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# The Swedish Paradox – Unexploited Opportunities!

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**Abstract**

The Swedish Paradox - high R&D expenditures and low innovation output - is still in operation, although there are signs that it has been somewhat mitigated recently. Preliminary explanations for the paradox are presented, and proposals are made for how it can be seen as opportunities that may be exploited through public innovation policy. This is done by relating to ten important activities in innovation systems, such as R&D, formation of new product markets, incubation and so on. It is concluded that many of the policy measures should be combined. Several of the proposals are related to the fact that the Swedish national system of innovation is dominated by large firms, which do not seem to be particularly efficient in transforming R&D expenditures into innovation output. To make the results of R&D more useful for Swedish society, the other nine activities in the innovation system should be emphasized to a larger extent in innovation policy.

**Key words**: The Swedish Paradox, Innovation, Innovation system, Innovation policy

# The Swedish Paradox –

# Unexploited Opportunities!

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## 1. Introduction

According to the Swedish Paradox, there is considerable investment in research and development (R&D) and innovation in the Swedish national system of innovation (NSI). However, the outcome in terms of innovations is meager. The paradox was formulated in 1991 and has been much focused upon in analysis, innovation policy and debate since then.

Obviously, the paradox points to low productivity or efficiency of the system, i.e. large inputs, but a small output. Still, it can, evidently, also be seen as an opportunity (or a 'potential') that can be exploited; it is both a problem *and* an unexploited opportunity! How this opportunity can be exploited is the topic of this report. It addresses what more could be achieved with the Swedish NSI if we did effective things in efficient ways, i.e. the right things in the right way. It also presents arguments implying that there are very strong reasons to develop a holistic innovation policy for the creation of welfare, economic growth and employment in the Swedish national system of innovation.

This report was presented at a seminar in Almedalen, Visby, Sweden, July 6, 2010. The seminar was entitled "Den svenska paradoxen – oexploaterade möjligheter!" ('The Swedish Paradox – unexploited opportunities!') as part of a larger half-day theme entitled "Innovation-driven Growth". The seminar was organized by Innovationsbron AB, which also initiated the writing of this report.

## 2. The Swedish Paradox – Somewhat Mitigated?!

The notion of a 'Swedish paradox' has been central to innovation policy discussions in Sweden for a long time. When Maureen McKelvey and I first formulated the Swedish paradox, it was expressed as a relation between high research and development (R&D) expenditures in Sweden and a low share of high-tech (R&D intensive) products in manufacturing (and exports) as compared to the average of the OECD member countries. It was seen as a paradox of a high input and a low output as measured by these specific indicators (Edquist and McKelvey, 1998). [1]

[1] This publication of 1998 was written in 1994, was internally published in 1996 and was based on a publication from 1992, which, in its turn, was a translation of a chapter in the final study of the Swedish Productivity

Since then, the expression has been used widely, but often formulated as a general relation between inputs and outputs in a 'looser' sense – e.g. that the investments in R&D in Sweden are very large, but that the 'pay-off' (in terms, e.g., of growth and competitiveness) is not particularly impressive (e.g. Andersson et al., 2002, Chapter 2).[2]

In Bitard, Edquist, Hommen and Rickne (2008), the Swedish national system of innovation (NSI [3]) was systematically compared to the NSIs of other small industrialized countries in Europe.[4] In that study we also reformulated the paradox in more specific terms than previously discussed in the research and policy literature. Our overall conclusion was that the Swedish NSI was not as capable, when compared to some other small industrialized countries, of transforming the resources invested in R&D and innovation activities on the input side into product and process innovations on the output side. In other words, the Swedish NSI was not very innovative, and the productivity (or efficiency) of the Swedish NSI was, in this sense, simply not high. Hence the existence of the Swedish paradox was confirmed on the basis of different, broader, more detailed and more recent indicators. (Bitard et al 2008)

The data in Bitard et al (2008) was based on the Community Innovation Surveys covering the period 1994-96 (CIS 2) and the period 1998-2000 (CIS 3), which were available when that analysis was made. Since then two more CISs have been published: CIS 4 (2002-2004) and CIS 2006 (2004-2006). Yet another CIS will be published during 2010. At CIRCLE Jon Mikel Zaballa and I are currently analyzing these new data, and the result will be published in autumn 2010.

From this forthcoming study (Edquist and Zaballa 2010), we can hint that the Swedish NSI ranking has improved with regard to the output of innovations for two categories of innovations (new to the firm and new to the market product innovations). For the other categories of innovations there is no clear trend. Hence, the situation on the output side has improved somewhat, but on the input side the Swedish NSI still invests much more than the countries compared. The Swedish paradox is evidently still in operation, albeit somewhat mitigated.

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Delegation of 1991 (Edquist and McKelvey, 1991). Thus, the Swedish Paradox was formulated in 1991.

[2] Other authors that have contributed to the analysis of the Swedish Paradox are McKelvey et al (2009), Ejermo and Kander (2006), Jacobsson and Rickne (2004) and Brogren 2010.

[3] Key terms – such as " innovations", "innovation policy", "national system of innovation - NSI", "organizations", "institutions" etc - are explicitly defined in Appendix 1.

[4] We presented comparative data for six small countries (Denmark, Finland, Ireland, Netherlands, Norway and Sweden) in the statistical appendix of Edquist and Hommen 2008.

## 3. Ten Key Activities in Systems of Innovation[5]

The innovation systems approach has been diffused and enjoyed acceptance to a substantial degree among researchers and, in particular, policy-makers since its inception around 1990.[6]

Innovation processes occur over time and are influenced by many factors. Because of this complexity, firms almost never innovate in isolation, but interact with other organizations to gain, develop, and exchange various kinds of knowledge, information and other resources. These organizations might be other firms (suppliers, customers, competitors) but also universities, research institutes, investment banks and public agencies. Organizations are the players or actors. (Edquist 1997: 1-2) [7]

The behavior of firms is also shaped by institutions, such as laws, regulations, cultural norms, social rules and technical standards, which constitute constraints and/or incentives for innovation. Institutions are here not considered to be the same as organizations, contrary to what is often assumed. Institutions are the rules of the game, influencing the actions of organizations (e.g. the firms). It is important to make a clear distinction between organizations and institutions, e.g to be able to study the interaction between the two..

The interactions of various organizations (players) operating in different institutional contexts are important for processes of innovation. The organizations as well as the contextual factors (e.g., institutions) are all elements of systems for the creation and use of knowledge for economic purposes. Innovations emerge in such '*systems of innovations*' (SIs). (Edquist 1997: 2)

The traditional System of Innovation (SI) approaches, such as Lundvall (1992) and Nelson (1993), focused strongly upon the components within the systems, i.e. organizations and institutions. More recently, some authors have focused more on what happens in the systems. One way of addressing what happens in SIs is the following. On a general level, the main or 'overall' purpose of SIs is, of course, to pursue innovation processes; that is, to develop and diffuse innovations. From now on, what we call 'activities' in SIs are the determinants

[5] This summary section is based on Edquist 2009.
[6] This is indicated by the fact that the following are the numbers of Google hits on June 21, 2010: "system of innovation": 1 290 000; "systems of innovation": 528 000; "innovation system": 306 000 and "innovation systems: 332 000.
[7] See appendix 1 for definitions.

of the development and diffusion of innovations. In other words, the activities are those factors that influence innovation processes. Examples of activities are R&D as a means of the development of economically relevant knowledge that can provide a basis for innovations, or the financing of the commercialization of such knowledge, i.e., its transformation into innovations. For a list of ten important such activities, please see Box 1.

The ten activities listed in Box 1 are not ranked in order of importance, but is structured into four thematic categories:

I. The provision of knowledge inputs to the innovation process,
II. Demand-side activities,
III. The provision of constituents of SIs, and
IV. Support services for innovating firms (see Box 1).

Each of the ten activities may be considered to be a partial *determinant* of the development and diffusion of innovations.[8] The "activities approach", briefly presented above, has been used as a basis for a general definition of an SI, according to which a system of innovation includes 'all important economic, social, political, organizational, institutional and other factors that influence the development, diffusion and use of innovations' (Edquist, 1997: 14; Edquist 2005: 183; Edquist and Hommen 2008: 6; Edquist 2008: 7).[9]

*Interactive learning* among organizations in systems of innovation is absolutely crucial for innovations to emerge. Empirical studies have shown that a majority of all innovations are developed as interactive learning processes between firms and other organizations. The stress on these processes of interactive learning in the SI approach means that it also emphasizes feed-back processes. The SI approach also draws particular attention to the fact that innovation processes are influenced from the *demand side* much more than earlier approaches, including the so-called linear approach, which regards innovations as a linear causal chain from basic research to applied research and development work to the final result in the form of new products and processes.

[8] The ten activities listed in Box 1 constitute a hypothetical list of determinants – and the list will be subject to revision when our knowledge about determinants of innovations increases. For the time being, it serves as a reasonable approximation of the determinants of innovation processes.
[9] See also Appendix 1.

## Box 1: Key Activities in Systems of Innovation

**I. Provision of knowledge inputs to the innovation process**

1. Provision of R&D and, thus, creation of new knowledge, primarily in engineering, medicine and natural sciences.
2. Competence building, e.g. through individual learning (educating and training the labour force for innovation and R&D activities) and organisational learning.

**II. Demand-side activities**

3. Formation of new product markets.
4. Articulation of quality requirements emanating from the demand side with regard to new products.

**III. Provision of constituents for SIs**

5. Creating and changing organisations needed for developing new fields of innovation. Examples include enhancing entrepreneurship to create new firms and intrapreneurship to diversify existing firms; and creating new research organisations, policy agencies, etc.
6. Networking through markets and other mechanisms, including interactive learning among different organisations (potentially) involved in the innovation processes. This implies integrating new knowledge elements developed in different spheres of the SI and coming from outside with elements already available in the innovating firms.
7. Creating and changing institutions – e.g., patent laws, tax laws, environment and safety regulations, R&D investment routines, cultural norms, etc. – that influence innovating organisations and innovation processes by providing incentives for and removing obstacles to innovation.

**IV. Support services for innovating firms**

8. Incubation activities such as providing access to facilities and administrative support for innovating efforts.
9. Financing of innovation processes and other activities that may facilitate commercialisation of knowledge and its adoption.
10. Provision of consultancy services relevant for innovation processes, e.g., technology transfer, commercial information, and legal advice.

Source: Edquist (2005)

## 4. Explanations of the Swedish Paradox - and how to exploit it

The identification of a problem and its causes may be called a diagnosis. The problem, i.e. in this case the paradox, identified in section 2 is here considered to be an unexploited opportunity, which may be exploited by means of innovation policy. However, in order to be able to design a policy to exploit these opportunities we need to know the causes behind. Causal explanations of socioeconomic phenomena are extremely difficult to produce. At the same time the malfunctioning of a national system of innovation may be so severe - for economic growth, employment or sustainability – that policy intervention cannot be postponed until a 'perfect' causal explanation has been achieved. It might be important to act on the basis of a very preliminary knowledge basis. A preliminary analysis of causes is better than no analysis at all. In this section, I therefore present a very preliminary discussion of possible causes behind the Swedish Paradox. A lot of new data and analysis would be needed to make it less preliminary. (Edquist 2001)

Initially, I summarize the analysis presented in Bitard et al 2008. Thereafter follows a discussion of possible causes structured in terms of the ten activities presented in section 3. This discussion is integrated with proposals of how to exploit these opportunities for the benefit of welfare, growth and employment.

The studies that maintain the existence of a paradox have also formulated different hypotheses to explain it, summarized in Bitard et al 2008 as follows:

(1) One proposition is that the knowledge resulting from R&D remains in the R&D sphere - e.g. in universities or corporate research units - and hence is not transformed into innovations. In other words, there are obstacles to the transfer of knowledge from the R&D sphere to the commercial sphere and results of R&D are therefore not made useful to society.

(2) Another hypothesis is that the paradox can be explained by the sectoral allocation of R&D expenditures.

(3) A third is that the internationalization of production has proceeded further than that of R&D, so that R&D carried out in Sweden bears fruit, as innovations, elsewhere, sometimes in the subsidiaries of Swedish multinational enterprises. In other words, the results of R&D carried out in Sweden are exploited abroad (Edquist, 2002, Sections 4.6 and 4.3; Brogren 2010).

In Bitard et al (2008), we find support for all three hypotheses.[10] There are problems with regard to the transfer of knowledge from the sphere of R&D to the sphere of production. The sectoral allocation of R&D is problematic.[11] It is also clear that the internationalization of production of Swedish firms has proceeded further than the internationalization of R&D, and that multinational industrial groups find Sweden considerably more attractive for R&D activities than for production (See, for example, Marklund et al 2004: 32). (Edquist 2008: section 5)

The dominance of incumbent large manufacturing firms (MNEs) in the Swedish national system of Innovation is a common element in all these explanations.[12] We are therefore persuaded that the underlying problem concerns the apparent inability of these large firms to translate innovation inputs into outputs – at least not in a way that secures that the return on Sweden's R&D investment is captured domestically, rather than abroad.

Let me now discuss explanations of the Swedish Paradox - and the potential exploitation of them - in the 'language' of the ten activities, as presented in section 3. It must be strongly stressed that more data and analysis are needed with regard to most of the activities. Hence, what follows is partly speculative and must be verified, or falsified, in detailed empirically-based analyses. I am touching on a vast area, and in a very brief - and therefore necessarily shallow – manner, implying that I do not have the aspiration to provide the detailed basis for innovation policy. Nonetheless, a virtue of this mode of analysis may be its holistic perspective.

## Activity 1: Provision of R&D

It is well known that the total R&D expenditures in the Swedish NSI are high; twice the EU average (Jacobsson and Rickne 2004). About a fourth is spent by public organizations and three fourths are spent by firms. This spending is highly dominated by the largest firms.

[10] See Sections 4.1, 4.3, 4.4 and section 6 in Bitard et al (2008).
[11] Se the discussion under Activity 1
[12] Three fourths of the Swedish R&D expenditures emanate from firms and large firms dominate this spending – see under Activity 1below.

On the *public* side a large proportion is spent on 'blue-sky' curiosity-governed basic research and a relatively small part on needs-oriented research – as compared to similar countries (such as Finland). There are reasons to put this relation under increased 'surveillance' and perhaps adapt the balance, i.e., devote more public resources to 'mission-oriented' R&D, relatively close to demand and needs. One reason is that needs are much 'closer' to new products and processes than basic research. [13]

A very large share of the *private* spending on R&D is accounted for by the large firms, and it has been shown that R&D and innovation expenditures of SMEs have not been exceptionally high in Sweden. For example, in 1994 - 96 Swedish SMEs spent 2.7 per cent of their turnover on innovation, whereas their Danish counterparts spent 4.9 per cent, i.e., the Danish SMEs spent 81 per cent more. For large enterprises the Swedish figure was 8.0 per cent and the Danish 4.8 per cent. While in most countries SMEs spend less on R&D and innovation than large firms, Sweden had the largest difference in this respect. (Bitard et al 2008: section 3 and section 7.1; Appendix in Edquist and Hommen 2008).

The ranking with regard to innovation output of Swedish firms, compared to Denmark, Finland Ireland the Netherlands and Norway) is about the same for large enterprises and SMEs – i.e., very low. Hence, a similar innovation output can be achieved with a lower input in SMEs compared to large firms in Sweden. These results suggest that the main problem related to the Swedish paradox resides more with the large firms that dominate the Swedish NSI than with the small and medium-sized ones. This is, however, related to the fact that the large Swedish firms have been the primary agents of globalization through outward FDI. As a result, much of the return on R&D and innovation expenditures investment is captured abroad, rather than domestically (Bitard et al 2008: section 6).

With respect to the (problematic) sectoral allocation of R&D, public policy-makers have generally ignored the lock-in of a large part of R&D expenditures and R&D results to large firms in traditional sectors. Public agencies have even financed R&D related to traditional sectors to a large extent, such as research in relation to forest-based industries in the 1990s. This focus has partly been balanced by the recent allocation of public R&D resources to "strategic" areas of research by the government.[14] There are reasons to stimulate the development

[13] See also discussion under Activities 3 and 4: the demand side and Brogren 2010.
[14] If this policy continues, the definition and operationalization of "strategic" becomes very important.

of new knowledge-intensive industries, by encouraging large firms to diversify into them, by assisting the birth and growth of new innovation-based firms in new sectors and by attracting foreign firms in advanced sectors of production.[15]

One infrastructural mode of doing so would be to focus the public R&D expenditures on new areas or areas that are characterized by discontinuities with regard to innovations (where uncertainty and risk are large and where firms can be expected to contribute least). This would be a way to use public R&D resources to support the development of radically new product areas or new sectoral systems of innovation. Thus, the R&D policy can contribute to diversification of the production structure. This would decrease the vulnerability of firms and regions that have a one-sided structure of production. It would contribute to getting away from negative lock-in situations that are characteristic of development trajectories with low growth and low employment. (Edquist, 2002, pp. 53-54).

However, public policy cannot influence strategies of large firms to any great extent. Hence, it is out of the reach of public innovation policy to reallocate private spending of R&D resources from large firms to SMEs. What can be done is to stimulate the R&D spending of SMEs, since a similar innovation output may then be achieved with a lower input.[16] Another possibility would be to try to increase the 'innovation result' of the spending of the large firms in some way.[17]

The innovation policies referred to here should include elements of 'attraction policies'. These are a matter of how MNEs - foreign-owned and Swedish - may be influenced to locate high productivity activities (such as R&D) within the borders of Sweden (Arvidsson et al., Chapter 8). However, there are certainly dilemmas associated with pursuing such policies in the present era of globalization. That the state in a small country, for example, subsidizes R&D activities of large, foreign-owned MNEs is a matter of discussion. At the same time, public support to (R&D in) Swedish innovation-based SMEs can also mean that the pay-offs for Sweden will disappear if the firms move early to other countries, (maybe because they get larger subsidies there) (Borrás et al., 2007).

[15] See also Activity 8: incubation.
[16] Se also Activities 8 and 9: incubation and financing.
[17] We will return to this issue below under Activity 8: incubation.

## Activity 2: Competence Building

Sweden is strong with regard to competence-building. Total spending on education and training as a proportion of GDP is high and a large proportion is spent on tertiary education. The Swedish labor force has a comparatively high level of educational attainment, with a rate of university graduation above the OECD average. (OECD: 1998: 37; OECD 2002: 54, 170; Bitard et al 2008: section 4.1.2) Apart from this, not much will be said about this activity here, the reason being that the relations between innovation and competence building are not particularly well understood – by anyone. Considerable analysis is motivated to decrease this ignorance. We need answers to basic questions, such as what kind of education (level, orientation, etc) enhances which kinds of innovations (product, process, radical, incremental, etc)?

## Activity 3: Formation of new product markets

New product markets may be created in response to demand based on human needs that existed long before there was any possibility of satisfying it, e.g. the case of penicillin. Alternatively, the development of a new product may satisfy a demand that the users did not know they had, e.g. the services of mobile telephony. Anyway, demand and markets are absolutely necessary for innovation processes to develop, since innovations *are* creations of economic and societal significance (see definition in Appendix 1). If there is no demand/market for products, there will be no product innovations.

As seen at the end of section 3, the innovation systems approach emphasises those factors that influence innovation processes from the demand side much more than earlier theoretical approaches (such as the linear approach mentioned). Such demand-side activities are 'formation of new product markets' and 'articulation of quality requirements' emanating from the demand side with regard to new products (see category II in Box 1).[18] Most demand develops spontaneously with its origin in private organisations or individuals.

However, demand may also originate from public organisations, which means that it is a matter of policy. Such demand-based innovation policy may be

[18] Users may be firms, individual consumers and public agencies.

defined as a "set of public measures to increase the demand for innovations, to improve the conditions for the uptake of innovations and/or to improve the articulation of demand in order to spur innovation and the diffusion of innovations." (Edler 2009: 3)

One demand-side policy instrument is Public procurement for innovation (PPI). It occurs when a public organization places an order for a product (a good or a service - or a system) that does not exist at the time, but could (probably) be developed within a reasonable period of time. However, R&D and innovation are needed before delivery can take place. PPI is an example of interactive learning between organizations, which has given the systems of innovation approach its name, and will be further discussed under Activity 6.

The actual *use* of demand-side innovation policy *instruments* has decreased since 1990. This also applies to the specific instrument of PPI.[19] In Sweden, for example, PPI was used much more from the mid-1900s to the 1980s than thereafter.[20] Since then it has been neglected. An accurate interpretation is that the interest in demand-side policy instruments at an *analytical* and *policy design* level has increased, but that this has not translated into specific initiatives with regard to the *implementation* of innovation policy. However, this might be currently undergoing a process of change. (Edquist 2009)

For example a seminar on PPI was arranged by three large Swedish companies in Almedalen in July 2009, where I presented a report on Public Procurement for Innovation (Edquist 2009). Further, VINNOVA commissioned a study entitled "Can Public Procurement Spur Innovations in Health Care" (Lundvall et al 2009) in the autumn of 2009, and VINNOVA also requested a large budget increase with the purpose of enhancing PPI the same year. Another example is that the Swedish Government appointed a government investigation in 2009 on how to increase the use of this instrument. The result will be presented in September 2010. Other initiatives have also been taken by the EU and various individual countries (Aho et al 2006; European Council 2006; Finland's EU Presidency 2006; Edquist 2009: section 5)

[19] The first book that exclusively addressed procurement and innovation was entitled "Public Technology Procurement and Innovation" (Edquist et al 2000). When it was published in 2000, the interest in PPI was almost non-existent. It has certainly caught up in the last couple of years! But this interest has not led to abundant specific policy initiatives

[20] Sweden has a great history in this respect – see Edquist 2009.

It is important that further policy initiatives are taken with regard to demand-side innovation policy, for example PPI - and that various forms of regulations are introduced, as briefly discussed under Activity 7. It is largely a matter of transforming or diverting *regular* procurement into public procurement for *innovation*. How this can be done is outlined in the literature referred to above. [21]

## Activity 4: Articulation of Quality Requirements

As indicated above, the development and diffusion of innovations are highly influenced from the demand side. This influence emanates mainly from *organizations* (players) that may be either private or public. On the private side, demanding customer firms or individual consumers may be important as the sources of articulation of quality requirements. On the public side there is PPI, regulation and other demand-side innovation policy instruments. When it comes to PPI such an articulation is the formulation of the functional specifications of the product or system demanded by the public agency.

Under activity 7 we address the *institutions* (the rules of the game) that may influence innovation processes from the demand side. The organizations that design and implement rules of the game are discussed under Activity 5.

## Activity 5: Creating and Changing Organizations

The most important organizations in systems of innovation are the firms – large and small. Firms are the main engines for carrying out innovations, although many other organizations are also involved, interacting with the firms in systems of innovation.

Regarding obstacles to technology transfer from R&D to the commercial sphere, most recent policies have concentrated on creating incentives and infrastructures for improving university-to-industry technology transfer (see also Activities 6, 7 and 8). Given that corporate sources account for ¾ of R&D

[21] If, however, human needs are transformed into effective demand and innovations spontaneously and automatically there is no need for policy intervention.

expenditures, it would be logical to address the overwhelming domination of business sector R&D by large firms. This is especially so, since SMEs can produce a similar output (innovations) with a smaller input (expenditures on R&D and innovation).[22] Hence, there are reasons to enhance R&D and innovation expenditures and efforts in SMEs in advanced sectors. At the same time, large firms are becoming less suitable partners for a national innovation policy, because of ongoing globalization. This issue, addressed under Activity 1, is also discussed under Activity 8.

Efforts to stimulate the transformation of research results, emanating from universities, into innovations in firms should be strengthened, by pushing the third mission (see Activity 7), and improving both financing and additional support services (see Activities 8 and 9) for innovating firms, particularly those formed to exploit academic research results.

The discussion of whether many or few new firms based on innovations are created (innovation-based entrepreneurship) and growing rapidly in the Swedish NSI, as compared with the NSIs in other countries, will not be pursued here. My only comment is that they are few – in all countries. Most new firms are simply not based on innovations, and the majority of those new firms that are innovation-based do not grow particularly rapidly. They might need support of various kinds to be able to do so: R&D support (Activity 1), incubation support (Activity 8), public seed funding (Activity 9). This is important because their growth rate may be very high whether they grow by themselves or partly supported by public support. Consider, for example, Microsoft, Apple and Google – firms that did not exist 30 years ago, or Swedish firms such as Axis Communications, Scalado AB, TAT AB and QlikTech AB.

In 2001 important changes were made in the organizational set-up of innovation policy in Sweden. NUTEK (The Swedish Board for Technical Development) was divided into two parts. One was still named NUTEK (now Tillväxtverket – The Swedish Agency for Economic and Regional Growth). The other one was named The Swedish Agency for Innovation Systems (VINNOVA). VINNOVA's mission is to promote sustainable growth by developing effective systems of innovation and funding needs-driven R&D. [23]

[22] See Activity 1: R&D

[23] The name is rather unusual, since national policy organizations are seldom named after an academic theory or approach.

In 1994 the Swedish government established seven 'Technology Bridging Foundations' in major university regions. Their mandate was to support the commercialization of (largely university-based) R&D by assisting inventors with patenting and aiding the start-up of SMEs by, for example, early-phase funding. In late 2004, the seven Foundations were, together with Industrifonden and VINNOVA, reorganized into one national organization with regional branches and the name was changed to Innovationsbron AB. Innovationsbron develops and supports, among other things, incubation (see Activity 8) and provides seed funding through direct ownership (see Activity 9), to assist commercialization of university-based R&D –and, increasingly, assist others in research institutes firms and the public sector.

The renaming and refocusing of relevant public activities and organizations in the early years of the 21st century is more important than only a matter of words. 'Innovation' is certainly a wider concept than 'technology' – see Appendix 1. The renaming also means that the scope and emphasis of 'policy' changed from a focus on 'industrial policy' in the 1970s to 'technology policy' in the 1990s and the current much wider 'innovation policy'.

### Activity 6: Networking

As emphasized at the end of section 3, interactive learning among organizations in systems of innovation is absolutely crucial for innovations to emerge.

Empirical data indicates that innovative collaboration and networking seem to develop organically among Swedish actors - private and public - and between Swedish and foreign actors. Swedish research often involves collaborations between researchers in firms and in universities or institutes, (private or public research organizations) resulting, for example, in joint publications or patents (Sandström et al., 2003). University-industry relations are frequent and important in some sectors.

Swedish firms frequently enter into licensing, joint development, marketing or distribution, outsourcing agreements, etc. A survey of collaboration in product development, covering all manufacturing firms in East Gothia found that 70 per cent of all product-innovating firms relied on partnerships (Edquist et al., 2000)

There is no reason to believe that Sweden is particularly behind with regard to interactive learning between organizations in the NSI. Even so, it is important to enhance collaboration and learning over organizational borders – because of the sheer importance of interaction for innovation. Today, private initiatives such as industry associations and bridging organizations, as well as government schemes of various kinds – for example Innovationsbron and VINNOVA – continue to provide arenas for meetings, coordinate suppliers, or spur university-industry relations by making such cooperation a prerequisite for financing.

Universities also have technology transfer organizations of their own. These efforts should continue – and even receive more attention from innovation policy agencies. They should also be aware that interactive learning between organizations is also of considerable significance in processes of public procurement for innovation, when pursuing third task policies and when creating various kinds of regulations, which are primarily motivated by concerns other than to enhance interactive learning.

## Activity 7: Creating and Changing Institutions

Regulations are forms of institutions (rules of the game). Regulations with regard to safety, energy and the environment trigger about 50-60 % of the development cost of a new passenger car or truck model.[24] This being so, the character and effects of these regulations are very important. Do they enhance innovations or do they constitute obstacles to innovations? Do they lead the innovation trajectories into useful paths – or do they produce lock-in situations?

The ‘university teachers’ exemption’ grants faculties at Swedish universities complete ownership of research results. Arguments for the university teachers’ exemption stress that it minimizes bureaucracy and does not preclude voluntary agreements between universities and the university-employed scientists (Sellenthin, 2004). The individual researchers may also make agreements with any other organization, i.e. flexibility is very high.

[24] I have heard high level representatives of Volov PV and Volvo AB give this figure publicly. This includes the CEO of Volvo AB (trucks, etc)

An alternative arrangement with mandatory university organizational involvement in the ownership of R&D results would require more effective technology transfer services provided by the universities (Rosenberg and Hagen, 2003, p. 25-26). Critics also point to a weak incentive structure with negative effects on both universities (Henrekson and Rosenberg, 2001, p. 225) and faculty (Etzkowitz et al., 2002). Many Swedish universities have introduced extensive infrastructures for enhancing commercialization, i.e. created organizations for that purpose (see Activity 5). The best combination is probably to keep the teachers' exemption and, at the same time, develop more efficient public organizations that can compete. An open issue is, however, how far into the 'market' universities should go. Should they provide large-scale funding to private organizations – or resign before that stage?

One important institutional measure has been to charge the universities with a third mission, which in 1998 was explicitly stated in the new regulation of universities as the task of engaging with the surrounding society, disseminating research information outside of academia and facilitating societal access to relevant information about research results (SOU, 1998, pp. 128 and 153-154). This reform was largely, though not exclusively, directed towards the commercialization of university-based research, through the promotion of various forms of university-industry collaboration. However, this third task is not regarded as important as the 'original' tasks (teaching and research), e.g., in academic appointments. Few means are devoted to it by governmental or other bodies. (Bitard et al 2008: section 7.2)

Deregulation is also institutional change. Deregulation of the capital market had already occurred in the 1980s. In the 1990s - after EU accession in 1995 - there were sweeping reforms in telecommunications (1993), electricity (1996), banking, finance, postal services (1993) and domestic air travel (1992). A central aim was to create new entrepreneurial arenas and innovation opportunities, in both Sweden and the EU.

Policies for supporting networking and collaboration between organizations are also institutional reforms. Still, the EU rules with regard to public procurement for innovation (PPI) are a set of institutions that have made such collaboration more difficult (Martin 1996). EU membership made it more difficult to pursue 'demand side' innovation policy (Edquist, 2002, pp. 40-42).

Sweden's post-war social-democratic welfare state favored large firms and strong trade unions (Esping-Andersen, 1990). Sweden also developed corporatist economic policy-making based on tripartite co-operation (Ruin, 1974; Edquist and Lundvall, 1993, p. 291). This corporatism has supported the dominance of the large firms in the Swedish NSI, and might also have impeded the creation and growth of innovation-based firms.

Corporatist arrangements and competition and trade policy seem to have prolonged the dominance of large firms and reinforced established innovation trajectories. These factors help to account for the much higher innovation expenditures of large firms, relative to SMEs, and Sweden's generally poor performance with regard to the introduction of new product innovations.

## Activity 8: Incubation

Incubation may be 'located' in established organizations (such as large firms) and/or in public organizations, where there may be an element of subsidy. The case of large firms is when new products are being developed in addition to or as a substitute for the firms' existing products. The new products require R&D, other development costs, initial marketing, etc. It might take several – or even many – years before the new product becomes profitable (which may never happen).

Normally, incubation in *large firms* is not a concern for public sector policy organizations. The large firms must be expected to use accumulated profits and experience to handle this. Hence, it happens - or should happen - 'spontaneously' and there is no 'problem' for public sector organizations to solve or mitigate.

However, a new idea or product is sometimes developed within a large firm somewhat outside of its perceived development trajectory and there is no incentive to exploit the possibility. The firm may patent the product and let it lie idle, or it may keep it secret. These are cases where R&D results fail to be transformed into innovations. This might be part of the explanation for the actual innovation output of large firms being comparatively low (se Section 2 and Activity 1). If knowledge that is potentially useful for society is locked-in in this way, there is a 'problem' that is not solved spontaneously. In such cases

there are reasons for public policy organizations in the field of innovations to try to initiate or support a process where these resources become useful for society. This could facilitate the spin-off of new innovation-based firms from large firms.

Teknopol AB in Lund is pursuing such an initiative as part of the "Mobile Heights Business Center"" initiative. The focus is on trying to make use of unexploited patents owned by large companies, by coupling them with entrepreneurs and using public funding to facilitate the process. The funders of this initiative are Innovationsbron, VINNOVA, Region Skåne, Region Blekinge and the EU structural funds (through The Swedish Agency for Economic and Regional Growth). [25]

For *small/new firms* - or firms that do not (yet) exist – the "traditional" incubation is crucial and publicly funded incubators are an established addition to the battery of innovation-supporting organizations in the Swedish NSI. Such support may make the difference with regard to whether a firm will be created or not, or whether it will (be able to) grow or not. Such incubators are often located close to Science Parks. Innovationsbron and VINNOVA are funders, and support to incubation is also provided by transfer units within universities, such as 'LU Innovation' at Lund University. Incubation support services may also be provided by private organizations that are then often so-called KIBS - Knowledge Intensive Business Services - firms (see Activity 10).

There seems to be reasons to increase the incubation activities in relation to the large firms, and stimulate spin-offs also from them (and not only from the universities). It is also important to support intrapreneurship in the large firms or enhance their diversification into new product areas in other ways. These measures may contribute to making the national innovation system operate more efficiently by mitigating the Swedish Paradox. However, the firms are much larger than public policy organizations and it may be sensitive to try to influence their strategies.

[25] The potential innovations emerging in the large firms are sometimes connected to key individuals that the firms do not want to lose. Such key persons might be very rare – one out of a hundred or a thousand. A tricky issue is then how to make it a win-win game when such individuals leave the (large) company – or find substitutes for them. On the whole, it is a matter of findings solutions that facilitate spin-offs by creating incentives for the big firms to make their knowledge available.

## Activity 9: Financing of Innovation Processes

Financing is a vast topic, but I will be very short on this Activity and restrict myself to briefly addressing seed funding. Closely related to incubation is the financing of processes of innovation in their early stages. Again, such funding is normally taken care of by large firms themselves when they diversify into new products: And so they should.

However for new/small firms the issue of early funding may be problematic. In the very early phases of the development of an innovation outside existing firms, financing is complicated because of the very large degree of uncertainty. Because of this uncertainty, private funding is simply not available in many cases. What is called "risk capital" is not prepared to accept such large uncertainties; it prefers later and more certain stages. This is true not only for the Swedish NSI, but for all innovation systems.[26] It is a 'problem' that is not spontaneously solved by private actors. If public agencies believe that they have the ability to solve or mitigate such problems, they should try. The new innovation-based firms need persistent capital and the state may be a provider of such capital when firms do not have the means. Another issue is that this inability of private actors to provide funding in early phases varies over time and between regions. This calls for a constantly repeated analysis of where and when such 'problems' are at hand.

## Activity 10: Provision of Consultancy Services

This activity focuses mainly on private consultancy services, and therefore on the KIBS (Knowledge Intensive Business Services) sector, since nearly all Sweden's private consultancies are located in the KIBS sector. Public consultancy services have been addressed under Activites 5, 8 and 9 (and others). Since Activity 10 does not concern policy to any considerable extent, the discussion will not be developed further in this report. Of course, this is not meant to neglect the importance of private consultancy services for incubation, for example.

[26] In the USA, this early stage is called 'The Valley of Death'.

## 5. Concluding remarks

The Swedish Paradox is still in operation, although there are signs that it has been mitigated somewhat recently. I have presented preliminary explanations for the Paradox, as well as proposed how it can be seen as *opportunities* that may be exploited through public innovation policy. I have done so by relating to *ten important activities in innovation systems*, such as R&D, formation of new product markets and incubation (see Box 1).

Let me conclude by pointing to some important issues. Public innovation policy organizations are needed in innovation systems, just like private organizations (e.g. firms). As we have seen, many policy measures should be combined with each other. Several of the proposals are related to the fact that the Swedish national system of innovation is dominated by large firms, which do not seem to be particularly efficient in transforming R&D expenditures into innovation output.

To make the results of R&D more useful for Swedish society, the *other nine activities* in the innovation system should be emphasized to a larger extent in innovation policy. To pursue these policies is generally not as costly in economic terms as R&D. However, the quality of the analytical basis and the competence required of policy-makers must be very high. The other nine activities include demand-oriented policies as well as public seed funding and support to incubation.

The public policy should focus on supporting SMEs and on trying to make use of the idle patents and product designs of large firms. However, the proposals in this report cannot be summarized since it already has the character of a summary. Those who want to repeat the policy proposals can go back to the discussion of the ten activities earlier. More data has to be created and collected and made the basis for detailed analyses with regard to each of the proposals. Such a detailed analysis of each proposal is necessary before a specific design of policy action and its implementation are possible.

As stressed in Section 4, however, the problems in the innovation system may be so severe that policy intervention cannot wait until the ‘perfect’ analysis has been provided. It might be necessary to act *now*, on the basis of a preliminary analysis. The discussion of the ten activities above can, simultaneously, be regarded to be a basis of a policy agenda. A thorough analysis of the ten

activities could be a great leap forward in the design of a holistic innovation policy for the Swedish national innovation system.

## 6. Kort sammanfattning på svenska/Short Summary in Swedish

Den svenska paradoxen - höga utgifter för FoU och liten utdelning i form av innovationer – gäller fortfarande, även om det finns tecken på att den har mildrats något på senare år. I rapporten presenteras preliminära förklaringar till paradoxen samt förslag på hur den kan ses som *möjligheter* som kan utnyttjas genom innovationspolitik. Detta görs genom att relatera till *tio viktiga aktiviteter i innovationssystem*, såsom F&U, skapande av nya produktmarknader och inkubation. En slutsats är att många policyåtgärder bör kombineras. Flera av förslagen är relaterade till det faktum att det svenska nationella innovationssystemet domineras av stora företag – och de tycks inte vara särskilt effektiva när det gäller att transformera FoU-utgifter till utdelning i form av innovationer. För att nyttiggöra FoU-resultat för det svenska samhället i högre grad, så bör *de andra nio aktiviteterna* i innovationssystemet betonas mer i innovationspolitiken.

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## Appendix 1: Definitions of Key Terms

| | |
|---|---|
| Innovations | new creations of economic and societal significance, primarily carried out by firms (but not in isolation). They include product innovations as well as process innovations. |
| Product Innovations | new - or improved - material *goods* as well as new intangible *services*; it is a matter of what is produced. |
| Process Innovations | new ways of producing goods and services. They may be *technological* or *organisational*; it is a matter of how things are produced. |
| Creation vs. diffusion of innovations | this dichotomy is partly based on a distinction between innovations that are 'new to the market' (brand new, or globally new) and innovations that are 'new to the firm' (being adopted by or diffused to additional firms, countries or regions). In other words, 'new to the firm' innovations are actually (mainly) a measure of the diffusion of innovations. |
| Systems of innovation (SIs) | determinants of innovation processes – i.e. all important economic, social, political, organisational, institutional and other factors that influence the development and diffusion of innovations. |
| Components of SIs | include both organisations and institutions. |
| Constituents of SIs | include both components of SIs and relations among these components. |
| Main function of SIs | to pursue innovation processes – i.e. to develop and diffuse innovations. |
| Activities in SIs | factors that influence the development and diffusion of innovations. The activities in SIs are the same as the determinants of the main function. The same activity (e.g. R&D) may be performed by several categories of organisations (universities, public research organisations, firms). And the same kind of organisation (e.g. universities) may perform more than one kind of activity (e.g. research and teaching). |
| Organisations | formal structures that are consciously created and have an explicit purpose. They are players or actors. |
| Institutions | sets of common habits, norms, routines, established practices, rules or laws that regulate the relations and interactions of individuals, groups and organisations. They are the rules of the game. |
| Innovation policy | actions by public organisations that influence the development and diffusion of innovations. In practice innovation policy consists of all actions by public organisations related to the ten activities listed in Box 1. |

Source: Edquist 2009

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