerade siffror och genomsnitt. Inga resultat kommer att presenteras på ett sådant sätt att identifikation av enskilda företag blir möjlig. Svarsformulären är kodade och endast uppsatsförfattarna har tillgång till kodförteckningen. Materialet ägs av uppsatsförfattarna samt handledare Karolina Ekholm, docent vid handelshögskolan i Stockholm och extern forskningsledare på SNS.

Kontakta oss gärna vid frågor! Vi är mycket tacksamma för er tid och medverkan. Enkätsvaren kan skickas per e-post eller i pappersexemplar till någon av adresserna nedan.

Klara Halkjaer

[19245@student.hhs.se](mailto:19245@student.hhs.se)

0708-80 72 00

Wargentinsgatan 3, 5 tr.

112 29 Stockholm

[18334@student.hhs.se](mailto:18334@student.hhs.se)

Frödingsv.6, 3tr

112 56 Stockholm

David Salsbäck

070-75 75 002

1. Vilken är din huvudsakliga funktion i koncernen (t.ex. VD, FoU-chef, etc.)?

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Vi kommer nu att ställa några frågor kring er koncerns verksamhet.

2. Hur stor var er omsättning 2004: \_\_\_\_\_miljoner SEK

3. Hur många anställda hade ni totalt i koncernen 2004: \_\_\_\_\_

4. Hur stora var er koncerns totala utgifter för FoU 1997 respektive 2004?

Ange i miljoner SEK

1997: \_\_\_\_\_ Varav i Sverige: \_\_\_\_\_

2004: \_\_\_\_\_ Varav i Sverige: \_\_\_\_\_

5. Var vänlig ange uppgifter om totalt antal anställda, FoU-utgifter samt FoU-årsverken<sup>12</sup> i era respektive verksamhetsländer<sup>13</sup>. I den mån ni har verksamhet i länder som inte återfinns i nedanstående lista, var vänlig ange dessa på de tomma raderna under respektive region. Om ni behöver mer utrymme, var vänlig skriv på separat blad som sedan bifogas enkäten.

Land/Region:	Antal anställda:	FoU-utgifter 1997:	FoU-utgifter 2004:	FoU-årsverken 1997:	FoU-årsverken 2004:
<b>Västeuropa:</b>					
Danmark					
Finland					
Frankrike					
Italien					
Nederländerna					
Norge					
Schweiz					
Spanien					
Storbritannien					
Tyskland					
<b>Öst- och Centraleuropa:</b>					
Estland					
Lettland					
Litauen					
Polen					
Ryssland					

<sup>12</sup> Med FoU-årsverken avses det arbete en heltidsanställd person inom FoU utför under ett år. En heltidsanställd person som ägnar halva sin tid åt FoU har gjort 0,5 FoU-årsverken.

<sup>13</sup> Om landspecifika uppgifter ej kan frambringas, vänligen ange uppgifter på regionsnivå (Västeuropa, Öst- och Centraleuropa, etc.).



Land/Region:	Totalt antal anställda:	FoU-utgifter 1997:	FoU-utgifter 2004:	FoU-årsverken 1997:	FoU-årsverken 2004:
<b><i>Nordamerika:</i></b>					
Kanada					
Mexiko					
USA					
<b><i>Latinamerika:</i></b>					
Argentina					
Brasilien					
Chile					
<b><i>Asien:</i></b>					
Indien					
Japan					
Kina					
Sydkorea					
<b><i>Oceanien:</i></b>					
Australien					
Nya Zeeland					
<b><i>Afrika:</i></b>					
Sydafrika					
<b><i>Övriga:</i></b>					

### Motiv för internationalisering av FoU

6. Hur viktiga är följande motiv för er koncerns beslut att lokalisera FoU-verksamhet utanför Sverige? (1= ingen betydelse alls, 5= mycket stor betydelse)

Motiv	
1. Anpassa produkt/process till specifika krav på den lokala marknaden	
2. Tillgång till kvalificerad FoU-personal	
3. Kostnad för FoU-personal är lägre än i Sverige.	
4. Produktionsenhet i landet kräver FoU i landet.	
5. Anpassa sig efter lagar och bestämmelser i landet (t.ex. tekniska standards).	
6. Ogynnsamt FoU-klimat i Sverige (andra faktorer än kostnader och tillgång till FoU-personal).	
7. Närvaro av företag med FoU-verksamhet som vår egen	
8. Närvaro av företag med FoU-verksamhet som kompletterar vår egen	
9. På nära håll bevaka teknologikutvecklingen inom vår verksamhet	
10. Dra nytta av offentliga FoU-stödprogram i landet.	
11. Annat:	

### Problem vid internationaliseringen av FoU

7. Hur allvarliga anser ni följande problemområden vara vid utlokalisering av FoU-verksamhet till OECD<sup>14</sup> - respektive icke-OECD-länder? (1= inget problem, 5= mycket stort problem)

Problem	OECD	Ej OECD
1. Skydd av immateriell egendom (IPR)		
2. Variation i regelverk och institutionell miljö mellan olika länder		
3. Språkbarriärer		
4. Koordinering av internationella FoU-team		
5. Ökade ledtider mellan innovation och kommersialisering		
6. Risk för dubbelarbete		
7. Kulturskillnader - Sättet att kommunicera och organisera arbetet skiljer sig åt mellan länder		
8. Risker för läckage i samband med kunskapsöverföring mellan länder		
9. Kostnadskontroll vid global FoU-verksamhet		
10. Annat:		

<sup>14</sup> Organization for Economic Co-operation and Development: Australien, Belgien, Danmark, Finland, Frankrike, Grekland, Island, Irland, Italien, Japan, Kanada, Luxemburg, Mexiko, Nederländerna, Nya Zeeland, Norge, Polen, Portugal, Slovakien, Spanien, Sverige, Schweiz, Storbritannien, Sydkorea, Tjeckien, Tyskland, Turkiet, Ungern, USA, Österrike.

Vi kommer nu att ställa några frågor som rör vilken typ av FoU-verksamhet som sker i er koncern och på vilka platser olika former av FoU utförs.

FoU delas ofta in i följande fyra nivåer:

- Grundforskning (grundforskning utan specificerade kommersiella mål)
- Tillämpad forskning (forskning med specifikt mål)
- Produktutveckling (förbättring och utveckling av existerande produkter)
- Processutveckling (nya eller förbättrade processer för framställning av produkter)

8. Ungefär hur skulle du uppskatta att er FoU-verksamhet i dagsläget fördelar sig med avseende på dessa områden?

Verksamhet	Procentandel av totala FoU-utgifter i företaget
Grundforskning	
Tillämpad forskning	
Produktutveckling	
Processutveckling	

9. Ungefär hur stor del av er koncerns nuvarande FoU-verksamhet i Sverige, övriga OECD-länder och icke OECD-länder tillhör respektive kategori? Ange svaren i procent.

Verksamhet	Sverige	övriga OECD-länder	icke-OECD länder
Grundforskning			
Tillämpad forskning			
Produktutveckling			
Processutveckling			

10. Hur betydelsefullt anser du att det är att er FoU-verksamhet ligger nära koncernens huvudkontor? (1= ingen betydelse, 5= mycket betydelsefullt)\_\_\_\_\_

11. Hur betydelsefullt anser du att det är att följande FoU-verksamhet ligger nära koncernens huvudkontor? (1= ingen betydelse, 5= mycket betydelsefullt)

Grundforskning	
Tillämpad forskning	
Produktutveckling	
Processutveckling	

Övriga kommentarer:

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