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Magnus Eklund

Adoption of the Innovation System Concept in Sweden

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Abstract
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In 2001 Sweden founded the government agency of VINNOVA, named after the OECD-endorsed innovation system concept. Criticising the common assumption that countries are passive and uncritical recipients of the approaches promoted by the OECD, this dissertation tries to show that Swedish actors were in fact very active and strategic as they contributed to the national adoption of the concept.

With inspiration from conceptual history and Quentin Skinner's analysis of the rhetorical use of concepts, this study focuses on the research funding reform process between 1995 and 2001, investigating how actors trying to defend the contested institution of sectoral research used the innovation system concept to rhetorically legitimise their project. To compare these uses with earlier ways of discussing innovation in Sweden, the innovation debate that arose in relation to the industrial crises of the 1970s and 1990s has also been studied.

It was found that the early Swedish innovation debate had paid little attention to the university sector. When Research 2000 in 1998 proposed that researcher-dominated research councils should be given control over sectoral research funding, a coalition in favour of industrially relevant research mobilised to protect its influence over research funding. The concept was now appropriated and used to rhetorically reframe the universities as part of a system with the main function of promoting innovations. By using the concept it was also possible to draw on the legitimacy offered by the OECD and science.

Keywords: conceptual history, Quentin Skinner, innovation system concept, innovation thinking, VINNOVA, OECD, Sweden, research policy, research funding reform, Research 2000, sectoral research, university autonomy, industrial policy, industrial crisis

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Federation of Private Enterprises (Företagarnas riksorganisation)	FR
Federation of Swedish Industries (Sveriges industriförbund)	SI
Industrial Institute for Economic and Social Research (Industrins utredningsinstitut)	IUI
Industry Committee (Industrikommittén)	
Royal Academy of Engineering Sciences (Kungliga ingenjörsvetenskapsakademien)	IVA
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Science Policy Advisory Board (Forskningsberedningen)	
Swedish Employers Confederation (Svenska arbetsgivareföreningen)	SAF
Swedish Governmental Agency for Innovation Systems (Verket för innovationssystem)	VINNOVA
Swedish Research Council (Vetenskapsrådet)	VR
Swedish Trade Union Confederation (Landsorganisationen)	LO

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Uppsala, August 2007

CHAPTER 1
Introduction

After six years of heated debate, a reformed institutional structure for public research funding was finally established in Sweden on January 1, 2001. One of the newly created agencies had ambitions beyond merely funding research and adopted the wider task of supporting technical change. It took the name VINNOVA, an abbreviation for the Swedish Governmental Agency for Innovation Systems.[1] Thus, Sweden was the first and so far only country in the world to name one of its agencies after a new social science concept that had swept into the policy rhetoric of many industrialised countries during the 1990s. The innovation system concept had emerged in the late 1980s as a Schumpeterian heterodox framework for studying and facilitating innovations, inspired by previous empirical studies on innovation as well as institutional and evolutionary economics. In particular it drew more systematic attention to the socioeconomic environment in which innovative activities take place and to how this environment may help or obstruct innovation.[2] Bengt-Åke Lundvall, situated in Denmark and one of the 'founding fathers' behind the new concept, was somewhat surprised when he learned it had been used to name a new government agency in Sweden:

> Suddenly I discovered there was something called … the Governmental Agency for Innovation Systems. I thought it was very amusing. I thought it was typical for Sweden. When they finally bring themselves together, they create a government agency.[3]

During the 1990s the innovation system concept was adopted and increasingly promoted by the Organisation for Economic Cooperation and Development (OECD). As a heterodox concept critical of neoclassical economics, it was not likely to be welcomed by all economists at the organisation, but it developed a strong standing within certain sections of it, in particular the Directorate for Science, Technology and Industry (DSTI). And, as the

[1] It has been disputed if VINNOVA really is something more than a funder of research. Håkan Gergils argues it is 'rather to be regarded as a research council than a strategic agency of innovation,' but the director of VINNOVA, Per Eriksson, would not agree with that statement. See Gergils (2006), p. 340, my translation; interview with Per Eriksson, September 20, 2006.

[2] The emergence of the innovation system concept will be described in greater detail in chapter two.

[3] Interview with Bengt-Åke Lundvall, January 18, 2006, my translation.

Canadian sociologists Mathieu Albert and Suzanne Laberge have shown, the concept was largely perceived by the outside world as coming with an OECD seal of approval. In a study, they interviewed twenty policy makers, bureaucrats and policy-linked researchers in Quebec about their relationship to the innovation system concept. Explaining why they adhered to the concept, most of interviewed subjects pointed to the legitimacy of the OECD and the scientific legitimacy of the academic scholars supporting the concept. Very few were able to maintain a critical distance to it. In the words of Albert and Laberge:

> [T]he high level of adherence to the IS [innovation system] approach by public sector employees can be largely explained by the prestige … of the OECD and its associated epistemic community, as well as by the cultural authority that science exerts on them, with these two factors bestowing cultural authority onto the IS approach.[4]

Observing the strong standing of the innovation system concept at the OECD and the increased use of the concept in member countries, many scholars have perceived countries as mainly passive recipients of the latest fashionable approaches promoted by the OECD. This has been particularly evident with Albert and Laberge. They paint a linear image of how ideas disseminate from the OECD to national governments and to regional policy makers:

> The IS [innovation system] dissemination process is a top-down chain for transmitting knowledge and beliefs …. This process begins at the top with the international institutions [such as the OECD and its DSTI] producing innovation-related knowledge …. At the other end are the regional civil servants, whose main task is to build a stakeholder consensus on the importance of developing a regional innovation system. National policy makers and bureaucratic carriers of ideas are situated between those poles…. The role of bureaucratic carriers of ideas is to convey the knowledge produced by the OECD and the epistemic community to governments and scientific/economic organizations…. As for regional civil servants, their role is to educate and mobilize the regional innovation actors.[5]

At the bottom of the chain, regional civil servants are socialised into adopting the worldview of the OECD, as Albert and Laberge argue that they have 'fully internalized the discourse they received from policy makers and bureaucratic carriers of ideas. This means that they have adopted the cognitive framework and analytical categories of the IS [innovation system] approach.'[6]

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[4] Albert & Laberge (2007), p. 241.

[5] Albert & Laberge (2007), p. 236.

[6] Albert & Laberge (2007), p. 237.

No other scholars have produced an equally elaborate model of the dissemination process as the one presented by Albert and Laberge, but many of them reinforce the image of countries as basically passive recipients of the approaches endorsed by the OECD. Beatriz Ruivo has compared historical accounts on science policy in several countries after World War II, finding striking similarities in their periodisations. It appears most industrialised countries have gone through the same paradigms of science policy. They all started out with the expectation of social progress by funding free basic research, evolved into using applied research to solve societal problems and ended up supporting interdisciplinary basic research in strategic areas of industrial relevance. In most cases shifts between these phases occurred simultaneously in the studied countries, with the United States taking a slight lead. Ruivo explains this puzzling similarity in policy with the existence of international organisations diffusing policy ideas between countries:

> The degree of homogenisation of science policies in advanced countries up to now has been attained chiefly through the OECD forum.… There is … an increasing network of science policy-makers, in which multilateral bodies, and other international bodies, such as OECD and, at the level of Europe, the EC, are playing an important role. These organisations help to spread empirical knowledge about new issues and policy instruments, as well as about analytical approaches developed by the scholars in the field.[7]

Benoît Godin also stresses the importance of the OECD in spreading policy ideas. It organises conferences and workshops, publishes books and reports, establishes committees composed of delegates from member countries and enrols academic scholars and national bureaucrats. Taken together, this makes the OECD a significant institutional arena for diffusing ideas. But the organisation also works actively to package and sell new approaches to its members. Digesting academic work on science and technology policy, it presents the results to policy makers in a rhetorical fashion with a focus on catchy buzzwords and slogans.[8] Similarly, Reijo Miettinen describes how national scholars and bureaucrats are involved in preparing the OECD policy documents:

> This collective preparation mechanism assures that ideas are quickly transmitted into national policies. The administrations of the participating countries are involved in the work through their own contributions, and the documents produced are disseminated to all participants. The project produces a huge pool of textual raw material to be used in the writing of policy documents in member countries.[9]

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[7] Ruivo (1994), p. 161.

[8] Godin (2006a), p. 23f. For a deeper discussion about the rhetorical character of OECD policy documents, see also Miettinen (2002), pp. 24–37.

[9] Miettinen (2002), p. 24.

Hence, a convergence in science and technology policy takes place thanks to an elaborate and international institutional structure, which provides a meeting place for scholars and policy makers from all over the world and where the OECD can achieve almost immediate impact for the latest fashionable policy ideas it is pushing. This convergence is apparently dominated by mechanisms such as imitation, fashion and legitimacy. Tarmo Lemola stated this with particular clarity:

> [T]he development of science and technology policy is largely dependent on social and institutional processes like imitation and fashion. Countries learn from each other and copy from each other either directly or through international organizations, and the result is increasing convergence of policies.[10]

Charles Edquist, one of the major academic advocates of the innovation system concept in Sweden, supports the view of governments as mesmerised by the legitimacy and prestige of the OECD:

> My hypothesis, which I can't confirm, is that Swedish academics and above all governmental policy makers, they can't decide for themselves what they think is good or not, and then they don't trust Charles Edquist to be able to do it either. What they go by is if the OECD attaches its OK stamp on something. Then you can use it. People are very bound by authority when it comes to the OECD.[11]

To sum it up, large parts of the literature on science and technology policy present a picture of countries as passive and generally uncritical recipients of the concepts or approaches endorsed by the OECD. Albert and Laberge presented an explicit model where ideas were disseminated in a linear fashion from the OECD to national governments and regional policy makers. But the assumption of passivity is often hinted at implicitly in the literature. It can take the form of a selective focus on the mechanisms through which the OECD can manipulate or persuade its member countries. It can also be implied through viewing national adoptions of the innovation system concept as unproblematic and in no specific need of scientific explanation, given the strong institutional base of the OECD and its status around the world. The assumption that countries are passive recipients is not unique to the field of science and technology policy. Christoph Knill, writing about the general causes behind policy convergence, sees the national adoption of approaches as self-evident, if those approaches are being promoted by international organisations. He simply notes that 'the promotion of policy models by international organizations with the objective of accelerating and facilitating

[10] Lemola (2002), p. 1486.

[11] Interview with Charles Edquist, January 20, 2006, my translation.

cross-national policy transfer as well as the emulation of policy models [can be a cause of policy convergence].'[12]

Even if the assumption of passivity is widely diffused in the literature, it is also problematic. It deflects attention from the mechanisms through which national and regional actors actively work to modify and translate international approaches to make them fit local conditions. In that way, the assumption has served to remove focus from potentially promising fields of empirical research. As Bengt-Åke Lundvall argues persuasively: 'In each single country the interpretation of the [innovation system] concept has been shaped by national specificities.'[13]

Adopting the Innovation System Concept in Sweden

My purpose with this study is to show that Swedish actors have in fact been far more active in the process whereby the innovation system concept was adopted in Sweden, than would have been expected based on the common image of countries as passive recipients of the concepts promoted by the OECD. Sweden is actually a particularly interesting country to investigate when it comes to the innovation system concept. Together with Finland, which adopted the concept in its science and technology policy as early as 1990, Sweden is often presented as a country where the breakthrough of the concept has been especially strong. This is largely due to the internationally unique step Sweden took by naming a government agency after the innovation system concept.[14] Also, many of the scholars generally associated with the concept are linked to Sweden in one way or another. Bengt-Åke Lundvall was born in Sweden, but is now a naturalised Danish citizen, Charles Edquist is Swedish, Maureen McKelvey has been working in Sweden for the last decades, Staffan Jacobsson is Swedish and Bo Carlsson is Swedish, but currently working at Case Western Reserve University in Cleveland, Ohio.

At the same time, paradoxically, Sweden has also been described by some observers as a country lacking a proper innovation policy, a country characterised by conservatism and inertia, having turned a blind eye to policy developments in the OECD and the rest of the industrialised world. This view is far from unanimously endorsed by students of Swedish innovation policy, but those who promote it have been very vocal in their complaints. Håkan Gergils argues that

> Sweden is not a role model when it comes to innovation policy.… [T]he Swedish policies during the 1990s have not been geared towards achieving a

[12] Knill (2005), p. 770. See also Holzinger & Knill (2005), p. 785f.
[13] Lundvall (2006), p. 11.
[14] See for example Lundvall et al. (2002), p. 214; Sharif (2006), p. 745; Jacob (2006), p. 443.

> national innovation system, NIS. Not even the concept appears to have crossed the mind of politicians, regardless of which party they belonged to.[15]

An investigation headed by Anders Flodström in 1999 wrote that 'Sweden has not yet carried on any … discussion [about innovation systems], neither among politicians nor among the representatives of business. The economic debate is still to a large extent performed in terms reflecting antiquated economic viewpoints.'[16] Similarly Charles Edquist complains that '[t]his [innovation system] approach did not catch on in Sweden, no one used it, not very much at least. Not until [around] the year 2000.'[17] Evidently, a certain puzzling ambivalence exists in the descriptions of Sweden. It appears to be a country spearheading the global adoption of the innovation system concept by naming a government agency after it, abounding with important innovation system scholars, but also a slow, conservative and indifferent country as far as the concept is concerned. If nothing else, this ambivalence is a clear sign that something interesting took place when the concept was adopted in Sweden and that the process merits further study.

Of course, the innovation system concept is not the only approach to have been adopted and promoted by the OECD during the last decades. Its main contender is the cluster concept, a term coined by the business economist Michael Porter in 1990. Clusters can be regarded as the network surrounding companies in a particular field, consisting of their relationships with customers, suppliers and other relevant organisations. Often this network is expected to be more or less geographically concentrated.[18] While endorsed by the OECD and fairly influential in Swedish regional policy, I argue that its impact in Sweden cannot rival that of the innovation system concept, and there are no government agencies named after it. Örjan Sölvell, perhaps the main Swedish advocate of the cluster concept, has complained about the lack of cluster policies in Sweden and argued that 'VINNOVA is still untested (and with a focus on research-based industry and broader innovation systems rather than clusters).'[19] The innovation system concept clearly stands out in Sweden because of the official legitimacy bestowed upon it by the creation of VINNOVA. Likewise Sweden stands out in the world by this very act of officially singling out the concept. These are my main reasons for choosing the innovation system concept and Sweden as my objects of study.

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[15] Gergils (2006), p. 272, my translation.

[16] Flodström (1999), p. 7, my translation.

[17] Interview with Charles Edquist, January 20, 2006, my translation.

[18] Porter (1990). For a more critical discussion about the cluster concept and its evolution, see Lagendijk & Cornford (2000); Martin & Sunley (2003); Benneworth & Henry (2004); Malmberg & Power (2006).

[19] Sölvell (2003), my translation.

The Approach of Conceptual History

Many observers have noted or complained about the vagueness and fuzziness of the innovation system concept. For some this diminishes its scientific credentials, because they want a scientific vocabulary to be precise and unambiguous. Others have viewed the vagueness as an advantage, as it enables the concept to mobilise actors across disciplinary boundaries and between academics and policy.[20] Either way, most would agree with Bengt-Åke Lundvall when he concedes that 'Innovation Systems means different things for different people.'[21] Of course the innovation system concept has emerged in a certain historical context, responding to certain contemporary questions, and this naturally affects the connotations given to it by various people and how it tends to be used. But there is no fixed content to the concept, and there are no absolute boundaries for the kind of situations in which it can be used.

In studying how the concept was adopted in Sweden it is probably more fruitful to perceive it similarly to how Paul Benneworth and Nick Henry view the equally fuzzy cluster concept: 'Rather than regarding clusters as a stable and well-defined entity perhaps it is better to consider clusters as a black box … in which a range of evolving academic and policy threads have been placed together.'[22] Even if most of the scholars who developed the innovation system concept accept that it has no absolutely fixed content as it is used today, many of them maintain normative notions of how the concept *should* be used, or what the original and 'true' content of the concept is. This is particularly evident when Bengt-Åke Lundvall looks back at the innovation system concept and its evolution. He complains about how it has 'degenerated,' how it has been 'abused' and 'distorted' while travelling from the academic to the policy world, compared with the connotations he originally intended for it.[23] For my research task it is not useful to make statements about what a proper way of using the innovation system concept should be or to assert any original and true content to the concept. I need tools that allow the content of concepts to vary, without assuming what their proper connotations and areas of use should be.

The emerging field of conceptual history is a tool that fulfils these requirements. Conceptual history can be seen as a research project studying the relationship between conceptual use and conceptual change in history, striving not to anachronistically contaminate the analysis with present preconceptions about what certain concepts stand for. Concepts are thus viewed as inherently ambiguous, variable and embedded in their historical contexts.

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[20] See for example Edquist (1997b), p. 26ff.; Miettinen (2002), p. 18ff.; Sharif (2006), p. 756ff.

[21] Quoted in Sharif (2006), p. 756.

[22] Benneworth & Henry (2004), p. 1015.

[23] See Lundvall (2006), pp. 2, 10, 14; see also Lundvall (2007), ch. 6.

The connotations given to a concept in a certain historical situation can be seen as an indicator of power relations and social structures in contemporary society, but also as powerful social institutions in their own right, affecting the mindset of people and thereby historical development. Two strands of conceptual history emerged independently in Germany and Great Britain, and both are today viewed as mainly complementary to each other, even though their focus differs somewhat.[24] The German research project, mostly associated with Reinhart Koselleck, has been aimed at studying how concepts such as 'democracy,' 'history' and 'power' changed as German society became increasingly exposed to modernity between 1750 and 1850. Concepts that had previously been used mainly by elite groups were widely diffused into society, and in the process they became more abstract and less linked to concrete everyday experiences. Parallel to their abstraction and detachment from present realities, the concepts increasingly incorporated expectations about the future in their connotations, and thereby became more suitable as politicised catch phrases and instruments of political mobilisation.[25]

German conceptual history has mainly been preoccupied with conceptual change over long time periods. However, my research interest in the present study is more in line with the British kind of conceptual history, generally associated with Quentin Skinner. He differs from Koselleck by emphasising how concepts are *used* in particular historical situations to achieve specific purposes, while paying much less attention to long-term shifts in the meaning or connotations given a concept.[26] Skinner himself sees this focus as possible to subsume within the more overarching German project: 'Koselleck is interested in nothing less than the entire process of conceptual change; I am chiefly interested in one of the techniques by which it takes place.'[27] Inspired by John L. Austin's philosophical theories of speech as an action and not just something referring to objects in the world, Skinner argues that the conceptual historian's task should be to recover the intention of authors when they used certain concepts in texts. To accomplish this, the scholar should research the social and intellectual context surrounding the author, which other authors he or she might be arguing with and what mission he or she wished to achieve by using the concept in a text. Above all it is important to study conventional ways of using the concept in that period of time, to find out if and in what way the author was innovating and did something new with the concept.[28]

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[24] See Richter (1995), ch. 6; Koselleck (1996); Skinner (2002), pp. 177f., 186f.

[25] For an overview of German conceptual history, see Richter (1995), ch. 2.

[26] The Skinnerian approach has increasingly made its way into the history of economic ideas; see for example Magnusson (1994); Magnusson (2004). For a deeper analysis of this approach, see Palonen (2003).

[27] Skinner (2002), p. 187. Cf. Koselleck (1996).

[28] See Skinner (2002), ch. 4; Palonen (2003), ch. 3.

Skinner pays specific attention to actors who want to accomplish something controversial in their contemporary society and who use concepts as part of rhetorical strategies to legitimise their projects. Here he makes a distinction between innovative ideologists, revolutionary actors who want to implement controversial societal changes, and apologists, conservative actors who want to defend an increasingly unpopular state of affairs. Their tools are concepts and words with the ability to perform evaluative functions:

> As I have indicated, I take … [the] defining task [of the innovative ideologist] to be that of legitimising some form of social behaviour generally agreed to be questionable. How can this task be successfully performed? As a preliminary to answering this question, it will be helpful to focus attention on a body of words that perform an evaluative as well as a descriptive function in our language.… They can be used, that is, to perform such acts as commending and approving – or else of condemning and criticising – whatever actions they are employed to describe.… [The aim of the innovative ideologist] must therefore be to show that a number of favourable terms can somehow be applied to their seemingly questionable actions. If they can bring off this rhetorical trick, they can hope to argue that the condemnatory descriptions otherwise liable to be applied to their behaviour can be set aside.[29]

Basically, Skinner sees two ways of 'manipulating' terms to serve these kinds of rhetorical purposes. First, the evaluative function of existing terms could be changed. Words conventionally used to praise could be transformed into condemning words and vice versa. Favourable or unfavourable terms could be neutralised, and previously neutral descriptive terms could be turned into words expressing approval or disapproval. Second, the conventional criteria for when a term expressing approval should be applied could be manipulated. With a new arsenal of terms expressing desired valuation, the case of the innovating ideologist or apologist could be rhetorically redescribed, replacing the negative presentation of what they wanted to achieve or defend with a more favourable one.[30] But they will always be bound by existing conventions among the people they wanted to persuade into accepting their manipulated terms. So the problem facing an innovative ideologist or an apologist 'cannot simply be the instrumental one of tailoring his account of his principles in order to fit his projects. It must in part be the problem of tailoring his projects in order to make them answer to the pre-existing language or moral principles.'[31]

Skinner has been criticised by Melvin Richter for preferring 'to deal with individual theorists, … [and showing a] lack of interest in the way groups, movements, and parties perceive and evaluate structural change.… [He

[29] Skinner (2002), p. 148f. For a specific discussion about the apologist, see Skinner (1973), p. 302f.
[30] Skinner (2002), pp. 151ff., 182ff.
[31] Skinner (2002), p. 173f.

seems] relatively insensitive to units of analysis larger than the individual theorist or school of thought.'[32] This criticism is largely unfair, even if Skinner often bases his reasoning on individual authors and their speech acts. But in the case of the innovating ideologist, he provides an example where the actors work on a group level. When the class of merchants grew stronger in early-modern Europe, they faced a society that for religious reasons frowned upon commercial activity. But by appropriating religious terms such as 'providence' and even the word 'religious' itself, and using them to describe their own controversial behaviour, they managed to tap into the legitimacy of Protestant religion and facilitate the rise of capitalism.[33] In fact, nothing stops his methodology from being applied to constructed aggregates of several authors representing positions in larger debates. This approach was adopted by Max Edling in his study of the constitutional debate in the newly independent United States. Inspired by Skinner, he analysed how the Federalists wanted to form a strong American government with a standing army that could stand up to the European countries. This was a controversial position, as contemporary American society was permeated with ideals that viewed the concentration of power and establishment of regular armies with great scepticism, perceiving such developments as a potential road to tyranny. But by using the concepts of 'liberty' and 'freedom' in new and innovating ways, the Federalists managed to present their constitution as a safeguard for the freedom cherished by the population. In this way Edling constructed the Federalists as an aggregate of all writers he could find, some of them anonymous, who favoured a strong government, and attributed intentions and rhetorical strategies to them as a collective.[34]

The innovation system concept is very much a descriptive and evaluative concept of the kind Skinner was interested in. Its basic premise is that the socioeconomic environment affects innovative performance, and the concept can therefore be used to evaluate elements of this environment based on their causal links to innovation. To the extent that innovation is perceived as a desirable good, elements that obstruct innovation are likely to be viewed as problematic, while elements that facilitate it are praised. Furthermore, the concept is filled with legitimacy from the academic context in which it emerged and from its status within the OECD, as has been indicated in the study by Albert and Laberge. Undoubtedly, the concept possesses many qualities that could make it a useful tool for an innovating ideologist or an apologist. Moreover, the best approach when studying rhetorical uses of the innovation system concept in Sweden must be to look deeper into the very

[32] Richter (1995), pp. 137, 139.

[33] Skinner (2002), pp. 147, 150f., 153ff. The example is based on Max Weber's classic analysis of the Protestant work ethic.

[34] Edling (2000), p. 20ff. For an account linking the American civic-humanist ideals that the Federalists had to struggle with to the republican traditions in classical Greece and the Italian renaissance, see Pocock (1975).

process that resulted in the creation of VINNOVA, namely the efforts to reform the Swedish public research funding system between 1995 and 2001.

Research Questions

It is a central argument in this study that Swedish research policy has been characterised by two competing and colliding coalitions, one focusing on university autonomy and the other on the social and economic usefulness of scientific research. From the 1940s and onwards, policy makers in Sweden have adhered to the general rule that as much research as possible should take place at universities, in order to prevent a separation between research and education. Much of the research performed in research institutes in other countries is therefore located at universities in Sweden. During the 1960s and 1970s government agencies increasingly asked universities to improve the knowledge base in their particular policy areas through research, so-called sectoral research. In that way, government agencies hoped to improve their policy in areas such as working life issues, spatial planning, agriculture or the environment. However, the term sectoral research has also often been applied to government agencies supporting technical change. These agencies differed from regular sectoral agencies not so much by using research as a tool to improve their own policy; instead, they supported research thought to serve the needs of a future industry based on technologies not yet existing. Even so, both forms of sectoral research ultimately viewed scientifically produced knowledge through an instrumental lens, appreciating it more for its relevance for present or future societal needs than for its own sake. It is in this extended sense I use the term sectoral research in the following study.[35] In the 1980s the strength of sectoral research began to be viewed as problematic by an alliance of university researchers and politicians. It was argued that university autonomy was threatened by the growing reliance on external sectoral research funding. To increase the scientific quality of sectoral research and to integrate it with the regular activities at universities, it was argued that sectoral research funding should be brought firmly under the control of researchers. Opposed to this was a coalition encompassing the Ministry of Industry, government agencies funding sectoral research, industry organisations and trade unions, all of which advocated a research policy influenced by social and economic relevance.[36]

As the Swedish system of public research funding was being reformed between 1995 and 2001, the dormant conflict between these two coalitions was brought into the open. In late 1998 a government investigation named *Research 2000* largely sided with the coalition aiding university autonomy.

[35] On sectoral research in Sweden, see Stevrin (1978); Nybom (1997), pp. 105–135.

[36] This argument is elaborated further in chapter four.

It proposed that all sectoral research funding should be transferred from the bureaucrats and societal representatives at government agencies to research councils, where representatives from the research community constituted a majority. The investigation caused an outcry among advocates of a research policy based on extra-scientific relevance, initiating a general mobilisation to save the institution of sectoral research.[37] Around this time a wave of new policy models were proliferating in the international arena that increasingly integrated research policy and innovation policy, going under names such as Mode 2, Post-Academic Science, Triple Helix and Pasteur's Quadrant. In these frameworks, research policy was not primarily about promoting scientific knowledge for its own sake; its main purpose was rather to serve as a vehicle for boosting innovation and economic growth. As indicated by the naming of a government agency after the innovation system concept, innovation aspects were making their way into the Swedish research policy debate by the late 1990s. In fact, as I show in Table 1 in chapter four, the innova–tion system concept was predominantly used in relation to the research funding reform process, before the occurrence of the concept exploded after the emergence of VINNOVA. This suggests that the embattled proponents of relevance-guided research did in fact pick up and use the innovation system concept as they involved themselves in the struggles of research funding reform. Against this backdrop, my main question is therefore: *how was the innovation system concept used by those supporting societal influence over the universities to rhetorically legitimise their projects during the Swedish process of reforming public research funding?*

But as Skinner notes, actors using concepts to legitimise their projects are bound by how these concepts are conventionally understood in their contemporary societies and may fail in persuading potential critics if they stretch the meaning of concepts too far. Establishing what the conventional ways of using concepts were is also necessary in order to discern if the rhetorical moves performed by innovating ideologists and apologists really constituted new and innovative ways of using the concept. In Sweden, a vigorous discussion about what was 'wrong' with the economy emerged with the industrial crises of the 1970s and 1990s. A variety of solutions were offered in the debate, and some of them suggested supporting innovation. In the early 1990s, a couple of participants in the debate also began to make use of the innovation system concept. Simultaneously, the Swedish government agencies in charge of supporting technical change developed their own viewpoints about how innovation worked, often in collaboration with large research projects involving groups of Swedish innovation scholars. These two arenas provide an ample foundation for investigating previous ways of talking about innovation in Sweden. I therefore complement my main question with a second one: *how was the innovation system concept used and how*

[37] See Benner (2001), ch. 4.

were innovations in general discussed in Sweden prior to the research funding reform process?

As the two questions above indicate, I am presenting a specific operationalisation of my general aim of studying how the innovation system concept was adopted in Sweden. Several aspects of the adoption are not covered by my research questions and have been left out of the spotlight. It might therefore be useful to point out what this is *not* a study of. First, this is above all a study of how the innovation system concept was adopted in Sweden at a discursive level. I am not investigating whether the concept really made a difference to Swedish policy, other than in the naming of a government agency. Admittedly, it is a quite interesting question to what extent the concept really constituted a new policy paradigm in Peter Hall's sense for Sweden, i.e. a change in the overarching goals for policy, its instruments and the settings of the instruments.[38] But this falls outside the scope of my study, which is more focused on the use of the concept in rhetorical arguments. Indeed, it can be quite difficult to associate changes in policy measures with abstract concepts. As Reijo Miettinen argues about the case of Finland, '[t]he rhetoric of NIS [national innovation systems] served to integrate policy areas, create political consensus, and find new foundations for traditional policy measures. However, it remains an open question as to how and to what extent this new language really reformed the actual policy making practices.'[39]

Second, as this is an adoption study rather than a reception study, I do not systematically investigate attempts by the OECD to influence Swedish policy. In other words, I have not tried to trace causal linkages between the endorsement of the innovation system concept by international organisations such as the OECD and increased Swedish use of the concept. This is rather a study of how the concept was adopted in Sweden and in particular of how domestic actors made rhetorical use of it in the reseach funding reform process. The OECD, seen as one possible source of influence among many other sources, features in this study when the organisation is drawn upon and used rhetorically by actors in the Swedish debate.

Delimitations are inevitable in all studies, and several issues that are interesting in their own right have no doubt been lost by my operationalisation. Even so, I argue that there are advantages to focusing on Swedish actors using the innovation system concept in order to legitimise their projects during the process of reforming public research funding. As I hope to show in the concluding chapter, it will put me in a position to argue that Swedish actors were in fact far more active when the concept was adopted, than would be assumed based on the current literature dealing with science and technology policy. Also, it will help us make sense of the puzzling duality in

[38] See Hall (1993), p. 278ff.
[39] Miettinen (2002), p. 86.

the descriptions of Sweden, where some present it as a country spearheading the adoption of the innovation system concept, while others paint a picture of a conservative country, ignorant about what goes on in the OECD.

Contribution to Existing Literature

Besides offering an empirically grounded criticism of the assumption that countries are passive recipients of the approaches and concepts endorsed by the OECD, it is my hope that this study will contribute to existing bodies of literature on three levels. First, some research is only now starting to emerge about how the innovation system concept developed and how it gained the acceptance of the OECD. Naubahar Sharif seeks to explain this process as the emergence of a tight-knit community of scholars and policymakers supporting the concept and who promoted it in opposition to neoclassical economics. They were helped by the process of globalisation and increased competitive pressures, which increased international interest in innovation.[40] Lynn Mytelka and Keith Smith focus on the interactive and co-evolving relationship between heterodox innovation theory and policy after the growth crisis of the 1970s. According to them, organisations like the OECD and the European Commission were sufficiently unhierarchical to provide havens where such heterodox thinking could blossom. The policy link was crucial, as that kind of theory was unlikely to evolve within existing disciplinary structures at universities.[41] Besides these two accounts, several other authors have touched upon the emergence of the innovation system concept.[42]

But not much has been done exploring its adoption in national contexts so far. Admittedly, Finland has received some attention, as it was the very first country to officially make use of the concept in its science and technology policy. Reijo Miettinen analyses how the innovation system concept was presented from 1990 to 2000 in the reviews published every third year by the Finnish Science and Technology Policy Council. He finds an increased reification of the concept, as it completed a transition from an analytic concept to an unquestioned belief that a Finnish innovation system really existed as a comprehensive entity that could be subject to planning and governance. There was also a shift of emphasis from the totality of factors in the system affecting innovative performance, to the more specific relationship between users and producers of knowledge.[43] Miettinen's focus differs somewhat from that of this study, as he is more interested in how the concept is pre-

[40] Sharif (2006).

[41] Mytelka & Smith (2002).

[42] See for example Miettinen (2002) ch. 3; Nilsson & Uhlin (2002), pp. 2–20; Lundvall et al. (2002); Lundvall (2004); Godin (2004); Albert & Laberge (2007).

[43] Miettinen (2002), ch. 4.

sented in a specific set of policy documents, while I investigate how it has been used rhetorically in a wider societal context. With the exception of Miettinen, the Finnish adoption of the innovation system concept is usually dealt with very superficially, without any thorough analysis of the mechanisms involved. Quite often its early embrace of the concept is presented as part of a success story, telling how Finland with great dedication emerged as an advanced knowledge economy from the devastating crisis it suffered in the early 1990s.[44]

Second, my study can fill some gaps in the literature about Swedish research policy during the turbulent 1990s. This literature deals with innovation issues as well, and sometimes even with the emerging innovation system concept, but without these things being the main focus. Mats Benner has studied how Swedish research policy evolved during the 1990s, above all emphasising the shifting institutional foundations for research policy, the networks of social and political actors underpinning it, how research is perceived by policy makers and the extent to which it is viewed as governable, and the question of continuity versus discontinuity in research policy.[45] Benner's historical overview overlaps somewhat with my study, and I have drawn heavily on it in constructing my version of how the innovation system concept was adopted in Sweden. But his approach is to treat research policy as a whole, without particularly singling out innovation issues and exposing them to systematic analysis. Mostly, Benner mentions the role of innovation ideas in Swedish research policy in passing, while my aim is to go much deeper in that area.

Peter Schilling is interested in whether Swedish research policy has evolved into supporting an entirely new mode of knowledge production, as has been argued by some scholars.[46] More specifically, he asks if Swedish research policy has been transformed into a policy for promoting innovations, if knowledge production is becoming more transdisciplinary, if universities increasingly interact with the business sector and if research is becoming more internationalised. His conclusions about the relationship between research policy and innovation policy in Sweden are interesting, as he argues that both areas continually have been kept in separate spheres.[47] I draw on

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[44] See for example Ylä-Anttila & Palmberg (2005); Gergils (2006), ch. 2. Jääskeläinen (2001) studies how the cluster and innovation system concepts were adopted in Finland during the 1990s, but I have unfortunately not been able to read his book as it is written in Finnish.

[45] Benner (2001).

[46] The influential argument, based on theoretical speculation rather than empirical studies, was that a new mode of knowledge production had emerged alongside the traditional one. Unlike Mode 1, which is characterised by disciplinary research at universities, research in Mode 2 transcends established disciplines and takes place in temporary constellations of researchers oriented towards practical applications. Instead of supporting knowledge for its own sake, research policy in Mode 2 is aimed at facilitating innovations; see Gibbons et al. (1994); Nowotny et al. (2001).

[47] Schilling (2005).

this conclusion in my own analysis, but I differ from him in that he does not pay any specific attention to the innovation system concept. In another account of Swedish research policy in the 1990s, Mark Elam and Hans Glimell take the above-mentioned theories of a qualitatively new mode of producing knowledge as their normative point of departure. They argue in favour of a socially and democratically accountable science, where decision-making has been brought from the 'ivory tower' into the public sphere and subjected to an extended peer review that allows a wide variety of social actors to voice their opinions. It is argued that most European countries are moving in this direction, but that Sweden instead has embarked on a different route by insulating its universities and championing an old-fashioned ideal of university autonomy.[48] Still, they do not pay any specific attention to the innovation system concept in the process they analyse. Bo Carlsson, Lennart Elg and Staffan Jacobsson deal briefly with the Swedish adoption of the concept in a forthcoming anthology chapter. They argue that the technological system concept they themselves had developed was better suited to Swedish policy practice, compared with the innovation system concept. Even so, the latter came to dominate the growth policy debate in Sweden during the late 1990s, largely thanks to its status at the OECD. Their account treats the naming of VINNOVA as a reaction to *Research 2000* and the struggle over research funding, but does not go much further in the analysis.[49]

Third, some research has recently been done on the role of innovations and the innovation system concept in Swedish policy documents produced after the creation of VINNOVA, quite often with a critical perspective, but differing from Elam and Glimell by picking the opposite side of the debate. Thomas Hellström and Merle Jacob investigated policy documents available on the websites of VINNOVA and three private research foundations supporting research based on industrial relevance. They argue that the present Swedish research policy discourse is dominated by stereotypical and simplified images of research as lacking in industrial relevance, largely due to the 'ivory tower' culture embraced by researchers. According to Hellström and Jacob, research policy also tends to be confused with innovation policy in the Swedish discussion.[50]

In a later article Jacob focuses on VINNOVA and its use of concepts taken from social science, including the innovation system concept. She argues that the social science concepts endorsed by the OECD are integrated into existing policy projects, which includes mobilising public R&D spending and other spheres in society for the support of innovation.[51] It is understandable that the emergence of VINNOVA, and the official sanction it gave the

[48] Elam & Glimell (2004).
[49] Carlsson et al. (forthcoming).
[50] Hellström & Jacob (2005).
[51] Jacob (2006).

innovation system concept, brought about an increased scholarly interest in how the concept is used. But an exclusive focus on the debate of today is also problematic, because present uses of the innovation system concept risk being projected ahistorically backwards in time. If the concept really has been enrolled in the project of opening up universities to social and economic demands, it is even more important to study how it was used before VINNOVA was founded, to make sure such recent ways of using it are historicised.

Use of Sources

A variety of sources have been employed to answer the questions asked in this study. As noted, I am mainly interested in how supporters of societal influence over universities used the innovation system concept rhetorically to legitimise their projects, as the research funding system was reformed between 1995 and 2001. This particular period of research policy has been covered to some extent by existing literature, and I draw upon it in constructing an outline of the reform process.[52] However, this research does not systematically analyse the use of the innovation system concept, which is the area where I hope to make a contribution. As the research funding system was being debated, a number of public investigations presented proposals that were perceived as very controversial and provoking by the supporters of societal influence over universities. But according to Swedish custom, before the government considers and decides on such proposals, an assortment of government agencies and interest organisations are given the opportunity to comment on them in writing. These written comments, or *remisser* as they are called in Swedish, have been my principal source when I analyse how the innovation system concept was used in the debate.[53] They are rhetorical documents, where the government agencies and interest organisations supporting societal influence over universities criticise proposals they dislike and try to replace them with suggestions based on their own visions of what a Swedish research policy should look like. As their aim is to persuade the government, this tendency would make them problematic if their descriptions were used as sources to depict the actual state of affairs. But as examples of rhetorical argumentation they make quite good sources. It is also important to remember that organisations are not monolithic entities. The

[52] See Benner (2001), ch. 3 and ch. 4; Elam & Glimell (2004); Schilling (2005), ch. 5.

[53] The written comments, as well as letters addressed to the government, were retrieved from Regeringskansliets arkiv- och dokumentcenter (The Government Offices Records Center). For the first five years Swedish government records are as a general rule kept at the ministries, after which they are moved the the Government Offices Records Center. Records older than 15–20 years are then gradually transferred to Riksarkivet (The National Archives). The records used in this study will therefore eventually be moved to the National Archives.

written comments do not necessarily speak for the whole of the organisation and may hide a variety of dissenting views. Even so, they do indicate the official view promoted by the organisation at that particular point in time. While the bulk of my material focuses on communication between the government and agencies or interest organisations, sometimes the debate on research funding also found its way into the media, where op-ed articles provide a source of attempts to persuade public opinion. Besides the public investigations that provoked them, the context surrounding the comments can be studied through government bills, which provides insight into the government's position on research funding, as well as its reaction to investigations and comments. By a tradition going back to the late 1970s, every newly elected government was expected to present a specific research bill, and during the reform process between 1995 and 2001 several other bills were also presented concerning research policy.[54]

However, in order to understand the restrictions facing those who wanted to legitimise their projects using the innovation system concept, and to make out if their use of the concept really was new and innovating, it is also necessary to investigate how innovations were discussed in Sweden prior to the research funding reform process. A public debate about what was 'wrong' with the Swedish economy emerged during the industrial crises of the 1970s and 1990s. Those proposed solutions that suggested boosting innovation are of particular interest to me, and my main sources here are books and newspaper articles aimed at taking part in the debate. Some public investigations, as well as letters to the government from proponents of innovation support, are also used as sources. These sources too served a rhetorical purpose, and their authors were trying to carve out a niche for innovation as an explanation for and a solution to the economic crisis, among all the other rival explanations and solutions figuring in the debate. They were also trying to persuade the government into adopting a policy supporting innovation. Still, this tendency does not obstruct my attempts to analyse how the innovation process was presented in these texts, as a point of comparison for later uses of the innovation system concept.

Parallel to the vocal public debate about the Swedish economy, I argue that a relatively coherent view on innovations was articulated by the government agencies supporting technical change. To a large degree, it had emerged in collaboration with groups of domestic innovation scholars. From 1968 to 1991 technical change was the responsibility of the Board for Technical Development (STU), which was superseded by the Agency for Technical and Industrial Development (NUTEK) in 1991. Before 1991 I have used the publication *STU-perspektiv* as a source of how STU viewed innovation. It was published more or less every third year between 1979 and 1989, as an

[54] On the tradition that every government should present a research bill, see SOU 1995:121, p. 37.

appendix to the organisation's application for funding from the government. As such, it reviewed the state of technical change in Swedish industry, as well as proposing how the agency should support it over the next three years. While no individual authors were named in the publication, it had been prepared by the industrial and scientific council at STU and was approved by the board of the agency. I have also used other reports published by STU, or reports published elsewhere but written by employees at STU. NUTEK did not publish anything similar to *STU-perspektiv*, but its viewpoints on technical change can still be accessed through appendixes prepared by the organisation to large-scale public investigations about the state of the Swedish economy in the early 1990s. One such public investigation was headed by the economist Assar Lindbeck in 1993, and a so-called 'long-term investigation' was supervised by the Ministry of Finance and published in January 1995. Also, the NYFOR investigation about the commercialisation of university research presented in 1996 is described by Mats Benner as having clear links to NUTEK, and Lennart Elg, responsible for innovation studies at NUTEK, served as its secretary.[55] This indicates that its conclusions may be seen as representative of the views held at NUTEK. Of course, it can be viewed as problematic to construct a unified view on innovation from several scattered reports and ascribe it to STU and NUTEK. But, as I hope to show in chapter three, the reports showed many similarities in the themes they brought up and in their analysis. Also, the same authors, such as Lennart Stenberg, Lennart Elg and Göran Marklund, recurred in many of the reports. Throughout the 1980s and 1990s STU and NUTEK collaborated with academic research groups and supported studies on innovation. The two most important groups were the Sweden's Technological Systems (STS) project led by Bo Carlsson and the network-oriented business economists headed by Håkan Håkansson at Uppsala University. Research reports and books from these groups provide sources for how they viewed the innovation process.

Besides the above-mentioned sources, I have also interviewed scholars and policy makers who in one way or another participated in the process when the concept was adopted in Sweden. The great bulk of my study is built on written sources, but interviews have sometimes served as complements. As is well known in the social sciences, interviews are not unproblematic as sources. Although I study events that took place fairly recently, human memory is notoriously unreliable even in the short term. Besides forgetting, the interviewed subjects can consciously or unconsciously reconstruct their memories based on the present situation. There is always a risk that they overestimate the importance of themselves or the organisation they represent, when offering information about how the innovation system concept was adopted. All the interviews were semi-structured bordering on non-

[55] See Benner (2001), p. 123.

structured, departing from a list of broad themes that interested me, but more often than not the discussion soon flowed freely into unanticipated areas.

Outline of the Study

In the next chapter I will present the historical emergence of the innovation system concept and its adoption by the OECD, placing it in an intellectual, social and economic context. Following that, chapter three deals with how innovations were discussed in Sweden from the late 1970s up until the mid 1990s, linked to the general debate about what was 'wrong' with the Swedish economy following the industrial crises of those decades. Moreover, it discusses how the Swedish government agencies STU and later NUTEK perceived the innovation process and how it was perceived in the research constellations they collaborated with. Then, in chapter four the process of reforming the research funding system in Sweden from 1995 to 2001, ending with the creation of VINNOVA, is investigated. Of special interest in this chapter is how this reform process involved new ways of using the innovation system concept to legitimise the project to increase societal influence over universities, and how these uses departed from conventional ways of using the concept or talking about innovation as studied in the previous chapters. Finally, chapter five wraps up the analysis and considers the conclusions drawn from the study.

CHAPTER 2

Emergence of the Innovation System Concept

After making its first appearance in the mid 1980s, the innovation system concept soon diffused into international organisations like the OECD and was adopted by policy makers in large parts of the industrialised world. Of course, it did not appear out of the blue, but should be seen as relying on previous historical trajectories of innovation thinking. This chapter is an attempt to place the innovation system concept within an economic and intellectual context and briefly outline its development over time.

Innovation Thinking Around 1960

It is often claimed that the decades after World War II were characterised by a strong belief in the possibility of transforming society for the better with the help of scientific basic research. During the war physicists involved in the Manhattan Project had shown the power of science by taming the atom into a weapon of unprecedented danger, but later also into peaceful nuclear energy. This achievement became paradigmatic for how the relationship between science and technology was perceived, where basic research was assumed to provide the influences for applied research, which in turn influenced the development of new products and processes, a view often named 'the linear model.' In 1945 Vannevar Bush, a scientific advisor to the United States government, captured the science-friendly sentiments in his report *Science – The Endless Frontier*. There he argued for continued public funding of basic research after the war, allowing researchers to follow their curiosity freely without being bounded by the consideration of implications. In the long run this contributed to social development by providing scientific impulses to technological change. Highly influential in the American government, these views soon spread over the industrialised world. Donald Stokes in particular has championed this description of the linear model and its influence.[1]

Stokes' presentation has suffered some criticism in recent years. David Edgerton notes that it is easy to find accounts criticising the linear model, but harder to find ones that advocate it. He takes this as an indication that the

[1] See Stokes (1997), pp. 2ff., 45–57. See also Mowery & Rosenberg (1993), p. 39; Freeman (1995), p. 9f.

linear model never really existed, except as a straw man constructed by recent innovation theorists who emphasise the interactive relationship between science and technology. That some academic scientists made exaggerated claims about the fruits of basic research with the intent of securing public funding cannot be taken as evidence that the linear model was widely accepted in the industrialised world. Edgerton aims to show that innovation scholars, non-academic scientists and engineers, as well as industry leaders, would not have supported a linear model of innovation in the 1940s and 1950s. He also questions the significance given to Vannevar Bush by Stokes and others. First, Bush argued for basic research to be supported because he feared it would fail to keep up with rising amounts of government and industrial applied research, and he did not claim that basic research was the main source behind innovation. Second, the influence of Bush has been widely exaggerated.[2]

Benoît Godin has sought to rehabilitate the linear model in the face of Edgerton's criticism. He agrees that it cannot be attributed to Vannevar Bush, but he is not ready to remove it from the post-war intellectual arena altogether. Bush may have seen basic research as a motor behind socio-economic progress, but he presented no specific model where the involved causal links were spelled out. Such a model rather emerged with the development of R&D statistics during the twentieth century. Up until the 1950s basic research, applied research and the development of products and processes were often mixed up statistically as 'research,' and there was no standardised way of measuring them in different countries. But in 1959 the National Science Foundation in the United States started using the now established taxonomy of basic research, applied research and development, and it specified instructions for how the three components could be separated in questionnaires. The OECD followed up in 1962 by presenting the Frascati manual, which spread the standardised and uniform way of measuring R&D over the industrialised world, creating a framework for internationally comparative R&D statistics. While developed for statistical purposes, Godin argues that 'the three categories also served to describe components or stages in the process of innovation, a description that culminated in the three-stage linear model: Basic research → Applied research → Development.'[3] Economists at business schools in the 1960s added a further stage that involved making the developed products or processes commercially viable and diffusing them into society, finally establishing a linear model of innovation. Resting on the foundation of internationally standardised statistical categories, the linear model remained strong despite the many critical attacks, as its rivals had not been able to provide an equally firm statistical base.[4]

[2] Edgerton (2004).
[3] Godin (2006b), p. 654.
[4] Godin (2006b).

Whether a straw man constructed by its critics or a reality embedded in international statistical categories, the linear model was something many of the later theories of innovation defined themselves in opposition to. They also largely defined themselves in opposition to neoclassical economics and its perceived inability to deal with technical change. During the twentieth century, economics had been increasingly oriented towards building sophisticated mathematic models, and the interest of economists tended to direct itself to issues suitable to such modelling. Microeconomic theory was concerned with optimal resource allocation in static circumstances, while macroeconomic Keynesianism studied how fiscal policy could be used to maintain full employment through boosted or restrained aggregate demand. In the first half of the twentieth century, Joseph Schumpeter had left the static framework by focusing on the entrepreneur as an agent bringing about innovation and thereby dynamic economic change. But the Schumpeterian view of the economy was largely marginalised and did not find its way into mainstream neoclassicism.

However, economists did touch on the role of technology indirectly when, from the 1950s and onwards, they tried to explain long-term economic growth, encouraged by the newly emerging statistical measures of national income. In a neoclassical framework, the output of growth was produced by inputs of more factors of production such as labour and capital. Diminishing returns eventually evaporated the gains of adding more units of labour and capital in a static environment, but the emergence of new technology was expected to continuously shift the production function and enable long-term economic growth. Economists were thus admitting that technical change was of vital importance to economic growth, but at the same time it was something residing outside of their models. They could not explain why and how technical change occurred using their standard neoclassical toolbox, but had to accept it as given by exogenous factors. Empirical studies of what made long-term economic growth happen, so-called growth accounting, found that inputs of labour and capital could only explain a minor part of the growth rates, while the large residual was assumed to be dominated by technical change.[5]

In the early 1960s Kenneth Arrow made some first attempts to venture into the residual by incorporating knowledge and learning into economic models. In his framework, knowledge was treated as standardised bits of information, expected to be easily transferable from individual to individual or company to company. It was treated as a commodity that could be bought or sold in the market, and the problem was how to ensure an optimal allocation of information in society when incentives might cause companies to

[5] See Rosenberg (1977), p. 85ff.; Nelson & Winter (1982), ch. 8; Nelson (1997), p. 36ff.; Godin (2004), p. 680ff.

invest too little in R&D.[6] He also introduced the concept of 'learning by doing' into the economic vocabulary. A worker is expected to become more productive through the experience of being involved in the production process and the associated learning, increasing company productivity even without the addition of labour, capital or technical change.[7]

Economic Crisis and New Innovation Thinking

While the two decades following World War II saw a golden age of high growth and productivity, this trend was reversed in the 1970s. Suddenly steadily increasing growth and productivity could not be taken for granted anymore, and both phenomena became problematic issues in need of explanation. With this new focus on the causes of long-term growth, it became even more unsatisfying to let the supposedly most important determinant, technical change, reside in an unexplained residual. Simultaneously the world experienced stagflation, the combination of high unemployment and high inflation, something deemed impossible in the Keynesian framework. This contributed to delegitimising the paradigmatic Keynesian way of viewing the economy and opened the door for new and alternative viewpoints.[8]

Many scholars viewed the neoclassical focus on deductive mathematical model building, inspired by physics, as an unsuitable framework for dealing with the often messy and differentiated processes of innovation. When Richard Nelson and Sidney Winter launched the alternative Schumpeterian methodological programme of evolutionary economics in the early 1980s, inspired by biology, they also made a new theoretical foundation available for innovation studies. Similar to biological evolution, they perceived the economy as consisting of companies and other organisations whose actions are governed by routines, institutionalised ways of doing things and deciding what to do. These routines are equivalent to the genes in biological evolution and tend to persist over time. But there are also mutations in the system that ensure variety, as companies might embark on the risky path of changing their routines, especially when faced with adverse circumstances where old ways of doing things no longer suffice. Over time selection forces will strengthen more efficient routines in a given environment and weaken the less efficient ones. This framework differed from neoclassical economics by focusing on the dynamic and historical development of the economy, rather than the static allocation of resources. It also dismissed the notion of opti-

[6] Arrow (1962b).

[7] Arrow (1962a).

[8] The link between the 1970s growth crisis and renewed innovation thinking has been made by Nelson & Rosenberg (1993), p. 3; Nilsson & Uhlin (2002), p. 2f.; Jessop (2002), ch. 3; Mytelka & Smith (2002), p. 1469ff.

mality as irrelevant in a dynamic evolving economy. Analysis and comparison should be directed at routines and institutions existing in the real world, not theoretical constructions of optimal ones. Finally, by placing itself closer to the empirical reality than neoclassical economics, evolutionary economics was better suited for transdisciplinary interaction with other social sciences.[9] Taken together, these differences increased the attraction of the approach to many innovation scholars. In the late 1970s Nelson and Winter had themselves applied their nascent evolutionary framework while surveying the existing literature on innovation. In their eyes, research so far had underestimated the complexity of the innovation process, as well as the complexity of the institutional structure supporting innovation. That institutional structure was likely to create different dynamics in different industries, and it could not be reduced to a few variables such as company size.[10]

The 1960s and 1970s saw an increase in empirical studies of innovation, several of them carried out in opposition to neoclassical economics and the linear model. Nathan Rosenberg was perhaps the most well-known empirical innovation scholar and published a series of articles during those decades, later collected in two major volumes.[11] Rosenberg's ambition was to remove focus from the major eye-catching technological breakthroughs, arguing that their economic effects had been overestimated. In fact, some of the economically most important innovations involved only minor changes in technology, as when overseas transport was revolutionised by the introduction of containers. If economic importance was the measure, innovation scholars should rather study the process where innovations became diffused throughout society, or the many incremental innovations that were necessary to make new technology usable in different contexts. A newly invented technology is usually crude and prone to errors, and its economic benefits can only be reaped after it has developed through a series of minor modifications.[12] He also picked up Kenneth Arrow's notion of learning by doing, where the increased skill that results from involvement in production adds to productivity. Rosenberg introduced the complementary notion of 'learning by using' to make sense of complex products consisting of subsystems that interact in unpredictable ways, such as airplanes and computer software. Often the bugs and errors embedded in these products will only emerge after an extended period of intensive use, contributing as a source of learning that sets in after the phase of production.[13]

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[9] Nelson & Winter (1982), ch. 17. The importance of evolutionary economics to innovation system thinking has particularly been stressed in Edquist (1997a). See also Mytelka & Smith (2002), pp. 1467, 1472.

[10] Nelson & Winter (1977).

[11] See Rosenberg (1977); Rosenberg (1982). For the importance of Nathan Rosenberg in the development of innovation thinking, see also Mytelka & Smith (2002), p. 1471f.

[12] See Rosenberg (1977), chs. 4 and 11; Rosenberg (1982), ch. 3; Kline & Rosenberg (1986).

[13] Rosenberg (1982), ch. 6.

Turning the linear model upside down, Rosenberg argued that the direction of scientific research was largely determined by technological factors. Technology can be seen as a practically oriented body of knowledge about what works in specific situations, while scientific knowledge concerns itself with the underlying principles that explain why it works. In general, technological knowledge tends to precede scientific knowledge as it to a larger extent is driven by economic incentives. From the pool of technological knowledge, science will pick up and explore those directions that offer the highest potential economic or social payoffs. Technology also steers science through the development of scientific instrumentation that sets boundaries for what researchers can observe and measure.[14] Together with Stephen Kline, Rosenberg elaborated his criticism of the linear model and presented the influential 'chain-linked model' as a more formalised alternative in the mid 1980s. Departing from a central chain of innovation covering the stages of design, development, production and marketing, it analyses feedback links going from later to earlier stages as well as feedback links from existing bodies of knowledge and new research.[15]

The OECD and the Emergence of the Innovation System Concept

When the innovation system concept emerged in the mid 1980s, innovation thinking had already made a profound departure from its position in the 1960s. The linear model, if it ever existed, had been thoroughly discredited in the debates on technical change, and for many scholars deductive neoclassical economics seemed a poor theoretical foundation for further analysis of innovation. Empirical studies had started to reveal the complex and interactive processes involved when new technology emerges and diffuses. It can be questioned to what extent the innovation system concept really brought something qualitatively new to the agenda. Bengt-Åke Lundvall argues that it was rather 'a synthesis of the most pertinent stylized facts produced by empirical research on innovation in the post war period ….'[16] But the concept did enable a more systematic attention to the socioeconomic environment in which innovative activities take place, and how it can facilitate or obstruct innovation. During the late 1980s and early 1990s innovation systems were usually discussed in terms of 'national innovation systems,' with a focus on the country-specific innovation environment. More or less independently of each other from the mid 1980s and onwards, several scholars started using

[14] Rosenberg (1982), ch. 7.
[15] Kline & Rosenberg (1986), p. 289ff.
[16] Lundvall (2004), p. 533. See also Mytelka & Smith (2002), p. 1472.

the concept when they performed empirical case studies on countries such as Japan, Denmark or the United States.[17]

Founder and director of the Science Policy Research Unit (SPRU) at the University of Sussex, Christopher Freeman was interested in explaining the trade performance of countries. Traditional explanations such as comparative advantages, wage levels and exchange rates were not sufficient to account for the long-term composition and competitiveness of external trade. This was rather a function of some countries taking a technological lead and maintaining it through continuous innovation, thereby increasing the difficulties for other countries to close in on the technology gap.[18] But technology changes in a cyclical fashion, and new techno-economic paradigms will emerge more or less regularly. These paradigms form around powerful generic technologies that often require a painful dismantling of existing infrastructures in order to be implemented. Shifts in techno-economic paradigms will therefore tend to destroy the technology gaps maintained by countries locked into obsolete tracks and create new gaps instead.[19]

To explain why some countries managed to adapt themselves successfully to new paradigms while other countries failed, Freeman analysed the national environment surrounding technical change. Here he acknowledged an intellectual debt to the nineteenth-century German economist Friedrich List, who had discussed the role of 'national systems of production' in promoting a German catch up with the then technologically advanced Great Britain. List also advocated the importance of learning and institutions in these systems.[20] Britain had attained a technological lead during the early industrial revolution, but lost it when new industries based on chemistry and electricity emerged in the late nineteenth century. This could be explained through the British lack of an institutionalised education system based on science and engineering and the associated inability of its industry to set up functioning R&D departments. In these respects, the environment in Ger-

[17] There has been a debate on when the innovation system concept was first used and by which scholar; see Sharif (2006), p. 750ff. Christopher Freeman used the term national innovation system once in an unpublished 1982 OECD paper, later published as Freeman (2004) [1982]. However, the term was used in passing and without being given a definition. In 1985 Bengt-Åke Lundvall made use of the innovation system concept in a research report on the interaction between users and producers, but without the national prefix. The first widely published mention of national innovation systems took place in 1987 when Freeman presented his book on Japan, conventionally taken to be the birth year of the innovation system concept. Interestingly, it appears that the first published appearance of the innovation system term occurred in the domestic Swedish innovation debate; see Vedin (1982), p. 16.

[18] Freeman (2004) [1982], p. 541ff.; Freeman (1987), p. 91ff.

[19] Freeman (1987), p. 64ff.; Freeman & Perez (1988).

[20] See Freeman (2004) [1982], p. 552ff.; Freeman (1987), p. 98ff.; Freeman (1995), p. 5ff. List has also been mentioned as an important intellectual influence for innovation system thinking by Lundvall (1992), p. 16.

many and the United States proved much more beneficial to adopting the new techno-economic paradigm.[21]

Freeman viewed information and communication technology (ICT) as the most important paradigm in present days, and the future welfare of countries depended on their ability to absorb it. Writing before the sluggish Japanese growth of the 1990s, he presented Japan as a prime example of an innovation environment perfect for such absorption.[22] While not so good at producing radical innovations of its own, Japan had since the Meiji reforms in 1868 developed an excellent ability to receive new technology from abroad and incrementally improve upon it. Refusing to accept foreign direct investments, Japan instead dismantled pieces of imported technology to figure out how they worked through reverse engineering. Freeman calls this innovation-friendly environment a 'national system of innovation' and defines it as '[t]he network of institutions in the public and private sector whose activities and interactions initiate, import, modify and diffuse new technologies ….'[23] One such important institution is the Ministry of Trade and Industry (MITI), with a good record of identifying the technologies that will be of importance in the future and proactively supporting their wide diffusion into Japanese society. The historical experience of reverse engineering produced companies well adapted to incremental innovation, without great cultural differences between production and R&D departments, or large status gaps between blue and white collar workers, making them work together in an integrated learning organisation. All this was aided by a good educational system and well-functioning training in the workplace. Freeman's analysis can be seen as an attempt to provide a framework for maintaining international competitiveness, without having to revert to neoliberal strategies such as lowering wages or dismantling the welfare state. In fact he presents Sweden as a positive example, claiming that its 'successful diffusion of ICT has been achieved whilst maintaining excellent social services, a rather high degree of consultations with trade unions and safeguards for civil liberty.'[24]

A member of the Innovation, Knowledge and Economic Dynamics (IKE) research group at Aalborg University, Denmark, Bengt-Åke Lundvall discussed the relationship between users and producers of technology, often with empirical illustrations from Denmark. He built upon Rosenberg's notion of learning by using, but took the fact that producers and users are normally institutionally separated from each other and need to communicate as his point of departure. The sources of innovation and growth did not come so much from formal R&D expenditures as from the quality of interaction be-

[21] Freeman (2004) [1982], p. 557ff.; Freeman (1987), p. 100f.; Freeman (1995), p. 6ff.

[22] See Freeman (1987); Freeman (1988).

[23] Freeman (1987), p. 1.

[24] Freeman (1988), p. 344; see also Freeman (1987), p. 90. Freeman's praise of Sweden is quite interesting, given the much more critical Swedish innovation debate analysed in chapter three of this book.

tween users and producers, prompting him to introduce the notion of 'learning by interacting.' Producers need access to the wants and needs of users, as well as their experience of using their products, while users need information about technological opportunities. But unlike Arrow's model, the exchanged knowledge could not be reduced to standardised bits of information, as it quite often was of a tacit and qualitative kind. Transferring tacit knowledge between users and producers was difficult, and the success depended largely on the socioeconomic environment in which it took place. Cultural and social closeness, mutual trust and shared codes of communication facilitated the interaction, but had developed historically over long periods of time. Formal institutions also contributed to the mutual trust that made communication easy. Especially in homogenous nation states such as Denmark, it was useful to focus attention on the national level while studying this kind of environment, or innovation system.[25] Although this analysis drew attention away from knowledge created by formal research, Lundvall admitted the importance of universities for innovation and saw the interaction between industry and university as a subset of the interaction between users and producers. But culture differed between industry and universities, and he saw good reasons to maintain those differences:

> If the academic mode of production is undermined and replaced by a profit-oriented mode of production, where pecuniary incentives become more important and where secrecy regarding the output becomes more frequent, the academic mode of behaviour may lose one of its principal merits – the tradition for world-wide diffusion of knowledge.… National systems of innovation may temporarily become strengthened when universities become subordinated to industry. In the long run, the production and world-wide distribution of knowledge may become weakened.[26]

Freeman and Lundvall largely focused on factors such as culture and the emergence of technological knowledge related to the organisation of production or the interaction between economic actors. In contrast, American scholars such as Richard Nelson and Nathan Rosenberg were more narrowly interested in the formal R&D system when they started using the concept, although they admitted there was more to the innovation system. Analysing innovation in the United States, world leader in R&D expenditures since World War II, they discussed how the institutional framework affected R&D issues. Companies' incentives to invest in R&D depended on their ability to keep the results to themselves, but the economic effects for society would be greater if the knowledge was widely diffused, a trade-off that might be alleviated with the correct institutional arrangement. They also discussed the

[25] See Lundvall (1985); Lundvall (1988); Lundvall (1992b); Lundvall (1992c).
[26] Lundvall (1988), p. 364f.; see also Lundvall (1985), p. 59ff.

effects of military R&D and procurement on the development of commercial technology and how it changed over time.[27]

Thus, the late 1980s and early 1990s saw an increased number of scholars who used the innovation system concept to describe an environment supporting or blocking the innovative activities they deemed most important, be it the ability to adapt to new techno-economic paradigms, to facilitate user-producer interaction or to ensure large enough private investments in formal R&D. This focus on the innovation environment can be seen as the culmination of a heterodox strand of innovation thinking, dissatisfied with the neoclassical methodological paradigm and seeking to discuss innovation in a more qualitative, historical and empirical framework. But parallel to this strand, neoclassical economists continued the project initiated by Kenneth Arrow in the early 1960s of integrating technical change into their deductive models. Endogenous growth theory, or new growth theory, was developed in the 1980s by the economists Paul Romer and Robert Lucas. In their model, profit-maximising firms involve themselves in R&D to come up with new technological knowledge, which can be seen as a function of human capital and existing stocks of knowledge. This new technological knowledge results in the design of a new product that can be protected by patent legislation, but it will also spill over and add to existing stocks of publicly available knowledge, thereby increasing productivity for other firms when they perform R&D. As part of the knowledge produced by firms will be a public good, firms will tend to underinvest in R&D, and there are good reasons for governments to support R&D and the creation of human capital.[28] Innovation system scholars have generally been unimpressed with the neoclassical attempts to make technical change endogenous. Richard Nelson argues that whatever insights endogenous growth theory may provide, they have already been well known by empirical innovation scholars for decades. Furthermore, the new growth theorists selectively engaged only those aspects of technology that were suitable for deductive equilibrium modelling, while disregarding the institutional framework and the organisation of production within firms.[29]

Viewed with disdain by most innovation system scholars, the emergence of endogenous growth theory may in fact have been a helpful boost to the breakthrough of their concept, at least according to Benoît Godin. Influenced by Romer and Lucas, neoclassical economists within the OECD began to open their eyes to the importance of technical change, and perhaps became more open to the introduction of heterodox innovation system thinking in the organisation.[30] Lynn Mytelka and Keith Smith argue that the OECD and the European Commission were less hierarchical as organisations compared with

[27] See Nelson (1988); Nelson & Rosenberg (1993); Mowery & Rosenberg (1993).
[28] Romer (1990).
[29] Nelson (1997).
[30] Godin (2004), p. 682.

the World Bank or IMF and more likely to accept the coexistence of heterodox innovation thinking alongside neoclassical economics. Niches, such as the Directorate for Science, Technology and Industry (DSTI) within the OECD, could be created within them that were more tolerant of alternative theories.[31] Many of the leading heterodox innovation scholars worked for and influenced DSTI during the 1980s and early 1990s, for example Richard Nelson, Christopher Freeman, Keith Pavitt and Bengt-Åke Lundvall, the latter as its deputy director between 1992 and 1995.[32] Many of these researchers were involved when DSTI initiated its Technology/Economy Program (TEP) in 1988, through which the recent waves of heterodox innovation thinking found its way into OECD policy documents. In particular the programme's final report, *Technology and Economy: The Key Relationships* (1992), has been seen by many scholars as the breakthrough for innovation system thinking within the OECD.[33] Admittedly, it is incorrect to view the OECD as a monolithic entity, and the heterodox strand of innovation theory is not likely to have gained universal acceptance within the organisation, at least not among all neoclassical economists. But the innovation system concept did become influential within the DSTI, and it received a prominent place in many of the later OECD publications. As such, the concept was viewed by the outside world as coming with an OECD seal of approval. Mathieu Albert and Suzanne Laberge's study of policy makers in Quebec confirms that the innovation system concept was in fact perceived this way.[34] Parallel with its increased acceptance in the DSTI and the OECD, the Finnish government was quick to pick up the concept in its policy language, as it struggled under a severe economic crisis following the collapse of the Soviet Union. As early as 1990 it played a prominent role in the guidelines published by the Science and Technology Policy Council in Finland.[35]

Besides its policy breakthrough in the OECD and Finland, the innovation system concept also raised its academic status through a couple of influential anthologies in the late 1980s and early 1990s. The first one came out in 1988 with the aim of spelling out an alternative to the neoclassical way of dealing with technical change. Even if it did not use the innovation system concept as its main focusing device, one of its sections used the heading 'national systems of innovation' and featured articles by Christopher Freeman, Bengt-Åke Lundvall and Richard Nelson.[36] In 1992 and 1993 two anthologies more explicitly founded on the innovation system concept were published. Lundvall's anthology was theoretically grounded, attempting to expand on his

[31] See Mytelka & Smith (2002), pp. 1470, 1474.
[32] Mytelka & Smith (2002), pp. 1474, 1478; Sharif (2006), p. 751f.
[33] See Mytelka & Smith (2002), p. 1474; Godin (2004), p. 683f.; Sharif (2006), p. 751.
[34] Albert & Laberge (2007).
[35] Miettinen (2002), ch. 4.
[36] Dosi et al. (1988).

discussion about interactive learning and user-producer relationships, sometimes with empirical illustrations from Denmark. In contrast, Nelson's anthology attempted to make sense of innovation systems through empirical and historical case studies on a number of countries. All the country studies were explicitly set out to be inductive and explorative rather than guided by pre-existing theory.[37]

After the innovation system concept had established itself in policy and academic circles in the early 1990s, it developed in several directions. First, the strong national focus of the early years was increasingly complemented by alternative delimitations of the relevant innovation environment. This process was reinforced by the general discussion among social scientists on whether the nation state was of importance anymore, or if globalisation had moved power to the regional and international level. Using the innovation system concept, which had been injected with legitimacy from the OECD and academia, many scholars directed their interest to the regional environment supporting innovative activities, or the environment surrounding innovation in certain economic sectors or for different technologies.[38] Second, Charles Edquist jumped into the innovation system debate in the mid 1990s and organised several international research collaborations, which among other things resulted in yet another innovation system anthology in 1997.[39] This work was encouraged by his personal dissatisfaction with the fuzziness and vagueness of the innovation system concept and the perceived need to make it more scientifically rigorous. In an ongoing research project supported by the European Science Foundation, he aims to more precisely pin down the systemic determinants of innovation and how they work. In collaboration with other innovation scholars, the national innovation systems in ten small countries are to be systematically compared, where the contributors are expected to follow a detailed guideline developed by Charles Edquist and Leif Hommen.[40] Third, in the last years Bengt-Åke Lundvall has spearheaded an attempt to apply the innovation system framework in the analysis of developing countries. Through the Global Network for Economics of Learning, Innovation and Competence Building Systems (GLOBELICS), a worldwide network of scholars, he hopes to strengthen innovation system research catering to countries outside the industrialised world.[41] Presenting the network together with Luc Soete, Lundvall argues that this will direct the attention of innovation scholars to where they can do most good:

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[37] Lundvall (1992); Nelson (1993). For a further comparison between those two anthologies, see McKelvey (1991); Edquist (1997b), p. 4ff.; Miettinen (2002), ch. 3; Mytelka & Smith (2002), p. 1472f.; Nilsson & Uhlin (2002), pp. 8ff., 17.

[38] See, respectively, Braczyk et al. (1998); Malerba (2002); Carlsson (1997).

[39] Edquist (1997a).

[40] See Sharif (2006), p. 758f.

[41] See Sharif (2006), p. 759.

> Our involvement over the last decades in numerous national and EU policy reports, advice, studies, with many other scholars, might marginally have contributed to some improvements in policy making and the academic understanding of the process of welfare increase associated with innovation and knowledge accumulation more generally, and its national distribution. However, compared to the utility of such research in the South, our personal utility has been marginal in the other meaning of the word. Hence, at the more personal level, we feel there is a strong need for scholars in the field of learning, innovation and competence building to start focusing on those parts of the globe where better insights might matter rather than be pecuniary led to focus on one's own rich periphery.[42]

The social consciousness expressed in the above quote, as well as the Marxist past of many of the innovation system concept's leading advocates, such as Lundvall, Edquist and Freeman, testifies to the 'leftist' origin of the term.[43] To a large degree its first uses can be seen as a reaction to the neoliberalism that emerged with Margaret Thatcher and Ronald Reagan in the 1980s. Countries should not compete in a globalised world through low wages and poor working conditions, but through the continuous development and diffusion of new technology. The exemplary country presented by Freeman was Sweden, with its ambitious welfare state and its quick adaptation to the ICT paradigm.

In contrast, and also from a perspective inspired by Marxism, Bob Jessop perceives the recent explosion of interest in innovation and competitiveness as an attempt to build a new regulatory framework to support capitalist accumulation after the breakdown of the Fordist and Keynesian welfare state in the 1970s. With innovations increasingly regarded as taking place in a socially embedded economy, previously accepted distinctions between economic and extra-economic spheres in society begin to break down. Sections of society that have previously been dominated by autonomous non-economic cultures, such as social policy or the university sector, may become colonised by this logic and enrolled in an ongoing project to enhance national competitiveness through a policy boosting innovation.[44] But as suggested by a quote from Lundvall in this chapter, at least attempts to colonise the university sphere are likely to be resisted by some innovation system scholars.

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[42] Lundvall & Soete (no date).

[43] See interview with Bengt-Åke Lundvall, January 18, 2006; Sharif (2006), p. 753.

[44] See Jessop (2002), ch. 3.

CHAPTER 3

Industrial Crises and the Early Swedish Innovation Debate

By the late 1990s the innovation system concept had firmly embedded itself in the growth policy discourse in many industrialised countries. It had been adopted by the OECD, Finland had been using it as a foundation for its policy rhetoric since the early 1990s and Sweden was just about to name a government agency after the concept. But the Swedish discussion about innovation did not start with the innovation system concept; in fact it had a long history to fall back on. In the 1940s and 1950s Erik Dahmén introduced Schumpeterian ideas into the Swedish economic debate, developed them and even anticipated Schumpeter's thinking on creative destruction. Until 1950 Dahmén worked at the Industrial Institute for Economic and Social Research (IUI), a think tank founded by Swedish industry and employer organisations, where his ideas continued to be influential. He later worked as a professor at the Stockholm School of Economics, all the time maintaining close connections with the leading Swedish banker and industrialist family Wallenberg.

Basically Dahmén criticised neoclassical economics for being static and relying too much on mathematical model building. Instead he advocated a focus on industrial transformation, economic history and the role of institutions. One of his major contributions was the notion of 'development blocks,' signifying the complementarity existing within groups of related innovations and physical investments made by companies. Dahmén had only a limited impact on the economics profession and the political system in Sweden, but he spawned a small group of followers, of which many had worked at IUI. Both Bo Carlsson and Gunnar Eliasson were prominent disciples of Dahmén.[1] All three of them participated when the Royal Academy of Engineering Sciences (IVA), in collaboration with STU, the Ministry of Industry and IUI started an investigation in response to the industrial crisis Sweden suffered during the 1970s. When the main report was published in 1979, it concluded that the crisis was likely to be permanent and that a renewal of the industrial structure was necessary. It suggested a strong increase in resources to support education and research in the natural and technical sciences, as well as

[1] On Erik Dahmén and his influence in Sweden, see Carlsson & Henriksson (1991); Pålsson Syll (1997), pp. 58–78; Johansson & Karlson (2002); Henriksson (2002); Karlson et al. (2007). Some even argued that the Dahménian legacy in Sweden served to crowd out interest for the new OECD-supported concepts of innovation systems and clusters for a long time; see Flodström (1999), p. 19; interview with Arne Eriksson, June 19, 2006.

company R&D. In general, the technical and industrial competence of Sweden needed to be strengthened in order to meet future technological challenges.[2]

The IVA report was only a beginning and parallel to it an intense public debate emerged on how to solve the industrial crisis in Sweden. In this chapter I will study the debate and try to identify the various strands of innovation thinking that emerged within it. Following that, I will investigate innovation thinking within the Swedish government agencies responsible for promoting technical change, as well as within the academic research groups they collaborated with or were influenced by. As was mentioned in the introduction, this chapter is meant to provide a background to my main research interest, namely how those wanting to open up universities to social and economic needs used the innovation system concept during the Swedish research funding reform process between 1995 and 2001. Therefore I will place special emphasis on how the studied innovation thinking dealt with universities and how it used the innovation system concept.

Interpreting the End of the Golden Age

Many scholars have associated the rising interest for innovation in the industrialised world with a general crisis for the post-war mode of production setting in around 1970.[3] Fordist mass production for mass markets had provided high rates of growth during the 1950s and 1960s, but after that many countries experienced problems of low growth, low productivity, high inflation and high unemployment. Discursively, the conventional Keynesian wisdom that had dominated economic debates in the post-war years lost its hegemonic position. The scene opened up for new interpretations about the nature of the economy, the causes of the crisis and the proper policies to promote growth. Some of these interpretations ventured in a Schumpeterian direction and emphasised the role of innovations.

The crisis of the industrial system that supported growth in the decades after World War II showed some peculiarities in Sweden that deserves mentioning. First, Sweden did not experience the high rates of unemployment many other countries suffered during the 1970s. This was mainly due to the political choice of making low unemployment rather than low inflation the top priority. On the other hand, inflation was in general higher in Sweden,

[2] IVA (1979). According to Bo Carlsson the report had a limited impact on Swedish policy, which continued to be mainly influenced by traditional macroeconomics; see Carlsson (2007), p. 120f.; Carlsson et al. (forthcoming), p. 4.

[3] See for example Nelson & Rosenberg (1993), p. 3; Nilsson & Uhlin (2002), p. 2f.; Jessop (2002), ch. 3; Mytelka & Smith (2002), p. 1469ff. Sharif (2006), p. 760f., is a notable exception, who focuses solely on globalisation and increased international competition as he explains the rising interest for innovation.

especially during the late 1980s.[4] Second, growth has been slower in Sweden than in many comparable countries since the 1970s, although growth rates began to improve from the mid 1990s.[5]

When the crisis hit Swedish industry it did so in two stages, one during the 1970s and one in the 1990s. Traditional Swedish industrial sectors, such as steel, forestry and shipbuilding, suffered badly during the 1970s, due to the oil crisis, new competitors and wage increases beyond productivity. For some years companies in struggling sectors were kept alive by the financial support of a mostly reactive industrial policy, but they where eventually restructured under government ownership. In the late 1970s and early 1980s a series of devaluations facilitated the recovery of Swedish industry. While the late 1980s saw a period of economic prosperity, although under high inflation, a second industrial crisis set in around 1990. A bubble in the real estate market, a bank crisis, speculations against the Swedish currency and high interest rates were factors that contributed to a strong downturn in economic activity. Between 1990 and 1993 growth rates were negative in Sweden. Under pressure from the economic situation, macroeconomic policy shifted focus and made the fight against inflation a top priority, allowing open unemployment to skyrocket from 1.7 percent to 8.2 percent between 1990 and 1993.[6]

Most observers agreed that the Swedish economy was in trouble after the 1970s, and a debate emerged about what was 'wrong' with it and how it could be corrected. Several interpretations on the nature of the crisis were presented during the last decades of the twentieth century. For traditional economic theory it was a matter of cutting the costs of companies to make them more competitive, through devaluations and restrained wage increases. This view was one of the main adversaries for innovation-oriented economic theorists. In a Post-Fordist economy, the latter argued, companies in the more promising and knowledge-intensive sectors do not compete by cutting costs as much as by coming up with and adopting new products and new ways of producing them.[7]

Another interpretation drew on the discussion about 'eurosclerosis,' the idea that the sluggish growth in Western Europe was caused by certain distortions stemming from the welfare state. Some voices suggested that these distortions were particularly evident in Sweden, to the extent of coining the phrase 'suedosclerosis.' Mancur Olson had pointed out that the existence of strong and well-organised interest groups, encouraged by corporatist governance, diverted resources in their favour. Olson made an exception for

[4] Lindvall (2004), p. 9ff.; Schön (2000), p. 480.

[5] Ljungberg (2005).

[6] Magnusson (1999), pp. 473–483; Schön (2000), ch. 6; Lindvall (2004), p. 11.

[7] See Best (1990). For entries in the Swedish debate, see Hägg & Johanson (1982), pp. 21, 207f.; Sölvell et al. (1991), ch. 6; Edquist (1993b), p. 31ff.; Ohlsson (1993), p. 7f.; Andersson et al. (1993), p. 14.

Sweden though, where the interest groups were so encompassing they had a stake in the general welfare of society. However, in time even encompassing organisations would devolve into narrower special-interest groups and pose a problem.[8] It was also claimed that Swedish policies had a distorting effect on economic incentives, which in part could explain the slow growth. The 1970s saw an expansion of the public sector, an increased tax burden falling on labour incomes and a high ambition to redistribute resources and maintain an egalitarian income distribution. According to the 'suedosclerosis' argument, these developments affected labour supply, as high average and marginal tax rates caused people to choose leisure rather than extra hours of work. By lowering the returns of education, the ambitious welfare state also discouraged human capital accumulation. Generous unemployment compensation reduced the incentives to look for a job.[9]

A third interpretation originated from Lennart Schön and a group of economic historians at Lund University. Based on a cyclical interpretation of Swedish economic development in the nineteenth and twentieth century, they made a distinction between transformation periods when blocks of new technologies are introduced and diffused in the economy, followed by rationalisation periods when they are exploited more efficiently. Growth and productivity is expected to be slower during the transformation phase, which made the sluggish Swedish growth after 1970 less alarming. The low growth rates were just a sign of the healthiness and thoroughness of the transformation period. Old industries such as steel and shipbuilding were restructured faster than in most other countries, and new industries based on electronics and life sciences were already evolving. The role of government policy is generally deemphasised in this perspective, as the periods of transformation and rationalisation tend to follow their own logic through history.[10]

Of course the cost crisis argument, the 'suedosclerosis' argument and the transformation/rationalisation argument far from exhaust all the positions and nuances in the debate on the Swedish growth crisis. Nevertheless, they paint a rough image of the intellectual climate surrounding those who wanted to promote innovations as a key determinant behind growth. In fact, as I hope to show, several different strands of innovation thinking emerged in the debate about what went 'wrong' after the Golden Age.

Bengt-Arne Vedin and the Entrepreneurial Inventor

One such strand emphasised the importance of individual inventors and can be linked to the innovation scholar Bengt-Arne Vedin, who presented it in a

[8] Olson (1982); Olson (1990), Olson (1996).

[9] See Lundmark (1983), chs. 1 and 5; Ståhl & Wickman (1993); Lindbeck et al. (1994).

[10] See Schön (1992); SOU 1995:4, appendix 3; Schön (2000), chs. 1 and 6.

number of reports from the early 1980s until the mid 1990s. Quite often the reports were collaborative efforts involving other innovation scholars, as well as participants from business and government circles, but for the sake of simplicity I will mainly accredit the thinking to Vedin. He headed a research project investigating the Swedish innovation climate at the think tank Center for Business and Policy Studies (SNS) in the late 1970s and early 1980s, and he also completed his Ph.D. within the project. Before that he had worked for IVA and as a reporter for the technology magazine *Ny Teknik*.[11] Eventually the project resulted in *The Swedish Innovation Climate* (1982), a theoretical and empirical analysis of the conditions for innovation in Sweden and how they could be improved. Interestingly, this book actually uses the term 'innovation system' in one passage: 'The "innovation system" is described as part of a general societal system, linked to among others the education system and the research system.' Although the sentence acknowledges some kind of systemic perspective, this very early usage of the term is most likely accidental rather than the result of a choice. It only occurs once and is not elaborated in the book.[12] Vedin also participated as a secretary in the investigation *Innovation Policy for Growth*, commissioned by the Ministry of Industry in 1981.[13]

According to Peter Schilling the 1981 report was to be agenda setting for Swedish innovation policy during the 1980s and early 1990s. In particular it instituted a clear separation between research and innovation policy:

> It is worth noting that innovation perspectives are not found in [Swedish] research policy during the 1980s. In fact a government report from 1981 explicitly stated that research and innovation should not be mixed, because there are fundamental differences between the two. This report set the agenda for innovation policy throughout the 1980s.[14]

This is in part a misinterpretation of Vedin's argumentation. It is true that Swedish research policy during the 1980s was more focused on promoting basic research and the researchers' control over funding than on facilitating innovations. This was mostly a reaction to the research policy of the 1970s, when large parts of university research were oriented towards needs within

[11] Interview with Bengt-Arne Vedin, April 7, 2006.

[12] Vedin (1982), p. 16, my translation. The origin of the term has been discussed, with Bengt-Åke Lundvall and Christopher Freeman suggested as its inventors; see Sharif (2006) p. 750ff. Recently the concept has been traced back to an unpublished OECD paper by Freeman from 1982. Now we may have a new candidate for first user!

[13] Ds I 1981:18. The other participants were Alf Sjöström (chairman) and Sten Henkow from the Ministry of Industry, Peter Jörgensen from STU, Torbjörn Ek, Leif Lundblad and Thomas Nilsson from innovation-oriented companies and finally Lars A. Ekström as an individual inventor.

[14] Schilling (2005), p. 77.

government sectors.[15] But the makers of research policy could hardly have received their inspiration from Bengt-Arne Vedin or the 1981 report. There are no explicit arguments to be found in his writing against integrating innovation and research policy. While Vedin does argue for an analytical separation between research and innovation, this is part of his criticism of the linear model. Instead of viewing economic growth as a function of R&D, he proposes innovations as an analytically distinct intermediary variable. There is no guarantee that increasing the input of R&D resources will pay off in innovations, so policy measures should be aimed at facilitating innovations directly rather than merely boosting R&D.[16] His definition of innovation policy is in fact built on the interplay between different policy areas:

> Innovation policy includes all the political measures affecting the development of innovations, i.e. the introduction of new ideas in society. Thus it will include large parts of the general political field, for example tax and other economic policies, the process of lawmaking, education policy and of course trade and industrial policy.[17]

Although there are no reasons in principle against an integration of innovation and research policy, Vedin does not seem to emphasise the role of research policy in his analysis. It is quite interesting that research policy is not even included among the policy areas he presents as affecting innovation. However, this does not mean the research system is entirely neglected in his analysis. The universities have a role to play in improving the innovation climate, but this role is mainly, though not exclusively, channelled through their function of providing education. They should incorporate innovation perspectives in the training of students, but also aid the start-up of new companies based on ideas from research.[18]

The general conclusion of the 1981 report and the SNS book was that the innovation climate in Sweden was not good and had in fact deteriorated since the 1950s.[19] This problem became even more pressing when the traditional industrial structure was in crisis. Vedin relied on the innovation cycle theory developed by William Abernathy and James Utterback and its distinction between new and mature technologies in his analysis of the Swedish growth problem. For a new technology, innovations require relatively small invest-

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[15] For Swedish research policy during the 1980s, see Premfors (1986); SOU 1995:121, ch. 4; Persson (2001), ch. 4; Benner (2001), p. 20ff.; Schilling (2005), ch. 4.

[16] Ds I 1981:18, p. 18; Vedin (1982), p. 41ff. This position is widely accepted in innovation research today; see Edquist (1997b).

[17] Vedin (1982), p. 108, my translation. See also Ds I 1981:18, p. 11.

[18] Ds 1981:18, p. 55; Vedin (1982), p. 368ff. An institutional separation between innovation and research support had been advocated much more clearly in SOU 1977:64, p. 227ff. But that time it failed to win over STU or the government, which preferred to keep the two areas more integrated; see Weinberger (1997), pp. 417–427; Persson (2001), p. 86ff.

[19] Vedin (1982), p. 168.

ments, while the potential returns are high. Companies based on new technology must constantly be prepared for change in order to compete, and product innovations dominate in this stage. These early innovations tend to have beneficial effects on employment. When the technology has matured, things are different. Investments in capital are high for companies based on mature technology, but returns are considerably lower than in the early phase. The shape of the product has by then settled in, so most innovations are process-oriented and have low or negative effects on employment. As both technology and markets are well established and fairly standardised, it is easy to move production around the world, and the latest instalment will be the most competitive.[20] Unfortunately Sweden had an industrial structure that was dominated by a few large companies, based on mature technologies and exporting generally low-tech products. All this made Sweden very vulnerable when newly industrialised countries began competing in the traditional sectors: 'We are in fact unusually vulnerable for new competition, price pressure or failing markets within the areas that dominate our [industrial] structure, and we are also unusually dependent on companies working with squeezed margins and limited growth possibilities.'[21]

In order to solve the growth problem, Sweden had to move beyond its traditional industries and introduce new ones based on technology in the early stages. Here innovation policy had a vital role to play. In Vedin's analysis of the innovation process, he emphasises the role of individual actors, such as the inventor coming up with the idea and the entrepreneur making it economically viable, rather than impersonal institutions and organisations. He praises the 'heroic,' 'creative' and 'visionary' character traits of innovative actors going up against established structures.[22] Some of his inspiration obviously comes from the Swedish history of 'genius firms' (snilleindustrier), companies founded around important innovations during the late nineteenth and early twentieth century, that eventually grew large and internationally competitive. These firms, such as SKF based on the ball bearing, the gas company AGA founded by Nobel Prize winner Gustav Dahlén and Alfa-Laval based on the cream separator, were explicitly mentioned in the report and presented as role models.[23]

Vedin was pessimistic about the possibility of renewing Swedish industry within the flora of existing companies. Established firms were bound by previous investments in the capital stock, but also in organisation and in the culture that had developed around a certain kind of activity. Therefore it would be 'not only rational, but in the short term necessary to refuse ideas

[20] Ds I 1981:18, pp. 16, 24f.; Vedin (1982), p. 72ff. See also Abernathy & Utterback (1978).
[21] Ds I 1981:18, p. 22, my translation. See also Vedin (1982), p. 96ff.
[22] See for example Vedin (1982), ch. 6.
[23] Ds I 1981:18, p. 22f.

outside the basic business idea and strategy of the firm.'[24] The mechanism for renewing industry had to work through the start-up of new and fresh companies, often in some kind of interplay with established firms:

> A significant part of the renewal will have to come from completely new companies – new companies that grow large, that are bought by existing large companies and become an injection there, as well as new 'firms' started within the framework of existing large companies. We have seen how all new employment in the private sector is created in new companies. We have seen that new organisational forms and new companies are necessary in order to successfully pursue new technology. If nothing else so that established companies will see what is on the way and thus be forced to abandon their defensive positions.[25]

The major task of an innovation policy was therefore to support radical innovations and the start-up of new companies. According to Vedin, the existing administrative structure was quite sufficient to implement such a policy, and there was no need to add any new layer of bureaucracy, nor was any extra funding needed. Rather, he suggested a temporary innovation committee, tied to the Ministry of Industry, with a six-year mandate. Its purpose was to watch how the national innovation climate developed and to facilitate cooperation between ministries. Every ministry and government agency should also make a member of its staff responsible for ensuring that innovation aspects were considered in the organisation's activities. Likewise, all new legislation should be reviewed from an innovation perspective.[26] However, in line with his emphasis on individual actors and their personality traits in the innovation process, the same theme colours his view on policy implementation: 'Measures and policies often play a smaller role than the choice of persons set to implement the measures and policies.'[27]

As the chain of events from the first idea to its profitable implementation was risk-filled and vulnerable, most of the proposed policy measures focused on supporting that journey. These included modifying the tax rules to increase the rewards of a successful innovation, aiding the development and formulation of new ideas to make them more persuasive, facilitating the flow of venture capital to new companies, strengthening the immaterial property rights of inventors, using technological procurement to encourage innovations and organising information campaigns about the importance of innovation.[28]

In sum, for Vedin an innovation policy based on aiding the courageous and visionary inventors and entrepreneurs was the key to solving Sweden's

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[24] Ds I 1981:18, p. 28f., my translation.
[25] Vedin (1982), p. 102.
[26] Ds I 1981:18, pp. 8, 51f.; Vedin (1982), p. 359ff.
[27] Vedin (1982), p. 357, my translation.
[28] See Vedin (1982), ch. 19; Ds I 1981:18, p. 31f., ch. 7.

vulnerable dependence on large companies based on mature technologies. These companies were not able to make the switch to new dynamic technology on their own, so the process must go through the start-up of new companies. This particular way of looking at innovations was partly a polemical reaction against international trends in innovation research, and in particular against Nathan Rosenberg, who according to Vedin had neglected the entrepreneur and focused too much on impersonal forces and incremental innovation in large organisations.[29] But it was also a reaction against contemporary accounts that emphasised the role of existing large companies in Swedish industrial renewal. For example, business and government representatives had jointly commissioned international consultants in the Boston Consulting Group to investigate how the Swedish industrial crisis could be alleviated, which led to a report in 1978. The consultants recommended Sweden to abandon or downsize industrial sectors, such as iron, steel, forestry and shipbuilding, where the international competitive situation had become untenable. Market forces alone were not sufficient to make new industrial sectors grow, so the government, industry and the trade unions should make a united and coordinated effort to investigate which sectors were promising and channel investments in that direction. This renewal would mainly have to take place within existing large companies, an idea that Vedin criticised strongly.[30] In the end however, his focus on inventors, radical innovations and new companies may largely be the product of his experience interviewing inventors for the SNS research project. When his dissertation had been published in 1980, he was still mainly interested in large companies and supporting radical product innovations within them:

> My dissertation … which came in 1980, but I designed the project in 1977 and then I was stuck in the same [thinking] as … the Boston Consulting Group … that is, that it was the large companies that were important for Sweden and that it was them one should study. But then when I worked with this … I started to turn around.[31]

During the late 1980s the economic climate in Sweden improved, partly due to devaluations and a boosted export sector. Unemployment continued to be low, and the industrial sectors in crisis had been restructured under government supervision. Some, such as the shipbuilding sector, had been dismantled entirely. Maybe this breathing space served to lessen the interest for innovations and industrial renewal. In any case, it took until the early 1990s before the innovation debate thrived again, this time against the backdrop of a second economic crisis, complete with negative growth, high un-

[29] See Vedin (1982), pp. 77, 303. Cf. Rosenberg (1977), chs. 4 and 11; Rosenberg (1982), ch. 3.
[30] Boston Consulting Group (1978), p. 8, ch. 6. For Vedin's criticism, see Vedin (1982), p. 80ff.
[31] Interview with Bengt-Arne Vedin, April 7, 2006, my translation. See also Vedin (1982), p. 15f.

employment and company bankruptcies. The early 1990s also saw a shift in power, as a centre-right coalition took over in 1991 from the Social Democratic Party, which had governed since 1982. The centre-right government only lasted until 1994, but it presided over the most severe years of economic crisis and a large part of the resurfacing innovation debate. According to Mats Benner, this new government did not pay much interest to industrial and technology policy. Rather, its aim was to promote growth through scientific research, where the universities were given considerable autonomy, while resources were concentrated in areas thought to be of importance for growth.[32] In particular, it boosted research by setting up a series of research funding foundations with money taken from the dismantled wage earner funds.[33] By channelling funding through private foundations, the government took the unique step of placing a considerable part of research funding outside the public sphere.

Nevertheless, the new government showed at least some interest in innovations when in 1993 it asked Bengt-Arne Vedin to once again investigate the Swedish innovation climate and propose policy measures. The focus on individual inventors and small companies previously associated with Vedin was mentioned already in the instructions to the investigation. It should 'throw light on what is needed in order to facilitate the commercialisation of innovations in Sweden, not least for the individual inventor or the small business owner.' Vedin was also asked to investigate the need for a foundation supporting innovation.[34] In the spring of 1994 he made another contribution to the innovation debate when he chaired a symposium on innovation policy at IVA. Four researchers presented papers on innovation, and the discussion was later summarised in a report by Vedin, with some help of a steering committee.[35]

According to Vedin, his focus on the inventor and entrepreneur still held sway in the knowledge economy:

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[32] Benner (2001), ch. 2, p. 212ff.

[33] The wage earner funds were an attempt by the trade union movement and the Social Democrats to counter certain side effects of the solidaristic wage policy, which demanded equal pay for equal work regardless of the competitiveness of the company. They were especially critical of the large profits produced in some companies and the concentration of economic power. Set up in 1982, Swedish industry and the centre-right opposition viewed the funds as a disguised attempt to socialise large parts of the private sector. When the centre-right coalition gained power in 1991, it immediately dismantled the wage earner funds and used the accumulated assets to establish research foundations and venture capital companies; see Lewin (1992) ch. 9; Benner (2001), p. 53ff.

[34] Dir. 1993:71, my translation.

[35] The researchers were Bo Carlsson, Stefan Fölster, Anders M. Lundgren and Jon Sigurdson. The committee included Birgit Erngren, head of NUTEK, Uno Afredeen and Roland Jacobsson, both entrepreneurs, and finally Anders Flodström, professor in physics. Flodström later played a major role in the adoption of the innovation system concept in Sweden.

> [I]t is a mistaken view to believe that the development towards research-based products … would have made the individual inventor a thing of the past.… For some products it is of course impossible to work from home or from the famous garage, but that far from applies to all.[36]

The major problem was that Swedish small and medium-sized companies were reluctant to grow into large ones. In an international comparison this made Sweden relatively unique, as most other industrialised countries had a section of medium-sized dynamic companies with growth potential to fall back on. Vedin explained this with 'the business owner's fear of losing control over his company, his life-work, his identity.' He would rather stay small and in control, than have his company taken over by outside investors. It was thus necessary to come up with ways of channelling venture capital into these companies that could share the risks associated with their growth, but without sharing the ownership.[37] Just like in the 1980s, creating new companies and making them grow was the key to economic success: 'The starting up of new Swedish firms and a company growth of American proportions would solve the economic problems of our country.'[38] Another concern was that small and medium-sized firms often lacked the skills and resources to nurture their innovations from the first idea to the stage where economic benefits could be reaped. Here several policy measures could help, above all making qualified counselling available. He also suggested placing recently graduated engineers in small companies, in order to both inject skill into the company and provide working-life experience for the new engineer.[39]

Many of the proposed policy measures were similar to the ones suggested in the 1980s. These included increased resources for technological procurement, modifications of the tax system to promote innovations, protection of the immaterial property rights of the inventor and information campaigns about the importance of innovations. Vedin again proposed that new laws should be reviewed from an innovation perspective and that someone in the government should bear the responsibility. However, here his ambitions seem a bit more modest compared to the early 1980s, when he wanted each ministry and government agency to have its own staff member responsible for the innovation perspective. Naturally he was in favour of a foundation supporting innovations and suggested forming the Innovation Center Foun-

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[36] SOU 1993:84, p. 112, my translation. Sometimes Vedin used more lyrical prose to describe the inventor: 'For the creator of something new it is also the desire and the compulsion to discover, invent and make up. It is an urge, a deeply satisfying emotion, to see the solution to a problem, to create and to develop new ideas. It is a reward to see them come true, like the artist's joy over the finished piece. The creation is also a compulsion …. [I]t is impossible not to ponder over problems or to try to find ways to bypass what seems inefficient, bad, difficult, troublesome.' SOU 1993:84, p. 10, my translation.

[37] IVA (1994), p. 14, my translation. See also SOU 1993:84, p. 120ff.

[38] IVA (1994), p. 15, my translation.

[39] SOU 1993:84, p. 135; IVA (1994), p. 15f.

dation, economically separate and with its own board, but within NUTEK. It should be able to grant 100 million crowns annually.[40] Such a foundation was in fact set up and given roughly 500 million crowns to distribute over ten years, taken from the dismantled wage earner funds.[41]

The 1990s reports also elaborated on the role of research in the innovation processes. As usual the linear model where innovations were seen as following from scientific breakthroughs was criticised. In fact there were many possible avenues innovations could take, and it was impossible to speak of one single innovation process. Some innovations could be linked back to breakthroughs in research, but they constituted a fairly small minority. Impulses for innovation could instead come from perceived needs in society, developments in the market situation or interaction with users. Impulses could very well work in the opposite direction of what the linear model assumed, with new innovations inspiring scientists to develop theory.[42] Too much emphasis had been put on innovations in research-oriented high-tech industrial sectors, to the point of forgetting that low-tech innovations are of equal importance to economic development.[43] In sum:

> It is not the primary task of the country's researchers to create innovations, and not many researchers possess the skills or interest needed to become an entrepreneur. A lot of resources have been spent on university-based enterprise during the last decades, and there are many examples of successful companies of this sort. However, this will most likely remain a limited part of the collected enterprise and the collected innovative activity in the country.[44]

One interesting aspect of the reports is that they increasingly make use of the innovation system concept. By the early 1990s Bengt-Arne Vedin had noticed the rise of the concept and read most of the anthologies that launched it.[45] In the 1993 investigation the concept occurs a number of times, usually in passing and without being given an explicit definition.[46] A year later, in the 1994 IVA report, it has made its way into the main title: *The Swedish Innovation System: National or International, One or Many?* Even here it is not explicitly defined, and there are no references to the international community of scholars associated with the concept in either of the reports. Based on the context in which it is used, some educated guesses can be made about what is meant with it, however. In general an innovation system appears to

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[40] See SOU 1993:84, ch. 8.

[41] Prop. 1993/94:206. According to Vedin this was the only major policy impact of his collected investigations; interview with Bengt-Arne Vedin, April 7, 2006.

[42] SOU 1993:84, p. 13ff. See also IVA (1994), p. 12f.

[43] SOU 1993:84, p. 111.

[44] IVA (1994), p. 16f., my translation.

[45] Interview with Bengt-Arne Vedin, April 7, 2006.

[46] See SOU 1993:84, pp. 6, 155ff., 172ff., 190.

be *all* the properties in the surrounding society that affect the likelihood of actors to venture into the risky business of pursuing an innovation:

> A nation's innovation system is often presented as the institutions that more or less directly have the purpose of stimulating innovations. Other factors are in fact more important, more precisely the surrounding climate of enterprise and the basic economic conditions. Just like the company, the nation is a product of its history, which influences the general psychological climate and the leading role models, the ruling industrial structure, existing networks within research, technology and enterprise. The innovation system therefore includes company behaviour, for example dependency on and construction of sub-contractor systems, attitudes towards spin-offs from existing large companies, common viewpoints ….[47]

In this way the concept was given a certain bias in favour of radical innovations, rather than incremental ones. This surrounding climate is separated by Vedin into three parts, some of which were mentioned in the quote. First, it consists of the general cultural and psychological climate, the extent to which innovations are a valued thing in society and the existence of role models to emulate. Second, it includes the general economic preconditions for innovation, such as access to venture capital, beneficial incentives from the tax system and a low interest rate favouring investments in innovations. Finally, given the longevity of the innovation process and the element of risk, the stability and calculability of institutions, interest rates and exchange rates are vital.[48]

The focus on individual inventors was shared by some other participants in the debate, for example the inventor and entrepreneur Lennart Stridsberg, who stressed this in a series of columns in the main daily *Dagens Nyheter* between June 1993 and January 1994. Creative people in Sweden were no longer interested in becoming inventors and starting up new businesses. Being an innovator was associated with high risks and low returns thanks to the tax system. Instead they pursued relatively safe careers within companies, universities, or as consultants.[49] The growth crisis could not be solved by boosting scientific research with further resources, as was the current government strategy. That only diverted more people from innovation and entrepreneurship, encouraging them to pursue careers in the university sector instead. Further research in the technical and natural sciences only produced more articles, but since they were publicly available, the findings could be transformed into new products anywhere in the world and were not a specific competitive resource for Sweden. In fact there was an established negative relationship between Nobel Prizes in science and growth. Japan was a prime example of a country with few resources devoted to basic research,

[47] IVA (1994), p. 10, my translation.
[48] IVA (1994), p. 10ff.; SOU 1993:84, p. 172ff.
[49] Stridsberg (1993b).

but with high growth (at least until the 1990s), while the opposite was the case for Great Britain.[50]

To sum it up, money should be spent directly on innovators and their companies rather than on research. But it was problematic to rely on venture capital, partly because it tended to favour established firms and partly because it made inventors lose control of their companies. Studies had shown that in America the main motivation of entrepreneurs was to make money, but in Sweden they favoured independence and control. A better option was to lend money to inventors without security, as had been done on a small scale in Sweden during the 1980s. This had resulted in the start-up of several dynamic companies, and the money had in time been recovered. On a larger scale, this could be the way out of the contemporary industrial crisis.[51] The Innovation Center Foundation was a step in the right direction, but compared to the magnitude of support for inventors and small companies in Japan, it was but a drop in the bucket.[52] Focusing the resources on inventors would make it possible to re-create the magnificent feats of ancient days:

> Many Swedes would be able to come up with new industrial products and employ lots of people if 'only' they received a couple of millions, had the possibility of calling the shots and had access to some committed advisers with whom they could discuss when they felt unsure. Around [the year] 1900 Swedes like that founded companies such as Aga, Asea, Ericsson and Nobel Industries. But that was long ago. For the last 40 years those kinds of Swedes have done other things than creating new export industries.[53]

Charles Edquist and the Social Science-Informed Innovation Policy

A second strand of Swedish innovation thinking can be associated with Charles Edquist and emphasised the importance of relying on social science research in an active government innovation policy. In particular, innovation system research could be a useful tool in transforming Sweden into a high-tech industrial economy. Edquist put much effort into promoting this view in Sweden during the 1990s. Oriented towards Marxism in the 1970s, he became interested in technological change while working on his Ph.D. in economic history at Lund University. During the 1980s he got to know some of the internationally famous innovation scholars, especially Nathan Rosenberg who often visited Lund. In the early 1990s he became aware of the innovation

[50] Stridsberg (1993d); Stridsberg (1993f).
[51] Stridsberg (1993a); Stridsberg (1993b); Stridsberg (1993c); Stridsberg (1994).
[52] Stridsberg (1993b); Stridsberg (1993e).
[53] Stridsberg (1993c), my translation.

system school through Bengt-Åke Lundvall, who invited him to conferences in Aalborg and collaborated with him on a comparison between the Danish and Swedish innovation system, meant to be a part of Richard Nelson's anthology.[54] This book, published in 1993, was largely an empirically oriented collection of case studies on the innovation systems in various countries. An earlier version of the paper was presented in 1991 as a research report at the Department of Technology and Social Change (Tema-T), Linköping University, where Edquist was working at the time.

Many of the thoughts in this paper had been anticipated in earlier works of Charles Edquist, but this time they were put together using the innovation system concept as an umbrella label. According to Edquist, the experience of working with the concept inspired him to continue his investigation of the Swedish case.[55] Indeed, several of the themes he later elaborated are present in the paper. Edquist and Lundvall's analysis was based on the following definition of an innovation system:

> The national system of innovation is constituted by the institutions and economic structures affecting the rate and direction of technological change in the society. Obviously, the national system of innovation is larger than the R&D system. It must, for example, include not only the system of technology diffusion and the R&D system but also institutions and factors determining how new technology affects productivity and economic growth. At the same time, the system of technological change is, of course, less comprehensive than the economy/society as a whole.[56]

Unlike Vedin's, this definition does not privilege any specific kind of innovation or the role of any specific kind of actor. In fact, Edquist and Lundvall's writing is generally on a level that emphasises more impersonal forces, such as institutions and organisational structures, while inventors and entrepreneurs tend to be absent. This trend can be seen in their reappraisal of Swedish genius firms in the late nineteenth century: 'The focus upon single inventtions and single inventors can be misleading to a certain degree. All of the breakthroughs were, obviously, cumulative in the sense that they were built upon a competence reflecting several decades of experience with metalworking and with technical development in engineering.'[57] As can be seen, both of the above quotes acknowledge the role of history and path dependence in shaping the direction of technology in a country.

The authors drew on a typology of innovations in their empirical analysis, and this typology continued to be central in Edquist's innovation thinking. Product innovations were new products (goods or services), while process innovations were new ways of making products. Sometimes the line between

[54] Interview with Charles Edquist, January 20, 2006.
[55] Interview with Charles Edquist, January 20, 2006.
[56] Edquist & Lundvall (1991), p. 7.
[57] Edquist & Lundvall (1991), p. 14.

product and process innovations could be blurred, as when a new product was used as a machine in the making of other products. There was also an analytical separation between the development of new technology and the diffusion of existing technologies. Absorbing a new technology throughout a country required a series of incremental innovations to make it fit into already existing structures.[58]

Beneath the superficial similarity between the two Nordic countries, Edquist and Lundvall found some significant differences in their innovation systems. Still, the result due to these systems was similar: '[T]he slowdown of economic growth [in Denmark and Sweden], at least to a certain degree, reflects weaknesses in the national systems of technological change.'[59] Historically, Denmark had developed an economy based on refined agricultural products, a strong cooperative movement and a dominance of small and medium-sized companies. In Sweden the main economic sectors were based on natural resources, such as forestry, mining and steel, or on engineering. A few large and multinational companies dominated the industrial structure.[60] Denmark spent few resources on R&D, while Sweden was only surpassed by Japan in the share of its GDP spent on research and development. Sweden was very good at absorbing new process technology, aided by a union movement with favourable attitudes towards rationalisation. Denmark fared less well in this area. Altogether, these facts made it all the more surprising that both countries had a very low R&D intensity among their products. For Sweden this was particularly puzzling, given the amount of resources it spent on R&D.[61] This was partly the result of an historical lock-in and could be very dangerous for Sweden's future economic development, considering that the potential for growth lay in high-R&D products:

> … Sweden is locked into the mechanical trajectory in the engineering industry and still quite tied to the raw material base in other sectors of industry …. The big firms have built, around them, networks of domestic suppliers directly dependent on the performance of the big firms.… If these big firms do not succeed in developing efficient production in the new high-growth product areas, the problem of stagnation can become very serious for the Swedish economy.... The whole institutional set-up, the whole innovation system (including state policy), seems to have been geared towards movement along one trajectory.… The average low-R&D character of Swedish production is a severe problem for the Swedish system of technological change. And this problem is certainly not solved spontaneously by the market. Therefore there are reasons to consider whether state intervention could mitigate the problem.[62]

[58] Edquist & Lundvall (1991), p. 8f.
[59] Edquist & Lundvall (1991), p. 29.
[60] Edquist & Lundvall (1991), p. 11ff.
[61] Edquist & Lundvall (1991), p. 29ff.
[62] Edquist & Lundvall (1991), p. 37f.

Several themes in this quote were be taken up and developed in later works by Edquist, including the graveness of the situation, the low-tech character of Swedish industry and the need for government intervention as market forces were unable to solve the problem.

In 1989 Charles Edquist was asked by the Ministry of Industry to evaluate government support for technology in the Swedish engineering industry. He found that although Sweden was already world leading in quickly spreading process technology, most of the support had been aimed at supporting that very process. Product technology was more important for growth and employment, but had only received a minor part of the support. Part of the problem was STU, an agency with economic and organisational interests in the system it was supporting and with too much influence over Swedish technology policy. Instead, he suggested increasing the competence in technology policy at the Ministry of Industry by creating a working group. Most of the policy measures he proposed, such as using tax incentives and technological procurement, would also fall outside the domain of STU.[63] According to Edquist himself, this evaluation diminished his chances of influencing STU or its successor NUTEK: 'Besides, I had very poor relations with NUTEK, because I did an evaluation of a large programme at NUTEK [then STU] that was partially critical and they couldn't take that so to speak. So I was partly banished for many years.'[64]

Out of favour with STU and NUTEK, Charles Edquist instead turned to influencing the political level. In the early 1990s he was approached by the Social Democratic opposition and asked to write two reports relating to industrial policy. At that time Göran Persson, later prime minister, and Anders Sundström, later minister of industry, were responsible for industrial policy issues within the party. Sundström wrote in the introduction to one of the reports that 'Sweden of today has no industrial policy. For the centre-right government this is an area to be dismantled. We Social Democrats offer an alternative. It is a new and active industrial policy, with cooperation and pragmatism instead of ideological rigidity.… We have asked Professor Charles Edquist to deliver a basis for this.'[65] There appears to have been a mild conceptual battle involved in the discussions behind the reports, signifying that there was still not a universally positive ring to the word innovation. The Social Democrats were reluctant to use the term 'innovation policy' and preferred sticking to the more traditional label 'industrial policy.'[66] But for

[63] See Edquist (1991), ch. 6.

[64] Interview with Charles Edquist, January 20, 2006, my translation.

[65] My translation. This introduction was added to Edquist (1994) when it was published within the Social Democratic report series *Industrial Policy for Growth* (Näringspolitik för tillväxt), as report no. 1. There was no such introduction when it was published as a research report at Tema-T.

[66] 'Göran Persson didn't like this thing called innovation policy, he wanted it to be called industrial policy …. But it turned out he was wrong, so to speak. The term used now is inno-

Edquist industrial policy was a word 'tainted by the dirty luggage of "emergency rescue" and government support to shipbuilding and other "dying" industries. The term innovation policy brings forward associations of change, flexibility, dynamics and future.'[67] Nevertheless, the collaboration resulted in the report *Innovation Policy for the Renewal of Swedish Industry* in 1993. The following year a report dealing more specifically with technological procurement was published.

Edquist criticised the present government for its 'view that the market in relatively sole majesty will solve everything for the best regarding industry's development.'[68] The centre-right government was preoccupied with macroeconomic management, tending to the budget deficit, the exchange rate and inflation, while ignoring the real economy. It appeared they expected lowered employer fees and a depreciated currency to lift industry from its deepest crisis since the Depression. Many of the traditional policy instruments had ceased to work during the past years. With the current budget deficit, it was impossible to boost demand in a Keynesian fashion, while international dependence and a floating currency made it difficult to set a Swedish interest rate separate from the rest of the world. This left industrial policy as the only viable way out of the crisis.[69] Traditional economic theory was generally a poor guide in this situation, because it had little to say about technological change, except that it was exogenous and the major determinant behind productivity and growth. Still, 'traditionally inclined economists have had access to the ears of policy makers to a higher degree than representatives from any other social science discipline. In other words, traditional economics has gained influence over a policy area about which the theory does not have very much to say.'[70] An innovation policy must seek inspiration elsewhere, for example in the budding innovation system approach. Presently the approach was still a loose analytic framework and needed to be made more rigorous and formalised before it could be of use. But when it has been 'developed further it will be able to function as a framework for formulating innovation policy.'[71]

Edquist argued that it was important to formulate precise and achievable goals in an innovation policy. That made it easier to evaluate policy measures afterwards, with the help of rigorous scientific theory: 'The connection between the instrument and the target needs to be scientifically established, i.e. it has to be certain – or at least probable – that the target will be reached if the

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vation policy, even in Sweden.' Interview with Charles Edquist, January 20, 2006, my translation. Note that Sundström used the term 'industrial policy' in his introduction.

[67] Edquist (1993b), p. 7, my translation.

[68] Edquist (1993b), p. 19.

[69] Edquist (1993b), p. 32ff.

[70] Edquist (1993b), p. 15, note 21, my translation.

[71] Edquist (1993b), p. 18, my translation.

measure is used in a proper way.'[72] A scientific foundation for innovation policy was useful in other ways as well. It safeguarded against a mindless import of policy programmes from other countries where the conditions for policy are different. But it also helped policy makers to maintain a tough stance towards pressures from vested interests, such as companies, government agencies or unions: 'The lobbyists are … often a conservative force that fortifies old structures and activities rather than initiating activities within new areas in a flexible way. But the future has no lobbyists.'[73]

The main problem with Swedish industry was that it, compared to other OECD countries, tended to produce low-tech products, or rather, that high-tech products did not diffuse easily into the Swedish companies. It was basically not a research problem, not a development problem, but an absorption problem. Being a small country, most of the product technologies used in Sweden are not likely to originate from domestic R&D, inventors or universities. Rather, they will have to come from abroad.[74] The problem is thus one of absorption, to increase the capacity of firms to adopt high-tech product technology regardless of where it might have come from. In Edquist's view, the importance of supporting Swedish inventors, R&D and the knowledge transmission from domestic universities had been overestimated: '[T]here is a strong unwarranted belief [in Sweden] that university research within the technical and natural sciences will solve the industrial problems.'[75]

The reasons for the general low-tech character of Swedish products remained to be investigated, but Edquist did propose some hypotheses. It was rational for the individual company to remain in the trajectory where it had built its competence, rather than venturing into uncharted territories. Given the Swedish tradition of devaluations, the export-oriented industries were under no particular pressure to make the switch to high-tech products. Even if they had wanted to, the low unemployment rate until the early 1990s made it difficult to find qualified engineers.[76] If nothing changed, newly industrialised countries would increasingly compete within the low-tech industries, while Sweden would de-industrialise and revert to an industrial structure 'resembling developing countries.'[77] But if the switch was made, a lot could be gained. High-tech products were generally friendlier to the environment,

[72] Edquist (1993b), p. 21, my translation.

[73] Edquist (1993b), p. 22f., my translation. Edquist's stressing of the need for scientific rigour in policy did not stop him from praising Japan for 'taking advice from bureaucrats and administrators who had learned economics the practical way – rather than from professional economists.… The Japanese policy was *very pragmatic* and not based on economic theory or on theory from any other social science discipline.' Edquist (1993b), p. 23ff., my translation, italics in original.

[74] Edquist (1993b), p. 56.

[75] Edquist (1993b), p. 71, my translation.

[76] Edquist (1993b), p. 51ff.

[77] Edquist (1993b), p. 68, my translation.

their market was expanding, and the R&D-intensive sectors were more productive, enabling them to pay higher salaries.[78] The key to getting there was to 'separate the industry into two parts and offer advantages to one of them.'[79] Policy measures included lower interest rates for investments in high-tech production, while also channelling venture capital into that sector. Technological procurement could lure companies into producing high-tech products, and the government could also build institutions to facilitate knowledge flows into companies from universities, inventors and abroad. However,

> [t]his type of institution building can be criticised based on the earlier discussion in this report. If the main problem is that companies do not absorb new R&D-intensive product technologies, this problem is not necessarily solved by creating institutional middlemen. It can be more efficient to … give the companies direct incentives to change their behaviour, for example through differing interest rates.[80]

When the Social Democrats gained power in 1994, their interest in Charles Edquist and the proposed innovation policy subsided, at least according to Edquist himself.[81] Still, he continued with his efforts to influence government policy for several years. This included holding lectures for officials at the Social Democratic Party (July 4, 1994), the Ministry of Industry (October 21, 1994, March 16, 1995, May 31, 1996, August 4, 1998) and the Ministry of Education (June 14, 1995, March 5, 1997).[82] He kept sending his latest articles and books to government ministers, offering his services as an innovation scholar. In 1994, for example, he complimented the Minister of Industry, Sten Heckscher, for a presentation he had made:

> I especially noticed what you said about the importance of maintaining a **scientific view** on industry (and industrial policy). (Anders Sundström often spoke of the need of an 'analytical foundation' for industrial policy.) This has, during the last years, become an increasingly common attitude in other countries. We who do research on the relationship between innovations, growth and employment can contribute with analyses here – of a different kind than the ones provided by traditional economists.[83]

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[78] Edquist (1993b), p. 45.

[79] Edquist (1993b), p. 73, my translation.

[80] Edquist (1993b), p. 75f., note 164, my translation.

[81] Letter to the Ministry of Industry, October 11, 1998, Dnr N98/2357/F, 1998-12-01, Regeringskansliets arkiv- och dokumentcenter. See also interview which Charles Edquist, January 20, 2006, my translation: 'I mean, had Göran Persson retained the interest he had then [when he was responsible for industrial policy in the Social Democratic Party] and with the power he later had [as prime minister], our economic situation would have been completely different today.'

[82] Tema-T (1996), pp. 30f., 45f.; Tema-T (1997), p. 37; Tema-T (1998), p. 25; Tema-T (1999), p. 20. See also Benner (2001), p. 120.

[83] Letter to the Ministry of Industry, October 25, 1994, Dnr N94/1625/NU, 1994-11-21, Regeringskansliets arkiv- och dokumentcenter, my translation, bold in original.

As time passed the tone in his letters became increasingly frustrated and disappointed with his perceived lack of impact on policy matters:

> When Göran Persson was responsible for industrial policy within the SAP [the Social Democratic Party], i.e. in 1993, I wrote a report for him …. Göran was very interested, and after the 1994 election there was a lot of talk about growth during a few months. After that it has been very quiet – and not much has been done on the part of the Ministry of Industry.… I am writing this because it hurts to see Sweden fall behind and because I have knowledge and experiences that could be of great importance for the creation of an **innovation policy that can bring increased growth and more jobs**.[84]

Edquist also tried to make his ideas about industrial renewal and innovation available to a wider audience through articles in the main Swedish newspapers.[85] In particular he stressed that Sweden had lost 125 000 potential industrial jobs because the high-growth sectors had not expanded at the same pace as in the rest of the OECD between 1975–91, a point he also made in several of the letters he had addressed to politicians.[86] Eventually his attempts to influence Swedish growth policy subsided, since he could not see any material effects.[87]

If Charles Edquist considered his policy efforts a failure, he was more successful in setting up the Tema-T department in Linköping, together with Maureen McKelvey, as an internationally oriented centre for innovation system research. In 1994 he initiated the Systems of Innovation Research Programme (SIRP) with two aims. First, he wished to develop theory and clean up the innovation system concept, which he saw as too fuzzy and vague. With further refinement it could be made into a more rigorous framework, capable of aiding a scientifically informed innovation policy.[88] Second, his collaboration with Lundvall for the Richard Nelson anthology had 'left a strong wish to go much more into depth on various aspects of the Swedish national system of innovation….'[89]

Sweden presented an interesting scientific case study, because the country spent one of the highest proportions in the world of its GDP on R&D while it still performed poorly in product innovations and industrial renewal, the so-called Swedish paradox. Numerous scientific papers and patents were produced, but apparently industry was unable to absorb them into produc-

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[84] Letter to the Ministry of Industry, October 11, 1998, Dnr N98/2357/F, 1998-12-01, Regeringskansliets arkiv- och dokumentcenter, my translation, bold in original.

[85] See Edquist (1993a); Edquist (1995a); Edquist (1996).

[86] See letter to the Ministry of Industry, October 25, 1994, Dnr N94/1625/NU, 1994-11-21; letter to the Ministry of Labour Market Affairs, March 17, 1995, Dnr A95/2429/RP, 1996-04-01, Regeringskansliets arkiv- och dokumentcenter.

[87] Interview which Charles Edquist, January 20, 2006.

[88] Edquist (1995b), p. 5f.

[89] Edquist (1995b), p. 4.

tion.[90] In analysing the Swedish case, the research programme meant to develop a methodology for mapping Swedish performance regarding process, product and organisational innovations in an international perspective. It was also to study how structural change in Swedish industry affected productivity, growth, employment and wages, as well as the causal mechanisms involved. Further, the obstacles to industrial renewal in Sweden were to be analysed, especially the role played by conservative companies and government policy, as well as the Swedish production structure and the composition of its R&D.[91] All this research on the Swedish case was planned to result in a book entitled *The Swedish System of Innovation: Anatomy and Performance*, but that book never materialised.[92]

From start Edquist developed connections between Tema-T and the international research community. Between 1994 and 1995 he coordinated the Systems of Innovation Research Network, which aimed to be 'an international, interdisciplinary network or "working seminar" with the task of building a more solid conceptual and theoretical foundation for the continued study of systems of innovation.'[93] Altogether, the network was composed of 25 innovation scholars from 15 different countries, meeting for conferences in the Swedish town of Vadstena, Lanzarote on the Canary Islands and the Swedish town of Söderköping. Their collaboration produced an anthology in 1997, edited by Charles Edquist.[94] With funding from the European Commission, he also coordinated the international research project Innovation Systems and European Integration (ISE) in 1996–98, a collaborative effort involving research groups in nine countries. The objectives were to extract policy implications from existing innovation system research, find out what the innovation system approach could say about the sources of employment and growth, explore how European integration affected innovation systems and if an innovation system at the European level was possible. The project was to study how the increased importance of science had affected the innovation process, the feasibility of technological procurement at a European level, the effect of funding and corporate governance on innovation and the historical experience of new firm and new technology entry in the European Union and Japan during the last decades.[95]

Charles Edquist moved back to Lund University in 2003, and the following year he became director of the Centre for Innovation, Research and Competence in the Learning Economy (CIRCLE). In recent years he has

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[90] Edquist (1995b), p. 8ff. The concept of a Swedish paradox has been criticised by Jacobsson (2002); Jacobsson & Rickne (2004) and Granberg & Jacobsson (2006), who argue that the amount of Swedish resources devoted to non-business R&D has been overestimated.

[91] Edquist (1995b), p. 13ff.

[92] Edquist (1995b), pp. 13, 33.

[93] Edquist (1995b), p. 5.

[94] Edquist (1997a); Edquist (1995b), p. 5f.; Tema-T (1997), pp. 44, 64f.

[95] Edquist (1998b), p. 6ff.; see also Edquist (1998a).

coordinated an international research project to more rigorously identify the determinants of innovation in Asian and European small countries.[96]

Innovation Thinking as a Critique of the Welfare State

Questions concerning innovation and industrial renewal attracted attention among some economists working for Swedish industry associations as well, and their contributions can be seen as constituting a third strand of innovation thinking. There are many similarities with the analysis of Vedin and Edquist, but their interpretation of the industrial crisis differed by drawing more heavily on the 'suedosclerosis' argument. In general, the industry-associated economists embedded their innovation discussion in a critique of the Swedish welfare state and how it distorted growth, but they shifted their focus to other distortions than the ones preoccupying traditional neoclassical economists.

One of the main advocates of an innovation policy in the early 1990s was Lennart Ohlsson, an economist working for the Federation of Swedish Industries and later for the Federation of Private Enterprises, the latter an association organising small and medium-sized companies. His dedication to discuss innovation issues was largely due to his own initiative, and he often had a hard time convincing the organisations he worked for to make industrial renewal a priority.[97] Even though he studied, and was influenced by, Schumpeter while working on his dissertation in the late 1960s and early 1970s, he argues that his interest for innovation emerged as a reaction to empirical observations, rather than from theoretical impulses. He was partly influenced by the time he spent at Stanford, where he could see Silicon Valley grow, but he also received inspiration from a book he wrote in 1969 about Swedish growth and foreign trade from 1871 to 1966:

> My insight into why … renewal was central to Swedish economic growth came from my 100 years study. I could see that we had switched specialisation several times during that period and at the same time had grown from a mediocre European country when it came to living standards to a country with a high level of wealth.[98]

In the late 1980s and early 1990s he performed empirical studies on the comparatively low-tech and middle-tech character of Swedish industrial production.[99] This was followed up by a couple of more debate-oriented

[96] Edquist (2007).
[97] Interview with Lennart Ohlsson, May 17, 2006.
[98] Interview with Lennart Ohlsson, May 17, 2006, my translation. See also Ohlsson (1969).
[99] See Ohlsson & Vinell (1987); Ds 1992:109.

books, aimed at criticising and changing Swedish growth policy in general.[100] Although Ohlsson agreed with the 'suedosclerosis' economists in general, he criticised them for what they left out:

> Even today … most economists emphasise the large public sector and the consequent high tax ratio of the GDP as *the* most important, or even the only, structural renewal problem.… No small open economy can remain flexibly adaptive with a tax ratio amounting to 57 per cent of GDP. However, the malfunction of the industrial part of the economy began *before* Sweden became internationally outstanding in this respect.[101]

What the economists had forgotten was the ability of the Swedish economy to renew its industrial structure, i.e. to complete the transition from low- and middle-tech to high-tech industries. This was an area where Sweden had performed badly since the late 1960s. In his analysis Ohlsson drew on the thinking of Lennart Schön, but presented less optimistic conclusions about Swedish renewal. The current industrial crisis was a 'secular crisis' of the kind occurring no more than two times a century. Previously such crises had taken place in the 1870s and 1930s and were associated with the obsoleteness of previous technologies, changes in the world economy, such as new competitors and changes in the localisation of production, and new means of communication.[102] From World War II and up until the late 1960s the United States was the technological leader of the world, and Swedish companies could develop by absorbing and modifying superior technology from abroad. But by 1970 the technology gap between America and the rest of the industrialised world had narrowed, putting pressures on Swedish industry to become radically innovative rather than merely emulative.[103]

A recovery thus depended on the ability to exploit new ideas and make them economically useful. Just like many other Swedish innovation scholars, Ohlsson made references to the grand old days of genius firms and nineteenth-century innovations, as a role model for future economic development.[104] Apparently the creative spirit of the Swedish people had not subsided since then, because patent statistics showed a continuous stream of inventions during the 1970s and 80s, most notably the ulcer medication Losec and the AXE switching system. The problem was rather to transform the inventions into domestically exploited innovations, and this was where government policy could make a difference.[105] Although focusing heavily on policy to

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[100] See Ohlsson (1991); Ohlsson (1993); Ohlsson (1997). Especially Ohlsson (1993) deals with innovation issues.

[101] Ds 1992:109, p. 10, italics in original. See also Ohlsson (1993), p. 83f.

[102] Ohlsson (1993), p. 13ff.

[103] Ohlsson (1991), p. 32ff. Cf. Edquist's argument that Sweden should aim at absorbing new product technology from abroad, rather than trying to develop its own breakthroughs.

[104] See Ohlsson (1993), pp. 16, 19, 42.

[105] Ohlsson (1993), pp. 16, 73, 81f.; Ohlsson (1997), p. 81ff.

promote innovations, Ohlsson made no references to the budding innovation system concept or even the international field of innovation studies in general. According to him, he did not begin studying the innovation literature until the late 1990s. He also suggested the name 'renewal policy' for the measures he proposed, rather than the by then more commonly used term innovation policy, as he viewed it as more encompassing. In fact, he did not hold the innovation system concept in high regard: 'That's a concept I don't agree with, actually. I think it's a very fuzzy concept.… I must say that for me, that's a term I think is more abstract than useful. I haven't read about that literature, or read that literature very thoroughly.'[106]

While incremental innovations and absorption of technology from abroad were important, Ohlsson argued that it was vital to emphasise radical product innovations during the recovery from the secular crisis.[107] The ideas necessary to develop such innovations could come from four possible sources: R&D within big companies, university research, individual inventors and entrepreneurs within small companies. It was not realistic to expect R&D in large companies to be able to pull off the industrial renewal on its own:

> [T]he contribution by large companies to growth and renewal is insufficient. Therefore sources of ideas such as small companies, private inventors and the researchers of the university sector will have to provide considerably more powerful contributions than before. These sources will need a more systematic interplay with external resources than the inventors of large companies.[108]

Large companies had the resources necessary to transform ideas into viable innovations, but were as organisations generally conservative. Radical ideas that departed too far from their traditional line of business could have a hard time finding acceptance. The situation was different for private inventors and small companies, where new ideas were easily accepted, but where the resources for developing them had to come from outside.[109] While the general trend in Swedish innovation thinking up until the mid 1990s had been to deemphasise the role of university research in the innovation process, Ohlsson was an exception. Although he admitted there were several other sources for innovation, he argued that 'university research in practice has had a remarkably underestimated role for the creation of really radical ideas [relevant to industrial renewal].'[110] However, Sweden had historically placed an unusually large emphasis on basic research within areas of little relevance to

[106] Interview with Lennart Ohlsson, May 17, 2006. Even though he did not use the concept and disliked it, some scholars have seen him as an early precursor of Swedish innovation system thinking; see Sandén & Sandström (2002), p. 201.
[107] Ohlsson (1993), pp. 41f., 51, 65.
[108] Ohlsson (1997), p. 168, my translation.
[109] Ohlsson (1993), p. 60ff.; Ohlsson (1997), p. 166ff.
[110] Ohlsson (1993), p. 52, my translation.

industry, which inhibited the university sector in facilitating industrial renewal. Prospects appeared to improve somewhat, and Ohlsson applauded the centre-right government and its effort to boost industry-relevant research by creating a new set of foundations to provide funding.[111] Still, most ideas stemming from university research should at best be considered as basic 'raw materials' and were likely to require much more resources before they were refined into a commercially exploitable state, compared to ideas from company R&D.[112]

The basic measures of a renewal policy were not that different from those proposed by Bengt-Arne Vedin. It was a matter of finding institutional solutions that made it easier to turn ideas into innovations, while making sure the benefits were not appropriated by foreign firms. It was especially important to help private inventors and small companies, who lacked the resources of big corporations and universities. Small companies embracing radically new technology needed to collaborate with external institutions that were patient and did not expect instant returns on their investments. Taxes should be low during the vulnerable start-up phase and increase when the technology had been made profitable. Similarly venture capitalists should be encouraged to hold off their demands for a return. To reach that state required a major overhaul of Swedish taxes and the financial system.[113]

Ohlsson also elaborated on the emergence of a knowledge economy and the demands it placed on Swedish companies. A high-tech firm did not rely so much on material capital investments as on the skill and creativity embedded in its employees. In order to remain flexible and innovative, it was necessary to continuously adjust the composition of skills in their staff, based on changes in technology or in the competitive environment. In some instances, an employee might possess a strategic competence for the company and needed to be tied closer to it through special rewards. But with technological change that competence could become obsolete, and then the company might need to lay off the employee. Here the Swedish welfare state posed a serious obstacle to creating an innovative industry, according to Ohlsson. The tough labour legislation that made it difficult to fire employees, as well as the solidaristic wage policy offering equal pay for equal work, were based on an obsolete image of a standardised industrial worker without specific skills. Companies competing based on knowledge needed to differentiate their wage structure, however, and offer special rewards to enhance strategic competencies in the firm. They also needed to be less bound by

[111] Ohlsson (1993), p. 54ff.

[112] Ohlsson (1997), p. 166. He made an exception for medical research, where the results were more easily translated into innovations.

[113] Ohlsson (1993), p. 74ff.

priority rules that disregarded such competencies when releasing manpower.[114]

The economic effects of the welfare state were also criticised by the Schumpeterian and evolutionary economist Gunnar Eliasson, working at IUI. Eliasson was interested in innovations, but developed his own theoretical vocabulary instead of relying on existing conceptual frameworks. Writing in 2000, he wanted to draw a clear distinction between innovation system thinking and his own theory that had emerged in the 1980s and 1990s. While innovation system scholars focused on how technology emerged, he dealt mainly with the commercialisation phase. Interestingly, he also accused the innovation system school of falling back into the linear model:

> All these models [including the innovation system school] are so constructed that technology drives the economic growth through linear influence from the input side. We have the classic linear sequence: R&D, creation (invention, innovation), diffusion and introduction. There is nothing in these models that thwarts, biases or stops the supposedly technology-driven growth.[115]

His own framework departed from the idea of an 'experimentally organised economy,' where actors possess incomplete information and are forced to more or less blindly chose between enormous amounts of possible business opportunities. Every time an economic actor tries something new, it can be viewed as an experiment, and in an efficient economy a selection mechanism allows the best efforts to prosper. If a company tries a radically new approach that turns out to be an advantage, the competitive environment changes and other companies are forced to react, either by reorganising or rationalising. If their response is not sufficient, they will go out of business. In an efficient economy bad projects or companies are not allowed to go on for too long, while potential winners are not discarded too quickly.[116] He also developed the concept of 'competence blocks,' analogous with the Dahménian development blocks, but emphasising human capital rather that physical investments. They consist of all the actors who make decisions affecting whether a project is continued or not. These include among others the customer, innovator, entrepreneur, venture capitalist and the industrialist. Lack of competence among any of these actors made the selection mechanism work less efficiently. Eliasson argues, for example, that the lack of competent venture capitalists in Sweden and Europe has hampered growth.[117]

Eliasson, together with some other economists working for IUI, concluded in a report that industrial renewal in Sweden had been lacking since the early 1970s, and without a change of track the country would be trans-

[114] Ohlsson (1993), pp. 37, 45, 85f.; Ohlsson (1997), ch. 7.
[115] Eliasson (2000), p. 85f., my translation.
[116] Eliasson (2000), p. 78ff.
[117] Eliasson (2000), p. 82ff.

formed 'over some decades, into a Latin American inflation economy.'[118] Sweden was uniquely dominated by a few large companies, thanks to an unofficial alliance between the state and big business dating back to the period following World War II. Large companies had been favoured by corporate taxes, as well as by a regulated and rationed credit market. But industrial renewal within large firms tended to follow existing technological paths, and Sweden risked ending up with a dangerously narrow technological base. Radical renewal depended on the entry of new small and medium-sized companies, but these were obstructed by the welfare state as it had developed since the 1970s. The large public sector and the high progressive income taxes supporting it hindered private wealth accumulation among budding entrepreneurs, while the regulated capital market and the lack of venture capital stopped funding through that avenue. Extensive regulation, labour protection legislation and the compressed wage structure imposed by the solidaristic wage policy also affected small companies more than large ones. A more differentiated wage structure based on the competence embedded in the work force offered incentives for the employees to increase their skills, facilitating industrial renewal. All in all, an innovative economy required the large public intrusion into the economy to be pulled back, together with deregulated labour and financial markets, so that the big corporations of tomorrow would be allowed to grow large.[119]

Innovation Thinking within STU and NUTEK

As has been shown, many of those who in the public debate advocated innovations as a solution to the industrial crisis expressed dissatisfaction with their influence on actual policy. Charles Edquist claimed to have been 'banished' from NUTEK after having presented an unfavourable evaluation of its predecessor and was equally frustrated in his efforts to influence Swedish politicians. Similarly, Bengt-Arne Vedin did not perceive himself to have had much of a policy impact besides the creation of the Innovation Center Foundation, and Lennart Ohlsson had trouble persuading the business organisations he worked for about the importance of innovations. This makes it interesting to study not just participants in the public debate, but also to look deeper into what kind of innovation thinking permeated the organisations actually in charge of promoting technical change in Sweden, namely STU and its successor NUTEK.[120]

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[118] Andersson et al. (1993), p. 51, my translation.

[119] See Andersson et al. (1993), ch. 1.

[120] After World War II the Swedish government gradually developed an institutional structure for supporting technical change. It started in 1942 when the Technical Research Council (TFR) was formed, at first mostly a passive recipient of research proposals. During the 1960s several new organisations were formed to facilitate the industrial exploitation of research,

There are good reasons to expect these agencies to have adopted a particular way of viewing innovations. First, Hans Weinberger argues that a shift in practice took place in STU during the 1970s, as the organisation no longer merely reacted to external grant applications from university and industry, but actively brokered networks between central competencies in order to enhance the development of certain technologies.[121] Second, an intellectual legacy from Erik Dahmén emphasised the importance of development blocks and the systemic complementarity between different parts of the economy. In this section I will look at innovation thinking within STU and NUTEK through the study of several reports and investigations associated with those agencies. Lennart Stenberg, Lennart Elg and, during the 1990s, Göran Marklund were influential in the formation of this thinking. I will also discuss some research projects involving innovation scholars at Swedish universities that either co-evolved with innovation thinking within STU and NUTEK, or provided important sources of inspiration.

Managing Networks and Absorbing Generic Technology

When a committee published an investigation about the future direction of STU in 1977, they urged the organisation to develop 'from an application-receiving and project-judging agency to a more active, planning, initiating and driving agency.'[122] The activities of STU spanned over a wide number of societal areas, and actors within those areas held competencies that surpassed those within the organisation itself. But one of the advantages of STU, according to the investigation, was its unique network of contacts with government agencies, companies, researchers and other actors with knowledge about their specific areas:

> Compared to the research community STU has greater knowledge about and better contacts with for example the sphere of activities where companies and government agencies are involved. Compared to the grant-receiving companies/innovators STU has greaterer knowledge and better contacts with for example the research and societal sectors etc. Through its main receivers of support and client categories STU has thus considerable comparative advantages in these respects. In short, STU has a unique and central position when it comes to competencies and contacts. Probably no other private or public

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including Malmfonden, INFOR and EFOR. The late 1960s was also a period when the Social Democratic government created institutions to underpin a more offensive industrial policy, and it merged the above-mentioned organisations and the Swedish Inventor Office into STU in 1968. Around the same time it also set up a specific Ministry of Industry. In 1991 STU merged with the agencies in charge of industrial development and energy issues into NUTEK; see Pontusson (1992), ch. 5; Weinberger (1997); Sandström (2000b); Persson (2001), pp. 78–92.

[121] Weinberger (1997).

[122] SOU 1977:64, p. 225, my translation.

> organisation is in a position that comes even close in the area of technical change.[123]

In many of the reports and investigations published by or otherwise linked to STU and NUTEK during the 1980s and 1990s, a recurrent theme was to present the agencies as network brokers, supporting technical change by linking together various persons or organisations with competencies that would otherwise not have met. This self-image as being a manager of networks also coincided with a view of the economy where companies' locations in networks with more or less long-lasting relationships were vital for their ability to compete and innovate. Explicitly influenced by Erik Dahmén, the agencies furthermore placed great interest in the systemic complementarity between different parts of the economy and how it influenced technical change. One of the clearest articulations of this view was given by STU in 1981:

> The making of a product is often built on the interplay between a large number of producers, often within different industries, who deliver raw materials, intermediate goods, components, means of production and finished products. Every production unit is in turn often part of a number of complex production systems. As products and processes are becoming increasingly more technically advanced, the demand for communication between different producers and users has increased.
>
> The environment a company works in is often of greater importance for the company's development potential than the industry it is a part of. Important environmental aspects can be access to skilled labour, contacts with secure and quality-aware subcontractors, closeness to qualified research competence, closeness to customers with high demands and with a readiness to test new products early on. Advanced competitors can also contribute to a positive environment. The relationships to its environment can therefore be seen as a significant resource for the company.… As customers and suppliers often can be found in different industries or societal sectors, analyses that restrict themselves to single industries will only to a limited extent show development blocks.… Education and research institutions, central experimental laboratories as well as funding, regulating and norm-setting government agencies also contribute to the preconditions.[124]

The Dahménian influence is clearly evident in the above quote, through the use of the development block concept and through the complementarity customer-supplier relationships produced between different industries and societal sectors. References to Erik Dahmén and development blocks were

[123] SOU 1977:64, p. 224f., my translation.

[124] STU (1981), p. 65, my translation. Other publications linked to STU and NUTEK discussing the importance of networks between companies and other organisations include STU (1983), p. 37f.; Ds I 1987:3, pp. 15f., 45ff.; STU (1989), p. 101; SOU 1993:13, appendix 2, pp. 39, 51ff., 58f., 75ff.; SOU 1995:4, appendix 11, pp. 17, 74, 89f., 104ff., 161; SOU 1996:89, pp. 10, 38, 140.

quite common in reports linked to STU and NUTEK during the 1980s and early 1990s.[125] Similarly, the notion that demand was not just a matter of quantities demanded at certain prices, but also a qualitative factor permeated many of these reports. Close relations with sophisticated customers who placed high demands on the goods or services they purchased pressured companies to improve their products and constituted a competitive advantage. For example, by acting as a sophisticated customer, governments could use its demand to boost technical change through technological procurement.[126] In short, companies were embedded in a network of more or less durable relationships with subcontractors, customers, fellow companies in the industry and other organisations. Impulses and knowledge were largely channelled through these relationships and affected the competitiveness of companies. It was important to be part of a technological network in order to exploit external technical resources, something that for example could give small companies involved in larger conglomerates of firms a head start compared with more independent small companies.[127]

According to STU, two general trends had contributed to the outlook of Swedish business networks. First, competing on the foreign market with companies of considerably larger size, Swedish firms tended to become specialised within a more narrow line of products in order to exploit economies of scale. This made Swedish companies specifically reliant on relationships with other companies to supply goods and services that larger companies could produce in house.[128] Second, the networks of Swedish companies had become increasingly international. Historically, domestic relationships between customers and supplier were an important driving factor in Swedish industrialisation. The development of an engineering industry was helped by its relations to a skilled Swedish iron and steel industry, while the emergence of an airplane and electronics industry was aided by government procurement. In the last decades however, the possibility of maintaining mainly domestic development blocks had disappeared. More and more of the important relationships for Swedish firms were developed with foreign customers and suppliers, and many Swedish subcontractors had not been able to compete successfully with their foreign competitors.[129] Still, it was important to embrace internationalisation, because it brought vital impulses from abroad. Trying to develop nationally self-sufficient industrial networks could be directly harmful. But it was at the same time essential to nurture national

[125] See Ds I 1987:3, p. 45ff.; STU (1989), p. 101; SOU 1995:4, appendix 11, pp. 17, 161.

[126] See STU (1983), p. 30; Ds I 1987:3, p. 4; STU (1989), p. 101. The concept of demanding customers would also be one of the main points stressed by Michael Porter, founder of the cluster concept; see Porter (1990), pp. 86–100.

[127] SOU 1995:4, appendix 11, p. 74; SOU 1996:89, pp. 10, 38.

[128] STU (1981), p. 84f.; Ds I 1987:3, p. 8; SOU 1995:4, appendix 11, p. 145.

[129] See STU (1981), pp. 66, 69; Ds I 1987:3, pp. 18f., 45ff.; SOU 1993:16, appendix 2, p. 58f.; SOU 1995:4, appendix 11, p. 161.

relationships in order to maintain Sweden as an interesting and dynamic industrial environment. One possible solution could be to place more emphasis on creating domestic networks around the development of new technology, rather than new products.[130]

As in many other industrialised countries, during the 1980s STU had developed a core interest in the importance of generic technologies, or technologies that could be applied in a wide number of industrial areas. Above all, the agency was interested in information and communication technology, biotechnology and the development of new materials with specific qualities.[131] It was generally felt that the old industrial paradigm had passed its prime, and that 'the 1980s will be the decade when the foundations of a qualitatively new industry are laid.… The outline of a growing future industry can already today be seen in the development work being done in different industrial laboratories.'[132] While celebrating the reception and development of new advanced generic technologies, STU and NUTEK did not share the concern that Sweden was stuck with an old-fashioned low-tech industrial structure, a view that was very influential in the public debate on innovation. In particular, they warned against placing too much emphasis on the size or relative share of the high-tech sector:

> Aggregate data on the size and growth in Sweden of the high-technology industry, as it is defined by the OECD, is in itself hardly a cause of alarm. Neither the size nor the growth of high-tech industry is remarkably small in Sweden.… In any case, the high-technological industry will for the time being remain a limited part of industry not only in Sweden but also in other OECD countries.[133]

Of more importance than its size was the function played by the high-tech sector in the industrial system. The high-tech sector was usually the first recipient of new advanced technology, and with the existence of a well functioning domestic network it could help spread such technology to more traditional industrial sectors. By supplying goods and services to these sectors, high-tech companies could help diffusion, as it was easier to provide efficient services to companies from the same country, but they could also function as sophisticated and demanding customers. Also, employees built competence in high-tech industries that they could bring with them if they moved to the other industries. In short, the problem was not the small size of the high-tech sector, but rather its lack of network ties to other companies.[134]

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[130] Ds I 1987:3, pp. 18f., 45ff.; SOU 1993:16, appendix 2, p. 58f.

[131] See STU (1981), pp. 21, 96; STU (1983), p. 11; STU (1986a), p. 25ff.; STU (1986b), pp. 7ff., 39f., 45; STU (1989), p. 9f.; SOU 1993:16, appendix 2, p. 53; SOU 1995:4, appendix 11, pp. 148, 162.

[132] STU (1983), p. 11, my translation.

[133] SOU 1995:4, appendix 11, p. 111, my translation.

[134] Ds I 1987:3, p. 43; SOU 1993:16, appendix 2, p. 72; SOU 1995:4, appendix 11, p. 110f.

Even though established Swedish industries were not a part of the internationally most dynamic developments, technology policy should still mainly be directed towards those industries. Their choice to adopt advanced technology or not could be influenced by policy, while high-tech companies had no option but to remain at the technological frontier.[135] A common theme in reports linked to STU and NUTEK was therefore the need to develop the broad industrial base and to build on the industrial traditions that had already existed in Sweden for a long time.[136] Especially the mechanical engineering industry was seen as playing a strategic role in the renewal of Swedish industry. If it could be made to adopt new advanced technology, such as new materials and electronics, the beneficial effects could spread to other industries. One of the main priorities for STU during the 1980s was to help diffusing information technology into the mechanical engineering industry.[137]

Promoting the importance of generic technologies, STU and NUTEK also noted that technical change had become more dependent on scientific research than before. Even though the most important developments in generic technologies were likely to take place abroad, successful absorption in Sweden required a domestic research competence in the areas. An ambivalent attitude towards the university sector developed in STU and NUTEK. On the one hand they admitted that the importance of interaction between universities and industry for technical change had grown, but on the other hand, the agencies were uneasy about relying too much on the university sector in promoting generic technologies. As mentioned, Sweden had discouraged the growth of research institutes, wanting to concentrate as much research as possible at the universities in order to avoid a separation between research and education. At the same time, R&D at Swedish companies was biased towards development, with little research being carried out, further emphasising the potential key role of the universities. An investigation performed by the Research Policy Institute at Lund University, that had been commissioned and published by STU, questioned if they could play that role:

> The question is if the university system is really fit to perform the task that is put before it. It is hardly probable that the resource needs of generic technologies can be met through the traditional research council funding. That kind of funding system has emerged to secure a balanced development in the

[135] Ds I 1987:3, p. 13; SOU 1995:4, appendix 11, p. 112.

[136] See for example Ds I 1987:3, pp. 4, 48; SOU 1993:16, appendix 2, p. 42; SOU 1995:4, appendix 11, p. 157f.

[137] Ds I 1987:3, p. 8ff. Christopher Freeman had praised Sweden for its quick reception of information technology; see Freeman (1987), p. 90; Freeman (1988), p. 344. On the other hand, it was this general project that Charles Edquist (1991) had criticised for focusing too much on aiding the absorption of process technology, while it according to him was product technology that brought employment and growth in the long run.

> field of basic research. It will probably function worse when it comes to concentrating resources within certain prioritised interdisciplinary areas.[138]

Instead, the investigation proposed developing the research funding functions at STU and promoting the capacity for research in Swedish industry. STU itself noted that 'the research organisation of the Swedish universities has not purposefully been designed to handle a wider role than traditional academic research.'[139] From STU and NUTEK's perspective of absorbing generic technology that required the establishment of research competence in new interdisciplinary fields, the Swedish model of concentrating research at conservative universities became increasingly problematic. During the early 1990s, this institutional arrangement was questioned by NUTEK:

> How far a development of the universities' service role towards industry can be driven without jeopardising their other functions is hard to say. An alternative is to abandon Swedish research policy's main principle of the primacy of universities and, like in most other industrial countries, build a more extensive industry-oriented technological infrastructure outside of universities.[140]

As has already been noted, the centre-right government created several research foundations in the early 1990s to support strategic research in favour of industrial development. In the eyes of NUTEK, however, too much effort was put into supporting university research with the expectation that new products would emerge to commercialise. In general, the universities' main economic function was to educate competent individuals, while its research results were of less importance:

> The conditions within medicine where scientific research results can have great commercial value should rather be described as an exception when it comes to the relationship between science and industry. The normal relation is instead that scientific research is used as one of several means to solve problems emerging during the development or improvement of a certain technology.… Many technologies are established empirically and only later will certain aspects of them be subjected to scientific research. For several technologies scientific research is still of little or no importance.[141]

Similarly arguments were presented in another report:

> The possibilities of research to function as a direct driving force for industrial development are … probably limited. The expectations sometimes more or less explicitly stated that university research will result in new products which

[138] STU (1986b), p. 45, my translation.
[139] STU (1989), p. 44, my translation.
[140] SOU 1993:16, appendix 2, p. 80, my translation. See also SOU 1995:4, appendix 11, pp. 135, 148.
[141] SOU 1993:16, appendix 2, p. 47f., my translation.

> then are to be transferred to industry for exploitation ascribe a role to universities that they cannot live up to.[142]

During the early 1990s, NUTEK became increasingly interested in the role of small and medium-sized companies and their relationship with the university sector. This was also an area where the universities were viewed as problematic and their internal culture was perceived as privileging research and publishing rather than interaction with industry. When university researchers did interact with industries, they sought out large companies or high-tech companies as partners, because those firms had the ability to formulate their problems in scientifically interesting terms. More 'ordinary' small companies tended to be neglected.[143] But the proposed solution was not so much to transform the universities, as to boost the competence level of small companies and make them more interesting as collaboration partners for the universities. The limited reception capacity for research-based information in Swedish companies was one of the major obstacles to their successful interaction with the university sector. Policy measures to alleviate the problem could include subsidising the recruitment of technically qualified personnel in small companies. It could also involve strengthening the ties between small companies and other larger or high-tech companies in order to promote knowledge transfer. In general, relationships with other firms were more important to small companies than relationships with the university sector.[144]

NUTEK picked up and used the innovation system concept in a report written for the long-term investigation in 1995. The agency was concerned that the Swedish national innovation system was poorly adapted to new technological challenges and that the innovative capacity of Swedish companies had been reduced due to changes in their environment. Internationalisation had reduced the likelihood of durable domestic relationships between Swedish customers and suppliers, and the historical tradition of boosting innovation through government technological procurement was likely to diminish in importance. Also, research collaborations between companies remained limited, and Swedish firms were not able to absorb research-based knowledge sufficiently.[145] These problems would not be solved through focusing solely on the university sector:

> The government technology policy in Sweden has increasingly been reduced to foremost comprising the funding of university research …. A lot indicates that technology policy to a larger extent must turn directly to the companies

[142] SOU 1995:4, appendix 11, p. 148, my translation.
[143] SOU 1993:16, appendix 2, p. 78ff.; SOU 1996:89, pp. 28f., 36, 108, 113.
[144] SOU 1993:16, appendix 2, p. 51; SOU 1995:4, appendix 11, pp. 15, 59; SOU 1996:98, pp. 30, 35, 39.
[145] SOU 1995:4, appendix 11, p. 13f., ch. 9.

and try to engage these in forward-looking R&D ventures that can contribute to strengthening the technological environment in Sweden.[146]

Co-Evolution Between Policy and Research

The network thinking on innovation that permeated many of the reports linked to STU and NUTEK did not emerge in isolation. To a large degree it was strengthened through interaction with network-oriented Swedish innovation scholars. Hans Weinberger names the 'network school' that formed around Håkan Håkansson, a business economist at Uppsala University, as one of the major intellectual influences on STU and NUTEK.[147] STU funded part of the group's research, and the network scholars also performed a couple of investigations for the organisation in the late 1980s.[148] This group's basic premise was that resources, be they physical, financial or linked to individual persons in the form of knowledge, were heterogeneous in the sense that their marginal utility depended on how they were combined with other resources. This made it rational for companies to develop strong enduring ties with a limited number of other firms, rather than keeping all external actors at arms-length distance like textbook neoclassical economics predicted. Every potential partner controlled a unique set of resources, and it was impossible to predict with certainty in advance how efficiently their resources combined with other resources. But as two companies invested further in knowledge about each other, they could solve each other's problems more easily. Still, the costs involved in gaining deeper knowledge about the other company limited the number of potential partners it was feasible to engage in a thorough relationship with.

More formally, the group developed a model where the heterogeneous resources were combined, used or exchanged through activities. These activities were linked together in a chain where suppliers, processing companies and customers were linked to each other. Actors controlled the resources and activities, while being engaged in enduring relationships with other actors. Bound by the network they were embedded in, they could not make any larger changes without considering how it affected customers and suppliers involved in the activity chain. In general, the network school emphasised how networks could constrain companies, as when strong ties made certain technological trajectories virtually impossible. But the combination of resources through networks also enabled companies to achieve things that had been impossible left on their own. Also, the network school emphasised the politics, conflict, power and struggle involved in technical change. Com-

[146] SOU 1995:4, appendix 11, p. 14, my translation.
[147] Weinberger (1997), pp. 470, 475. See also Carlsson et al. (forthcoming), p. 7.
[148] E-mail from Lennart Elg, July 18, 2007.

panies could have vested interests in old technology, and their resistance needed to be overcome if newer technology was to be introduced.[149]

STU was in fact responsible for setting up its own academic school of thought in innovation theory. In 1987, true to its network managing practice, it assembled a number of innovation scholars at IUI, Chalmers University of Technology and the Research Policy Institute, under the leadership of Bo Carlsson.[150] Basically, the initiators at STU had already coined the term 'technological system' and asked the scholars to fill it with content. Eventually, the researchers involved in the research programme *Sweden's Technological Systems and Future Development Potential,* also known as the STS project, decided on a definition. In short,

> A *technological system* may be defined as a network of agents interacting in a specific *economic/industrial area* under a particular *institutional infrastructure* or set of infrastructures and involved in the generation, diffusion, and utilization of technology. Technological systems are defined in terms of knowledge/competence flows rather than flows of ordinary goods and services. They consist of dynamic *knowledge and competence networks*. In the presence of an entrepreneur and sufficient critical mass, such networks can be transformed into *development blocks*, i.e. synergistic clusters of firms and technologies within an industry or a group of industries.[151]

As indicated by the quote, the scholars placed a lot of emphasis on entrepreneurs and their ability to identify and exploit business opportunities, or their economic competence. This competence is a scarce resource, unevenly distributed among economic actors. Moreover, economic actors always run the risk that the competence they have gained may lock them into specific trajectories and make them unable to respond to alternative challenges. Relevant components in the institutional infrastructure include the university sector, which plays an important role in increasing the absorptive capacity of a country, through the early identification of new promising technologies and a quick adaptation of its research and education activities. Institutions that could bridge various actors and increase their interaction were also of importance, such as government agencies, industry associations and research institutes, as were the capital markets.[152] Interestingly, and probably due to an

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[149] See Hägg & Johanson (1982), ch 2; Håkansson et al. (1993), chs. 1 and 12. The network school also presented their model on the international arena; see Håkansson (1982); Håkansson (1987); Håkansson (1989).

[150] The researchers also included, among others, Richard Stankiewicz, Staffan Jacobsson, Anders Granberg and Gunnar Eliasson. On the emergence of this research project, see Tryggestad (1995), p. 10ff.; Weinberger (1997), p. 470ff.; Carlsson et al. (forthcoming).

[151] Carlsson & Stankiewicz (1991), p. 111, italics in original. The term technological system had previously been used by the technology historian Thomas Hughes (1983), who used it to denote the systemic relationships that emerged between technologies, actors and institutions; see also Edquist (1997b), p. 4, note 10; Weinberger (1997), p. 22ff.

[152] See Carlsson & Stankiewicz (1991); NUTEK (1992), ch. 3; SOU 1995:4, appendix 10, ch. 3.

overlap with the innovation scholars at IUI who had criticised the welfare state, they also argued that '[a]s concerns Sweden much also indicates that the tax system and the social welfare system have contributed forcefully to lowering the level of innovative entrepreneurial activities during several decades'[153]

At first, the technological system scholars tried to differentiate their approach from the innovation system approach, which had emerged parallel to it. While innovation system scholars during the early 1990s mostly focused on national factors affecting innovation, these factors were expected to be specific for different technology areas in the technological system approach. Also, the entrepreneur played a more emphasised role for scholars discussing technological systems.[154] However, as the innovation system approach became more interested in other levels than the national, and as the concept gained legitimacy from the OECD, technological systems were gradually included in the family of innovation systems. Bo Carlsson and his scholars even started using the term technological innovation system as synonymous with technological system.[155]

Having developed their basic framework, the scholars started applying it to different areas of Swedish technology. First off was factory automation, a mature area where Sweden had been very successful in absorbing technology. This was followed by the more recent areas of electronics, pharmaceuticals and powder technology, creating a close overlap with the generic technologies STU had been particularly interested in. Universities received some criticism for having been slow to identify and adapt to new emerging technologies, especially in the fields of factory automation and electronics. On the other hand, industry had also been slow to adapt in the case of electronics, which showed the need for a technology policy that was proactive both in the face of industry's own perceived needs and university research interests.[156] But the major problem identified by the technological system scholars was rather the inadequate level of competence among Swedish subcontractors. These needed to move into technically more advanced production in order to survive international competition. If the domestic base of subcontractors disappeared, technological systems that had developed for decades could be undermined. Larger companies could always enrol international subcontractors, but less advanced firms were disadvantaged by the lack of domestic ones.[157]

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[153] SOU 1995:4, appendix 10, p. 26, my translation.

[154] See SOU 1995:4, appendix 10, p. 10.

[155] For scholars treating technological systems as part of the innovation system family, see Edquist (1997b); Sharif (2006). For technological innovation systems, see Carlsson et al. (forthcoming), pp. 9, 17f.

[156] NUTEK (1992), ch. 2; SOU 1995:4, appendix 10, ch. 2. Besides reports in Swedish, the scholars also presented their research results in international publications; see Carlsson (1995); Carlsson (1997).

[157] SOU 1995:4, appendix 10, chs. 4 and 7.

Conclusions

Even though the innovation system concept is a recent phenomenon, Sweden can fall back on a long history of discussing technical change, going back to when Erik Dahmén introduced Schumpeterian thinking into Swedish economics in the 1940s and 1950s. In particular, the innovation discussion thrived as Sweden suffered two severe industrial crises during the 1970s and early 1990s. In this chapter I have tried to identify the various strands of Swedish domestic innovation thinking that emerged as the best ways of solving the crises were debated. I have also investigated the specific network outlook on innovation that dominated the government agencies in charge of technical change, as well as its co-evolution with Swedish academic innovation research. Basically, this chapter functions as a background to my main research interest, namely how those wanting to open up universities to social and economic needs used the innovation system concept during the Swedish research funding reform process between 1995 and 2001. Thus, I have placed special emphasis on how universities are dealt with and how the innovation system concept is used.

As this chapter has shown, the innovation thinking that emerged in Sweden during the 1980s and early 1990s was quite heterogeneous, and four main strands can be identified. Bengt-Arne Vedin was a central character in the first one, which was largely inspired by the historical establishment of 'genius firms' in Sweden during the late nineteenth century. For thinkers within this tradition, the main purpose of an innovation policy was to recreate this accomplishment through the support of individual inventors and their ability to start up new companies. Charles Edquist developed a second strand during the early 1990s, as he argued for a thorough restructuring of a Swedish industrial sector he perceived as obsolete and low-tech. Instead of relying on market forces, a strong government policy was needed, insulated from special interests and armed with scientific innovation theory. Special support should be offered to the high-tech sector through beneficial interest rates, lower taxes, venture capital and technological procurement. A third strand of innovation thinking criticised the welfare state for distorting the incentives to innovate. Companies were prevented from rewarding strategic competencies through a differentiated wage structure, or from continually adjusting their composition of skills through layoffs in response to changes in the environment. These distortions mainly affected small companies, which were important players in the process of industrial renewal. Lennart Ohlsson, Gunnar Eliasson and Bo Carlsson can be linked to this line of thinking.

Common to these three strands is a general concern with the low-tech nature of the Swedish industrial sector, combined with an alarmist rhetoric warning that Sweden might revert back to third world status or become a Latin American inflation economy. Many of these scholars also complained about a lack of influence in policy matters. Interestingly, a fourth strand of

innovation thinking had developed in the agencies responsible for supporting technical change, focusing on the role of networks. STU increasingly viewed itself as a network broker, bringing together various competencies in order to promote technological change. Unlike the three previously mentioned strands, STU and its successor NUTEK were less concerned with the alleged low-tech character of Swedish industry. The relative size of the high-tech sector was not as important as how well it performed its function of diffusing new technology to the more traditional industries. In renewing Swedish industry, it was necessary to focus on those sectors where a competence had already developed historically and make them absorb new generic technologies. STU and NUTEK were particularly interested in diffusing information technology into the mechanical engineering industry. This network perspective was developed under the influence of Håkan Håkansson and the 'network school' at Uppsala University. But STU and NUTEK also set up a new academic research group from scratch, forming the STS project led by Bo Carlsson and coining the concept of technological systems.

One common theme that covers many of the innovation scholars studied in this chapter is their explicit or implicit downplaying of the university sector and its role in the innovation process, although there were some exceptions. Many of the participants in the debate argued explicitly against the importance of universities. Some accounts rarely mentioned them at all or focused more on issues that were unrelated to them. Vedin stressed that university research was only one impulse among many in the innovation process and not the most important one. For Edquist, Sweden was a small country, and the most important technological developments were likely to take place abroad. Instead of supporting domestic research, efforts should be made to increase the capacity of companies to absorb foreign technology. STU and NUTEK were sometimes concerned with the perceived disinterestedness of university researchers in contributing to technical change, their inability to deal with research that fell between disciplines, and their lack of interaction with smaller companies. Still, the proposed answer was not to transform universities, but rather to build new research structures outside the university sector and to increase the competence of small companies so they made more interesting partners. In some instances, STU and NUTEK downplayed the importance of scientific research for innovation and argued that at least for small companies it was more important to develop links with other companies than with universities. The STS project viewed the universities as important in identifying new technology early on and argued that they had not performed that role very well in the cases of factory automation and electronics. But the most pressing problem was rather the inadequate competence and competitiveness of Swedish subcontractors.

When the innovation system concept emerged in the early 1990s, at least three of the mentioned strands of innovation thinking picked it up and used it. Vedin applied it in his efforts to promote entrepreneurial inventors and

boost new genius firms. Likewise, Edquist presented it as a scientific foundation for his project of renewing Swedish industry through a determined government policy, although it required some refinement before it could be really useful. Finally, NUTEK used the concept to lament the lack of good network ties between Swedish companies.

CHAPTER 4

Research Funding Reform and the Innovation System Concept

As the previous chapter showed, a vigorous innovation debate had already existed for decades in Sweden when the innovation system concept gained prominence worldwide in the 1990s. It would not be unreasonable for an observer to assume that this historical legacy of discussing innovation was of major importance when the concept made its breakthrough in Sweden and was used in the naming of a government agency. But even though the domestic debate paid some attention to the innovation system concept in the early 1990s, the introduction of the concept into Swedish discourse took place in a quite different setting. In fact, the innovation system concept made a spectacular leap from an innovation debate that focused on industrial policy and was generally disinterested in the university sector, to a debate about how the public funding of university research was best organised. It was as a result of the attempts to reform Swedish public research funding between 1995 and 2001 that the Governmental Agency for Innovation Systems, VINNOVA, was founded.

Indeed, the leap made by the concept can be seen in Table 1, which presents the number of hits the term 'innovationssystem' produced in a search among Swedish newspapers in the database Affärsdata, from 1990 to 2006. A first observation is that the founding of VINNOVA evidently played an important part in the institutionalisation of the innovation system concept in Swedish discourse. The number of occurrences started to take off in the year 2000. But of the 21 hits that year, 17 referred to articles published in August and the following months, when it had already been made clear that an agency named after the concept was to be set up. Moreover, while the innovation system concept was used sparingly in the press before the emergence of VINNOVA, in the years 1999 and 2000 it was predominantly used in relation to the process of reforming Swedish research funding. I will argue in this chapter that the presented leap resulted from what Quentin Skinner would call a 'rhetorical manipulation' of the innovation system concept. The criteria for when the concept could be applied was changed by a coalition of actors seeking to defend the contested institution of sectoral research and increase societal influence over university research, in order to present their controversial project in a more favourable light.

Table 1: *Hits on the term 'innovationssystem' in the newspaper database Affärsdata, 1990–2006.*

	Total number of articles	Articles dealing with the research funding reform process	Articles not dealing with the research funding reform process
1990			
1991			
1992			
1993			
1994	2		
1995			
1996			
1997	1		1
1998	2		2
1999	6	4	2
2000	21	15	6
2001	33		
2002	102		
2003	90		
2004	79		
2005	86		
2006	72		

Source: Affärsdata (www.ad.se).
Comments: Articles from 104 Swedish newspapers, as well as from Swedish news agencies and press releases, have been included in the search. Duplicates were removed.

In the mid 1990s the institutional structure governing research funding in Sweden was a patchwork of organisations that had emerged over time during the last half century. It started in the 1940s when separate research councils for medicine, science, technology and social science/humanities were founded. With the exception of the research council for technology, representatives elected by researchers constituted a majority on their boards, and the grants were supposed to be awarded based purely on scientific principles. A second layer was added to the funding structure in the 1960s and 1970s when sectoral research expanded in magnitude, i.e. research performed by the universities, but ordered and funded by government agencies that wanted to increase the knowledge base in their policy areas, or to support the process of technical change. Finally, a third layer emerged in the early 1990s when the centre-right government set up a series of research foundations with money from the dismantled wage earner funds. The private foundations were technically not an instrument of public research policy, but their aim was to promote basic research in areas of industrial relevance.[1] From the mid 1990s this fragmented institutional structure began to be perceived as a problem, and a series of public investigations discussed how it could be reformed. The

[1] See Stevrin (1978); Premfors (1986); Nybom (1997); Persson (2001); Benner (2001); Schilling (2005). For a discussion about the layered nature of Swedish research funding, see Edqvist (2002); Edqvist (2003).

discussion resulted in a major reorganisation of the public organisations for research funding in 2001.

This reform process coincided with an international discursive shift where innovation became increasingly associated with research and the university sector. Above all four theoretical developments contributed to this. One of them was initiated by the Swedish Council for Research and Planning (FRN), a body responsible for coordinating the research councils and facilitating transdisciplinary research. In the early 1990s it commissioned an international group of scholars to investigate the conditions affecting knowledge production, and the result was published in 1994 as *The New Production of Knowledge*.[2] Basically, this group's argument was that more and more people receive scientific training and are then dispersed throughout society. As a consequence, the production of knowledge is becoming increasingly diffused, rather than centred at universities and research institutes as had traditionally been the case. The new conditions of knowledge production imply a new logic that has emerged alongside the traditional disciplinary production of knowledge at universities. They term the new knowledge production system *Mode 2* while the traditional one is called *Mode 1*. In Mode 2 knowledge is created by temporary constellations of researchers with different disciplinary backgrounds, working together on problems oriented towards applications. All this means that knowledge is closely tied to the context in which it is produced and is diffused through the movement of researchers to new projects, rather than through published articles. The production system is dynamic, with constantly changing problem-based constellations and no pressures towards institutionalisation.[3]

Meanwhile, companies rely on knowledge production to survive in an intensified competitive environment, but most of them lack the resources to satisfy that need through their own R&D, making links to other possible knowledge sources vital.[4] The research that takes place at universities is one such source, and the writers argue that governments will (and should) be more sensitive towards industrial needs in their research policies and that research policy will turn into an innovation policy:

> [G]overnments have shifted from the support of science for its own sake towards innovation policy.… This intrusion of the wider interests of society is sometimes resented by scientists because it is felt to erode the independence of the 'Republic of Science'. But there are good reasons for this shift in the

[2] The scholars included Michael Gibbons, Helga Nowotny, Camille Limoges, Martin Trow, Simon Schwartzman and Peter Scott.

[3] Gibbons et al. (1994), pp. 1–16. The argument was further elaborated by some of the involved scholars in Nowotny et al. (2001).

[4] Gibbons et al. (1994), p. 50.

> locus of authority in the development of science: it reflects the distributed nature of knowledge production.[5]

In short, the knowledge produced today is not knowledge for its own sake emerging from universities. Rather, knowledge is now produced everywhere in society, and it is also closely linked to specific societal needs. Universities will have to adapt to this new reality and give up its 'ivory tower' status, becoming more of an equal partner to other producers of knowledge and adjusting its 'supply' to the changing 'demands' of society and industry.

Similarly, John Ziman has suggested a new mode of knowledge production that he calls 'Post-Academic Science,' emerging as the scientific community adapts itself to irreversible changes in its environment. More expensive research equipment and increasingly transdisciplinary problems demand further coordination among research efforts. A long period of boosted resources for research has been followed by 'steady-state' funding, with a focus on the efficient use of existing resources rather than expansion. The growth period has also made the scientific community largely dependent on external resources. Moreover, Ziman argues that many research areas, such as genetic research, have presently reached states where it is particularly useful to pursue applications. This has led to a strong emphasis on the utility of research and a convergence between the academic and industrial modes of knowledge production. Traditional academic norms, such as the public nature of research results, are questioned when commercial interests enter the academic world. In short, the academic sector is loosing its traditional special status, and it is increasingly viewed as just another area for public governance and accountability.[6]

A third attempt to link innovation and university research was made by the sociologists Henry Etzkowitz and Loet Leydesdorff in the mid 1990s. They coined the concept 'Triple Helix' to characterise the relationship between universities, industry and government, implying a systemic relationship where the three actors are becoming more interdependent. There is also a trend that they lose their institutional distinctiveness and take on functions previously attributed to the other actors. Industry has become a producer of knowledge while universities can spin off new companies, for example.[7] Finally, Donald E. Stokes launched his book *Pasteur's Quadrant: Basic Science and Technological Innovation* in 1997. His aim was to attack the view that basic research aimed at understanding the world and use-driven innovation are two fundamentally different things that should be kept institutionally separate. Analysing Louis Pasteur's work in microbiology he concluded that it was simultaneously oriented towards understanding the world

[5] Gibbons et al. (1994), p. 162.

[6] Ziman (2000), ch. 4.

[7] See Etzkowitz & Leydesdorff (1997).

and practical use, breaking down the traditional distinction between basic science and innovation. It was therefore no longer acceptable to spend public money on research based purely on curiosity and expect social progress in the future. Rather, it was necessary to make publicly funded basic research more receptive to societal needs.[8]

Some innovation scholars objected to this discursive marriage between innovation and university research, most notably Bengt-Åke Lundvall, who in his research had studied innovation as a product of learning due to user-producer interaction rather than science:

> While triple helix (Etzkowitz) and the new mode of knowledge production (Gibbons et al) may take a normative stance in arguing for integrating universities and other knowledge institutions more deeply into the economic process there was no such normative message in the original NSI-perspective.… [T]he current drive toward the market [adaptation of universities] is driven by the lop-sided understanding of innovation as emanating almost solely from science and therefore it goes too far.[9]

The knowledge produced at universities is no doubt important for economic and social development, but Lundvall nevertheless stressed the need to develop a relative autonomy between universities and economic interests, or the state. If the relationship is too close, the scientific credibility of research results might be devalued. In this respect he made a comparison to the autonomy given central banks, in order to protect the credibility of money.[10] But even though some voices dissented, the discursive shift was influential both in academic and policy circles.

Increased Polarisation in the Swedish Research Policy Debate

When the Social Democrats gained power in 1994, they appointed Carl Tham as minister of education. Until 1998 he headed an activist team at his ministry that was set out to reform the university sector and make it more receptive of societal needs. This meant a departure from a Swedish tradition of research policy that had emphasised university autonomy and trustful

[8] Stokes (1997). The concept of Pasteur's Quadrant would later be highly influential in VINNOVA; see interviews with Per Eriksson, September 20, 2006; Suzanne Håkansson, September 27, 2006.

[9] Lundvall (2006), p. 15.

[10] Lundvall (2006), p. 15f.; see also Lundvall (1985), p. 59ff.; Lundvall (1988), p. 364f.; Lundvall (2007), ch. 6. Several other innovation scholars defended university autonomy in the face of economic needs; see Edquist & Flodström (1997), p. 74f.; McKelvey (1998); Jacobsson (2002), p. 357ff.; Jacobsson & Rickne (2004), p. 1369; Granberg & Jacobsson (2006), p. 327ff.; interview with Bengt-Arne Vedin, April 7, 2006.

relationships between researchers and government. According to Mats Benner, Tham viewed the universities as old-fashioned and hierarchical institutions, whose practitioners worked in a tradition that made them disregard the social implication of their research. If they were left alone to follow their own curiosity, areas of vital importance to society would tend to be neglected by research. Therefore, he embarked on a programme to increase 'democratic' influence over the universities, making sure 'changes and reforms were implemented quickly and consistently and antiquated institutions torn down, not unlike when a theatre or a museum comes under new management.'[11]

This ambitious reform programme was very much in line with the theoretical developments mentioned above, but Tham and his closest aids claimed not to have read those books or to have been influenced by them. Benner is unable to find any direct link between theory and the reform programme and he is left guessing about possible influences: '[I]t is obvious some kind of influence between research [about the role of universities in the knowledge economy] and political practice [in Swedish research policy] took place after all, or at least parallel developments in research and policy.'[12] Still, there is no mention of that kind of research and the associated theoretical developments in the research bill presented by Tham in September 1996, which merely states that '[t]he social relevance of research should be given more significance in all research. That is why all research financiers and researchers should increasingly pay attention to the relevance of the research being done.'[13] The reform programme intended to make university research relevant to *all* of society and did not privilege industrial needs or innovation, as had been the case in the theoretical literature. In fact, the word innovation is rarely mentioned in the research policy documents of the time.

Besides making research more socially relevant, the reform programme aimed at democratising the hierarchical structure of universities. This involved making the positions of professors and other university researchers more similar, facilitating the careers of female researchers and providing additional support for research from a gender perspective. There were also attempts to aid regional development by increasing the resources given to the smaller colleges and universities scattered throughout Sweden, rather than focusing on the established large ones. Finally, a 'third mission' of interacting with society was legislated, in addition to the traditional university missions of research and education.[14] All these reforms took place while severe cutbacks in research funding were being made. The industrial crisis during the early 1990s had left Sweden with a budget deficit comprising 12 percent

[11] Benner (2001), p. 126, my translation.
[12] See Benner (2001), p. 147, my translation.
[13] Prop. 1996/97:5, p. 2, my translation.
[14] Benner (2001), pp. 112ff., 129ff.

of GDP, and the government strategy was to spread the reduced spending evenly across all policy areas, including research funding.[15] The cutbacks were justified with the emergence of new private research foundations in the early 1990s, and their resources were meant to compensate for the reduced traditional funding through faculties, research councils and sectoral government agencies. To increase the coordination between the foundations and public research policy that was needed for such compensation, the government changed the legislation so it could appoint and dismiss foundation board members freely. In the end, the research councils lost approximately 15 percent of their budgets and NUTEK's funding of technical research was cut back by 30 percent. The government also reduced the funding for international research collaborations.[16]

The head-on reform programme, in combination with the reduced funding, antagonised some members of the research community. Part of their counter-offensive took the form of several op-ed articles in the newspaper *Dagens Nyheter*, signed by hundreds of researchers. In particular they criticised the cutbacks, which they meant could irreparably harm research environments that had been built up over many years and that signalled 'an indifference for research and education bordering on contempt.'[17] The articles also criticised the idea that research should be evaluated based on societal relevance. That trend had been amplified when a larger portion of the research was funded by foundations, whose explicit purpose was to support research of strategic importance to economic development. Instead, the authors argued for the importance of pure basic research:

> The research areas of strategic importance today will be irrelevant a bit into the twenty-first century. We cannot today foresee what part of the research frontier will gain strategic importance in the future.… If Sweden does not quickly halt its dismantling of free basic research we will eventually lag helplessly behind in the development of future society. Basic research in the natural, technical and medical sciences has created the foundations of the society we live in today. The future society will probably build on the advances of basic research to an even greater extent.[18]

According to Benner, this position was shared by some of the Social Democrats who still favoured basic research and a more traditional research policy: '[A]n old interest network between (some) university researchers and parts of

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[15] See Benner (2001), p. 91. This strategy can be contrasted with that of Finland, whose government also struggled with a major deficit at the time, but instead decided to increase public research funding with the explicit intent of enhancing the country's status as a knowledge economy; see Gergils (2006), p. 107f.; Miettinen (2002), p. 81; Ylä-Anttila & Palmberg (2005), p. 10ff.

[16] Benner (2001), p. 98ff.

[17] Andreksson et al. (1996), my translation.

[18] Ahlberg et al. (1998), my translation. See also Ahlman et al. (1996); Albertsson et al. (1998).

the state apparatus began to re-establish itself after the first shock brought by the research policy reforms and the cutbacks had subsided.'[19] Perhaps the relatively isolated position of Carl Tham and his activist Ministry of Education can help explain why several public investigations dealing with research policy did not follow the focus on societal relevance endorsed by his ministry.

Reforming the Research Funding System

From the mid 1990s and up to the new millennium, the Swedish government had set up several commissions to investigate the possibility of reforming the fragmented research funding system. These investigations set in motion an interesting process, where various societal interests within and outside the state apparatus were given the opportunity of articulating their own visions of how the research system should function. All this took place at a time when new ideas about the role of universities in society were introduced in the debate. Several more or less dormant lines of conflict were brought into the open in this process, for example the already mentioned opposition between supporters of curiosity-driven basic research within autonomous universities and advocates of research more directly based on societal relevance. But overlapping this overarching division were other lines of conflict such as the organisational rivalry between the Ministry of Education and the Ministry of Industry, which both had research-supporting agencies sorting under them.

Above all, the conflicting positions brought forward by the reform process concerned the future of sectoral research. As noted in chapter one, sectoral government agencies ordered research to improve the knowledge base in their specific policy area, be it working life issues, spatial planning, agriculture or the environment, or to support the process of technical change. In Sweden research for sectoral needs was traditionally performed at universities rather than at research institutes, which was more common internationally. This reliance on universities made sectoral research particularly vulnerable to the discussion about university autonomy. While sectoral research expanded greatly during the 1960s and 1970s, perhaps more than in any other country, it began to be perceived more and more as a problem by the supporters of university autonomy during the 1980s, and this view increasingly influenced the political system.[20] Critics argued that a large part of the universities' funding consisted of short-term grants by sectoral agencies and that this posed an obstacle to the long-term development of the universities' capability to

[19] Benner (2001), p. 160, my translation.

[20] Aant Elzinga argues that the sectoralisation of research policy 'took an extreme form' in Sweden; see Elzinga (1988), p. 35.

produce knowledge. In order to solve that problem, they proposed a direct transfer of funds from the sectoral agencies to the university system. In that way researchers could maintain a greater degree of control over the sectorally relevant research questions. With such a system, universities could more easily integrate sectoral research with their long-term strategies for knowledge production. Not surprisingly, the sectoral agencies protested against this attempt by universities to wrest control over sectoral research funding, but the university-friendly view had influenced many political parties. Still, the Social Democratic government in power during most of the 1980s was reluctant to implement a direct transfer of funds, fearing that it might create tensions between sectoral ministries. Rather, the government at first instructed the sectoral agencies to be more sensitive to the long-term development of knowledge at universities as they offered grants. During the latter half of the 1980s the government took the further step of moving the research funding function from bureaucrats and societal representatives in the sectoral agencies to structures within the agencies resembling research councils, where a majority of researchers would make the important decisions.[21]

In Sweden, the main organisation supporting innovation and technical change was STU, sorting under the Ministry of Industry. It was merged with some other agencies into NUTEK in 1991. As mentioned, both these agencies were considered sectoral, even though their sectoral policy area displayed some differences in delimitations compared with more typical sectoral agencies. The purpose of their research funding was not only to serve current industrial needs, but also the needs of a future industry based on technology not yet existing. Even so, as sectoral agencies they were very much affected by the turn of the pendulum in favour of university control of sectoral research. For STU the funding of technical basic research was transferred to a newly formed research council in 1990, the Research Council of Technological Sciences (TFR). These changes were implemented without enthusiasm by STU.[22]

Sectoral Research Under Attack: *Research and Money* (1996)

The process of reforming Swedish research funding started in March 1995, when the Research Funding Investigation was commissioned by the Ministry of Education to investigate ways of reforming the research funding structure. To a large degree, this investigation has been neglected by scholars on Swe-

[21] See Persson (2001), ch. 4; SOU 1995:121, ch. 4.

[22] See Weinberger (1997), ch. 8; Persson (2001), ch. 7 and ch. 8. At first TFR sorted under the Ministry of Industry, but in 1993 it was transferred to the Ministry of Education.

dish research policy, most likely because very few of its proposals were implemented. Its main historical legacy was to provide legitimacy for the cutbacks in research funding during the mid 1990s.[23] In an account of the reform process, it is tempting to choose the later and more famous investigation *Research 2000* (SOU 1998:128) from 1998 as the natural starting point, given its paradigmatic status for the following debate. Nevertheless, there are some merits in going back a few years to the more unknown *Research and Money* (SOU 1996:29), released in 1996 by the Research Funding Investigation. This especially holds true when studying how the innovation system concept was adopted in Sweden. Even though its impact on the following reform process was small, its suggestions were considered controversial and provocative by many actors in Swedish society, especially the sectoral agencies. A comparison between the reactions to this investigation and later investigations dealing with the reform of research funding, will show important discursive continuities and changes at a time when new concepts and ideas were diffusing.

Susanne Eberstein, a member of parliament from the Social Democrats, was asked by the Ministry of Education to head the Research Funding Investigation, with Mats Ola Ottosson and later Björn Brandt serving as secretaries.[24] In their instructions, the investigators were given a broad mandate to evaluate the research funding system and offer suggestions for reform. They were especially asked to analyse possible 'balance problems,' for example between the various research-funding organisations, between the universities' internal resources and external funding, between basic and applied research and between research in different disciplines. In order to perform the analysis they were instructed to assemble statistical data on research funding during the previous decades, but also to consider the impact of new sources of funding such as the foundations.[25] In interpretating their mission, the investigators concluded that it concerned the funding of research only and that development issues were not covered by its mandate ('only the R in R&D').[26]

Summarising changes in research funding during the last fifteen years, the investigation stressed that the share of external funding for universities, which included funding from research councils, sectoral agencies and foundations, had increased over time. Between 1984/85 and 1994/95 external funding had increased by 94 percent, while the internal funding had only increased by 36 percent. To restore the proportions of 1984/85 required a transfer of almost two and a half billion crowns to the universities, roughly

[23] The investigation is briefly mentioned in Benner (2001), p. 99f.; Edqvist (2002), p. 39; Schilling (2005), p. 96f.

[24] Eberstein was also aided in the investigation by Ulf Heynman, Sonya Dahl, Ulf Sandström and Kjell A. Johansson.

[25] Dir. 1995:41.

[26] SOU 1996:29, p. 27, my translation.

half the funding available from research councils and sectoral agencies at the time of writing. While this development was problematic, the investigation could not recommend such a transfer, as it would seriously drain the public research-funding organisations of resources and make them unable to function.[27] Still, the investigation saw the increased reliance by universities on external funds as a threat to academic freedom. Faculty grants provided a foundation for researchers' freedom to choose their own problems and methodologies, but even those grants might end up serving the interests behind external funding:

> External grants are received after a consideration of the scientific quality of the project and, when applicable, its relevance. In order to be successful in the competition surrounding grants, the faculties must thus dedicate their base resources to research in line with the interests of external contributors. In a situation where a large part of the faculties' resources consists of external grants, the faculties will have to spend their entire faculty grant to maintain the long-term competence necessary to receive sufficient external grants.[28]

With the emergence of research foundations and EU research funding in the early 1990s, the problem with external funding had been amplified. This especially held true for technical research, which already had the highest share of external funding, 63 percent in 1992/93. As the new sources of grants were heavily oriented towards technical research, that share might increase even more.[29]

Technical research had been handled in a separate report by Ulf Sandström and Mats Benner, social scientists at Linköping and Lund Universities. Their mission was to discuss the organisational structure that funded technical research, especially the relationship between NUTEK and the research councils. Assuming that fundamental differences existed between basic and applied research, they argued against integrating them too far. Integrating all technical research funding into TFR, while reducing the role of NUTEK to supporting companies, would marginalise certain types of research that did not fit into the research council's priorities. Similarly basic research could be hurt if TFR was absorbed into NUTEK and all technical research was evaluated based on its relevance for contemporary or future industrial needs.[30] Their solution was to let both organisations focus even more on what they did best, which implied a transfer of resources, approximately 300 million crowns:

> One implication of this would be that NUTEK's instructions could change in the direction of supplying the needs of industry-related applied research in

[27] SOU 1996:29, pp. 14, 83f., 101.
[28] SOU 1996:29, p. 100, my translation.
[29] SOU 1996:29, pp. 87, 100.
[30] SOU 1996:20, ch. 7.

> the Swedish innovation system. Some of the grants [offered by NUTEK] that presently have a basic research character could be transferred to the new financiers [the research foundations].… [B]asic research would be handled by the research councils and the foundations, while the applied and development-oriented research would be taken care of by the sectoral agencies. To make the system work several networks of cooperation must emerge between the concerned agencies.[31]

Interestingly, the innovation system concept is here used in the context of arguing *against* an integration of innovation and research policy. The Research Funding Investigation picked up the idea of transferring 300 million crowns from NUTEK's support for technical research, but embedded it in its own discourse of universities threatened by a too strong reliance on external funds. Instead of giving the money to foundations or research councils, they proposed it should be transferred directly to universities in order to build up their long-term research capability. While public funding for technical research would be reduced as a consequence, it could be compensated for by the new research foundations.[32] Besides the direct transfer of funds from NUTEK, the investigation also proposed two more general measures to facilitate the long-term knowledge-producing capabilities at universities. First, organisations offering external funds should be required to pay an overhead fee, which would be used to enhance that capability. Second, 'model contracts' should be introduced that made it impossible for universities to accept agreements where they had to meet the offered external funds with their own resources, or take over operations.[33]

Organisationally, the investigation argued in favour of collecting the research councils into one single government agency, the Board of Research Councils, within which the research councils retained a large degree of their independence. While NUTEK represented a wide and integrated competency in industrial and innovation policy, the organisations supporting basic research were divided into several research councils, each with its own limited administrative resources. A unified agency was more capable of representing the interests of basic research as a whole. It would also have an increased ability to provide the government with knowledge and advice when decisions were made concerning basic research. Besides that, a unified agency would be more efficient in supporting transdisciplinary research, the concentration of resources into certain fields of research and the diffusion of research results into society.[34] Half of the board members in the agency should represent the research community and the other half societal interests, while the included research councils should be governed by a majority of research-

[31] SOU 1996:20, p. 87, my translation.
[32] SOU 1996:29, p. 214.
[33] SOU 1996:29, p. 102f.
[34] SOU 1996:29, p. 138ff.

ers.[35] For sectoral research, the investigation viewed the pluralism of government agencies involved in it as a problem. For agencies that were small or only supplied a few grants, the temptation of steering research based on narrow sectoral interests might become too overwhelming:

> Research should as far as possible be done without presumptions, while research steered by sectoral needs runs the risk of offering predictable results. There is also a risk that narrowly defined projects geared towards interests temporarily occupying the sector will be prioritised. In the worst case scenario, funding would be channelled into projects where the results simply confirm the policy already decided upon by the agency, while projects where the results might question that policy are held back.[36]

The pluralist organisational structure where several small and large agencies supported research should thus be rationalised, transferring the funding of sectoral research into independent organisations or independent units within existing agencies. These units should be large enough and have sufficient administrative resources to ensure that the research perspective was given due consideration when grants were offered, in addition to the relevance perspective. Ideally they should be organised as sectoral research councils, where research and sectoral interests were given equal weight on the board.[37]

In sum, the proposals of the Research Funding Investigation can be seen as a continuation of the sectoral research debate of the 1980s. Just like then, the main concern was that universities relied too much on external and sectoral grants and that this situation endangered academic autonomy. The solution was to strengthen the universities' capability of planning and coordinating long-term research, and this might require transfers of money from the research-funding agencies to the university sector. Some of this transfer could be general, like the overhead fee research-funding agencies should pay, and some more specific, like the proposed transfer of 300 million crowns from NUTEK to universities. The organisations funding sectoral research should be made to further resemble research councils, to ensure that research perspectives were given consideration in the offering of grants. This university-friendly approach was thus in line with the historical tradition, but not so much in line with the inclinations at the contemporary Ministry of Education. Neither was it in line with the wishes of those organisations that favoured a research policy based on industrial and social relevance, including those funding sectoral research.

[35] SOU 1996:29, p. 146ff.
[36] SOU 1996:29, p. 167, my translation.
[37] SOU 1996:29, p. 164ff.

Reactions to *Research and Money*

As is traditional in Sweden, several organisations were given the opportunity to comment on the investigation's findings. Some organisations also sent letters to the government, elaborating their view on research policy ahead of the 1996 research bill. According to a summary of the comments made by the Ministry of Education, the universities were enthusiastic about the investigation's report, the research councils somewhat less enthusiastic and the sectoral agencies downright critical.[38] This section will focus on the more critical responses to the report, especially from organisations with an explicit stake in Swedish economic development. Not surprisingly, NUTEK was the organisation most dismissive of the report and its proposals. In its view, the problem facing the Swedish research system was the exact opposite of the problem presented in the investigation. It was not a matter of universities depending too much on external impulses and with too few internal resources. On the contrary, according to NUTEK, funding dedicated to curiosity-driven basic research, which included both faculty grants and research council grants, had increased during the last decades, while funding for sectoral research based on relevance had lagged behind. University independence from society was not threatened; rather it had become too strong and risked obstructing attempts to solve the real problem in the research system. That is,

> how the R&D funded by the government can better be taken advantage of and made useful in the development of society and economy. The government's measures to make the research base useful for industrial growth and renewal are severely neglected and far too small in an international comparison.[39]

The government should aim its research policy at facilitating interaction between university and society. NUTEK argued it could fall back on a long and fruitful experience of building networks and encouraging interaction between university and industry. The agency also claimed that such interaction had been met with very positive attitudes among researchers. Imposing model contracts and overhead fees would send the wrong signals and inhibit interaction. Similarly the transfer of 300 million crowns from NUTEK to the university sector, a figure 'taken out of the blue' according to NUTEK, would

> virtually extinguish the government's future capabilities to through NUTEK enhance the renewal of research and the universities' interaction with industry within strategic technology areas and means that the government deprives itself of the possibility of influencing the strategy development in the industry-

[38] Short summary of comments, Ministry of Education, Dnr U96/1033/F, 1996-09-12, 15, Regeringskansliets arkiv- och dokumentcenter.

[39] Comments from NUTEK, Dnr U96/1033/F, 1996-09-12, 15, Regeringskansliets arkiv- och dokumentcenter, my translation.

> oriented research, in the hope that independent foundations will be ready to take responsibility for industrial policy.[40]

In its comments, IVA criticised the investigation for limiting itself to a narrow university-oriented perspective, focusing mainly on the area of responsibility sorting under the Ministry of Education. There was little or no analysis of the connection between research and industrial development or sectoral policy, nor of the mechanisms through which research is exploited in society. IVA proposed a coordinated research policy focusing on economic growth, carried out in close cooperation between the Ministry of Education and other sectoral ministries, especially the Ministry of Industry. Just like NUTEK, IVA questioned the picture presented in the report, arguing that its separation between internal and external resources was arbitrary. Funding from the research councils should rather be viewed as an internal resource for the university system, controlled by researchers and geared towards curiosity-driven basic research. When it came to technical and industry-relevant research, Sweden lagged behind other countries, which made it an important area to boost. Finally IVA discouraged the transfer of funds from NUTEK and saw no problem with a sectoral agency supporting both applied and basic research.[41]

The Federation of Swedish Industries also criticised the university-centred focus of the investigation, arguing that it 'passed on the impression that research exists first and foremost for its own and the researchers' sake!'[42] In a society where competition was fierce and companies were more and more dependent on knowledge, it argued that research policy should be integrated with education and industrial policy into what they called 'knowledge policy.' The responsibility for this new policy area should not be given to the Ministry of Education, as it was too closely linked with the university sector and its wants and needs. Rather, the knowledge policy should be coordinated by someone more independent of the universities. While Sweden had one of the highest R&D rates in the world compared to its GDP, public support for technical and industry-relevant research was much too low, even though the new foundations were a step in the right direction. It might be necessary to cut back on public research funding due to the fiscal situation, but it was vital to exempt industry-relevant research. Therefore it was not advisable to transfer funds from NUTEK.[43]

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[40] Comments from NUTEK, Dnr U96/1033/F, 1996-09-12, 15, Regeringskansliets arkiv- och dokumentcenter, my translation.

[41] Comments from IVA, Dnr U96/1033/F, 1996-09-12, 15. See also letter from IVA to the government, April 4, 1996, Dnr U96/1033/F, 1996-09-12, 15, Regeringskansliets arkiv- och dokumentcenter.

[42] Comments from the Federation of Swedish Industries, Dnr U96/1033/F, 1996-09-12, 15, Regeringskansliets arkiv- och dokumentcenter, my translation.

[43] Comments from the Federation of Swedish Industries, Dnr U96/1033/F, 1996-09-12, 15. See also letters from the Federation of Swedish Industries to the government, February 27,

Finally, the Swedish Trade Union Confederation (LO) also noted the internationally high R&D rate, but complained that this had helped neither economic growth nor the structural renewal of Swedish industry towards knowledge-intensive production. This was partly due to a lack of competence from the government in funding and ordering research, but also to the structure of the university system:

> The research system is dominated by something strongly resembling local wage earner governance, i.e. the collegial research community retains the main responsibility for goals, evaluation and the steering of resources. Such a system can be expected to optimise the usefulness of research for researchers – not for society. This also appears, in a too large extent, to have been the case.[44]

It was important to give groups outside the scientific community a say in research policy. These outside groups should not only include industry, but also the public sector and wage earners. They should all strive to improve their competence in dealing with the research sector.[45]

The investigation and the critical comments present two competing images of the main problem in Swedish research policy in the mid 1990s. For the investigation, universities were increasingly dependant on external funding and narrow sectoral interests. Critics argue, on the other hand, that curiosity-driven basic research was well supported in Sweden while industry-relevant research lagged behind. The picture drawn is largely depending on how the research councils are interpreted, as an external source of funding or as subjected to the logic of researcher control and basic research. NUTEK, organised industry and the trade unions shared many themes in their critique of the investigation, such as the need for greater societal influence over both basic and applied research and the need to boost industry-relevant research, even in times of fiscal crisis. Interestingly, the discussion rarely refers to the OECD or the emerging field of innovation research, including the sections of it explicitly striving to integrate research and innovation policy, such as Mode 2 and Triple Helix. At one point the innovation system concept is mentioned, but as part of an argument against such integration.

When the government presented its research bill in September 1996, it did not adopt many of the proposals in the investigation. In line with the dominant position at the Ministry of Education, it advocated a focus on the usefulness of research for society. Involving the research councils in a single agency was not supported, as it risked making the bureaucratic structure

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1996 and April 30, 1996, Dnr U96/1033/F, 1996-09-12, 15, Regeringskansliets arkiv- och dokumentcenter.

[44] Comments from LO, Dnr U96/1033/F, 1996-09-12, 15, Regeringskansliets arkiv- och dokumentcenter, my translation.

[45] Comments from LO, Dnr U96/1033/F, 1996-09-12, 15, Regeringskansliets arkiv- och dokumentcenter.

more cumbersome. Keeping the research councils intact within the agency would also maintain existing barriers between research areas. The government showed some interest in the possibility of a complete merger between the research councils, but it allowed the present structure to continue for the time being. Instead, the research councils were instructed to set up a body facilitating coordination between them.[46]

Nor did the government wish to implement model contracts or the overhead fee. Avoiding unfavourable conditions in their cooperation with the outside world should be the responsibility of universities themselves, and the form of such cooperation should be allowed to vary between different universities. To extract a fee, and thereby force external financiers to support the long-term development of knowledge-producing capabilities at universities, might discourage them from interacting with the university sector.[47] The government was more interested in the proposal of cutting back NUTEK's funding of technical research by 300 million crowns, which fitted well into its general project of solving the fiscal crisis. It adopted the view that this cutback could be compensated by the new foundations and advocated the measure in an April 1996 economy bill, almost directly after the investigation had been made public.[48] However, it did not accept the proposal of transferring the money directly to the universities.[49]

Neither the supporters of the investigation nor its critics were likely to be too pleased with the research bill. The investigation did not manage to push through its image of an increasingly threatened university autonomy and did not achieve a transfer of resources to the universities' own pockets. But the critics could not stop the cutbacks in technical research funding either.

Sectoral Research Under Attack: *Research 2000* (1998)

Except for the legitimacy it provided for funding cutbacks, *Research and Money* did not alter the status quo in Swedish research funding. The research councils remained in their old form, as did the sectoral agencies supporting research. In a way, the Ministry of Education was back to square one in its attempt to reform the research funding structure. A new commission was appointed in May 1997, named *Research 2000*. It consisted mainly of parliamentarians from the parties represented in the Swedish parliament and was headed by university chancellor Stig Hagström, with Sonja Dahl as secretary.[50] Just like the Research Funding Investigation, it was given a broad

[46] Prop. 1996/97:5, p. 206f.
[47] Prop. 1996/97:5, p. 114f.
[48] Prop. 1995/96:150, p. 97.
[49] Prop. 1996/97:5, p. 258.
[50] This investigation has also been dealt with by Benner (2001), pp. 169-187; Elam & Glimell (2004), p. 35ff.; Schilling (2005) p. 100ff.

mandate to evaluate the publicly funded research system in its entirety. But unlike that investigation, the instructions this time specifically stated which perspective the system should be analysed from. If the ministry was unhappy with the university-friendly direction taken by *Research and Money*, they were less likely to take chances this time:

> There is a legitimate demand from a democratic society to guide research in the direction of what it perceives as especially urgent areas.… Internal scientific priorities can be of long-term importance for competence and knowledge in society. Therefore these priorities must be discussed and accounted for also outside the research community.… The large Swedish investments in research and development (R&D) have not fully been transformed into innovations, new employment or increased social welfare.… To some extent this is a product of circumstances outside the area of research. But it is also evident that research to a large degree also must be directed to what is socially and economically useful.[51]

The instructions basically repeated the activist Ministry of Education's position, as it had been fleshed out in the 1996 research bill. Explicitly, the ministry asked the investigators to 'analyse the Swedish investments in research from the perspective of society's needs and the possibilities of research.' One of the major goals for research policy was to ensure that university research contributed to economic and social development. Given that fact, the investigation's mission was to 'evaluate and analyse the socio-economic usefulness of publicly funded research and the possibilities of increasing this in relation to the public investments.'[52] Even though the choice of perspective had been pre-decided in the instructions, the investigation was given more freedom in how that perspective was to be applied to the university system. It was asked to evaluate a wide assortment of questions, including the division of responsibility between organisations in the research system, the overall direction of public research investments, the future organisational structure in research funding and how the interaction between university and society could increase.[53] Further instructions were added in December 1997, when it was ordered to investigate how small and medium-sized universities had handled their research funds.[54]

As the commission performed its investigative work, it maintained only brief communications with the Ministry of Education, while instead making sure its fellow parliamentarians were well informed of its progress.[55] When it presented its finished report in late 1998, it became obvious that the commission had rebelled against its instructions and thrown the officially sanctioned

[51] Dir. 1997:67, my translation.
[52] Dir. 1997:67, my translation.
[53] Dir. 1997:67. See also Benner (2001), p. 169ff.
[54] Dir. 1997:154.
[55] Benner (2001), p. 172f.

perspective of social and economic relevance overboard. Here the diverse list of tasks in the instructions provided an excuse:

> It is hardly possible to throw light on, comment, judge and possibly also reform everything the instructions specify in one single context.… The wide framework for the investigative mission and the large number of issues specified in the instructions have been perceived by Research 2000 as a signal that it is free to raise the issues it judges important and not as a literal request to deal with 'everything' that concerns research in Sweden.[56]

Once it had freed itself from the instructions, the aim of the commission was to offer a political manifesto for Swedish research policy, rather than a detailed list of proposals for what should be done.[57]

Viewing itself as a manifesto, the investigation continued along the lines of the university-centred tradition that had characterised the 1980s research debate, as well as *Research and Money*. But this time it went even further in protecting university autonomy and attacking sectoral research. Societal and economic interests were best served by increased resources for scientific research, where researchers themselves were left alone to pose questions and define priorities. In this way, it complied somewhat with its instructions to focus on the social and economic results of research. Present societal interests should not be allowed to dominate research policy, in order to safeguard future societal interests:

> Publicly funded research has expanded for a long time and according to a pattern where increased emphasis has been placed on research that in various ways has been judged to be relevant for society. Research 2000 is of the opinion that too much interest has been paid to evaluating the usefulness of different research investments *in advance* instead of actually exploiting the results that come out of research. Useful research results cannot be ordered, no matter how much one may wish that expensive investments in research will pay off. On the contrary, the increasingly specific demands that research should produce useful results risk making research less useful in the long run, as research priorities are made out of today's societal problems, which already tomorrow will be the issues of yesterday, and free research will be marginalised. It is the free research that historically has contributed the most useful results. Free research is a precondition for the existence of new knowledge to develop into applications in various areas.[58]

Just like *Research and Money*, the investigation described a situation where the relative position of pure basic research had shifted in favour of research based on societal problems and applications during the last decades. Research foundations and EU funding dedicated to industrial relevance had added to the shift. Lately there had even been demands that research funded

[56] SOU 1998:128, p. 11f., my translation.
[57] See Benner (2001), p. 172.
[58] SOU 1998:128, p. 4, my translation, italics in original.

by faculty grants and research councils should be socially useful. To address this imbalance, it suggested large increases in funding for basic research. But in line with its ambition as a manifesto offering 'overarching priorities and guidelines,' it did not give any specific proposals regarding sums.[59] Especially basic research in the natural and technical sciences needed a boost. This kind of basic research was also most likely to have an effect on economic development in the long run.[60]

The investigation made a distinction between researcher-governed research and purchaser-governed research. In researcher-governed research, researchers themselves initiated research based on their own interests, and the results were evaluated based on scientific criteria. But in purchaser-governed research an organisation outside the university system, such as a company or a government agency, had found the need for research in its area of activity. It placed an order with the university to fulfil its need of knowledge, and the results were evaluated based on its relevance for the purchaser, as well as by standard scientific criteria.[61] Both these kinds of research were legitimate as far as *Research 2000* was concerned, but it was troubled to find that most of the sectoral research performed in Sweden did not conform to either group. Rather, sectoral research could be seen as a third hybrid model, combining characteristics of researcher-governed and purchaser-governed research. The commission called this proxy-governed research, where university-based researchers design projects and propose them to sectoral agencies in the hope of grants, just like with researcher-governed research. But the projects are evaluated by a mixed group of sectoral interests and researchers appointed by the agency, rather than the scientific community. This group acts as a proxy for the interests concerned, such as perceived present and future industrial needs, when they decide on grants. Researchers are also supposed to act as proxies, considering sectoral needs as they construct their proposals.[62] This was not a good thing, according to *Research 2000*:

> Sectoral research has been responsible for many valuable investments in research. In spite of that, in the view of Research 2000 it is doubtful if this is a good form. It is rather a half measure that cannot accommodate the demand for relevance and closeness to users in purchaser-governed research, nor the demand for originality and scientific quality in researcher-governed research.… Research 2000 is of the opinion that future government investments in research should take the form of either researcher-governed research or purchaser-governed research.[63]

[59] SOU 1998:128, pp. 58ff., 67f.
[60] SOU 1998:128, p. 87f.
[61] SOU 1998:128, p. 60f.
[62] SOU 1998:128, p. 61.
[63] SOU 1998:128, p. 61f., my translation.

NUTEK could be seen as a prime example of proxy-governed research, and here the investigation concluded that public investment in resources would do a better job if they were channelled directly into basic research and the education of graduate students, rather than through NUTEK. By creating a stimulating general research environment in Sweden, the preconditions for industry in-house R&D would also improve. Aiding basic research in the technical and natural sciences was a step towards achieving that goal.[64]

This analysis of proxy-governed research and its drawbacks also coloured the investigation's proposals regarding the organisational structure of research funding. Unlike *Research and Money* it did not advocate a single government agency for all the research councils. The overarching division of funding between disciplinary areas was a matter for the government, and this removed the major purpose of a single research council. Instead, the existing structure should be replaced by separate research councils for social science/humanities, medicine, natural science and technology, as well as an organisation responsible for transdisciplinary research and cooperation between the research councils. This organisational structure was virtually identical to the existing one. However, a big novelty was the proposed transfer of all research funding from the sectoral agencies to the new research councils, which would thus be responsible for both basic and applied research.[65]

Considering that all the new research councils sorted under the Ministry of Education, this meant a concentration of the power behind research funding to that ministry, at the expense of other sectoral ministries. As traditional, the research councils should be governed by a majority of researchers elected by the scientific community. In short, sectoral research as it had existed in Sweden for several decades was about to be abolished. This kind of research would be put under collegial researcher control, while non-scientific sectoral interests were marginalised in the evaluative process. Sectoral agencies whose only purpose was to fund research could thus be shut down, while the rest could be streamlined down to their functions that did not involve research funding.[66] Instead, government agencies and the government itself was to increase its ordering of purchaser-governed research. Such research should not be initiated by researchers and should benefit the agency's ability to function in its own area of activity, rather than some social or economic interest for which the agency acts as a proxy. In short, the agency was to act like a private company does when it orders research from universities.

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[64] SOU 1998:128, p. 108f. Many scholars have attributed this criticism of sectoral research to influence from Sverker Gustavsson, a professor of political science who had worked at the Ministry of Education during the late 1980s and who had been a long-standing critic of sectoral research; see Benner (2001), p. 174f.; Elam & Glimell (2004), p. 32ff.

[65] SOU 1998:128, p. 192ff.

[66] SOU 1998:128, p. 192ff.

This required government agencies to build up a competency in initiating and ordering research.[67]

Research 2000 proved to be a formidable challenge to the advocates of socially and economically relevant research, much more than the earlier *Research and Money* had been. It was no longer a matter of merely increasing the share of researchers on the boards granting sectoral research funding or transferring some more funding directly to the universities. This time virtually complete researcher control over sectoral grants was on the agenda, which meant the end of sectoral research as it had traditionally been carried out in Sweden. Whereas *Research and Money* had tried to protect university autonomy with an institutional separation between funders of basic and applied research, *Research 2000* wanted them both integrated. However, this integration would take place under the control of university-based researchers and their curiosity. Thereby the investigation inverted the integration between innovation and research policy envisioned by the literature proposing a qualitatively new mode of knowledge production.

When the report was released in late 1998, the surrounding political context had also changed, as Carl Tham had just been replaced by fellow Social Democrat Thomas Östros as Minister of Education. Östros discontinued the confrontative stance of his predecessor, and his tenure was characterised by efforts to appease the enraged parts of the research community.[68] This meant that the Ministry of Education could no longer necessarily be counted on to support the viewpoint of social and economic relevance. Supporters of sectoral research were thus more isolated than they had been just a few years earlier. At the same time the ministries for labour market affairs, energy and communications had been added to the Ministry of Industry, creating a 'super ministry' with a supposed focus on growth issues. With the stroke of a pen, *Research 2000* threatened to remove all resources for funding industry-relevant technical research from the newly born ministry and the agencies that sorted under it.

Reactions to *Research 2000*

Whereas *Research and Money* had passed virtually unnoticed in the media a few years earlier, *Research 2000* sparked an intense debate about research policy in the Swedish press. Stig Hagström and Sonja Dahl set it off by presenting a summary of their conclusions in *Svenska Dagbladet*, one of the main Swedish dailies.[69] This was followed by sixteen more op-ed articles in the same newspaper, discussing the merits of curiosity-driven basic research versus research more directly based on societal relevance. All the research

[67] SOU 1998:128, p. 106f.
[68] See Benner (2001), p. 187ff.
[69] Dahl & Hagström (1998).

councils came out in strong support of the investigation, seeing it as a 'sobering up in research policy, away from a [19]90s characterised by a continuous impoverishment of the free basic research at our universities.' Integrating applied research into the research councils was not the same thing as abandoning research motivated by sectoral interests. On the contrary, this would improve its scientific quality and build stronger research environments, to the long-term benefit of society.[70] Similarly fourteen professors from the natural sciences argued that economic growth was best served 'if the norms of the international research community are allowed to guide the use of scarce resources. For research to be close to social needs is therefore a reason in favour of researcher control rather than against.'[71]

If the research councils and parts of the scientific community supported the investigation, the critical voices were the same as they had been in 1996, i.e. sectoral agencies and those with a strong stake in industrial development. Directors of five research-supporting sectoral agencies, including NUTEK, accused the investigation of turning back the clock 'to a time when university research was very isolated from the rest of society.… [T]he hard work of the last years to find forms and incentives for increased interaction and increased exchange of knowledge … risks being spoiled.'[72] Strong criticism along similar lines also came from IVA and the Federation of Swedish Industries.[73] The reaction from the Industry Committee, a collaborative organisation set up in 1997 by trade unions and industry associations in the industrial sector, was particularly interesting. According to it,

> [r]esearch policy needs to be developed into an innovation policy for increased growth. For R&D to provide good results it needs to be put into a wider context. Within the OECD this is called innovation policy. The innovation system consists of the mechanisms for how R&D results are exploited, incentives for the actors in the system, the funding actors, the R&D-performing organisations etc. Even policy areas like economic policy, industrial policy, education policy, regional policy, labour market policy are included.[74]

Here the innovation system concept was used as part of an argument against a perceived insulation of the university sector from the rest of society. If universities were an essential part of a system of relationships between organisations and institutions in which innovations occurred, it could be argued that isolating this important part from the rest of system would be artificial and unfortunate. In short, this use of the concept can be seen as an attempt to rhetorically frame the universities in a different light and thereby to break with the traditionally respectful and trusting attitude towards university

[70] Jeffner et al. (1999), my translation.
[71] Kyllander et al. (1999), my translation.
[72] Erngren et al. (1998), my translation.
[73] Modéer (1998); Östberg (1999).
[74] Duker et al. (1999), my translation.

researchers. This respectful attitude, which Donald Stokes had associated with Vannevar Bush and perceived as highly influential in the industrialised world, left researchers to follow their own curiosity shielded by the notion of university autonomy, which was expected to boost technological progress in the long run. In Sweden, a particular brand of such thinking had developed under Tage Erlander, Social Democratic prime minister between 1946 and 1969. Personally fascinated with the promises of free basic research, he increased its funding and organised two conferences in the mid 1950s where politicians could interact with the top researchers. Olle Edqvist describes Tage Erlander's general outlook on research policy as follows: 'Let the researchers go about as they see fit, and we will all harvest the results.'[75]

The quote from the Industry Committee also used the innovation system concept as a vessel for transferring legitimacy from the OECD to the authors' particular position in the local Swedish research policy debate. If other countries in the OECD had transformed their research policy into an innovation policy, Sweden risked lagging behind if it did not do the same. This use of the concept was a clear departure from conventional ways of using it or talking about innovations in Sweden. Authors using the concept in the early 1990s had not urged the university sector to adapt its norms and practices in order to fit into an innovation system. As noted in the previous chapter, Bengt-Arne Vedin had stressed that university research had been overestimated as an input for innovation, while Charles Edquist had argued that it was more important to absorb technology from abroad than to support domestic research. Before the late 1990s, NUTEK was more interested in building new research structures outside the universities and in turning small companies into interesting scientific collaboration partners, than in changing the role of existing universities. Also, the OECD had never been used as a source of legitimacy. When Charles Edquist tried to influence Swedish policy in the mid 1990s, he referred to the concept's academic and potential scientific status instead.[76]

The innovation system concept was used only once in the press debate, but parallel to that discussion Swedish organisations were preparing their comments in advance of the preliminary research bill expected in April 1999. In those comments, the OECD and the new use of the innovation system concept played a more prominent role. Interestingly, one of the more critical and elaborate responses to *Research 2000* came from abroad. In January 1999 the UK-based consultancy firm Technopolis released a 66-page report, polemically entitled *Research 2000 or Research 1950?* Erik Arnold, fluent in Swedish and one of the firm's managing directors, was aided by Catherine

[75] Edqvist (2003), p. 213, italics removed. See also Stevrin (1978), pp. 93ff., 116; Elam & Glimell (2004), p. 26ff.

[76] See his argument in Edquist (1993), p. 18ff.

Whitelegg and Ben Thuriaux in the attack.[77] Their aim was to present and review the scientific progress they meant had occurred in research and innovation studies during the last decades: 'The intellectual framework of **Research 2000** is hopelessly out of date. It takes no account of the past 50 years or so of research on research, the growing literature on innovation or the debate in the OECD over the past 20–30 years on the role of technology in industrial development ….'[78] To fill in the gap Arnold et al. made extensive use of this new research as they deconstructed the arguments of *Research 2000*, above all the literature on Mode 2 and innovation systems. In general this research was treated as uncontested and objective scientific knowledge, as when the Technopolis report argued that the 'community who does research on research generally accepts that science is splitting up into two modes of knowledge production.'[79] The claim was not followed by any references or supporting arguments. Ignoring the critical debate that had developed around concepts like Mode 2 or innovation systems and implicitly presenting them as uncontroversial and uncontested in the scientific community, signals an appeal to the legitimacy of science in the debate. This constructed image of science is presented as cumulative and generally uncontested, rather than open-ended and critical, thereby increasing the supposed folly of *Research 2000* when the investigation ignored its results.

Somewhat at odds with this implicit image of objective and unanimous science, Arnold et al. also portrayed scientific research as deeply embedded in power relations. The idea of free research in modern societies was an illusion. Even in a university system insulated from the rest of society, individual researchers still depended on resources that were external to them as persons. As a result they were forced to involve themselves in negotiations and power struggles with a scientific community that controlled funding. The basic research agenda is 'controlled by the curiosity, and the vested interests, of the existing scientific establishment. Individual researchers have to find a compromise between what they would do if they really were "free" and what the scientific establishment is prepared to fund.'[80] More funding through channels outside the university system could in fact increase the freedom of individual researchers by offering a wider array of possible funding channels

[77] Erik Arnold had some influence at the Ministry of Industry as it responded to the challenge from *Research 2000*; see interview with Suzanne Håkansson, September 27, 2006, my translation: 'He said the same thing that people were thinking at the ministry then, the Ministry of Industry, but he said it with prettier words.'

[78] Arnold et al. (1999), p. 3, bold in original.

[79] Arnold et al. (1999), p. 15. In fact the literature on Mode 2 has faced some criticism in the academic community and is far from generally accepted; see for example Godin (1998); Shinn (1999); Shinn (2002); Elzinga (2004).

[80] Arnold et al. (1999), p. 13.

and bypassing those presumably conservative gatekeepers who had made it to the top of the scientific community.[81]

Leaving too much control over funding in the hands of the research community is not a good idea. *Research 2000* had tended to present scientific research as 'a kind of world-class intellectual athletics, which constantly challenges the *status quo*,' but the traditional disciplinary research associated with Mode 1 is basically slow, conservative and unable to react to social demands.[82] When the scientific criteria of Mode 1 are used to evaluate transdisciplinary research oriented towards applications (Mode 2), the result can often be counterproductive. In a worst-case scenario it can undermine the emergence of new fields of study. Science itself has no criterion for choosing between projects based on relevance, and judgements based purely on scientific criteria tend to conserve existing structures.[83] To make things worse, the traditional scientific way of evaluating research based on peer review had become less reliable in the last decades as competition for funding increased. Reviewers have strong incentives to give poor reviews to competitors, in order to protect their own funding.[84]

Research 2000 had assumed that basic research aids economic development through the production of codified research results, made public and published in journals. In fact, only a minor fraction of the published research results matter for economic development. Also, if the advantages of basic research were connected exclusively to published research, those results would be easy to tap into for foreign free riders and could not be considered a specific Swedish competitive advantage. Basic research did bring advantages to the rest of society, but through side effects such as the tacit skills and networks people acquire at universities, which they can transfer to others or bring with them as they moved between university and society. All these beneficial side effects of basic research required extensive networks between the universities and the rest of the innovation system. Universities could not retreat into an 'ivory tower' position and expect its codified research results to somehow be transformed into welfare in the future.[85] One way of avoiding this kind of retreat could be to subsume research policy under an innovation policy, and lift it from the Ministry of Education to a higher governmental level. This had been done in Finland where research policy was coordinated by the Council for Science and Technology, with the prime minister acting as chairman. Such a body should be set up in Sweden as well.[86]

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[81] Arnold et al. (1999), p. 20.

[82] Arnold et al. (1999), p. 12, my translation, italics in original.

[83] Arnold et al. (1999), p. 17ff.

[84] Arnold et al. (1999), p. 15.

[85] Arnold et al. (1999), p. 35ff.

[86] Arnold et al. (1999), p. 65. The suggestion of setting up a research and innovation body at the governmental level has recurred several times in the Swedish debate since the late 1990s; see Flodström (1999), p. 88f. and Gergils (2006), p. 283ff. See also comments from NUTEK

In conclusion, basic research could only benefit society if the surrounding innovation system functioned properly, including the linkages between it and the university sector. This had become evident in some countries in Latin America and South Asia that had boosted basic research, but where the economic results had been absent due to nonexistent linkages between the new universities and the rest of the economy.[87] The Swedish situation was not that dissimilar:

> The debate needs, therefore, not to be about the question 'Do we need more basic science?' as **Research 2000** suggests. Sweden actually funds more basic science per head of population than most countries, and that science is more productive of scientific outputs than science in most places. Yet Sweden has steadily been slipping in GDP per head of population, compared with other advanced economies. The first question for **Research 2000** ought therefore to be 'If we're so clever, how come we ain't rich?'[88]

Of the domestic organisations, NUTEK was perhaps the most critical, fearing a finishing blow to its research support after the drainage of 300 million crowns just a few years earlier. To them the investigation was 'of inferior quality and misleading.' Following its advice would isolate the universities from the rest of society, leading to 'a daredevil experiment, which would lead Sweden in the wrong direction towards an extreme R&D system, without equivalents in any other OECD countries.' NUTEK had spent decades building structures facilitating the interaction between university and industry, as well as funding problem-oriented, transdisciplinary research. If those achievements were torn down, it would take a long time to rebuild them and Sweden would fall further behind in welfare compared to other countries.[89]

A large body of research on the relationship between research and innovation had emerged in the last decades, which *Research 2000* had chosen to ignore. This research showed that one could not simply fund basic research based on researcher curiosity and expect the results to translate into economic development. Just like the Technopolis report, NUTEK pointed out that codified research results were only one part of the potential benefits offered by the university sector and not necessarily the most important one. Universities also supplied methods, scientific instruments and the tacit skills embedded in individuals. Traditional disciplinary research was by nature conservative and needed problem-oriented, transdisciplinary research as a catalyst for change, but also as a channel for bringing ideas sprung from practical experience into the academic world:

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and the Industry Committee, Dnr U1998/4107/F, 1999-04-15, 10, Regeringskansliet arkiv- och dokumentcenter.

[87] Arnold et al. (1999), p. 33f.

[88] Arnold et al. (1999), p. 7, bold in original.

[89] Comments from NUTEK, Dnr U1998/4107/F, 1999-04-15, 10, Regeringskansliet arkiv- och dokumentcenter. See also Benner (2001), p. 185f.

> Research on innovations and innovation systems shows among other things that the interplay between disciplinary and problem-oriented research, where both stimulate each other, is a very important factor for the development of both research and industry. The policy discussion within the OECD differs strongly from the narrow [university] perspective of the investigation. The OECD uses an innovation perspective that includes the need for government measures far outside basic research.[90]

Research 2000 was stuck inside the linear model, expecting free basic research to boost economic development, while not considering the travelling of impulses in the opposite direction. Lately NUTEK's activities had shifted focus away from a traditional support of research projects, to the building of infrastructure between universities and industry. If its resources were transferred to researcher-controlled research councils, they would revert back to traditional research support, and no one would be around to handle the vital infrastructure-building activities.[91]

NUTEK's reaction to *Research 2000* is particularly interesting, because it shows how abruptly the innovation system concept was appropriated and enrolled in the defence of sectoral research. In 1998, just before *Research 2000* was launched, NUTEK had published a large volume entitled *The Swedish National Innovation System: A Quantitative Study*. It had been prepared for the OECD programme Knowledge Flows in National Innovation Systems, under the leadership of Göran Marklund. Assembling a vast amount of macro-level statistical data to assess how well the Swedish national innovation system functioned, Marklund and his team painted a fairly optimistic picture. According to them, '[t]he available data on innovation indicate that Swedish industry is quite innovative by international comparison.'[92] Furthermore, Sweden also excelled in R&D expenditures in relation to GDP, in patenting and in scientific publications and citations. Their major complaints concerned a lack of natural scientists and engineers with higher education, as well as too little research in the natural and technical sciences.[93] After *Research 2000* arrived, NUTEK's description of the Swedish innovation system immediately turned more pessimistic. In January 1999 the director of NUTEK, Per-Ola Eriksson, downplayed the optimistic conclusions his organisation had presented a few months earlier:

> This autumn some troubling signals arrived. In a NUTEK report to the OECD the Swedish innovation system is analysed. In spite of internationally high Swedish investments in R&D and registered patents, economic growth is low. The return [on these investments] should be much higher. There are

[90] Comments from NUTEK, Dnr U1998/4107/F, 1999-04-15, 10, Regeringskansliet arkiv- och dokumentcenter, my translation.

[91] Comments from NUTEK, Dnr U1998/4107/F, 1999-04-15, 10, Regeringskansliet arkiv- och dokumentcenter.

[92] NUTEK (1998), p. 6.

[93] NUTEK (1998), ch. 13.

> thus several indications of deficiencies in the Swedish R&D system, especially in the intersections between university and industry.[94]

In its comments IVA did not refer to the innovation system concept or the OECD explicitly, but noted that the investigation had not 'taken the experience of other countries and current "research on research" into consideration. Internationally the value for knowledge production of problem-oriented, interdisciplinary research … is emphasised.' It also hinted at the emergence of new theoretical frameworks when it argued that 'a research system exclusively built on researcher guidance cannot accommodate the whole nation's need for research. It does not go well with the need for interaction and modern theory about the production of knowledge.'[95] Admittedly, the economic situation of universities had been squeezed in the last decade, as the body of students had expanded greatly without a compensating increase in resources. This made it tempting for the investigation to look upon sectoral research as a potential 'large and generous source of funding.' Sectoral research performed a vital social function, however, which could be lost in researcher-controlled research councils. Therefore IVA in fact supported the suggested increase in resources for universities, as long as it was not taken from other parts of the research system. That might remove the temptation to touch sectoral money. Undoubtedly the research funding system needed reform, but *Research 2000* was not an adequate foundation to work from. Further investigation was necessary, but it was important that the reform process included the Ministry of Industry and not just the Ministry of Education, in order to safeguard sectoral research interests.[96]

Just as in 1996 the Federation of Swedish Industries complained about the narrow university-centred view in the investigation, at a time when university-based knowledge was becoming more and more important for industry. From the perspective of the investigation, research existed only for the sake of researchers. But the Federation also followed the apparent trend of using the OECD and innovation research as weapons in the research policy debate:

> The investigation has therefore … not sufficiently adopted the perspective that research policy together with above all industrial policy, but also other policy areas, can contribute to facilitating economic growth. The role of research for innovations and technical change is not treated in a convincing way. The discussion and analysis performed during the last years within for

[94] Eriksson (1999), my translation.

[95] Comments from IVA, Dnr U1998/4107/F, 1999-04-15, 10, Regeringskansliet arkiv- och dokumentcenter, my translation.

[96] Comments from IVA, Dnr U1998/4107/F, 1999-04-15, 10, Regeringskansliet arkiv- och dokumentcenter, my translation.

> example the OECD about processes and systems for facilitating innovations are unfortunately not considered in the report.[97]

In the eyes of the Federation of Swedish Industries it was incorrect to place basic research and strategic research with an eye towards utility in opposition. In fact, much of the strategic research of relevance for industry was likely to take the form of basic research without any immediate applications in mind. It supported increased funding for basic research, but argued that faculty grants for basic research should be geared towards areas of strategic importance. The research funding structure needed reform, but just like IVA it stressed that such reform could not depart from *Research 2000* and that the Ministry of Industry should be involved in future investigations.[98]

Unlike its reaction in 1996 and the vocabulary used by some of its member unions, LO was fairly mild in its comments on *Research 2000*. It expressed 'a profound respect for the unconditional search for knowledge,' as well as a high regard for the autonomy of the research community. *Research 2000* was very 'stimulating reading,' if a bit 'one-sided' in its bias towards university needs. Still, LO could not endorse the proposed transformation of the research-funding organisations, as this proposal was 'based more on intuition than matter of fact evaluation.' Even though the investigation's critique of sectoral research might be valid to some degree, there had been no thorough analysis of the consequences of transferring sectoral funds to the research councils, or if they even were competent to handle that kind of research. Especially when it came to NUTEK the removal of sectoral research funding was not acceptable to the union movement. NUTEK had 'played an important role when it came to pointing out strategic research areas and had supported forsightful investments in basic research.' Further investigation was needed before any action was taken to reform the research-funding institutions.[99]

The unions in the industrial sector, together with the industry organisations in the Industry Committee, used a somewhat harsher tone. In their comments they complained that *Research 2000* had not 'absorbed the discussion about "the innovation system" being carried on in other countries.' Accepting the policy recommendations of the investigation meant isolating

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[97] Comments from the Federation of Swedish Industries, Dnr U1998/4107/F, 1999-04-15, 10, Regeringskansliet arkiv- och dokumentcenter, my translation.

[98] Comments from the Federation of Swedish Industries, Dnr U1998/4107/F, 1999-04-15, 10, Regeringskansliet arkiv- och dokumentcenter.

[99] Comments from LO, Dnr U1998/4107/F, 1999-04-15, 10, Regeringskansliet arkiv- och dokumentcenter, my translation. The mild tone may to some extent reflect the personal opinions of Gudmund Larsson, research secretary at LO, who wrote the comments. He had been a critic of sectoral research and a collaborator with Sverker Gustavsson, with whom he wrote a research bill at the Ministry of Education in 1987; see Björnsson & Samulesson (2002). As shown in this study, other statements made in the name of LO or its member unions suggest that not all parts of the union movement shared his university-friendly views.

the university sector from industry and the rest of society, and the Swedish economy would ultimately pay the price. Instead research policy should be seen as a subsection of a larger policy area aiming to facilitate innovations, as was increasingly the case in the OECD. This policy area needed to transcend the traditional division of government work into sectors and ministries.[100]

Compared with the reactions of sectoral agencies, trade unions and industry organisations against *Research and Money* in 1996, the concerns appear to have been similar in 1998–99. Just like then, the organisations argued for the social and economic relevance of university research and against 'ivory tower' universities pursuing research for its own sake. As Mats Benner notes, the late 1990s was a period where '[investigations with] a university-centred analysis and a network consisting of parliamentarians, research councils and universities stood against an alliance of sectoral agencies, interest organisations, the Ministry of Industry and innovation analysts.'[101] But something significant had apparently changed between 1996 and 1998–99. When NUTEK responded to the challenge posed by *Research and Money*, it mentioned the OECD once and made no use of the innovation system concept, but when the organisation criticised *Research 2000* it referred to the OECD 19 times and innovation systems 12 times.[102] On the single instance the innovation system concept was used in 1996, it was as part of an argument against integrating the funding of basic and applied research, thereby separating innovation and research policy. It seems that the innovation analysts had not openly joined the alliance against 'ivory tower' research in Sweden as late as 1996.

Two years later the basic outline of the argument was the same: the social and economic relevance of research needed to be taken into consideration. This time, however, the full force of innovation research was used to emphasise that point of view. Top level organisations like LO and the Federation of Swedish Industries had still not explicitly adopted the innovation system concept as a weapon in the debate, but member organisations closer to the industrial sector, as well as NUTEK, had. As the economic situation improved in Sweden after the mid 1990s, the debate on obsolete and low-tech industrial structures had subsided. With the process of reforming Swedish research funding and the discussions this provoked, the innovation system

[100] Comments from the Industry Committee, Dnr U1998/4107/F, 1999-04-15, 10, Regeringskansliet arkiv- och dokumentcenter, my translation.

[101] Benner (2001), p. 187, my translation.

[102] See NUTEK's comments on Research and Money, Dnr U96/1033/F, 1996-09-12, 15, and on Research 2000, Dnr U1998/4107/F, 1999-04-15, 10, Regeringskansliet arkiv- och dokumentcenter. Even taking into consideration that the comments in 1996 were 12 pages and the comments in 1999 were 23 pages, NUTEK mentioned the OECD 0.8 and innovation systems 0.5 times per page in 1999. The corresponding numbers for 1996 were 0.1 and 0 respectively.

concept had found a new discourse in which to be embedded. This appropriation of the concept marked a clear departure from the conventional ways of using it or talking about innovations in Sweden, which enabled it to perform some new rhetorical functions. It conveyed an air of legitimacy from science and the OECD to the positions already taken by industry-friendly organisations in the Swedish research debate. By subsuming research policy into a wider policy area called innovation policy, the university grip over research policy could be broken. With universities rhetorically framed as a part of an innovation system, a new theoretical vocabulary was given to the already existing project of opening them up to economic and social demands. Since an innovation policy was theoretically assumed to transcend traditional sectoral divisions, the innovation system framework also offered an excuse for elevating research policy from the Ministry of Education, perceived by some as too university-oriented, to the governmental level. Such proposals had been made already in 1996 when the Federation of Swedish Industries argued for an integrated 'knowledge policy' which was *not* to sort exclusively under the Ministry of Education.

The emerging status of the innovation system concept in the OECD and the academic community had two effects on the Swedish debate. First, it provided an opportunity to argue that the Swedish research debate had ignored a vital and growing body of scientific literature on innovations and their connection to research. To achieve this it was important to downplay the contested and open-ended nature of the scholarly innovation debate and present a selection of the propositions in it as generally accepted 'research results.' Second, given the role of the OECD in the diffusion of policy, it was also possible to argue that most other industrial countries were in the process of transforming their research policy into an innovation policy. Sweden was likely to fall behind its main competitors if it did not follow suit. To sum it up, the discursive marriage between innovations and research, coupled with the high status of the innovation system concept in the OECD in the late 1990s, presented itself as a well-timed and well-needed weapon for the proponents of economically relevant research in Sweden. Especially since it appeared at a time when complete researcher control over research funding did not appear too unlikely.

As shown in the comments to *Research 2000*, the innovation system concept had spread through several sections of Swedish society by late 1998. Above all organisations connected to the industrial sector, such as trade unions, industry associations and of course NUTEK, had opened their eyes to it. Besides the national research policy debate, there existed a parallel tendency at the regional level in Sweden where OECD-related concepts increasingly came into use. In early 1998 the government had decided that industrial policy should be founded on regional conditions to a larger degree than before. All regions were asked to produce regional growth agreements in a collaborative partnership between local government bodies, the business

sector and universities, inspired by how partnerships worked in the EU Structural Funds. These agreements were inventories of the economic structure in the regions and their strengths and weaknesses, meant as plans for future development.[103]

When the first set of finished growth agreements was presented to the government in November 1999, they made heavy use of the cluster concept, while the innovation system concept was virtually ignored. As the cluster concept had stronger geographical connotations, it was apparently judged as a more convenient tool in producing regional growth agreements. The cluster concept had also played a prominent role in the government bill introducing the agreements, which might have influenced the regional choices of using it.[104] As the growth agreements were renewed in later years, the innovation system concept found its way into them as well.[105] Two factors probably contributed to that. First, the regional dimensions to the concept had been increasingly emphasised in the literature on innovation systems by the late 1990s, facilitating a convergence between the innovation system and cluster concepts.[106] Second, as the later series of growth agreements were being elaborated, VINNOVA had already been founded, and the legitimacy of the innovation system concept had thereby been further institutionalised in the Swedish discussion. Nevertheless, up to the emergence of VINNOVA a temporary 'division of labour' had emerged, where the innovation system concept was mainly used in the national research policy debate, while the cluster concept dominated growth-oriented regional policy.

In April 1999 the government presented its opinions in a preliminary research bill. By then Carl Tham had been replaced with Thomas Östros as minister of education, as has already been noted. A main priority for the new Ministry of Education was to defuse the polarised conflict that had erupted between the government and parts of the research community.[107] Partially discarding the activist stance and the insistence on social relevance, the ministry became more sensitive to the wishes of the university sector. In the 1999 research bill, the government accepted and reproduced many of the views presented in the investigation. Just like *Research 2000* the government stressed the difficulty of ordering useful research results:

> New knowledge is undoubtedly an important factor for [social and economic] change. Nevertheless, research is often a high-risk project, which cannot guarantee immediate returns. Neither basic research nor applied re-

[103] See Prop. 1997/98:62, ch. 9.

[104] See Prop. 1997/98:62, p. 24f. For evaluations of the first set of growth agreements and the role of the cluster concept in them, see Ds 2000:7 and Ds 2001:15, p. 32f.

[105] For evaluations of later series of growth agreements and the increased use of the innovation system concept, see Ds 2002:34 and Ds 2003:43.

[106] Braczyk et al. (1998) is an example of such literature.

[107] Benner (2001), p. 187ff.

> search, researcher-initiated nor purchaser-initiated research can guarantee revolutionary research results, which immediately can be put into practical applications. Still, research can lead to completely unexpected and revolutionary progress. What makes research special is the systematic search for knowledge in ways accommodating the highest demands for reliability and quality, but at the same time offering space for creativity and originality. The foundation for research results is often a patient and long-term effort.[108]

Basic research was of great importance for the research system, mainly as the foundation for other types of knowledge production, as well as more directed and applied research. Given the uncertainty and long-term nature of such research, it was however unlikely for it to occur without public funding. Supporting academic freedom, basic research and the education of graduate students were to be the main priorities of Swedish research policy.[109] Besides acknowledging the importance of basic research, the government also accepted the investigation's description where basic research had become embattled during the last decade. Increased demands for the immediate utility of research results, external financiers not fully covering their costs and thereby using up money for free basic research, budget cutbacks and the emergence of new financiers dedicated to industrial relevance, all together shrank basic research's part of the pie. Against this background the government agreed to increase public funding for basic research, especially in the technical and natural sciences.[110]

Despite their recruitment of the innovation system concept, the OECD and scientific research results, the proponents of economically relevant research had not managed to push their alternative description on the government. The OECD and innovation systems were nowhere to be found in the bill, while ample space was given to some of the major points stressed by *Research 2000*. Still, the bill offered some hope to those wanting to save sectoral research. In several passages the government noted the importance of government funding for research more directly based on sectoral needs, in parallel with the suggested boost for basic research.[111] This suggests the government still viewed the support of 'proxy-governed research' as a legitimate activity, even though the attack on sectoral research in *Research 2000* was not explicitly criticised. It also allowed several of the measures taken under Carl Tham to remain in place, such as the legislated third mission of interacting with society and the more relevance-oriented guidelines for research policy established in the 1996 research bill.[112] Most importantly, the government accepted the calls for further investigation made by some critics of

[108] Prop. 1998/99:94, p. 5, my translation.

[109] Prop. 1998/99:94, p. 8ff. These arguments were repeated in later research bills; see Prop. 1999/2000:81, p. 18; Prop. 2004/05:80, p. 9.

[110] Prop. 1998/99:94, pp. 19f., 22f.

[111] See for example Prop. 1998/99:94, pp. 7f., 11, 20, 21f.

[112] Prop. 1998/99:94, pp. 9, 32ff.

Research 2000 and did not make any decisions on the organisational structure, postponing the question to the upcoming research bill in early 2000. A new investigation was to come up with suggestions before that, with special emphasis on decisional criteria for the consideration of grants, as well as on how the demands for both scientific quality and relevance were to be handled. An important question was the representation of interests and competencies in the bodies deciding over grants.[113] Here the government expressed some scepticism about privileging researchers too much when social relevance was at stake: 'If agencies are given responsibility for both scientifically motivated research and research-supporting activities in different societal areas, it is only natural that the broad responsibility should be mirrored in the composition of the deciding body.'[114]

In this way, the government had passed on the challenge dropped upon it by *Research 2000* for yet another year. With careful wording designed not to aggravate the research community, the government pushed the proposed organisational changes aside and gave the sectoral agencies and their supporters further breathing space, although the abolishment of sectoral research still remained on the agenda.

Saving Sectoral Research: The Third Round of Investigation

Within a month after the preliminary research bill's release in April 1999, the investigative wheels began turning again, putting the Swedish research funding system under its lens for the third time since 1995. The Ministry of Education commissioned Hans Wigzell, professor of immunology and president of Karolinska Institutet, to perform the investigation. Its instructions were basically a more fleshed out version of the sketched outline in the last research bill: to focus on the decision-making bodies and how competencies and interests should be represented in them. An implicit word of caution was given that, besides scientific quality, relevance was a priority in research of societal importance, a sign that the government has distanced itself from the privileging of scientific quality in *Research 2000*.[115] Still, the Ministry of Industry was not content to let the Ministry of Education handle the investigation all on its own this time. Parallel to the main investigation it appointed Anders Flodström, professor of physics, president of the Royal Institute of Technology (KTH) and previously president of Linköping University until 1998, to propose changes to the agencies sorting under it. He was aided by

[113] Prop. 1998/99:94, p. 46f.
[114] Prop. 1998/99:94, p. 47, my translation.
[115] Dir. 1999:68.

Suzanne Håkansson from the Ministry of Industry as his secretary.[116] Flodström had been a vocal critic of *Research 2000* and interpreted his mission as one of making sure the propositions of *Research 2000* were not repeated:

> One can possibly say that there was a fear from … the sphere around the Ministry of Industry that the investigation [by Wigzell] would treat the technology area only as an academic discipline, like the humanities or something like that, and that it would result in the government funding of research being based only on internal academic decisions, so that's why I got this mission.[117]

Suzanne Håkansson paints a similar picture:

> And then came … [*Research 2000*] which made people so incredibly angry and nervous [at the Ministry of Industry] and they thought it was a setback from what they thought they had accomplished. So it was an injection for the whole system to react, so that investigation [Flodström 1999] came a little bit as a reaction to [*Research 2000*] …. That's how I interpret it at least.[118]

In a way Flodström's investigation marked a breakthrough for the innovation system concept, as it was used extensively in it. With the exception of some passing mentions in previous reports, this was the first time the concept had made its way as a central theme into an investigation at the governmental level. Especially Charles Edquist, who knew Flodström well from their time together at Linköping University, paints a strong picture of the importance of the investigation for spreading the concept into Sweden, as well as his own role in it:

> That investigation [by Flodström] … there it [the innovation system concept] was introduced, and very much so.… It was because … I don't know if he remembers it now, but the reason I suppose he brought it up here was that he had so-called professor conversations at Linköping University …. [W]e sat and talked for an hour and then I said there was something called innovation systems too and you know Anders, he catches on to something like that. 'What is it?' he said and then I told him what it was, I think I sent the red book [Edquist 1997a] to him. And then it suddenly came in as a central part of this investigation.… Perhaps this coincidence that I told Anders Flodström there's something called innovation systems, perhaps that was more important than everthing I wrote. It's very possible.[119]

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[116] The investigations by Wigzell and Flodström have also been covered by Benner (2001), p. 190ff.; Elam & Glimell (2004), p. 42ff.; Schilling (2005), p. 105ff.

[117] Interview with Anders Flodström, August 9, 2006, my translation.

[118] Interview with Suzanne Håkansson, September 27, 2006, my translation.

[119] Interview with Charles Edquist, January 20, 2006, my translation. See also interview with Bengt-Arne Vedin, April 7, 2006, my translation: 'I believe it was Charles [Edquist] who influenced Anders [Flodström] who influenced the government [to name VINNOVA after the innovation system concept].'

Flodström himself cannot remember any such specific instance when the innovation system concept came to his attention. However, he does list Edquist as one of his main sources of inspiration in his thinking on technical change, besides Thomas Andersson and Paul Romer, the man behind new growth theory.[120] A few years earlier Flodström and Edquist had written an article together, exploring the implications of the newly legislated third mission for universities. The text, which mentions the innovation system concept in passing, but without elaborating on it, attempted to strike a balanced view in the debate. Both university integrity and the importance of interaction with society were stressed. This signals how the concept had not yet been enrolled in the project of opening up universities to economic demands at the time of the article's writing in 1997. According to the writers, the importance of well-functioning connections between university and society had increased with the rise of high-tech knowledge-intensive industries. Besides producing new knowledge, universities were important as 'windows' to the outside world by absorbing knowledge produced outside Sweden and diffusing it into the country. It was also important for universities to absorb knowledge of important needs and questions in society in order to adapt its priorities.[121] But this increased interaction made it all the more important for universities to maintain their integrity, especially when dealing with industry. Given the economic power of industry, differences in culture and norms between universities and the economic sector risked being eradicated, making universities just another player on the market. Industry needs also risked crowding out other important societal needs regarding research. In short, a too close relationship between universities and industry 'could lead to short-sightedness and to the stalling of scientific development or to it being forced into too commercial trajectories of development.'[122]

Although a connection undoubtedly existed between Edquist and Flodström, some factors speak against Edquist's hypothesis about his own role when the innovation system concept came into the investigation. First, as has been shown previously in this chapter, the concept was already widely diffused into parts of Swedish society by the time Flodström was commissioned to write his report. It had already been used as part of the struggle against researcher dominance over economically relevant research, of which Flodström's investigation can be seen as a part. This made the central position of the concept in the investigation less of a novelty than could be assumed if one had not studied the reactions to *Research 2000*. Second, the innovation system concept had been used already in the instructions to Flodström's investigation:

[120] Interview with Anders Flodström, August 9, 2006.
[121] Edquist & Flodström (1997), p. 69ff.
[122] Edquist & Flodström (1997), p. 75, my translation.

> Internationally the innovation system concept has become increasingly common.… Sweden has a comparatively strong scientific base. With a better functioning innovation system the return from investments in research and development could increase.… The mission [of the investigation] is to investigate how the agencies [sorting under the Ministry of Industry] … which are of importance for the Swedish innovation system, can be made more efficient and coordinated in order to increasingly contribute to societal development and growth.[123]

With the prominent position of the concept in the instructions, it would have been quite surprising if the investigation had not made use of it as well. Flodström himself mentions the instructions as a major reason for the concept's central place in his investigation and claims it was only during his work with the investigation that he became fully aware that it existed.[124]

In its introduction the investigation made some general statements about the need for an innovation policy in Sweden, something that so far had been lacking compared to other countries. Especially Finland was presented as an example to follow, where 'a national system for innovations [had been] created through political consensus about industrial policy. The government and the industrial sector has there gathered around the common target of sustainable high growth through the continuous renewal of industry.'[125] Up until today no such consensus existed in Sweden, but it could be created if 'the present and antiquated division into sectors is dissolved … and replaced with an intensified cooperation and network-building [activity] at and between all levels ….'[126] Even if the investigation was bound by its instructions to limit itself to only those agencies sorting under the Ministry of Industry, it should be remembered those agencies are also part of an innovation system, whose functioning was just as important to Swedish economic development as the interest rates set by the central bank.[127] Following this initial plea, a section followed introducing the innovation system concept and its history written by Arne Eriksson, a consultant who had previously worked for the Ministry of Industry.[128]

Hans Wigzell and the Ministry of Education's investigation did not adopt the same perspective in its analysis. It noted the prominent place of the innovation system concept in its twin investigation, but argued that the research system as a whole had several purposes besides aiding economic growth:

> Since another investigation is working with this [innovation system perspective] as its point of departure within the mission of the Ministry of Industry

[123] Flodström (1999), p. 106f., my translation.
[124] Interview with Anders Flodström, August 9, 2006.
[125] Flodström (1999), p. 7, my translation.
[126] Flodström (1999), p. 8, my translation.
[127] Flodström (1999), p. 8.
[128] See Flodström (1999), ch. 2.

> … we will not develop the theme here. We observe that the issue of innovations and innovation systems is important because in our type of society it is closely related to economic growth, but that it only represents one of many demands on the research system.[129]

Safeguarding the relevance of research and staying open to social and economic needs was one of the important qualities in a well-functioning research system, but that system also had other tasks to fulfil. This included enforcing scientific quality standards, being able to coordinate efforts across disciplinary boundaries, being flexible enough to change direction when needed, being internationally connected and having the administrative capacity to provide the government with investigations and advice.[130] Even if the two investigations did not depart from exactly the same perspective, they interacted with each other throughout the investigative process, making sure their proposals were well-coordinated and not contradictory.[131]

Hans Wigzell did not accept the proposal in *Research 2000* of integrating sectoral and basic research into researcher-controlled research councils, as it did not 'offer a reasonable organisational base for the [sectoral] area-oriented research, above all seen from the perspective and interests of users.'[132] Instead he suggested separating the research funding system into two kinds of organisations. On the one hand there should be research councils whose main objective was to promote scientific quality in their funding. Considering social and economic relevance was not a central task for them, since it 'was not their role in the [research] system.'[133] Wanting to increase the ability to concentrate resources and the flexibility of the research system, Wigzell returned to the idea of a single research council as it had been presented by *Research and Money* in 1996. But Wigzell was not content with a 'federated' structure where the original research councils retained most of their independence in the new agency. It was hard to believe a federation 'of its own free will would appropriate increased resources to meet the demands we place on the concentration of resources, flexibility and offering advice.'[134] Within the new unified council, named the Swedish Research Council, there should be three committees handling research grants for technical and natural sciences, for medical sciences and for social science and the humanities respectively. The members of the committees should be elected by the research community, as had been the case with the old research councils. Researchers should be in a majority position on the board of the Swedish Re-

[129] Ds 1999:68, p. 33f., my translation.
[130] See Ds 1999:68, ch. 2.
[131] Ds 1999:68, pp. 26, 64; Flodström (1999), p. 7.
[132] Ds 1999:68, p. 57, my translation.
[133] Ds 1999:68, p. 48, my translation.
[134] Ds 1999:68, p. 49, my translation.

search Council, where interests from society and industry were also to be represented.[135]

On the other hand the fragmented organisational structure for sectoral research was to be simplified into three 'area-oriented' research-supporting agencies. These included a research council for social and working life issues, a research council for agriculture, environment and natural resources, and an agency for technical development, communication and spatial planning. Wigzell saw some problems in mixing sectoral research for spatial planning and communications with technical development, as these areas showed some intrinsic differences. Research funding for communication and spatial planning generally supported social science faculties, while funding for technical development tended to be received by technical faculties. Still, the emerging information technology increasingly required coordination between technical change and infrastructure building, which could be facilitated by an interplay between technical and social science research.[136] The area-oriented agencies should have boards including both members with knowledge of sectoral needs and members with a firm competence in research, making sure that both relevance and scientific quality were enforced. He did not mention whether researchers or sectoral representatives should hold a majority position.[137]

Flodström's investigation limited its suggestions to the agencies sorting under the Ministry of Industry. These agencies should remain under the ministry, but with an altered organisational structure.[138] An 'R&D agency' should be set up, collecting most of the research funding functions sorting under the ministry. Perhaps research funding from other ministries, such as for spatial planning, could be added as well. Its main responsibilities would be to fund R&D projects, to interact closely with the users of research results, to strengthen the interaction between universities, research institutes and industry and to support the diffusion of knowledge into small and medium-sized firms. The agency should focus on promoting sustainable growth and pretty much overlapped with the agency for technical development, communication and spatial planning mentioned by Wigzell. Both industry and the research community should be represented on the board, but it was not mentioned if any of them should have a majority position.[139] Besides the R&D agency, Flodström also proposed an agency collecting and analysing information about the Swedish innovation system and its future, as well as an agency that provided company services and developed methods for industrial policy.[140]

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[135] Ds 1999:68, p. 50ff.
[136] Ds 1999:68, p. 58f.
[137] Ds 1999:68, p. 61f.
[138] Flodström (1999), p. 87.
[139] Flodström (1999), p. 90ff.
[140] Flodström (1999), p. 93ff.

Both Wigzell and Flodström suggested a committee at the governmental level to integrate research and innovation issues, with obvious inspiration from Finland. Wigzell called it the Research and Development Committee, while Flodström preferred it to be named the Research and Innovation Committee. Both agreed it should be led by a 'strong' minister, specified by Flodström to be the prime minister or the deputy prime minister. Equipped with its own permanent administrative resources, it should consist of relevant government ministers, representatives from industry, the research community, research-funding organisations and trade unions.[141]

When the two investigations were released in November 1999, they presented a compromise position in the heated research policy debate. Curiosity-driven basic research was given its own sphere of influence with the researcher-controlled Swedish Research Council, which did not answer to demands for social or economic relevance. On the other hand, research based on sectoral needs was saved from being integrated into traditional research councils dominated by peer review. Three sectoral research-funding agencies were suggested, where relevance was a central priority along with scientific quality. Still, the wording about who should control those agencies was somewhat vague in the investigations. Supporters of economically relevant research also received support for one of their major demands; the lifting of research and innovation issues to the governmental level. This would more emphatically put innovation issues on the national agenda and transcend sectoral divisions between the Ministry of Education and other ministries.

Reactions to Wigzell and Flodström

When they commented on the investigations, the research councils basically accepted the compromise. They did not insist on researcher control over all the new research-funding organisations, but argued for the inclusion of representatives elected by the scientific community in them, to boost their legitimacy in the scientific community. Still, some voices were reluctant to give up researcher control over sectoral research. Few universities commented, but Gothenburg University argued for a researcher majority in all new organisations, to prevent scientific quality from dropping. Similar reasoning came from an organisation for Ph.D. students at Uppsala University.[142] On the other hand, friends of sectoral research could breathe out in relief as the challenge from *Research 2000* appeared to have passed. The Industry Committee, which had sent some harsh criticism in the direction of *Research 2000*, praised the new investigations in *Svenska Dagbladet*:

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[141] Ds 1999:68, p. 79ff.; Flodström (1999), p. 88f.

[142] Comments from the research councils, Gothenburg University and the Ph.D. students' committee at Uppsala University, Dnr U1999/4040/F, 2000-03-21, 1, Regeringskansliets arkiv- och dokumentcenter.

> After the research policy investigation presented almost a year ago we felt obliged to exclaim 'Forget Research 2000' … in an SvD op-ed article. Apparently the government was of the same opinion and put it aside. Instead they appointed two new investigations …. This time we can say: Continue building on these investigations![143]

Most of the proposed organisational changes were accepted in the Industry Committee's comments, but it cautioned that the Swedish Research Council should not 'solely be an internal concern for researchers, but that an interaction should occur in applicable parts with industry and the surrounding society ….' It was important to admit representatives from industry to the research-funding organisations, but it perceived Wigzell and Flodström to be vague on that matter. A suitable name for the R&D agency was the 'Innovation Agency,' to show the importance of an innovation policy integrated into research policy.[144] Similar arguments came from the Federation of Swedish Industries, which praised the innovation system perspective in Flodström and complained about Wigzell's lack of 'connections to innovation, enterprise and growth.' When setting up the Swedish Research Council 'traditional [research] council culture' should not be allowed to dominate its performance. Relevance criteria should be applied in all four of the research-supporting agencies, making it necessary to include representatives from industry at all levels, including the three committees on the Swedish Research Council.[145] Along the same lines, IVA argued that Wigzell's exclusive focus on the support of research risked cutting off 'the connection between research and development …. The connection between research policy … and other policy areas, for example innovation and growth, is something the continuing investigation of research funding and organisation must take into consideration.'[146]

NUTEK agreed with Flodström that Sweden needed an innovation policy based on an innovation system perspective, but could only find a weak link between that perspective and the proposed organisational structure. Splitting NUTEK into one agency for industrial policy and one for research and innovation support was not in line with a system perspective where different activities were integrated. If two agencies were created anyway, the R&D agency should focus on supporting long-term research generating generic technologies and developing R&D environments receptive to industrial

[143] Duker et al. (2000), my translation.

[144] Comments from the Industry Committee, Dnr N1999/13161/ITFoU, 2000-03-21, 2, Regeringskansliets arkiv- och dokumentcenter.

[145] Comments from the Federation of Swedish Industries, Dnr N1999/13161/ITFoU, 2000-03-21, 2, Regeringskansliets arkiv- och dokumentcenter.

[146] Comments from IVA, Dnr N/13161/ITFoU, 2000-03-21, 2, Regeringskansliets arkiv- och dokumentcenter.

needs. Efforts to facilitate the application of knowledge from R&D in industry could be transferred to the industrial policy agency.[147]

Given the many calls for an innovation policy from organisations close to the industrial sector, it is interesting to note that not all representatives from private business supported the creation of a new policy area to support innovations. The Swedish Employers Confederation (SAF) shared the concern that the research at universities should be relevant to economic development, including the research supported by the Swedish Research Council. Nevertheless, Flodström's investigation 'proceeds … from innovation policy ambitions SAF cannot support. The proposed structure of agencies gives the government a too dominating role in an innovation system, which to such a large degree consists of the companies themselves.' Innovations, admittedly vital to economic growth, occur successfully when companies are allowed to work freely, surrounded by a well-functioning competitive market economy. They do not rely on the government embarking on an extensive innovation policy. This made SAF criticise Flodström's use of the innovation system concept:

> The innovation system is according to SAF's opinion not a part of the general conditions for enterprise that it is the task of industrial policy to facilitate. A reasonable demand for pluralism demands that the innovation system concept is not limited to a single national phenomena, but can be created and recreated at all levels in the economy where the model is applicable. With the direction of Flodström's investigation, and with the extension the 'national innovation system' has received, the companies' development resources – more or less collectively – are viewed as part of the national system a government innovation policy would encompass.[148]

While sympathetic to the project of ensuring that university research adapts to economic needs, its liberal laissez-faire outlook stopped SAF from using the innovation system concept as a weapon in that effort. Framing the universities as parts of an innovation system and calling for research policy to be transformed into an innovation policy might help wrest the control over research funding from the researchers' hands. But that created at the same time a dangerous precedent for government interference in the economy, which SAF could not accept on ideological grounds.

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[147] Comments from NUTEK, Dnr N/13161/ITFoU, 2000-03-21, 2, Regeringskansliets arkiv- och dokumentcenter. According to Göran Marklund, this criticism may not have been shared by the whole organisation of NUTEK. Some members of the Department for Innovation Systems, which had been formed in January 2000 out of large parts of NUTEK Teknik, thought that the sections of NUTEK that supported R&D and innovation had been poorly integrated with other parts of the organisation. They also thought that the current leadership did not privilege such support, so an organisational separation did not necessarily seem like a bad idea for them; see interview with Göran Marklund, July 19, 2007.

[148] Comments from SAF, Dnr U1999/4040/F, 2000-03-21, 1, Regeringskansliets arkiv- och dokumentcenter, my translation.

All in all, most comments accepted Wigzell's proposal of maintaining a division of research funding into two separate areas, where curiosity-driven, researcher-controlled research and research for social and economic development each were allowed to follow its own logic. Nevertheless, this did not stop both sides in the research funding debate from exhibiting 'imperialistic' tendencies towards the other part's sphere of influence. Proponents of curiosity-based basic research argued for the importance of evaluating sectoral research based on scientific quality criteria, and to improve its legitimacy in the scientific community by strengthening researcher control over it. At the same time advocates of social and economic relevance were not able to keep their hands off research supported by the Swedish Research Council, insisting that it too should consider relevance criteria.

In March 2000 the government presented two parallel and partly overlapping bills, dealing with the suggestions of Wigzell and Flodström respectively. Largely, the bills adopted academic peer review as the main mechanism behind public research funding, but went further than Wigzell by extending it far into the sphere of research based on sectoral needs:

> Decisions regarding research funding with public means must be taken by organs and persons with competence in making required scientific and other judgements. To ensure the highest possible quality and provide a good legitimacy in the research system, research-funding agencies whose main mission is research support must be led by boards where researchers are the majority and where these have been elected by representatives of the research community.[149]

This governance principle did not just apply to the Swedish Research Council, but also to agencies funding research based on sectoral relevance, such as the ones covering social and working life issues, environment, agricultural sciences and spatial planning. Nor had the calls to make the Swedish Research Council receptive to social and economic needs been heeded by the government. It was given a 'pure quality-enhancing mission' to support 'basic, curiosity-based research of highest scientific quality within all scientific areas.' In the eyes of the government, curiosity-driven research was an important area to support, given the difficulty of predicting the usefulness of different types of research in advance, thereby repeating the basic argument behind *Research 2000*.[150] All this finally spelled the end of sectoral research as it had traditionally been carried out in Sweden. It can be seen as a return to the ideals of *Research 2000*, but also as the culmination of a historical process that started in the 1980s, where control over sectoral research funding gradually shifted from bureaucrats and societal representatives to researchers.[151]

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[149] Prop. 1999/2000:81, p. 14f., my translation.

[150] Prop. 1999/2000:81, p. 18, my translation.

[151] See Sandström (2000a), p. 1; Sandström (2002), p. 13ff.

Still, the government made an exception to its governance rule by establishing the R&D agency, which was seen as different from other research-supporting agencies:

> [The R&D agency covers an area] where guidance based on needs is of particular importance. The motivation is that the agency's activity should answer to direct needs, which are identified within industry, the public sector and other concerned parties. Its governance should therefore mirror both the need for scientific quality and the need for users of research to be given a strong influence over the agency's activities.[152]

In short, the R&D agency was the last remaining haven for relevance-driven research funded outside the researcher-controlled research council structure. This 'refuge' consisted of a mix of research-funding areas that had previously been part of different agencies. It inherited the support of technical research from NUTEK, while communication research and parts of the working life research were added from other agencies. Energy research was considered to be too integrated with the other activities of the agency responsible for energy issues to be placed in the R&D agency. Spatial planning, which had been a part of the R&D agency in the investigations, was instead to be included in the researcher-controlled sphere.[153]

The new agency was supposed to 'initiate and fund need-guided R&D for the support of the Swedish innovation system and a sustainable development and growth.' Here the innovation system concept became a convenient tool in bringing together all those different research areas that had made it to the R&D agency and integrating them within one single framework. Research for technical change, working life issues and communications covered different disciplines and catered to different users, but they could all be considered parts of the innovation system. Working life research dealt with leadership, learning and work organisation, 'generating knowledge of importance for the development of a working life marked by dynamics and innovation capability.' Likewise innovations depended on a well-functioning communication system.[154] Besides the R&D agency, many of those organisations suggested by Flodström were also set up. An agency offering support for companies, which inherited the name NUTEK, was established. Similarly, an agency for collecting and analysing growth-related information was named the Swedish Institute for Growth Policy Studies (ITPS).[155] While several of Flodström's proposals were adopted by the government, including his use of the innovation system concept, it made no mention of the research and innovation committee or of lifting such questions from the Ministry of Education

[152] Prop. 1999/2000:81, p. 15, my translation.
[153] Prop. 1999/2000:81, p. 36.
[154] Prop. 1999/2000:81, p. 36, my translation.
[155] Prop. 1999/2000:71, p. 16ff.

to the governmental level. Instead the government assigned the minister of education to be the coordinating force in research issues, rather than the prime minister. It considered expanding the Science Policy Advisory Board, an existing body consisting of representatives from the scientific community and industry, led by the minister of education, to let it deal with innovation issues as well.[156] In the end, the government created an innovation policy council led by the minister of industry, expecting it to cooperate with the Science Policy Advisory Board.[157]

No doubt the advocates of curiosity-driven basic research had pushed their agenda quite successfully in the research funding reform process. In the end there would be two different spheres for research based on scientific curiosity and research based on relevance, but the boundary between them had shifted. Hence, the 'R&D agency' was the only remaining island where bureaucrats and representatives of societal interests could exercise decisive control, in a sea of funding based on peer review and traditional research council principles. Even so, many of the agencies proposed by Flodström were set up, creating an organisational structure for a potential innovation policy, but there was no lifting of innovation issues to the governmental level like in Finland. What emerged instead was a reduced version of the proposed research and innovation committee, without its own administrative resources and not led by the prime minister.

Institutionalising a Two-Track System

After six years and three rounds of investigations, the new Swedish organisational structure for research funding finally saw the light of day on January 1, 2001. By then, the 'R&D agency' had been baptised into VINNOVA, the Swedish Governmental Agency for Innovation Systems. Sweden had become the first and so far only country in the world to name one of its agencies after the innovation system concept, something often presented internationally as an example of how forceful the concept's impact has been in the industrialised world.[158] Per Eriksson, former president of the Blekinge Institute of Technology, was appointed director of the agency. During his presidency, the Blekinge Institute of Technology had become internationally famous as a model college when it came to facilitating interaction between the academic sector and industry, encouraging visits from innovation scholars like Nathan Rosenberg and Henry Etzkowitz. Situated in a region where the traditional industries were in crisis, Eriksson had early on promoted research in information and communication technology and was dedicated to enroll-

[156] Prop. 2000/2001:3, p. 15f.
[157] Prop. 2004/05:80, p. 11.
[158] See for example Lundvall et al. (2002), p. 214; Sharif (2006), p. 745; Jacob (2006), p. 443.

ing local business and local public authorities in the activities of the college.[159] Through Jan-Evert Nilsson and Åke Uhlin, scholars at the Blekinge Institute of Technology, Per Eriksson had already become aware of the innovation system and Triple Helix concepts. In particular, he had found the Triple Helix concept useful for describing the practice he had already developed as president of an institute of technology. Participating in a group performing some final investigative work in the months before VINNOVA's founding, he studied the previous investigations by Anders Flodström, Hans Wigzell and Göran Marklund, and he was approached by Charles Edquist with whom he held some meetings.[160] Given the prominent place of the innovation system concept in previous investigations, the investigators wanted to associate it with the R&D agency in some way, but they were also cautions about it being a potentially short-lived fad:

> We reasoned in the group about innovation systems and what we reasoned about was that … it is probably very good to pick it up now, it can fit with our ideology and how we want to run things and so, but we were insecure if the name would last in the long run, how long-lived will the innovation system concept be? And then we wanted to come up with a name for the agency that was so to speak a more popular and simple name [VINNOVA].[161]

Still, after VINNOVA was founded he stressed publicly that 'the ideological base for the agency [of VINNOVA] is what is today called innovation system, and that is a system thinking about how … R&D money can contribute to … sustainable growth ….'[162] Once the step had been taken to provide the concept with this kind of institutional legitimacy, Swedish actors clearly had new incentives to apply the innovation system concept when issues were being discussed. One telling example is the sudden introduction of the concept into regional growth agreements after the creation of VINNOVA, as has previously been mentioned. Similarly, the concept increasingly found its way into government rhetoric. In upcoming government bills covering research policy, industrial policy or regional policy, the discussion was more often than not framed around the innovation system concept.[163]

Undoubtedly, the discursive breakthrough for the innovation system concept has been impressive in Sweden. Still, the project of making sure that Swedish research would be evaluated mainly based on its economic and social usefulness, the project that adopted the concept and brought it into Swedish discourse, can at best be described as a mixed success. It did manage to avert the research system envisioned by *Research 2000*, where the

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[159] See SOU 1996:89, p. 186ff.; Sörlin & Törnqvist (2000), p. 233ff.; interview with Per Eriksson, September 20, 2006.

[160] See interview with Per Eriksson, September 20, 2006.

[161] Interview with Per Eriksson, September 20, 2006, my translation.

[162] Eriksson (2001), p. 50, my translation.

[163] See above all Prop. 2001/02:2 and Prop. 2004/05:80, ch. 8.

grants to all research were distributed based on peer review principles. In the end, however, the project was only able to stake out the territory surrounding the new research-funding agency VINNOVA. Most research, including large parts of the research based on relevance, was funded in traditional researcher-controlled research councils where peers reviewed peers. Peter Schilling characterises Sweden as an ideal-typical 'two-track' system, where a research policy supporting curiosity-driven basic research co-exists alongside an innovation policy, in two separate tracks. This model supposedly emerges when the bonds between the government and industry are weak, while the bonds between the government and the universities are strong. On the other side of the spectrum lies Great Britain, where the facilitation of innovations has become the main integrating principle behind all research policy. Countries like Finland and the Netherlands fit between those two extreme points.[164]

Even though it was institutionalised as a compromise between supporters of curiosity-driven basic research and advocates of research directed by social and economic needs, the two-track system did not end the opposition between these two camps. In particular, disagreement continues to exist over the relative amount of resources that should be channelled through each respective track. An investigation published by the Swedish Research Council attempted to separate free and directed research statistically and was troubled to find that free research had declined, while directed research had increased since the mid 1990s.[165] From a different perspective, Håkan Gergils investigated the Swedish innovation system for SNS and complained that the budget of VINNOVA was only a third of the budget of Tekes, the equivalent agency in Finland. The Swedish Research Council, on the other hand, had been very successful in increasing its resources through lobbying. Besides questioning the current flow of resources, Gergils also criticised the Swedish Research Council for not considering relevance or utility as it decided on grant applications.[166] For many innovation policy advocates, the perceived bias of the system in favour of curiosity-driven basic research is one of the weakest links in the Swedish innovation system. This is evident in Gergils' analysis:

> As has been said earlier, Sweden does not have a national innovation policy. The politicians have not developed a NIS [national innovation system], according to the OECD model, like for example Finland has. Instead, Sweden has had a research policy. Our country is one of few – if not the only one – that has safeguarded the linear model to its last breath …. Research has also meant basic research for Swedish politicians, and nothing else. This is an at-

[164] Schilling (2005), p. 148ff.
[165] Sandström et al. (2004).
[166] Gergils (2006), pp. 307, 314ff.

> titude that transcends party lines. Sweden has thus not had an innovation policy.[167]

Along the same line, leaders of the trade union movement, the central employer organisation and some of the research-funding foundations argued in an op-ed article in *Dagens Nyheter* in 2004 for a new research policy. According to them, 'research policy needs to be changed from a too strong preoccupation with the research community's internal scientific demands to an increased emphasis on the knowledge that can be transformed into growth-creating production.' Research based on industrial and social needs had long been neglected, but it was precisely that kind of research that produced economically important innovations.[168] A first step to what might become an integration of the two tracks was taken in 2004, when the Ministry of Industry and the Ministry of Education together launched *Innovative Sweden*, a strategy to make Sweden more competitive.[169] But while this strategy involved the two ministries in deeper cooperation, the institutional two-track system still remains.

Before the election in September 2006, the Social Democrats and the centre-right opposition both promised increased resources for research, which largely would take the form of faculty grants to universities. Winning the election, the centre-right coalition had offered two billion crowns in increased support for research.[170] This appeared to strengthen the research-oriented track, but in April 2006 Dan Brändström had been asked to perform yet another investigation about the future of the research funding system. He was instructed to proceed from 'the need for high scientific quality and increased profiling, closer cooperation and a division of labour between different universities.' The instructions also voiced concern that Swedish universities were too dependent on external resources. But the government was not interested in simply handing over money to the universities. In order for universities to receive increased faculty grants, these needed to be more closely linked to quality evaluations so that an optimal allocation could be ensured. Brändström was asked to analyse different ways of measuring the scientific quality of research, but he was also instructed to consider extra-scientific performance indicators, such as 'the diffusion and extraction of utility from research results.'[171] At the time of writing, the investigation is not yet finished, but the linking of faculty grants to indicators covering both scientific and extra-scientific performance may possibly open the door for increased integration between the two tracks through the allocation of faculty grants.

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[167] Gergils (2006), p. 280, my translation.
[168] Narvinger et al. (2004), my translation.
[169] Ds 2004:36.
[170] Samuelsson (2006).
[171] Dir. 2006:29, my translation.

In short, the advocates of economically relevant research have successfully launched the innovation system concept into Swedish discourse. But they had to settle for the compromise of a two-track research system, instead of the single one-track system focusing on innovations that had been envisioned by the literature suggesting a new mode of knowledge production. The future will have to tell if the discursive breakthrough of the innovation system concept is strong enough to erode academic resistance in the long run, or if the two-track system will continue to exist in one way or another.

Conclusions

In the late 1990s innovations and academic research became increasingly viewed as interconnected in the international debate. New models like Mode 2, Post-Academic Science, Triple Helix and Pasteur's Quadrant emerged and contributed to this development by stressing the need of opening up universities to economic demands. Some innovation scholars objected to subordinating universities to an economic agenda and downplayed the importance of academic research for innovations, but the discursive marriage between innovation and research was still strong in policy circles. At the same time Sweden embarked on a six-year-long process to reform its research funding system, which ended in the internationally unprecedented step of naming a government agency after the innovation system concept. In the late 1990s, the concept was predominantly used in relation to this debate, thereby making a leap from the concept's first occurrences in a domestic innovation debate that was largely disinterested in the university sector. I argued in this chapter that the leap can be analysed as a strategic and rhetorical 'manipulation' of the concept by actors who wanted to defend the contested institution of sectoral research and make university research more economically and socially relevant.

Swedish research policy has been characterised by two parallel and colliding coalitions, partly due to a particular and internationally unusual way of organising research. Instead of being performed at research institutes, research based on social and economic relevance was taken on by the university sector, which acted as a research institute for the entire Swedish society. When research based on sectoral relevance expanded greatly during the 1960s and 1970s, the stage was set for the first coalition. Concerned that a large share of its resources consisted of external sectoral funding, the universities and their allies in the political system worked together in the 1980s to gain control over that funding. Demands were raised that research funding should be transferred directly from sectoral government agencies to the universities. Thereby the scientific quality of sectoral research would be improved, as would its integration into the universities' regular activities. While the government was reluctant to perform a direct transfer, it increased

researcher influence in the sectoral agencies and made their grant-distributing bodies resemble research councils. *Research 2000* continued this project in the late 1990s by suggesting that sectoral funding should be transferred to researcher-controlled research councils.

The second coalition in Swedish research policy was in part a reaction to the first one and became especially prominent with the research funding reform process in the mid 1990s. Its aim was to increase social and economic control over research and to improve returns from investments in research in terms of social and economic development. Between 1994 and 1998 this project enjoyed the support of the Ministry of Education under Carl Tham, but it was also strongly advocated by trade unions, industry organisations, sectoral research-funding agencies and the Ministry of Industry. It is noteworthy that this coalition paid very little attention to the innovation system concept in the mid 1990s. Charles Edquist made numerous attempts to lobby the Ministry of Education and make them aware of the innovation system concept, but with few notable results. No mention was made of the concept in the research bills produced by Carl Tham and his ministry. Similarly many reactions to the university-friendly investigation *Research and Money* in 1996 argued emphatically for a research policy based on industrial needs, but made no attempts to enrol the innovation system concept. Only on a few occasions was the concept used in a research policy context, but then as linked to arguments suggesting a continued separation between innovation and research policy, or defending university integrity in the face of industrial demands.

In late 1998 *Research 2000* launched its attack on sectoral research funding, provoking a new wave of criticism from supporters of socially and economically relevant research. While the demand for research to be guided by industrial needs had not changed since 1996, the innovation system concept was used extensively this time. It was also used in a way that clearly departed from how the concept traditionally had been used in Sweden, where universities and the OECD had largely been deemphasised or left out of the innovation discussion. By rhetorically presenting the university sector as part of a system producing innovations, it was possible to criticise the traditional image of universities as organisations pursuing human curiosity in relative isolation from the surrounding society. Using the concept also transferred legitimacy from the OECD to the already existing project of opening up universities to social and economic needs. If other countries in the OECD had transformed their research policy into an innovation policy, Sweden risked falling behind if it did not do the same. In order to achieve this effect it was necessary to present the link between research and innovation as generally uncontested and uncontroversial in innovation research, thereby downplaying the critical and open-ended nature of academic discourse. Advocates of university autonomy, who saw free, curiosity-driven basic research as beneficial to development in the long run, could then be accused of

ignoring clear and uncontested 'research results.' In this way the innovation system concept was used to draw legitimacy from both the OECD and science.

While the supporters of research guided by social and economic relevance were very successful in introducing the innovation system concept into Swedish political discourse, they did not manage to wrest control over research from the researcher-dominated research councils. VINNOVA was indeed named after the concept, but it only funded research supporting technical change, communication and some working life issues. All other research, including much of the research motivated by sectoral needs, was funded through faculty grants or research councils mainly consisting of representatives elected by the scientific community. Even if the project of Innovative Sweden has introduced some cooperation between the Ministry of Industry and the Ministry of Education, Sweden of today can be described as a two-track system, where a research policy supporting curiosity-guided basic research co-exists with an innovation policy. How stable the two-track system is remains to be seen, as supporters of free basic research and relevance-driven research continue to battle over resources.

CHAPTER 5
Conclusions

In January 2001 Sweden became the first and so far only country in the world to name a government agency after a new and fashionable social science term: the innovation system concept. This concept had emerged in the late 1980s as a heterodox and Schumpeterian approach for making sense of how the socioeconomic environment affected innovative performance. During the 1990s it was adopted and increasingly promoted by parts of the OECD and was generally perceived as endorsed by the organisation. Many scholars have therefore explicitly or implicitly assumed that countries are mainly uncritical and passive recipients of the concepts and approaches that the OECD takes under its wings. However, this assumption is problematic as it ignores the mechanisms through which national and regional actors actively work to modify and translate international approaches to make them fit local conditions. My purpose with this study has been to show that Swedish actors were in fact far more active in the process in which the innovation system concept was adopted in Sweden, than would be expected based on the assumption that countries are mainly passive recipients. Sweden is an interesting country to study because of the ambiguity in how it is presented. On one hand, it was the first country to name a government agency after the innovation system concept, and many of the most noteworthy innovation system scholars are associated with Sweden in one way or another. On the other hand, some accounts have presented it as a slow and conservative country that paid little attention to what went on in the OECD.

In operationalising the general Swedish process of adopting the innovation system concept, I was inspired by Quentin Skinner's branch of conceptual history. Viewing concepts as inherently ambiguous and firmly embedded in their historical contexts, he focuses on the 'manipulation' of concepts by actors who want to accomplish something controversial in their contemporary societies. He makes a distinction between innovative ideologists, striving to implement revolutionary changes deemed questionable by some sections of society, and more conservative apologists, wanting to uphold an increasingly unpopular state of affairs. To achieve these ends they both enrol concepts and terms capable of performing evaluative functions. By changing the evaluative nature of the concept or its criteria of application, they are able to rhetorically redescribe their projects and present them in more favourable light. The innovation system concept can very much be seen as an

evaluative concept in this sense. Focusing on how the socioeconomic environment affects innovative performance, it can be used to evaluate social institutions based on how well they contribute to innovation. Moreover, the concept is also filled with legitimacy from science and the OECD.

VINNOVA, the agency named after the concept, emerged after a six-year-long process of reforming the Swedish system for public research funding. This process has been my main research interest, as it brought two opposing groups into open confrontation. On one side stood those who valued research driven by scientific curiosity and autonomous universities, on the other side groups that envisioned a university sector increasingly guided by social and economic relevance. In particular the latter group picked up and used the innovation system concept to promote its viewpoints. But in order to analyse if their use of the concept during the research funding reform process really constituted a manipulation of it in a Skinnerian sense – i.e. if it was used in a new way – it was also necessary to study how innovations had been discussed traditionally in Sweden. Here I investigated not only how the promotion of innovations was presented as a solution by some to the industrial crises Sweden suffered during the 1970s and 1990s, but also the particular innovation thinking that had emerged in STU and NUTEK, the government agencies responsible for technical change. Of course, this focus is a particular operationalisation of the Swedish adoption of the innovation system concept, and there are many aspects of this process that are left outside the scope of my study. For example, my focus is on the discursive adoption of the concept, and I do not study if it contributed to an actual change in Swedish policy. As this is an adoption study rather than a reception study, I have not attempted to systematically trace the links between the OECD and Sweden. Instead, I have focused on how the organisation is used rhetorically by actors in the domestic Swedish debate.

Turning to the early Swedish innovation debate, I have shown that a heterogeneous group of authors pointed to the importance of promoting innovations in order to deal with the industrial crises. Among these authors I have tried to identify some main strands of innovation thinking. One such strand took its inspiration from the historical Swedish legacy of 'genius firms' and stressed the importance of focusing on individual inventors and their ability to start up new companies. This strand can also be seen as a reaction to international trends in innovation research, which was accused of overemphasising impersonal institutions and incremental innovations in large organisations. Sweden was perceived to be locked into an old-fashioned industrial structure based on mature technology. But while many hoped for the existing large companies to renew themselves, such companies were described as conservative by nature. Just as in the late nineteenth century, industrial renewal had to come from new firms formed around central innovations that were either absorbed into existing large companies or grew into new large companies. Often, the inventor and entrepreneur were merged into

the same person, and writers in this tradition generally praised their visionary and pioneering character. Favourable tax rules, protection of immaterial property rights and easy access to venture capital could aid inventor-entrepreneurs on their risky journey to create new genius firms. This line of thinking was promoted by Bengt-Arne Vedin and Lennart Stridsberg.

A second strand of Swedish innovation thinking can be linked to Charles Edquist and suggested an active government innovation policy, insulated from special interests and informed by rigorous social science research. Edquist too saw the Swedish industrial structure as old-fashioned and stuck in a low-tech trajectory, and he did not expect an industrial renewal to occur through market forces alone. It was rational for individual companies to retain established technologies, and given the Swedish tradition of devaluations they had few incentives to renew themselves. But the switch to a more high-tech industrial structure could be made through a government policy that offered special advantages to high-tech industries with the help of interest rates, venture capital and technological procurement.

Economists working for Swedish industry organisations presented a third strand of innovation thinking. While there were similarities to the previously mentioned strands, they differed by emphasising the distorting effects of the welfare state on innovation. Sweden needed to renew its industrial structure and small companies played a vital role in the process, but small companies were also particularly vulnerable to demands from the welfare state. Increasingly basing their production of goods and services on knowledge, they needed to continually adjust the skill composition of their workforce based on changes in the environment, but were prevented from doing so through a tough labour legislation that restricted hiring and firing. Similarly, the solidaristic wage policy that demanded equal pay for equal work, regardless of the competitiveness of individual companies, prevented them from rewarding employees with strategic skills. Tax rules also stopped the accumulation of wealth among new entrepreneurs. Lennart Ohlsson, Gunnar Eliasson and Bo Carlsson articulated this kind of criticism.

All three strands were concerned about the low-tech character of Swedish industry, and sometimes their rhetoric reached alarmist proportions, warning that Sweden could turn into a developing country if nothing was done about it. At the same time, many of the authors in these strands complained about their lack of influence on actual policy. In the agencies that were in charge of supporting technical change in Sweden, STU and from 1991 NUTEK, a fourth strand of innovation thinking had emerged, often in collaboration with groups of innovation scholars. These included the ‘network school’ that had emerged around Håkan Håkansson, as well as the project to study Sweden’s technological systems. STU and NUTEK viewed themselves as brokers of networks, supporting the development of new technologies by bringing together various competencies that would otherwise not have met. This also influenced their view on the economy, where the competitiveness of compa-

nies was perceived to depend on their position in long-lasting networks of customers and suppliers. Sweden had a long tradition of industrial development through the continuous interaction between domestic users and producers, but it was argued that the networks companies were embedded in had become increasingly international in recent years. While this was a positive development, it made it necessary to aid domestic relationships to maintain a dynamic Swedish industrial environment. Unlike the three previously mentioned strands of innovation thinking, STU and NUTEK were not so concerned with the low-tech character of Swedish industry. The size or relative share of the high-tech sector mattered less than how well it performed its function of transferring advanced technology to more traditional parts of the economy. Rather than focusing on the high-tech sectors, government policy should emphasise the introduction of new generic technologies in traditional Swedish industries. In particular it was important to diffuse information technology into the mechanical engineering industry.

The traditional Swedish innovation discussion was thus quite varied and heterogeneous, but one common theme was shared by most of the accounts. Lennart Ohlsson was an exception, but apart from him, authors within these strands of innovation thinking explicitly or implicitly deemphasised the role of universities in the innovative process. Some of them argued that the importance of universities had been overestimated. Others noted that university research was important, but placed most of their emphasis on discussing other factors behind innovation. In some accounts universities were rarely mentioned at all. Bengt-Arne Vedin stressed that university research was only one of many possible inputs in the innovative process and not necessarily the most important one. For Charles Edquist it was more important for a small country like Sweden to absorb new technologies from abroad, rather than promoting domestic technological breakthroughs through research. STU and NUTEK admitted that it was important to build a strong domestic research base when receiving generic technologies and that universities had a role to play. Still, they were uncertain if the university sector was fit to play that role. Universities tended to be disinterested in supporting technical change, found it difficult to deal with research issues transcending traditional academic disciplines and were biased towards interacting with large companies able to formulate their problems in scientifically interesting ways. But while the universities and their internal culture were seen as problematic, STU and NUTEK did not suggest changes affecting them directly. Rather, the agencies wanted to bypass universities and boost resources for research institutes that were more sensitive to industrial needs. They also wanted to increase the competence of small companies and make them more attractive as collaboration partners for universities. In some instances STU and NUTEK argued that the importance of research for innovation had been overestimated and that it was more important to build ties between companies than between companies and universities, at least for small firms.

When the innovation system concept emerged in the early 1990s, it was picked up and used by many of these strands of innovation thinking. Bengt-Arne Vedin used it to denote the environment in which entrepreneurial inventors started up new companies. For Charles Edquist it provided a theoretical framework for the strong government innovation policy he proposed for Sweden, even though the concept still needed some development to be useful. Finally, NUTEK made use of the innovation system concept as it discussed the lack of ties between Swedish companies.

Thus, a vigorous discussion about innovation had already existed for decades in Sweden by the early 1990s. An observer could easily be led to assume that this historical legacy would be a major cause of the later breakthrough for the innovation system concept in Sweden. But in fact the adoption of the concept took place in a different setting, namely the efforts to reform Swedish research funding. I have shown in chapter four that before VINNOVA was created in 2001, the innovation system concept was chiefly used in relation to that reform process. Quite surprisingly, the concept appears to have made a sudden leap from its first appearance in an innovation debate predominantly interested in industrial policy, paying relatively little attention to the university sector, to a discussion focusing on how university research should be funded. This leap was the result of a rhetorical and strategic manipulation of the concept, which I will analyse using the Skinnerian framework already presented.

Swedish research policy had its own historical legacy, characterised by an ongoing conflict between two opposite and competing coalitions. Since the 1940s it had been a general rule in Sweden that as much research as possible should be performed at universities, in order to avoid an institutional separation between research and education. Hence, much of the research that was located at research institutes in other countries took place at universities. During the 1960s and 1970s Swedish government agencies increasingly asked universities to perform research in order to improve the knowledge base in their policy area, while agencies promoting technical change funded research to serve the needs of future industries based on technologies not yet existing. Both kinds of agencies were driven by an instrumental view of scientifically produced knowledge, focusing on its relevance for present and future societal needs. The research they supported was generally called sectoral research. In the 1980s an alliance of university researchers and politicians began to view the perceived dominance of sectoral research as problematic, arguing that university autonomy was threatened by the increasing reliance on external sectoral resources. The main goal of their project was to bring sectoral funding under researcher control, either by transferring it directly to the faculty grants, by creating structures resembling research councils within the sectoral agencies or by transferring the funding to independent research councils where researchers were in control. This would improve the

scientific quality of sectoral research and make it easier to coordinate with the curiosity-driven basic research that was carried out at universities.

At a time when sectoral research was increasingly questioned, a second coalition, which emphasised the importance of research guided by social and economic relevance rather than pure scientific criteria, grew in importance during the 1990s. Between 1994 and 1998 this coalition enjoyed the support of the Ministry of Education under Carl Tham, but it was also supported by NUTEK and other sectoral agencies, the Ministry of Industry, the industry associations and the trade unions. At this time there was also a wide proliferation of policy-oriented academic models that assumed a substantial relationship between university research and innovation, under the names of Mode 2, Post-Academic Science, Triple Helix and Pasteur's Quadrant. Proponents of the innovation system concept were more reluctant to make strong claims about the role of universities, and some of them, such as Bengt-Åke Lundvall, were vocal supporters of university autonomy. Nevertheless, before 1998 the Swedish coalition supporting socially and economically relevant research paid little attention to the new conceptual developments. In 1996 the investigation *Research and Money* caused a lot of irritation within the relevance-oriented camp, as it was seen as narrowly siding with universities and disregarding links between research and economic development. NUTEK ran the risk of having 300 million crowns of its research funding resources transferred directly to the universities. But among all the angry reactions there was no mention of the new approaches, this at a time when Charles Edquist was particularly busy lobbying the Ministry of Industry and the Ministry of Education to make them aware of the innovation system concept. In the one instance the innovation system concept was mentioned, it was as part of an argument in favour of separating innovation and research policy, while transferring resources from NUTEK.

In late 1998 a second investigation was presented that once again caused strong reactions from the supporters of socially and economically relevant research. *Research 2000* criticised sectoral research and proposed that all funding for such research should be lifted from the government agencies, their bureaucrats and the representatives of societal interests, to be transferred to research councils where representatives of the research community were in control. This meant the end of sectoral research as it traditionally had been carried out in Sweden. Thus, by the end of 1998 the relevance-oriented coalition in Swedish research policy found itself in a position resembling both Skinner's innovative ideologist and his apologist. On one hand they were revolutionaries trying to implement the controversial change of opening up universities to social and economic demands. This took place in a society where some university researchers fiercely guarded university autonomy and curiosity-guided research and where Swedish politicians, following the tradition of former Prime Minister Tage Erlander, tended to be receptive to such researcher demands. On the other hand, they were also

conservatives defending the social institution of sectoral research that had been increasingly questioned since the 1980s. *Research 2000* threatened to deal a final blow to it in 1998, making the situation particularly serious.

The relevance-oriented coalition largely responded to this challenge by picking up the innovation system concept and changing its traditional criteria for application. As has been seen, the early Swedish innovation debate had been embedded in a discussion about how to solve the industrial crises and had paid relatively little attention to the university sector. This also held true for the first uses of the innovation system concept in Sweden during the early 1990s. Internationally, some of the leading scholars behind the concept championed university autonomy and were against subordinating universities to industrial demands, a position for example taken by Bengt-Åke Lundvall. Still, there were advantages attached to introducing the concept into the efforts to make academic research more socially and economically relevant. Manipulating the innovation system concept was an easy task, as it had been seen by scholars and policy makers as notoriously vague from the start, and as it lacked commonly accepted connotations. Also, it was a technical and academic term that only a small group of people were familiar with in the late 1990s. Thus, there was no strong or widely diffused alternative interpretation of the innovation system concept to compete with. Through conceptional manipulation it was possible to break with the traditional image of universities as autonomous units where researchers followed their own curiosity and instead present them as components of an innovation system. If the functioning of the innovation system depended on how well the components interacted with each other, university autonomy became a problematic concept because it isolated one of the more important components. The innovation system concept also functioned as a vessel carrying legitimacy from the OECD. It made it possible to argue that the other countries within the OECD were in the process of integrating innovation aspects in their research policy and that Sweden would fall behind competitively if it did not do the same. Similarly, the relevance-oriented coalition could appeal to the legitimacy of science, arguing that the advocates of university autonomy and the proposals of *Research 2000* were out of touch with developments in innovation research during the last decades. This, of course, required that the contested status of the relationship between universities and innovation within such research, as well as the support for university autonomy among some innovation scholars, be glossed over. Reactions to *Research 2000* from the relevance-oriented coalition made ample use of these advantages, and references to the OECD and the innovation system concept were numerous.

Hence, the innovation system concept was successfully launched into Swedish discourse, and some parts of the questioned sectoral research were eventually saved. Sectoral research funding for technical change, communications and some working life issues was collected in the new agency of VINNOVA. While the apologetic strategy was partly successful, the propo-

nents of research guided by social and economic relevance fared less well as innovating ideologists. In the new institutional structure for public research funding that emerged in January 2001, most of the resources were channelled through the Swedish Research Council, which was controlled by researchers and not bound to consider extra-scientific relevance as a criteria. Large parts of sectoral research were transferred to sectoral research councils where researchers were also in control. In the end, VINNOVA found itself to be an island where bureaucrats and representatives from societal interests could maintain some decisive influence over research funding, surrounded by a sea of researcher-dominated research councils. Instead of the integration between research and innovation policies that had been envisioned by scholars and policy makers promoting a new mode of knowledge production, there was an institutional compromise keeping research and innovation policy on two separate tracks. The struggle over resources between the two coalitions continued even after this compromise, and it is an open question if it will last or if an integration of the two tracks will occur. In 2004 the Ministry of Education and the Ministry of Industry together launched the strategy Innovative Sweden, which might be a step in that direction. Also, while the government wants to increase faculty grants and thereby strengthen the research track, it instructed an ongoing investigation that was initiated in 2006 to consider how the faculty grants could be linked to performance indicators rather than simply given to the universities. These indicators could include extra-scientific elements, such as the social or economic utility of research, thereby opening a new door for the possible integration between the two tracks. But any far-reaching integration is likely to be met with academic resistance.

The conflict that emerged over research funding in the aftermath of *Research 2000* has already been covered by existing research, above all by Mats Benner, but also by Peter Schilling, Mark Elam and Hans Glimell. Still, this research has underestimated the abruptness with which the innovation system concept was recruited into the research policy discussion and the degree of rhetorical manipulation of the concept that was involved. This is partly because these scholars have not applied a Skinnerian perspective, which draws attention to such manipulation, to the conflict. But it is also a result of their almost exclusive focus on the debate that followed *Research 2000*. Looking at the previous investigation *Research and Money*, as well the reactions it provoked, modifies the picture somewhat. Just a few years earlier a similar discussion to the one caused by *Research 2000* had taken place between advocates and critics of university autonomy, but almost without references to the innovation system concept or innovation research. Similarly, these scholars have not studied the prior decades of innovation debate in Sweden. Thus, they have not been able to compare the later usage of the innovation system concept with the historical legacy of an innovation debate largely disinterested in universities. My contribution lies in showing how late and sudden the introduction of the concept into the project of mak-

ing university research economically relevant actually was in Sweden, and it may thereby serve as a corrective against temptations to ahistorically project this current relationship backwards in time.

Focusing on the rhetorical manipulation involved as Sweden adopted the innovation system concept, it is also easier to make sense of the already mentioned puzzle. The two opposing representations of Sweden can both be interpreted as, at least in part, emanating from the rhetorical strategies of the project to make research more relevant. Elevating the innovation perspective in Sweden and naming a government agency after the innovation system concept can be read as an attempt to transfer legitimacy from the OECD to the national projects of saving sectoral research funding and opening up universities to social and economic demands. It can also be seen as a tool for rhetorically breaking with the image of autonomous universities and framing them as part of a larger system. Similarly, the complaints about Swedish disinterestedness can to some extent be interpreted as frustration over the institutional compromise that came out of the research funding reform process and the continued separation between innovation policy and research policy. Moreover, it is a rhetorical strategy to overcome that separation and encourage further integration between the two tracks of Swedish research policy.

Through this study I have tried to show that Swedish actors were far more active and strategically aware when they adopted the innovation system concept, than would have been expected based on the image of countries as passive recipients implicitly or explicitly found in much research. In fact, the OECD threw its weight behind the innovation system concept at precisely the right time for the Swedish protectors of sectoral research, presenting a much-needed weapon just when university researchers seemed about to extend their control over the whole field of public research funding. Appropriating and manipulating the concept allowed for an active rhetorical strategy of redescribing universities and appealing to the legitimacy of science and the OECD. What at first glance might appear to be a classic case of passive fashion-following reception, with Sweden even going as far as naming a government agency after the latest OECD buzzword, reveals after a deeper look domestic actors actively pursuing their own agendas, picking up and using fashionable concepts if and when it benefited them.

Is Sweden a special case and have other countries conformed more to the model of passive recipients when they adopted the innovation system concept? Given the lack of research on the adoption of popular OECD concepts in different countries, any answer to that question will have to be somewhat speculative. Håkan Gergils and Peter Schilling both argue that the Swedish academic sector was particularly strong and efficient in the protection and promotion of free basic research and university autonomy. As the rhetorical modification and use of the innovation system concept occurred as a reaction to that strength, incentives for active conceptual manipulation might not be

as strong in countries with weaker proponents of university autonomy and less open conflict in the research policy arena. On the other hand, it can be argued that the supposed strength of Swedish university autonomy should be taken with a grain of salt. Such claims have often been rhetorically embedded in the conflict over research funding. Proponents of relevance tend to emphasise the dominant position of free autonomous research in Sweden, while advocates of autonomy rather point out the weakness of such research and how it has been undermined by increased external funding. Schilling presents Sweden as one extreme in his model over the various degrees of integration between innovation and research policy. In Sweden very little integration took place, while Great Britain to a larger degree integrated the two tracks. Countries like Finland and the Netherlands fitted in between. But Schilling makes a much deeper analysis of the Swedish case, while the other countries in his model are dealt with more superficially. It is not impossible that he overestimated the uniqueness of Sweden.

In any case, the potential opposition between research for its own sake and research for the sake of societal relevance exists in all industrialised countries, even if it does not take the form of open conflict as in Sweden. There are also incentives to use the innovation system concept rhetorically outside the field of research policy, for example as a weapon to break the power of neoclassical economists over public policy. Countries are composed of several social groups with different perceived interests and world views. It is likely that new concepts and approaches at least to some degree enter countries by being adopted by certain groups and being used rhetorically in the struggle with other groups, as was the case with the innovation system concept in Sweden. That is why the common image of countries as passive recipients of fashionable OECD concepts needs to be complemented with an increased focus, both in theory and in empirical research, on the mechanisms whereby actors actively appropriate and use the concepts in national or regional settings.

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