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**LOST IN TRANSLATION?
SCIENCE, TECHNOLOGY AND THE STATE SINCE THE 1970S**

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1. The end of an era

With the benefit of hindsight, the late 1960s can in many respects be seen to mark the end of an era in Swedish societal development. In politics, more than two decades with Tage Erlander as Prime Minister now approached an end, gradually opening up for a new generation of politicians eager to take over the main responsibilities of government. The generation shift coincided with the emergence of a number of strong popular movements such as the peace movement and the environmental movement, which successfully pushed for new political and economic perspectives to be introduced into the overall societal debate. This was reflected in an increased problematization and politicization of ideas that had hardly been questioned to any greater extent before, such as the neutrality policy and the established meanings attached to the welfare state.

In Swedish industry, for its part, the swift and above all smooth development that had started in 1945 seemed, at a first glance, to continue in an uninterrupted way, contributing to high levels of GDP growth. In reality, however, this aggregate picture was far from clear-cut. The global competitive pressure was increasing in an unprecedented way, and some industries experienced a steady decline in their profit margins during the 1960s, while at the same time Sweden's share in world trade decreased. At the level of the factory floor, this troublesome trend was reflected in high levels of stress and a growing feeling of insecurity in the face of firms' efforts to rationalize production, ultimately leading to a wave of strikes and radicalized relations between employers and labour unions.

From the perspective of science and technology, on the other hand, the period from the late 1960s also marked the dawn of a number of revolutionary discoveries and inventions, such as the microprocessor and the technology of recombinant DNA. These and other developments, which as a rule originated outside Sweden, would with time open up a vast space of opportunities for industry and business as well as for other parts of society, and

they would play key roles in the painful process of structural change in the Swedish economy during the decades that were to come.

Against this background, Swedish state actors faced tremendous new challenges in their efforts to influence science- and technology-related activities in the country. The purpose of this chapter is to explore how the Swedish state attempted to respond to these new challenges, and how state actors sought new ways to legitimate their actions – at a time when the myths of neutrality and welfare appeared more and more to be losing much of their attraction and broad acceptance.

2. From the industrial policy offensive...

Towards the end of the 1960s, it became increasingly obvious that the ruling Swedish social democratic party, which since 1946 was headed by Prime Minister Tage Erlander, approached a generation shift at its top level. In the local elections that were held in 1966, the party achieved disappointingly poor results, and the dominant party profiles – apart from the 65-year-old Erlander also the 60-year-old Gunnar Sträng, Minister of Finance – did not anymore make the same persuasive impression as before in their role as leaders of the country. When Erlander in a self-critical assessment of the poor elective performance pointed at a new need for “activation”,¹ it seemed that the chance had come for a new generation of leading social democrats to take a step forward on the political stage.

The most popular candidates in the discussion about Erlander’s possible successor as Prime Minister were Olof Palme and Krister Wickman,² who at that time were both in their early forties. Palme became Minister of Education in 1967 and was the one who actually succeeded Erlander as Prime Minister in 1969. Krister Wickman, for his part, being an economist and working in the Ministry of Finance, became an influential person in what has later been labelled the ‘industrial policy offensive’, an initiative launched by the social democrats in January 1967.³ The offensive, with a variety of new political moves and actions, was one of the most important results of the self-assessment that followed the party’s disappointing performance in the 1966 local elections, and it had

substantial impact on the relationship between science, technology and the state in Sweden. But it also became a central power platform for many of the younger social democrats – apart from Wickman also, for example, Kjell-Olof Feldt and Rune Johansson. Olof Palme, in his role as Minister of Education, later complemented the industrial policy offensive through a number of initiatives in the field of education policy (see further below).

Wickman and his party colleagues formed a working group, which during the first half-year of 1967 prepared a far-reaching reform programme. When the programme was formally presented at an extra party congress in October 1967, the offensive approach awoke considerable attention. At the congress, the need for far-reaching government action was motivated by problems of “transformation” in the Swedish economy. Sweden was seen to be increasingly drawn into the gales of international competition, accelerating technological advancements and, in relation to this, pervasive structural change in industry.⁴ The political goal of the social democrats, as formulated by them, was, as before, to guarantee security and welfare, but the ongoing trends in the world meant that it was now becoming much more difficult to reach these aims. In order to actually reach the goals in these turbulent times, a radical strengthening and sharpening of state action was therefore deemed necessary. Concretely, it was a matter of a need for the state to deal with, for example, the negative social consequences of technological change in terms of unemployment, dangerous industrial work and other problems.⁵ But it was also about how the state could ‘help the market’ in fields where private business did not really have the courage to invest in new products and processes of benefit for society⁶ – an argument that seemed to take inspiration from modern economic and social scientific research on the relation between technological innovation and economic development.⁷

The industrial policy offensive involved the creation of important new organizations and institutions. Some of these were explicitly directed at the field of science and technology, while others rather addressed industry and economy in a wider sense. An early example was the creation of a state-owned Investment Bank in 1967, whose goal was to ‘create a

new and efficient form of long-term financing of productive investments in business'.⁸ Krister Wickman, who was responsible for the initiative, deemed it 'possible that a relatively large share of the bank's efforts will be devoted to innovation and development projects within technologically advanced sectors'.⁹ The creation of the new state bank was obviously a reaction to the trend of rapidly falling profits in a number of industries in the 1960s (typically the same industries which in the 1970s became known as 'crisis industries').¹⁰ The falling profits pointed at the need for structural change in Swedish industry, in the direction of more profitable lines of business – both at the level of the economy as a whole and within individual firms.

The debate that preceded the creation of the new bank turned out to provide further creative input to the overall industrial policy offensive, as indicated by the large number of party motions focusing on this topic in 1967.¹¹ An interesting tension in this debate was the one between proponents of support to already existing firms and industries, on the one hand, and on the other proponents of support to a more radical process of creative destruction, suggesting that Swedish industry would have to orient itself towards new types of products rather than already existing ones, and that this would inevitably involve a painful wave of bankruptcies in the 'old' economy, generating unemployment and other negative side effects, in a way which however on the long term would prove beneficial for the country. There was a fear among the latter that the Investment Bank would rather reinforce the already existing industrial structure, rather than altering it in the directions that international developments seemed to necessitate and which would be needed to guarantee the survival of Swedish industry in the long run.¹² This tension would later on be more pronounced in the political debate.

The following year it was decided that a Ministry of Industry was to be established.¹³ According to Benner, the motive for the ministry's creation was 'the larger role of industrial development in the political sphere, combined with the need for coordinating the different policy instruments in the area'.¹⁴ The new ministry, which formally opened in January 1969, was essentially a spin-off from the Ministry of Finance, from which it took over the units for industrial policy and state-owned enterprises, energy and mining,

and technical research, while some additional functions were also added.¹⁵ The first Minister of Industry became Krister Wickman.

The quest for stronger coordination and centralization was a quite general trend in Swedish politics (as well as Western politics in general) during these years. Together with the creation of the new ministry, the most important example of this in the field of science and technology was the creation of the National Board for Technical Development (STU) in 1968.¹⁶ This new organization, which was formally proposed at the party congress that year and whose creation appears to have happened very quickly and with only few people involved, was based on the idea to merge a number of already existing bodies and thus strengthen coordination.¹⁷ The need for such a larger body focusing on technical development, as formulated in the corresponding government bill, stemmed from the increasing role of technology in strengthening the competitiveness of Swedish industry, but also from the opportunities that technical progress was associated with when it came to its role in solving problems relating to, for example, environmental pollution, traffic security, education and health care.¹⁸ The bill also referred to an OECD report from 1963, where Sweden had been described as the ‘envy of Europe’ but where the organizational and institutional landscape for industrial policy was considered too fragmented.¹⁹

STU:s first general director became Martin Fehrm, who had until then been the director of the Defence Research Institute (FOA), Sweden’s at that time clearly largest research institute. The main task assigned to STU was to provide financial support to R&D. However, STU also came to regard itself as having a strong social mission. This was reflected in a focus on technologies for ‘social sectors’ and an ambitious intra-organizational department for planning. The planning department seemed to grow in importance within STU during its first years of existence, under the strong influence of its planning director Gösta Lagermalm, who had earlier filled a similar position in one of the organizations that were merged into STU, the Technical Research Council (TFR).²⁰ Hence STU came to embody the new spirit of industrial policy in Sweden in the years

around 1970, characterized by a radicalized strive for centralization, long-term planning and social relevance.

A related part of the new offensive policy were the proposals that were put forward in a major Industrial Research Investigation shortly after the social democratic extra party congress in 1967. The investigation argued for a considerable increase in government expenditures to the various private-public industrial research institutes that had been built up since the end of the war. Such institutes had been created mainly in industries which lacked the 'development pair' relations that had come to characterize sectors such as telecommunications, nuclear power, high-voltage transmission and military aircraft. Through the government bill that led to the creation of STU, it was decided that STU would take the major responsibility for the funding of industrial research. STU approached this task in an offensive way, leading to the creation of a surprisingly large number of new industrially oriented research institutes. Funding was organized through large framework programmes between STU and the respective institutes. The level of funding increased by more than 100% during the second half of the 1960s. Up to 1970, 4 new collective research institutes were established, and by 1975 another 3 new institutes had been launched.²¹ This seemed to be well in line with the spirit of the overall industrial policy offensive, focusing especially on what were expected to become future-oriented high-tech industries.

The government bill that led to the creation of STU also contained a number of additional components of far-reaching significance. In particular, this concerned the creation of a state-owned development company, SU (Svenska Utvecklings AB). The inspiration came from the recent establishment of a number of *private* development companies, the most prominent of which was the Wallenberg-controlled Incentive. The private development companies had 'an orientation towards science-based technologies and industrial applications, based on an organized interaction between Swedish scientists and companies',²² and the state did not want to be worse. Hence the goal of SU was to support the development of new technologies and new industrial applications, while keeping strong links to public authorities. The specific fields of technology of interest to

SU should be ‘systems, products and technologies that are important from a societal viewpoint’.²³

Another public company was Svetab (Svenska Industrietablerings AB), which was initially founded as a subsidiary of SU but in 1969 achieved an independent status. Svetab sought to cooperate with private companies and other organizations with the aim to create new employment in Swedish regions that experienced a general decline.²⁴

The industrial policy offensive was complemented by related government initiatives, for example, in the field of education policy. Minister of Education Olof Palme, following the results of a state-commissioned investigation called UKAS, in 1968 launched a reform aimed at adapting university education to the concrete needs of industry, the idea being to create a set of comprehensive educational programmes that were to replace students’ free selection of individual courses. University education, as it was argued, needed to be more profession-oriented. It was this policy that became the igniting spark for the Swedish version of the European student uprising in May 1968, since many leftist student representatives regarded the reform as an expression of the government’s too close alliance with the ‘capitalists’.²⁵

All in all, when Olof Palme succeeded Tage Erlander as Prime Minister in October 1969, Swedish state initiative for science and technology already seemed to develop with impressive leaps: the organizational fragmentation of the system seemed to be counteracted through the creation of STU and the new Ministry of Industry; the establishment of state development companies had been launched and these now headed towards the exploitation of new technological fields in business; university education was being brought in line with actual demands in industry and society; etc. The general belief in the government’s ability to rationally plan for a bright technological future, and the necessity for it to do so, was in many respects greater than ever before.

3. ... to the structural crisis

Following the first oil price shock in 1973/74, Sweden was drawn into a global economic recession. The crisis came somewhat later in Sweden than in most other European countries, but when it did come, the country was on the other hand more severely hit by it than most others.

When a wide array of previously strong Swedish industries faced acute problems, the tension between the support for the old and the new became more pronounced than it had been before. The overall approach of the government, which from 1976 was a new centre-right coalition led by the new prime minister Torbjörn Fälldin, became one of supporting the crisis-ridden industries. It was thought that the negative development was of a temporary nature and that the problems in industry could be overcome with the help of active and selective state support. State aid experienced a virtual explosion in the years 1976-1978, and the office of the new Minister of Industry, Nils Åsling of the Centre Party, came to resemble an emergency department for industrial companies that faced the threat of bankruptcy. The state organized far-reaching support for keeping up the employment within the crisis industries, and the state also became active as an owner of many companies in consequence of a nationalization drive – for example, in the steel and the ship-building industries.²⁶

The preference for dealing with problems in crisis-ridden industries meant indirectly that the resources for investing into new areas were more limited. And in addition, those instruments that had been built up with the purpose of supporting technological change and economic renewal were largely transformed into defensive instruments, as will be described in the following.

With regard to the state-owned development companies, for example, both SU and Svetab were originally quite offensive organizations, directed at advanced high-tech fields as well as at speeding up process innovation in established industries. But when the Swedish economy in the mid-1970s headed into the crisis, the roles of the public development companies tended to be reinterpreted, and they were in practice transformed into instruments for handling companies that faced stagnation. As Benner argues, the

‘initial offensive roles of SU and Svetab were transformed into a defensive responses to declining employment. The two companies were ambitious but unsuccessful attempts to regulate industrial development, to increase socially desirable investments, and alter the regional location of investments.’²⁷

Another example of initially offensive state measures that were later transformed into more defensive responses to the economic crisis, were the so-called ‘branch surveys’ that were carried out by the Industrial policy council (Näringspolitiska rådet). The council was itself a new organization, established in 1968 and consisting of representatives from politics, industry, trade unions, etc. The investigations that were carried out were followed by public support to certain branches of industry, usually in the form of training and export subsidies. But similarly to Svetab and SU, the actual result was a focus on sectors that were in crisis, rather than looking to future emerging fields.²⁸

A somewhat similar development came to characterize STU, the most powerful of the science- and technology-related state bodies. Bertil Agdur, a well-known professor of microwave engineering at KTH who in 1971 succeeded Martin Fehrm as the agency’s general director, complained in an increasingly louder voice about the much too strong links between STU and existing Swedish industry that the subordination of the agency to the Ministry of Industry meant. This connection prevented, in Agdur’s view, STU’s full participation in the more radical transformation of the economy in the direction of new fields – including fields where Swedish industry had not yet accumulated any strong competence. Agdur’s vision was to make STU a ‘transformation apparatus’, whereas the political narrow-mindedness, in his view, forced the agency to act as an ‘administration apparatus’, i.e. a body mainly in charge of administering and reinforcing already existing structures.²⁹ Agdur’s dynamic personality and politically unrealistic proposals made him short-lived as STU general director, but the problems he addressed continued to trouble the agency.

The years of the industrial policy offensive and its somewhat abrupt decline coincided in many cases with the end of the large state-led technological programmes that had been

central to the development of the 1950s and 1960s. On the military side, the defence budget experienced a decline in 1968 – for the first time ever since the end of the war – while at the same time the share of military research dropped from around half of total government R&D expenditures in 1960 to below 30% in 1970, implying that the defence-related innovation projects had no longer the same central priority as before. In particular, the main R&D work within the Viggen fighter aircraft project, which for several years had formed a dominant part of the overall Swedish R&D landscape, was now about to be completed. A disappointment was in this connection that all attempts to export the aircraft failed. REF!

The negative trend in military R&D seemed to be confirmed by the decommissioning of the heavy-water nuclear reactor at Marviken in 1969, which had symbolized and embodied the ‘Swedish line’ in nuclear engineering – with its close links to ambitions to develop nuclear weapons. Hence the state-led AB Atomenergi was marginalized in the further nuclear development. REF!

At about the same time, the close collaboration between Asea, Sweden’s ‘national champion’ in the electrical engineering business, and the state-owned electric utility Vattenfall seemed not to be continued to the same extent as before.³⁰ Asea remained a successful company, but when it increasingly focused on foreign markets, Vattenfall was increasingly seen as just one of several key innovative customers to the company.³¹

A similarly disappointing experience was the cooperation between Asea and the state railway operator, SJ, for the development of high-speed trains. SJ first expressed an interest in acquiring a high speed train in 1968-1969, but throughout the 1970s little happened in practice. While foreign companies successfully created a number of high-speed trains (e.g. Fiat’s ‘Pendolino’ train, which was launched in 1976), SJ’s and Asea’s cooperative development work for the ‘X2000’ train did not result in any formal procurement until 1982. When completed, it was arguably a technical success, but hardly a commercial one. The train disappointingly failed to conquer export markets.³² In this

way, X2000 became a symbol of the apparent malfunction of the old technology policy instruments.

An important aspect of the 'boom years' had been that it required unprecedented amounts of raw materials, and that great emphasis was therefore put on industries capable of processing raw materials, such as the steel industry. A symbolic end to the power of the state in promoting the Swedish raw materials industries came in the 1970s through the failure of the grandiose 'Steel Plant 80'. This was a plan for the creation of a new steel production facility in Luleå in northern Sweden and was planned to become larger than anything the nation had ever seen in this field. If realized, it would have been the largest industrial project in Swedish history. The first proposals to the project were presented in May 1974, and several versions of the project were presented during the following two years. However, the rapid decline during these two years in the demand for steel, especially in the crisis-ridden shipbuilding industry, reduced the state's interest in the enormous project. Against this background, it was abandoned by the new centre-right government that took office in 1976.³³

In the building industry, the crisis became evident when the 'million programme' approached its end in the first half of the 1970s. The aim of this programme had been to build one million dwellings during a period of ten years in a scale-intensive, industrialized fashion with the application of modern standards and new process technologies. With the programme coming to an end, the system was confronted with 'a crisis of breakdown proportions', and employment in the sector decreased dramatically.³⁴

But not all sectors followed this depressive pattern of development. An important example of a sector where the state showed that it could still act powerfully as a visionary and innovative buyer was the telecommunications sector. In 1970, the public telephone operator Televerket and the telecommunications equipment manufacturer Ericsson jointly initiated a large-scale project with the aim to develop a fully digital telephone switch, labelled AXE. The project was highly successful and laid the foundation for an overall Swedish success in the telecommunications industry in the digital era.³⁵

There were also some promising developments in a few industrial sectors where the role of the state was more diffuse, such as in automobiles and in chemical engineering. A particularly promising part of the chemical industry was pharmaceuticals, which was still small but which had grown impressively during the 'boom years', supported not least by the expansion of the public health care system. With the rise of molecular biology in the 1970s and 1980s, and powered by a massive increase in computer power in the same period, great hopes were now raised for the future of the overall Swedish bio-pharma sector.

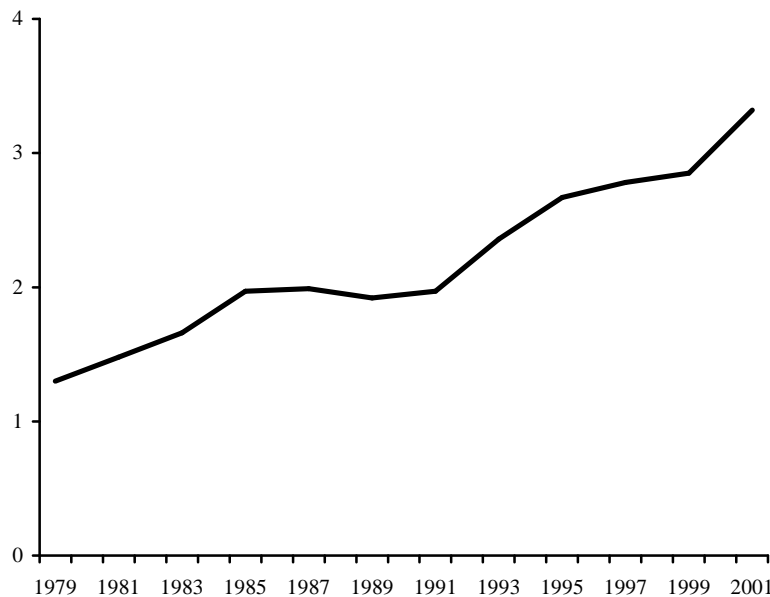
All in all, however, the development in the 1970s was depressive from the perspective of state-led action. Offensive state initiatives became increasingly rare. At an aggregate economic level the public investment ratio was reduced by 50% between 1970 and 1980. Investment activities of the state and municipalities, which had been extremely high up to around 1970, dropped in a striking way. The earlier rapid expansion of many infrastructure systems, schools, hospitals, municipal administration, etc., seemed to stagnate.³⁶ As noted by, for example, economic historian Lennart Schön, it seems peculiar that the pressure for rationalization in these years to such a great extent came to be directed at education, health care and related sectors, i.e. at the production of 'human capital' which in the 'third industrial revolution' should have been viewed as increasingly important for economic growth and societal progress: 'New technological opportunities within these areas and new complementarities with other activities should have created points of departure for expansive [public] creativity. When demand pressure and the need for renewal and diversification increased, however, the lack of broad initiating capacities and creative space became a growing problem'.³⁷

In private business, the situation was different and the trend more encouraging. As already mentioned, the new centre-right government responded to the problems in industry largely by providing subsidies to crisis-ridden sectors. At a first glance, it would seem that this would have encouraged a path-dependent behaviour in that the crisis-ridden businesses, with the help of the state support, were given the chance to continue

along their earlier lines of business. In reality, however, it turned out that the crisis industries, despite this ambivalent incentive, were able to adjust themselves with impressive speed and efficiency to the new structural and competitive circumstances in both Sweden and globally. Restructuring proved highly successful, especially in international comparison, and the crisis-ridden industries, having gone through a painful process of bankruptcies and factory shut-downs etc., largely managed to adapt themselves to the new era through the exploitation of new technology and organizational methods.³⁸

At the level of industry in general, business investments in research and development increased in an impressive way from the 1970s and onwards. This can be seen in contrast to the dramatic drop in the public investment ratio. It was these private R&D investments that to a large extent would lay the foundation for Swedish technological advancements in the new era. But in contrast to the earlier period, the state would now no longer be involved in the same direct way in building up the innovative strength of the country.

Figure x. R&D expenditures in the Swedish business sector as a share of GDP, 1979-2001 (percent)



Source: Statistical Yearbook of Sweden.

4. The coming of a neo-liberal era

The period from the mid-1970s to the early 1990s became a time of substantial confusion and contradiction regarding the interpretation of science and technology in Swedish society. On the one hand, there were many positive signs. From an aggregate macroeconomic perspective, the Swedish economy recovered in the 1980s, with high and stable levels of both GDP and productivity growth.³⁹ And the enormous increase in private R&D investments reflected a growing optimism and enthusiasm in firms' exploitation of the new technological revolutions in the fields of electronics, biotechnology, new materials and other areas.

At the same time, however, the overall societal climate was growing more pessimistic concerning the role of science and technology in modern society. The somewhat naïve, as it now appeared, development optimism of the postwar decades was gone. A fierce opposition against nuclear power infected domestic political life. The relations between industrial workers and employers were radicalized. And the peace movement pointed at the increasing risk for abuse of new, advanced technologies for destructive purposes. The military conflict in Vietnam was a central topic in the Swedish political debate, while at the same time the Cold War seemed colder than ever following the end of the 'détente' period. In the 1980s, fiction writers in the critical genre were inspired by the Cold War as well as by the approaching 'Orwell year' (1984) in depicting a deteriorating industrialization and technification of society, with its negative social and environmental consequences and the likely abuse of new information technologies for the state's detailed surveillance of individual citizens. The German sociologist Ulrich Beck, for his part, took inspiration from the Challenger accident and the Chernobyl catastrophe in spring 1986 in launching the concept of the 'risk society',⁴⁰ whereas the Finnish philosopher Georg Henrik von Wright argued that the idea of societal progress in the technological era was merely a 'myth', which lacked any true meaning.⁴¹ In Sweden, the murder on Prime Minister Olof Palme only two months before the Chernobyl disaster, and accidents such as the first crash of the new fighter aircraft JAS Gripen in 1989 seemed to confirm that times were not what they had been.⁴²

This widespread development pessimism was reflected in an increasing scepticism concerning the ideological foundations that had underpinned the ‘Golden Age’ of the 1950s and 1960s. The idea of a ‘strong state’ and its key role in boosting Sweden’s scientific and technological progress, started to be challenged. The apparent failures of the policy initiatives of the 1970s gradually let the anti-thesis of a strong state become dominant in the following period: neo-liberalism.

A cornerstone of the neo-liberal ideology was that new technologies did as a rule not need any far-reaching support from the state. The most important task for the state in terms of supporting innovation was to ensure that markets function properly. Technological shifts were typically seen as a more or less automatic result of competitive rivalry in the capitalist economy; technologies were seen to emerge at a high rate even without any far-reaching state initiatives. The exceptions were few, and ‘state intervention’ (i.e. into the ‘normal’ working of the free market) was seen as legitimate only in obvious cases of ‘market failure’.

The neo-liberal principles found their way without any greater difficulty straight into the Swedish ‘people’s home’ – despite the fact that the social democrats, who hardly considered themselves ‘neo-liberals’, in 1982 managed to regain the political power. The new lines of thinking were attractive especially for a number of young economists that worked as experts and advisors in the Ministry of Finance, but also in the Ministry of Industry. The latter had traditionally been populated by individuals with an engineering background, but from the end of the 1980s these persons were complemented – and increasingly replaced – by young, university-educated economists.⁴³ To some extent the same trend characterized the professionals at state agencies such as STU, where the new economists in several cases came to play key roles in state-ordered inquiries that paved the way for spreading the ideas of deregulation and liberalization to infrastructural sectors.⁴⁴

The market economy-oriented thinking thus increased in Swedish politics, with a growing interest in the capitalist mechanisms of competition as a crucial driving force in

economic development. Similar trends dominated within the European Commission in Brussels. Its Chairman from 1985, Jacques Delors, was a socialist, a fact that however did not prevent the Commission from becoming a visionary force in Western Europe concerning its striving for institutional transformation in the sign of deregulation and the 'single market', i.e. free cross-border competition within the EC.

After the fall of the Berlin wall in 1989 and the collapse of the Soviet Union in 1991, Sweden was not anymore geographically situated between socialist and capitalist countries, but increasingly squeezed between the Anglo-Saxon spearheads of private capitalism in the West and the avant-garde of socially ruthless, neo-liberal 'shock-therapy' initiatives in the former socialist countries in the East. From this perspective, it was but logical that a highly ideology-driven, neo-liberally oriented centre-right coalition, won the parliamentary elections in 1991, paving way for a new government led by Carl Bildt.

The neo-liberal shift in Swedish (and international) politics took place in parallel with the breakthrough of the 'information society'. Among other things, the development in the field of microelectronic technology opened up for a global communication and transport revolution. It created new and above all cheaper possibilities to build and coordinate world-wide networks – both for production and for sales – between and within businesses and economies. In combination with neo-liberally inspired deregulation efforts in large parts of the world, the result of this revolution was a pervasive internationalization of private business, a dramatically growing world trade and an intensifying global competition.

The internationalization of industry was more far-reaching in Sweden than in most other Western countries. Swedish foreign investments increased drastically, from an earlier stable level of around 0.5-1% of GDP during the post-war decades, to a level of about 5% of GDP in 1990.⁴⁵ Apart from foreign investment, Swedish firms were also internationalized through cross-border mergers and acquisitions. Examples included Asea, Pharmacia, Astra and Volvo. Rationales for such mergers included the need to cut

costs in the face of the increasing global competition and the increasing complexity of technologies, which motivated firms to share R&D efforts – either through mergers and acquisitions or through some form of strategic alliances. But a side-effect of this trend was also Swedish control over the R&D that was carried out within ‘Swedish’ corporations was diminished.

Some of the classical Swedish technology-intensive state agencies were strongly inspired by the international success of private Swedish corporations. The seemingly promising vision that emerged was to keep the ‘boom years’ alive through internationalization of the agencies. Actors such as Vattenfall (in electricity) and Televerket (in telecommunications) felt so confident in their understanding of their own technological superiority that they started to search actively for business opportunities abroad, particularly in third world countries, aiming to spread the technological wonders of Sweden to these poor parts of the world. The new trend had its origins in state aid to third world countries, but it accelerated markedly from the mid-1970s.⁴⁶ It was not until the 1990s, however, that the first state agencies seriously started to penetrate international markets. In doing so, as illustrated by the cases of Vattenfall, Telia, Nordea and other firms, they also lost much of their ‘Swedishness’.

A typical neo-liberal trend was also the movement of Swedish business culture in the direction of Anglo-Saxon forms of ‘corporate governance’. This implied that the previously very important role of strong and active owners of significant Swedish enterprises – such as the Wallenberg family – was weakened, being replaced by a growing role of more anonymous and mobile shareholders who did not necessarily interfere with or try to influence the long-term planning of corporate strategy and future areas of activity. The deeper implication of this was that business was increasingly decoupled from society at large, whereas the meeting place for firms and their owners was increasingly concentrated to the stock market.⁴⁷

5. The transformation of state initiative

Internationally, a major problem with the neo-liberal thinking and in particular the free trade doctrine that during the 1980s grew increasingly dominant in large parts of the world, was that the corresponding political initiatives in a variety of countries did not have the desired and expected effects on economic performance. This concerned especially large parts of Latin America and Africa, which experienced serious debt crises. The opening up of markets for international competition turned out to be disastrous for ongoing efforts to build up a national scientific and technological competence base, and the development thus largely prevented these poor countries from any serious process of accumulating advanced technological capabilities.⁴⁸ Somewhat similar difficulties were experienced in most Central and East European countries after the collapse of socialism and the introduction of strongly neo-liberal economic policies there. While the neo-liberal reforms in the East turned out to be successful in terms of their impact on GDP growth, they were also linked to a radical decline – and in some cases a total collapse – of the previously accumulated R&D base.⁴⁹

In contrast, several East Asian countries – notably the four ‘dragons’ of South Korea, Taiwan, Hong Kong and Singapore – which managed to retain a strong role of the state during the 1980s, became the major showcases of how new successful state initiatives for science and technology could be realized outside of Western civilization. The 1980s was also the height of Japan’s intricate public-private networks that were seen to underpin major technological advances. Critics of the neo-liberal political trend, particularly in the Anglo-Saxon world, pointed during these years increasingly to Japan and the new ‘dragons’ as an inspiring contrast to the overly ideology-driven Western developments. It was in this context that the notion of ‘national systems of innovation’ entered political discussions in the West.⁵⁰ The concept of ‘national system’ hinted at a far from marginal role for the state in supporting technological innovation, contradicting the more standard economic policy thinking at that time about the relationship between science, technology and the state. It did not argue for a centrally planned economy, as in the socialist countries, but nevertheless for a strong or at least a ‘half-strong’, activist state.

In Sweden, the national systems concept was vigorously promoted and introduced into political circles from the early 1990s by Charles Edquist, a professor in his forties at the Department of Technology and Social Change at Linköping University.⁵¹ However, state agencies in Sweden had shown considerable interest in what may be interpreted as ‘systemic’ ways of thinking already in the 1970s. The painful Swedish experience of the structural crisis increased various state actors’ interest in modern understandings of technological change, as it now seemed obvious that there were no simple ‘recipes’ concerning the state’s contribution to technological and societal progress. Organizations such as STU and IVA therefore developed a growing interest in economic and social scientific research on technological change – ‘innovation studies’ – in which the more established, but overly simplistic models of the innovative process were problematized.⁵²

Especially STU would with time gladly embrace the ‘systemic’ view of the innovation process. Building on these ideas, STU under its new general director Sigvard Tomner, who replaced Bertil Agdur in 1975, developed during the 1980s more and more to become what historian of technology Hans Weinberger labels a ‘network entrepreneur’ in the Swedish organizational landscape for science and technology.⁵³ This implied that the role of the state in technological development was not only to create laws and rules, to fund education and research, to provide seed capital and to act as competent buyer of innovative products, but also that it, as the Ministry of Industry formulated it in an investigation presented in 1987, in addition should ‘stimulate and support cooperation and interaction in the development process, particularly in early development stages when new patterns of cooperation are built up and where many actors are involved’.⁵⁴ In other words, an important task for STU, as a government agency, became according to this view to enable communication and links between different types of actors.⁵⁵

STU’s transformation during the 1980s is interesting especially if seen in relation to the neo-liberal political fashions that were so dominant during these years. The agency can hardly have found it easy to gain broad political backing for what it regarded as necessary actions and the corresponding need for certain policy instruments. Its success in maintaining an image of itself as a trustworthy and indispensable organization in the neo-

liberal era appears to be result in part of its ability to build alliances and coalitions with other actors, such as technical universities and private firms' R&D departments, enrolling these in striving for resources and legitimacy. However, STU's role was not uncontroversial, and its growing power in the field of science and technology policy was heavily criticized by Charles Edquist and others.⁵⁶

Apart from the opposing views in Swedish society between proponents of a 'strong' and a 'weak' state initiative, an old conflict was also the one between support to old and to new industries. As emphasized in **section 3**, the 1970s came to be dominated by clearly defensive measures in terms of protecting crisis-ridden industries. In the 1980s, however, a consensus gradually formed around the persuasion that future economic growth and social welfare would have to be closely linked to technological advances in a number of *new* fields, notably electronics, biotechnology and advanced materials. Far-reaching expectations were built up for fresh, innovative sectors to succeed or at least complement the stagnating crisis industries as engines of economic and societal development. This shift in thinking tended to increase the overall status and role of STU as a government agency, since it was the main government agency in charge of supporting new technological developments in the country. This was so especially in light of the seemingly vanishing role of other, complementary forms of state initiative for innovation – notably the decline of the 'development pairs', which during the 1950s and 1960s had been so powerful, but whose golden days now seemed to have passed once and for all. In the 1990s, the role of the development pairs was further weakened through the corporatization and privatization of state agencies such as Vattenfall (in electricity), Televerket (in telecommunications) and SJ (in railways).

Meanwhile, state initiative was also transformed in other ways. In the 1980s and 1990s, the 'knowledge-based society' was increasingly proclaimed – partly as an ideal for the future and partly as a diagnosis of current Western societies in the 'post-fordist' era. The quest for the knowledge-based society became a new and powerful way to legitimate state initiative during these years. In particular, the role of *science* was increasingly emphasized – and re-interpreted. **STU's initiation of 'framework programmes' for**

technical research reflected this new trend, gradually deemphasizing its direct involvement in and support to industrial development and instead orienting itself increasingly towards technical research, where the technical universities rather than industrial companies played the main role.⁵⁷ However, STU was merely responsible for a small share of all government expenditures on research and education, and in science-centred state initiatives STU could therefore not play a leading role. Instead, the Ministry of Education became a central actor, along with the diversity of research councils that belonged under this or other ministries. Under the lead of Per Unckel of the liberal-conservative Moderates from 1991, the Ministry of Education became central not only for science- and technology-related state initiatives, but for the new government's ambitions as a whole. Unckel's Ministry was, among other things, also responsible for the main initiatives within the field of IT.⁵⁸

Universities were identified as the main locations for production of scientific knowledge in Sweden and the development of these was therefore favoured. The main focus in the investments was on university education (rather than on university research) as a key activity for knowledge-building. After almost 20 years of stagnating numbers of university students, following the events of 1968, the number of students started to grow exponentially from the late 1980s.⁵⁹ Science and engineering thereby grew particularly rapidly, increasing their weight in the overall higher education system. During the 1980s the share of science and engineering graduates was slightly above 10% of the total number of degrees awarded. During the 1990s, this figure increased dramatically, and at the height of the popularity of science and engineering in 2001, coinciding with the IT boom, the share had grown to 27%.⁶⁰ The main increase in government funding took place after the centre-right government had taken office in 1991, launching a major expansion of higher education throughout the country.

In terms of research, the shift to a centre-right government in 1991 was associated with the creation of a number 'strategic' research foundations with considerable amounts of funding that were taken from the earlier so-called 'wage earners' funds'. The meaning of the term 'strategic' remained somewhat unclear, but in practice the new foundations

responded to the demands for interdisciplinary research of direct interest for both academia and business – largely corresponding to the notion of ‘mode 2’ science that was coined internationally at about the same time.⁶¹

In a more long-term view, state expenditures did *not* experience any increase in their importance in the overall budget. Particularly if compared to the enormous increase in business R&D expenditures during the same period (see [figure 1](#)), government expenditures on R&D rather experienced a radical decline, as shown in [figure 2](#). Between 1983 and 2001, the weight of state R&D expenditures was nearly halved. In this sense, i.e. if measured in terms of direct funding, the state had started a gradual withdrawal from its previously central role in the overall organizational landscape for science and technology in Sweden.

Figur x. Government R&D expenditures as a share of total R&D expenditures in Sweden, 1983-2001 (percentages).



Source: Statistical Yearbook of Sweden, selected years.

The crisis years in the early 1990s also opened up for other reforms. STU, for example, was merged with National Energy Administration and the National Industrial Board (SIND), to form the larger National Board for Technical and Industrial Development

(Nutek) in 1991.⁶² The merger can perhaps be seen as expressing a new reconciliation between the interests of ‘old’, already established industries (as embodied in SIND) and the interests of ‘new’, risky and future-oriented business activities based mainly on recent scientific and technological advances (as represented by STU). In the new political landscape, where education and research was more strongly stressed than industrial development per se, Nutek (and its later successor Vinnova) increased its emphasis on acting as a network entrepreneur in the overall innovation system. It now sought to legitimate its existence and activities mainly in terms of the need to resolve what became known as the ‘Swedish paradox’, i.e. the apparent contradiction between the country’s very high levels of expenditures on science and technology and the relatively weaker outcomes in terms of economic benefits.⁶³

Apart from the merger between ‘old’ and ‘new’ business interests through the creation of Nutek, another reconciliation, or ‘synthesis’, that came to characterize the technological *Zeitgeist* of the 1990s was the one between neo-liberally oriented economic thinking and environmentalism. These had previously been understood as largely incompatible, as signaled by, for example, the Club of Rome’s famous report on the ‘Limits to Growth’ published in the early 1970s.⁶⁴ From the late 1980s, however, the concept of ‘sustainable development’ was launched, indicating that an increasing technification and industrialization of society was not necessarily to be seen in contradiction to environmental awareness. As indicated by the complementary concept of ‘ecological modernization’, technological and industrial advances were now reinterpreted in such a way that they were not anymore seen mainly as the *source* of environmental problems, but rather as the *solution* to these problems. In Sweden, this way of thinking seemed to fit well especially with the social democratic traditions, whose Prime Minister from the second half of the 1990s, Göran Persson, proclaimed a new, ‘green’ version of the ‘people’s home’ as a new vision for the future of the country.⁶⁵

A major shift in the relation between science, technology and the state resulted from Sweden’s EU accession in 1995. From the perspective of technology policy in relation to Sweden’s proud history of the state and state agencies as lead customers of innovative

products, an important consequence of the country's adaptation to EU standards was that 'public technology procurement' had to take place without the previously so crucial intimate user-producer relationships. This was a result of the dominance of neo-liberal 'auction theory' being practiced in the EU. It also meant that the Swedish state was no longer allowed to favour domestic companies in large tenders for new technologies.⁶⁶

All in all, however, the 1990s became an interesting and offensive – though sometimes also confusing – period of initiatives not unlike the 'industrial policy offensive' in the late 1960s, although the focus was now not so much on industry in itself, but rather on the role of education and research, with high expectations on these to quickly become engines of economic development. It was an ambitious attempt to concentrate state action for science and technology, emphasizing in particular the creation of a 'knowledge-based society' and gradually also the new green version of the 'people's home'. The IT boom in the late 1990s contributed further inspiration for optimism and technology-driven visions of societal development. In a sense, it was as if the long period of deep economic and societal problems that had started in the mid-1970s and that had continued up to the early 1990s was in reality hardly more than a parenthesis in an overall bright modernization process, which could still continue for centuries to come.

6. Lost in translation?

The new technological optimism that had come to characterize the late 1990s came to an abrupt end in the first few years of the new millennium. The stock exchange crash in March 2000, in which IT firms played the central role, became a symbol of the technological hybris and the overoptimistic visions of the 'new economy' that had proliferated during the second half of the 1990s. The following year, the Swedish high-tech flagship Ericsson experienced a severe crisis and seemed to be on the verge of collapse. The new societal climate was also reflected in, for example, the fact that the long trend of an increasing interest of young people in science and engineering was broken after the IT crash in 2000-2001.

Internationally, the new wave of terrorism and the attempts of countries to deal with the corresponding threats, served to reemphasize the 'darker' sides of science and technology in the 21st century. The negative trend was reinforced by a new wave of nuclear armament expressions in countries such as North Korea and Iran, as well as by the growing momentum of climate change and the failure to integrate large countries such as the United States and China in binding countermeasures. At the same time, the unprecedented economic development in China and India seemed to indicate a tectonic shift in the world economy in the direction of Asia, with a possible decline of the US as the major driver of global development, thereby leading to an increased uncertainty about future patterns of development on the global scale. Some analysts now thought that technological superiority in the future belonged to China, India and other Asian countries.⁶⁷

How, then, can we describe the state's role in science and technology in the early 21st century? And how is state initiative legitimated nowadays, when the myths of neutrality and welfare do no longer seem to offer the same basis for argument as before? Let us in the following discuss the major shifts and differences as compared to the 'Golden Age' of the 1950s and 1960s.

Firstly, relating to the emergence of a more neo-liberal climate in global as well as Swedish politics from the 1980s and onwards, there have been increasing doubts about the possibility and desirability of long-term forecasting and planning for technological and industrial development. This is so within the overall societal context⁶⁸ as well as within individual sectors. In several fields a smooth and seemingly predictable development in the boom years has been interrupted and superseded by patterns of change that are difficult to explain and even more difficult to extrapolate into the future. (The sudden stagnation in the growth of energy consumption from around 1970, and strongly irregular variations since then, is an example⁶⁹). The state has responded to this new situation by becoming much more careful in its attempts to 'intervene' in the gales of technological and industrial change. In particular, this has led to a situation where state actors are unwilling to participate directly in technological projects and to provide

support to specific industries or individual firms. This is illustrated both by the vanishing role of the ‘development pairs’ and by the relative unwillingness, as compared to before, to steer the evolution of domestic science towards certain particular fields of societal relevance. At the same time, as shown in the previous section, the relative weight of governmental R&D funding in the overall system has experienced a steady decline. The role of the state has become much more indirect, abstract and fluffy, with an emphasis on creating good ‘conditions’ or a suitable ‘climate’ for the progress of science, technology and innovation in Swedish society. With the good conditions in place, the free market is then expected to do the rest – with a little bit of state help in terms of Vinnova and other state agencies in their roles as fairly diffuse ‘network entrepreneurs’, which try to stimulate the communication and interaction between different actors.

As touched upon in [section 4](#), the difficulties to plan and steer the development are strongly linked to the phenomenon of globalization and internationalization of both production and innovation. Several of the most important Swedish firms from the boom years – and even many former state agencies – have lost much of their Swedishness through transnational mergers and acquisitions, making it much more difficult to retain the earlier tight links between the interests of Swedish industry and the interests of Swedish society. It is a traumatic dilemma for high-level policymakers that what is good for Volvo or Ericsson – or, for that matter, former state agencies such as Telia or Vattenfall – is no longer necessarily good for Sweden.

The roaring globalization of the 1980s and 1990s has also made it impossible to keep the myth of national ‘technological independence’ alive. In reality, seemingly ‘Swedish’ technologies, also in very sensitive areas, have never been much under Swedish control, since a variety of components and knowledge have always been imported. This was so already in the 1950s and 1960s, but this circumstance was at that time hardly discussed politically. From the 1980s, however, the deep Swedish dependency upon a variety of suppliers – of everything from uranium and oil to semiconductors and polymers – became increasingly obvious, and it has grown in importance as a result of the enormously increasing complexity of key technologies. It has thereby become clear to a

growing number of actors and observers that Sweden – whether in the private or the public sector – would hardly be able to produce anything at all if the links with foreign suppliers and other actors would be cut off.

While technology-intensive businesses, as a result, face the challenge of coordinating their growing global innovation networks, state initiative in the new millennium faces tremendous challenges in terms of integrating and coordinating a wide array of political efforts into a coherent whole. This is related both to the increasing complexity of science and technology and to a corresponding increase in societal complexity. Governments nowadays understand that the ways in which innovation can contribute to the fulfilment of various societal goals is dependent upon initiatives in everything from industrial policy, research policy and education policy to tax policy, foreign trade policy, competition policy, environmental policy and a variety of other policy areas. But while the understanding for this is on increase, state actors face an almost hopeless task to integrate these diverse fields into an overall ‘innovation policy’ which is not full of inherent contradictions. The situation is further complicated by the recognized need to complement efforts at the national level with activities at the local and regional levels in order to strengthen the overall system, implying a far-reaching decentralization of state initiative. Universities, for their part, have also had to accept additional layers and levels of activity – notably through the addition of the ‘third task’, i.e. the legally regulated duty of higher education institutions to interact with the surrounding society, especially business – which makes the tasks of universities appear much more fragmented than before.

In general, while state actors become increasingly aware of the new challenges, it remains an open question whether and to what extent the state can actually develop a capability to deal with them in practice. Nutek and its successor Vinnova have themselves repeatedly criticized the weak coordination capacity of the state,⁷⁰ reflecting a dissatisfaction within this agency concerning the gap between understanding the need for change and actually having the capability to translate this understanding into meaningful practical action.

Vinnova itself has experienced a gradually increasing respect and status within the Swedish state administration. But its role has also been questioned by several analysts. For example, historian of science Sven Widmalm argues that Vinnova has become an ‘ideology-producing agency’ that seeks to monopolize a number of crucial policy fields, including research policy, where innovation is only one of several aspects and where Vinnova should therefore play a much less prominent role than it attempts to do. In this interpretation, Vinnova can be seen to fit into what political scientists Johannes Lindvall and Bo Rothstein have identified as an ‘obscure division of labour’ within the country’s policy-making and administrative structures, with a gradual decoupling of state agencies from the central institutions of democracy.⁷¹

Other analysts have questioned whether and to what extent the creation of new agencies, the formulation of new strategies, the launch of new funding mechanisms and so on during the last couple of decades really correspond to any actual fundamental changes in state initiative. In some cases it may be argued that the ‘new’ drive for strengthening the ‘system of innovation’ is mainly about changes in expression and language, i.e. an issue of ‘translation’ without any fundamental transformation. The decline of the old, powerful state initiatives in science and technology would in this sense have vanished without really being replaced by anything that could take its place – despite the loud emphasis in the political debate about the need for state support to science and technology in the ‘globalizing learning economy’. The state would in this sense be ‘lost in translation’.

In this context one may also ask what the actual purpose of state initiative is – and should be – in today’s technological society. With the increasing power of state agencies, arguably at the expense of democratic institutions, there is an obvious risk that state agencies such as Vinnova evolve to become what might be interpreted as self-referencing entities, where success is defined in terms of the agencies’ own survival in the administrative system and their ability to acquire larger resources from the government budget – whereas alternative goals such as supporting a better quality of life or a strong economic development of the country remain in the shadow. The support of Vinnova to

‘innovation studies’, as a research field within the social sciences, has sometimes been interpreted in this way, i.e. as a way to legitimate the agency’s own activities.⁷²

More generally, if science and technology were previously viewed as concrete vehicles in the pursuit of modernization – ‘for welfare and warfare’ – they have now become more abstract variables in economic equations, embedded into stock market fluctuations, venture capital and intellectual property rights. The ‘innovation imperative’ is no longer first and foremost seen in relation to the fulfilment of certain goals in society, but much more a response to the fears of being left behind in the global struggle for economic competitiveness. It has become utterly difficult or even impossible to discern the ‘goal’ of scientific and technological change, and different groups of actors use their interpretative flexibility to define very different development purposes.

To motivate and legitimate state action in this new era, the concept of the ‘knowledge-based society’, the quest for ‘sustainable development’ and the identification of the ‘Swedish paradox’ can be seen to function as important rhetoric tools. The challenge of the knowledge-based society has been used as a way to legitimate the expansion of, in particular, university education and related activities, as well as to carry out reforms in the research system. The quest for ‘sustainable development’ (or ‘ecological modernization’) has been used to legitimate state initiatives that aim to boost economic growth, since economic growth is no longer seen as contradictory to an accelerating technology-based economy; on the contrary, economic growth is seen as a prerequisite for the state’s ability to come to grips with environmental problems. The ‘Swedish paradox’, for its part, has been widely used by Nutek and its successor Vinnova to motivate the need for this agency’s ‘networking’ with the aim to solve problems in terms of the interaction between different parts of the overall innovation system.

The importance of the knowledge-based society and of sustainable development, as well as the need to resolve the ‘Swedish paradox’, are examples of fairly uncontested and widely shared understandings in the context of scientific and technological development in today’s Sweden. As indicated above, these new interpretations have grown

increasingly meaningful and instrumental for state actors when it comes to legitimating Swedish state initiative since around the 1980s, and as such they have arguably replaced the old ‘national myths’ of neutrality and welfare that had their golden days in the 1950s and 1960s. If a new national mythology has been unfolding during the past decades, it might in this sense be one in which Sweden is viewed as a highly successful forerunner of the knowledge-based society, championed especially by its people’s deep devotion to telecommunications and information technologies, while at the same time considering itself as the avant-garde of environmental friendliness, in which the deep national traditions of close relations between human life and nature is seamlessly merged with a self-image of Sweden as a high-tech country with the ability to use modern technologies for good purposes.

¹ Cf. Ulf Sandström, *Framåtskridandets nyckel. Om framväxten av efterkrigstidens svenska teknik- och näringspolitik*, SISTER Working Paper (Stockholm, 2000), 19.

² See e.g. SIFO, *Indikator*, no. 5, 5 September 1968.

³ Mats Benner, *The Politics of Growth: Economic Regulation in Sweden, 1930-1994* (Lund, 1997), 109; Hans Weinberger, *Nätverkstreprenören. En historia om teknisk forskning och industriellt utvecklingsarbete från den Malmska utredningen till Styrelsen för teknisk utveckling* (Stockholm, 1997), 357.

⁴ Weinberger, 361.

⁵ *Ibid.*, 363.

⁶ *Ibid.*, 364.

⁷ E.g. Kenneth Arrow, ‘Economic welfare and the allocation of resources for invention’, in: Universities-National Bureau Committee for Economic Research, *The Rate and Direction of Inventive Activity* (Cambridge, MA, 1962), 609-626.

⁸ Prop. 1967:56, 30.

⁹ *Ibid.*

¹⁰ See e.g. Bo Carlsson, Johan Örtengren, Petra Lantz, Tomas Pousette and Fredrik Bergholm, *Industrin inför 80-talet* (Stockholm, 1981), 31. The profits in the ‘crisis industries’ fell from above 10% throughout the 1950s to no more than 1% in 1967.

¹¹ Weinberger, 358.

¹² Cf. Weinberger, 374.

¹³ Prop. 1968:164 and 165.

¹⁴ Benner, *Politics of Growth*, 114.

¹⁵ Prop 1968:165, 6.

¹⁶ Prop. 1968:68.

¹⁷ Weinberger, 359f.

¹⁸ Prop. 1968:68, 73.

¹⁹ Prop 1968:68, 28; cf. Weinberger.

²⁰ Weinberger, 381ff.

²¹ Sverker Sörlin and Johan Gribbe, *En ny institutssektor. En analys av industriforskningsinstitutens villkor och framtid ur ett närings- och innovationspolitiskt perspektiv* (Stockholm, 2006), 27f.

²² Benner, *Politics of Growth*, 113

²³ Prop 1968: 68, 58. As concrete examples were brought up medical technologies, educational technologies, environmental technologies, production, distribution and use of energy, development of

transport and communication systems, enhancing of traffic security, development of administrative systems and appliances.

²⁴ Prop 1969:56, 4.

²⁵ Tobias Harding, 'Universitet som frihet eller fostringsanstalt', *Svenska Dagbladet*, 19 April 2006.

²⁶ See e.g. Enrico Deiaco, Eric Giertz and Göran Reitberger, *Teknikparkens roll i det svenska innovationssystemet – historien om kommersialisering av forskningsresultat*, VINNOVA Forum, Innovationspolitik i fokus, VFI 2002:3 (Stockholm, 2002), 43-50.

²⁷ Benner, *Politics of Growth*, 114.

²⁸ *Ibid.*, 115.

²⁹ See Bertil Agdur, 'Utan möjligheter att arbeta på de större problemen', *Dagens Nyheter*, 26 April 1974, quoted in Weinberger, 406f.

³⁰ Mats Fridlund, *Den gemensamma utvecklingen. Staten, storföretaget och samarbetet kring den svenska elkrafttekniken* (Stockholm, 1999), 212f.

³¹ See Mats Fridlund, 'Innovatörernas reträtt', in: Per Högselius and Arne Kaijser, *När folkhemselen blev internationell. Elavregleringen i historiskt perspektiv* (Stockholm, 2007).

³² C. Edquist, P. Hammarqvist and L. Hommen, 'Public technology Procurement in Sweden: The X2000 High speed train', in: C. Edquist, L. Hommen and L. Tsipouri (eds.), *Public Technology Procurement and Innovation* (Boston, 2000).

³³ Benner, *Politics of Growth*, 119f.

³⁴ Catharina Gråbacke and Jan Jörnmark, 'The State and the Swedish Building Industry: the Making of the Million Housing Programme', this volume.

³⁵ See e.g. Mats Fridlund, 'Switching Relations and Trajectories: the Development Procurement of the AXE Swedish Switching Technology', in: C. Edquist, L. Hommen and L. Tsipouri (eds.), *Public Technology Procurement and Innovation* (Boston, 2000).

³⁶ Lennart Schön, *En modern svensk ekonomisk historia* (Stockholm, 2000), 501.

³⁷ *Ibid.*

³⁸ See e.g. Schön, 492f.

³⁹ *Ibid.*

⁴⁰ Ulrich Beck, *Risikogesellschaft: Auf dem Weg in eine andere Moderne* (Frankfurt am Main, 1986).

⁴¹ Georg Henrik von Wright, *The Myth of Progress*, Lecture held at the 4th International Alvar Aalto Symposium, Jyväskylä, August 1988.

⁴² Cf. Wilhelm Agrell, 'Från nationell teknikförsörjning till försvarsindustri i kris', in Wilhelm Agrell (ed.), *Makten över forskningspolitiken: Särintressen, nationell styrning och internationalisering* (Lund, 1990).

⁴³ Per Högselius and Arne Kaijser, *När folkhemselen blev internationell. Elavregleringen i historiskt perspektiv* (Stockholm, 2007), 78f.

⁴⁴ *Ibid.*

⁴⁵ Schön, 515.

⁴⁶ See e.g. the government official report SOU 1980:23, *Statligt kunnande till salu*, where these ideas were thoroughly discussed. The report was worked out by a commission headed by the economist Bengt Dennis, who soon thereafter advanced to become President of the Bank of Sweden.

⁴⁷ Cf. Marcus Zackrisson, *Financial Systems and the Financing of High-Technology Small Firms: The Cases of Sweden, Linköping and Santa Clara County* (Linköping, 2003).

⁴⁸ E.g. Chris Freeman, 'Continental, national and sub-national innovation systems – complementarity and economic growth', *Research Policy*, vol. 31, 2002, 191-211.

⁴⁹ Per Högselius, *The Dynamics of Innovation in Eastern Europe: Lessons from Estonia* (Cheltenham, UK and Northampton, MA, USA, 2005); Per Högselius, 'The Dynamics of Innovation in Post-Socialist Countries: Challenges and Opportunities', in Bruno Sergi et al. (eds.), *Industries and Markets in Central and Eastern Europe* (London, 2006).

⁵⁰ Chris Freeman, *Technology Policy and Economic Performance: Lessons from Japan* (London, 1987); Bengt-Åke Lundvall (ed.), *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning* (London, 1992); Richard Nelson (ed.), *National Innovation Systems: A Comparative Study* (New York, 1993).

⁵¹ See e.g. Magnus Eklund, *Adoption of the Innovation System Concept in Sweden* (Uppsala, 2007), 57ff.

⁵² Elaborations on modern models of the innovative process formed an important part in SOU 1977:64, a public survey that was to come up with a suitable organizational form for STU and propose relevant forms

of activity for the agency. The STU-committee was headed by Lennart Holm, general director of the State Planning Agency.

⁵³ Weinberger, 441.

⁵⁴ Ds I 1987:3, *Utvecklingsblock i förnyelse av svensk industri*, cited in Weinberger, 437.

⁵⁵ Weinberger, 469

⁵⁶ Eklund, 60.

⁵⁷ Weinberger, 490.

⁵⁸ Benner, *Kontrovers och consensus: Vetenskap och politik i svenskt 1990-tal* (Stockholm/Nora, 2001), 67, 86.

⁵⁹ See e.g. *Statistical Yearbook of Sweden 2005*, p. 564. The nominal number of new students increased in a discontinuous way after the higher education reform of 1977, which redefined the concept of 'higher education' to include also a variety of professional education and vocational training.

⁶⁰ Calculated from data in *Statistical Yearbook of Sweden* (selected years).

⁶¹ E.g. Benner, *Kontrovers och consensus*, 60f.; cf. Michael Gibbons et al., *The New Production of Knowledge: The dynamics of science and research in contemporary societies* (London, 1994).

⁶² Weinberger, 496ff.

⁶³ Sven Widmalm, 'Innovationssamhället', in: Mats Benner and Sverker Sörlin (eds.), *Kunskap – Sveriges framtid?* (Stockholm, forthcoming); cf. Charles Edquist and Maureen McKelvey, 'High R&D intensity without high tech products: A Swedish paradox?', in: Klaus Nielsen and Björn Johnson, *Institutions and Economic Change: New Perspectives on Markets, Firms and Technology* (Cheltenham, 1998), 131-149.

⁶⁴ Donella H. Meadows et al., *The Limits to Growth: A Report for the Club of Rome's Project on the Predicament of Mankind* (London, 1972).

⁶⁵ See e.g. Jonas Anshelm, *Mellan frälsning och domedag. Om kärnkraftens politiska idéhistoria i Sverige 1945-1999* (Stockholm/Stehag, 2000).

⁶⁶ C. Edquist, L. Hommen and L. Tsipouri (eds.), *Public Technology Procurement and Innovation* (Boston, 2000).

⁶⁷ E.g. Jon Sigurdson, *Technological Superpower China* (Cheltenham, 2006).

⁶⁸ Cf. Johannes Lindvall, 'Den starka statens ekonomiska politik', in: Bo Rothstein and Lotta Vahlne Westerhäll (eds.), *Bortom den starka statens politik?* (Stockholm, 2005).

⁶⁹ See e.g. Högselius and Kaijser, 51.

⁷⁰ E.g. *VINNOVAs forskningsstrategi. Strategi för hållbar tillväxt* (VINNOVA Policy, VP 2003:3).

⁷¹ Johannes Lindvall and Bo Rothstein, 'Sweden: The Fall of the Strong State', *Scandinavian Political Studies*, vol. 29, 2006, 47-63.

⁷² Widmalm.