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THE SPECIFICITIES OF FINNISH INDUSTRIAL POLICY – CHALLENGES AND INITIATIVES AT THE TURN OF THE CENTURY*

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ABSTRACT: The Finnish experience in the 1990s represents one of the few examples of how knowledge can become the driving force in economic growth and transformation. The country's industrial structure that was previously raw material-, energy-, and capital-intensive changed in less than a decade to primarily a knowledge-intensive on. During the first year of the 21st century Finland has topped the list in various competitiveness rankings and is also number one in OECD's PISA studies of youth's learning skills and educational attainment. The aim of this paper is to discuss the nature and role that industry policy has played in these developments, with an explicit focus on the specificities and recent shifts in policy thinking and implementation in Finland. We discuss the emergence of new industrial policies in Finland in the early 1990s, the main policy initiatives and measures, present the organisational landscape of these new policies, and conclude with a partial assessment of the success of policies and future challenges.

KEYWORDS: Finland, industrial policy, innovation systems, clusters, globalization

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TIIVISTELMÄ: Suomen talouden kehitys 1990-luvulla osoittaa, että tieto ja osaaminen voivat olla todella merkittäviä tekijöitä talouden kasvussa ja rakennemuutoksessa. Raaka-aine-, energia- ja pääomaintensiivinen talous muuttui vuosikymmenessä suurelta osin osaamisvetoiseksi. Suomi on sijoittunut kansainvälisten kilpailukykyvertailujen kärkeen ja menestynyt hyvin myös esimerkiksi OECD:n koulusaavutuksia mittaavassa PISA-tutkimuksessa. Raportti tarkastelee elinkeinopolitiikan roolia talouden ja teollisuuden rakennemuutoksessa, sen erityispiirteitä suhteessa muihin kehittyneisiin maihin sekä viimeaikaista ja näkyvissä olevaa muutosta politiikka-ajattelussa. Raportissa kuvataan elinkeinopolitiikan tavoitteissa, keinoissa ja organisaatioissa tapahtuneita muutoksia 1990-luvulla sekä arvioidaan lopuksi politiikan menestyksellisyyttä. Elinkeinopolitiikan painopisteen muutos, jossa innovaatio- ja teknologiapolitiikka sekä kansallinen innovaatiojärjestelmä nostetaan tärkeimmälle sijalle, on vaikuttanut Suomen talouden menestymiseen.

AVAINSANAT: Suomi, elinkeinopolitiikka, innovaatiojärjestelmä, klusterit, globalisaatio

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1 Introduction

1.1 Background

The Finnish experience in the 1990s represents one of the few examples of how knowledge can become the driving force in economic growth and transformation. The country's industrial structure that was previously raw material-, energy-, capital and scale-intensive changed in a less than a decade to primarily knowledge-intensive.

During the first years of the 21st century Finland has been ranked three times on the top in World Economic Forum's (WEF) competitiveness studies, as one of the most developed IT economies, and also number one in OECD's PISA (Program for international Student Assessment) studies of youth's learning skills and educational attainment [1]. In addition, the country was able to produce success stories like Linux and Nokia who grew into global scale in during the 1990s. In the beginning of the 1990s, Finland's prospects seemed much gloomier, however. The country was hit by the most severe economic downturn in any OECD country since the World War II. GDP fell by 10 % in just three years and unemployment rose from 3 to 17 %. But the recovery was fast and based on major industrial restructurings. The most important factor was the phenomenal growth of ICT (information and communication technologies) production. But also some of the more traditional industries – like pulp and paper and engineering – renewed through rapid globalization and more intensive use of ICT.

The economy went through a both *between-industries* and *within-industries* structural change. In between-industry transformation the immense growth of electronics – i.e. telecommunications equipment industry – was the key. Within-industry change was that of a creative destruction – almost in all industrial sectors a large part of low productivity plants was closed down.[2] As a consequence, by the end of the 1990s the productivity level of manufacturing was among the highest in the world, and the ICT sector played a major role in the economy. Finland went from being one of the least information and communication technology (ICT) specialized countries to becoming the single most specialized one. This is exceptional. In ICT laggards rarely catch up, let alone leapfrog, the leaders.

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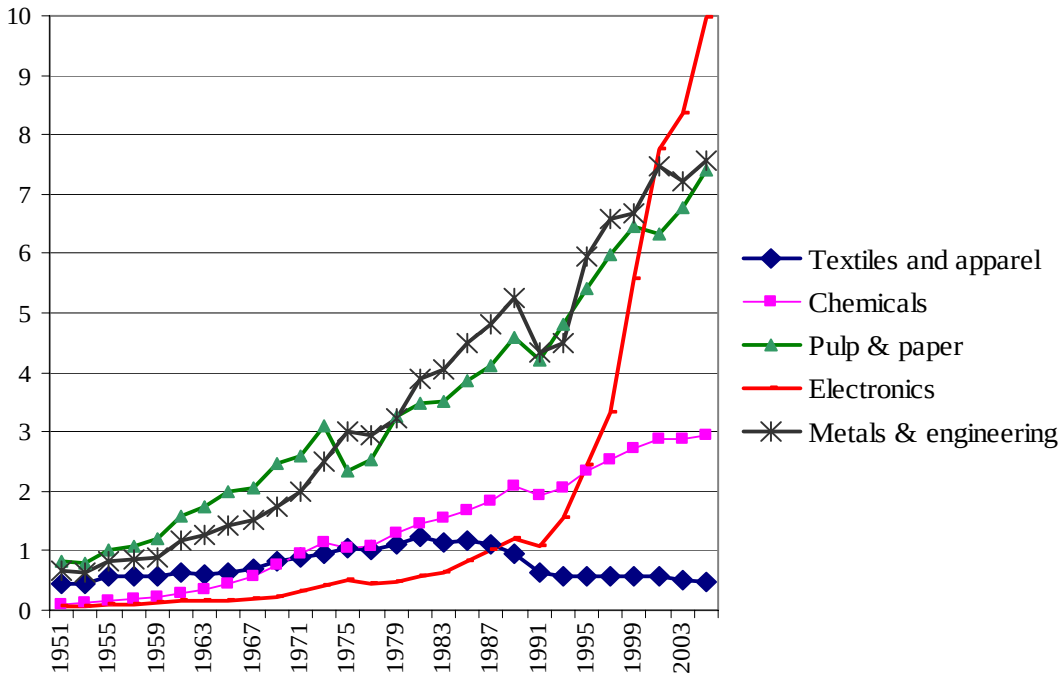
1 PISA index measures educational attainment among 15 year old students

2 See Rouvinen and Ylä-Anttila (2004)

Figure1. Finnish manufacturing production volume by industries (billions of euros in 2000 prices)

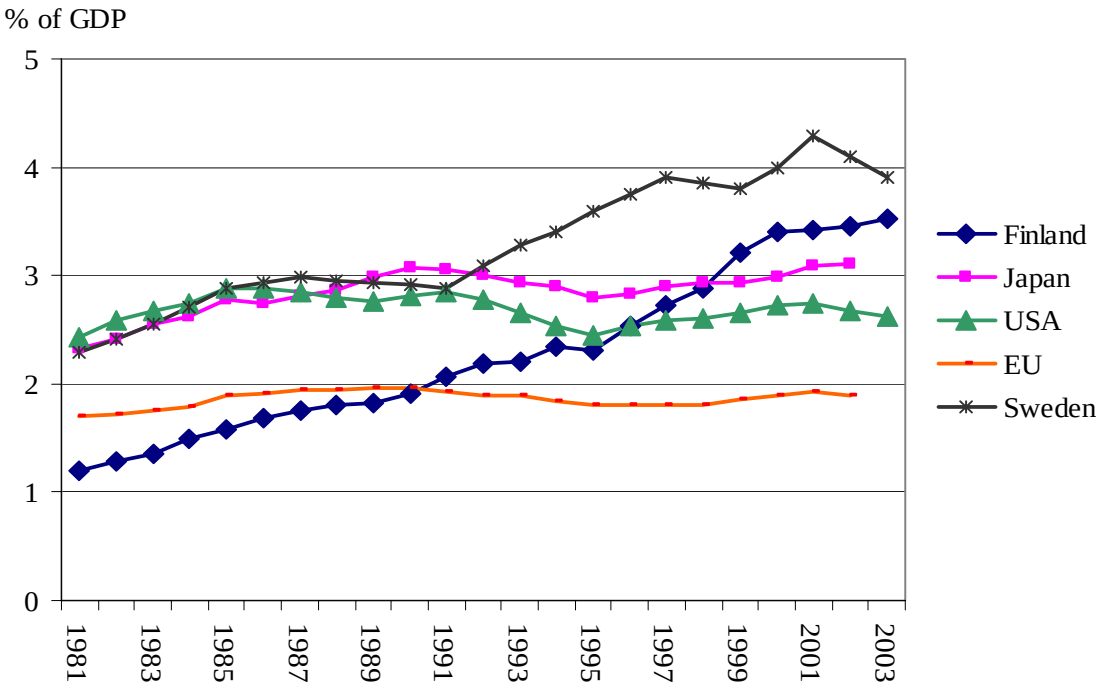


Source: Statistics Finland

Finland's remarkable recovery from the recession and stellar performance are in considerable part attributable to ICT production and manufacturing as a whole. Policies had their role, as discussed below, but it was private enterprises, Nokia and others, who did most of it. Although it might look like it, there was no master plan that fostered the profound structural change and expansion of the ICT sector.

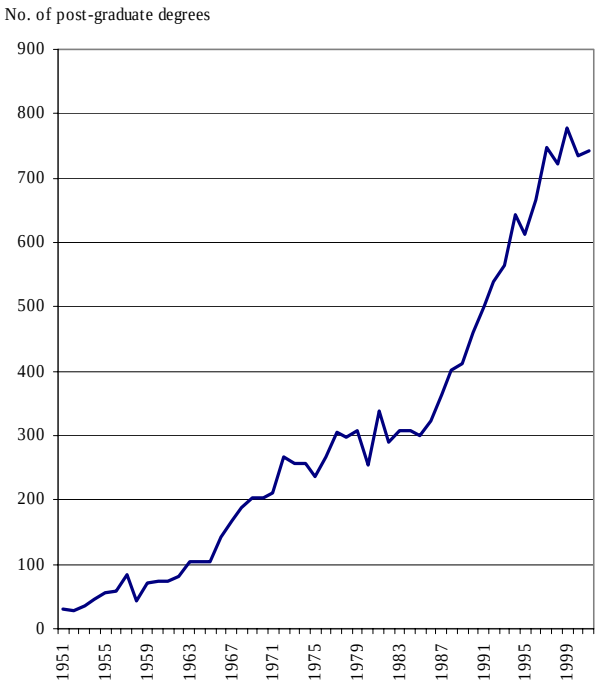
To put it briefly, industry policy thinking in Finland has gone through substantial changes during the last couple of decades: from separate science and technology policy to integrating them, from macro-oriented structural policies towards long-term micro policies, from selective and target oriented to conditions providing policies, and, finally, since the 1990s towards systemic view in policy making by putting education, R&D and innovation in the centre of industry policies, and taking the concepts of national innovation system and industrial cluster as basic policy frameworks. Figures 2 and 3 highlight the changes quantitatively.

Figure 2. R&D expenditure in selected countries

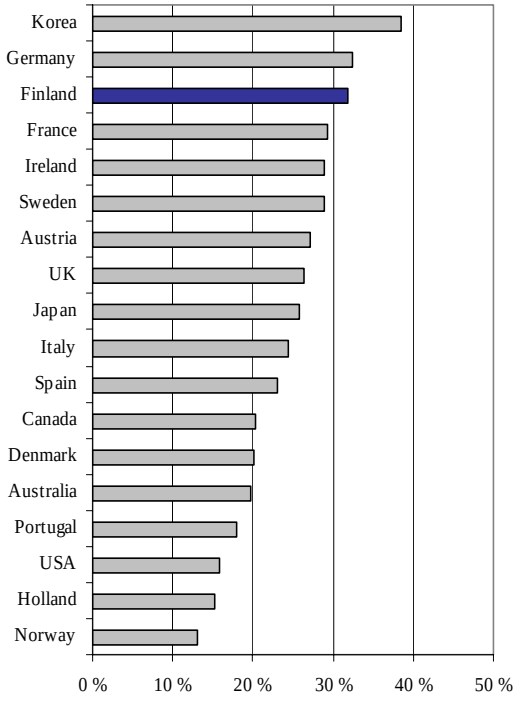


Source: OECD Main Science and Technology Indicators

Figure 3. Higher-level education in science and engineering



Source: Vartia and Ylä-Anttila (2003)



1.2 Aim and scope of paper

In light of the profound structural transformation and outstanding industrial performance the aim of this paper is to discuss the role of industry policies in the developments especially in the recent period. We look at in greater detail the factors that caused the changes in policy priorities and assess the consequences. Acknowledging the difficulties of international policy comparisons we seek to identify the specific features of industry policy making in Finland.

In accordance with the changes in Finnish policy thinking, we take a broad view on industrial policies. Industrial policies are here defined as conditions providing policies, i.e. comprising of measures for influencing the quality of the business environment of enterprises. Industrial policies in Finland have in recent years assumed a proactive role rather than reacting to problems induced by changes in the international economic environment.[3]

The changes in policy priorities are well in line with the widely acknowledged view that national competitive advantage today is created to a larger extent by decisions made at micro level – in firms, financial institutions, and various innovation policy agencies. Hence, enhancing competence building, technological change and innovation are in the core of today's industry policy. We argue that the determined and rapid incorporation of this new industrial policy can be taken as the prime example of the specificity of industrial policymaking in Finland. Accordingly, we focus on this aspect while leaving aside others which are less specific to Finnish industrial policy (such as competition and energy policies, public enterprises and procurement etc.).

The paper is organized as follows. In section 2 we take a closer look at the 1990s and the new industrial policy approach in Finland. In section 3 we move to specificities of Finnish industrial policies in more detail. Section 4 concludes by attempting to assess the successfulness of policies from today's perspective, and in light of future challenges.

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[3] See the most recent policy document by the Ministry of Trade and Industry (MTI Publications 9/2001), which defines industry policy as "business environment policy". That is further defined as "…*composed of a wide variety of measures for influencing the quality of the business environment of enterprises"*. See also Georghiou, Smith, Toivanen and Ylä-Anttila (2003) that includes an evaluation and short overview of shifts in policy thinking.

2 The establishment of new industrial policies in Finland

2.1 Structural pressures and industrial policy responses

The institutionalization of industrial policy in Finland dates back to the 1970s even though the government played an important role already much earlier e.g. through state-owned companies, trade, monetary, and exchange rate policies. During the first decades of Finnish industrial policy in the 1970s and 1980s the emphasis was on macro-economic measures to secure growth and employment as the ultimate goals. These measures were compatible with the regulated nature of Finnish markets and typically covered subsidies to ailing industries, infant-industry protection, and frequent devaluations to boost export industries – wood, pulp and paper in particular. The shift towards new industrial policies in the early 1990s can be interpreted as a response to structural pressures that characterized the Finnish economy at the time. The main feature of this new industrial policy was a stronger emphasis on longer-term microeconomic policies, combined with the strong integration of technology and industrial policies.

BOX 1: The severity of the economic recession in the early 1990s

The structural pressures that Finland experienced in the early 1990s have their origin in vulnerabilities created in the previous decade. Despite exceptionally robust economic growth throughout the 1980s, the Finnish economy was largely dependent on the forestry-related industries which had been favoured through devaluations, and capital and export credit provisions. The robust economic growth of the 1980s had also coincided with a deregulation of financial markets. By the early 1990s, it became evident that this deregulation had been poorly timed and too rapid, as evidenced by excessive foreign debt and subsequent crises in the banking sector. The emerging crises compounded further due to the collapse of trade with the Soviet Union. As a result a decade of robust growth and relatively successful, but short-sighted, macroeconomic policies had now turned into a period of exceptionally severe economic recession with a decline of GDP of 10 percent during 1991-93, and a drastic rise of the unemployment rate from 3 % to 17 % during the same period.

The industrial policy discussion of the early 1990s was largely flavored by the prospects of a severe economic recession and the one-sidedness of the Finnish industrial structure, even though engineering, electronics and ICT had become increasingly important fields. Further, negotiations for EU-membership were now underway and had been endorsed by large parts of society. In these conditions, the limitations of shorter-term macro-oriented industrial policies became evident, especially since these would be constrained by common EU regulations governing monetary and trade policies that had constituted important policy elements in the past. Policymakers were now forced to shift focus and elaborate on new policy models and practices.[4]

[4] See Jääskeläinen (2001). There was a shift in policy thinking towards microeconomic policies which emphasised factors affecting longer term economic growth – as opposed to short term macro policies with the aim of

The traditional subsidizing policy, i.e. supporting ailing industries or "backing the losers", is only of marginal importance in the current policy making in Finland. "Picking the winners" type of polices, alike, turned out to be more than difficult when technological advance accelerated and globalization started to change the international market place in the early 1990s. Consequently, the emphasis in industry policy moved to improving overall operating conditions of business enterprises, i.e. to enabling policies instead of interventionist. Locational competition took an important part in industrial policies. Due to increasing international mobility of production factors the basic policy aim was to make the country an attractive location for internationally competitive firms.[5]

2.2 Innovation systems and industrial clusters the basis for industrial policy

A specificity of the Finnish 'model' has been the early application of a systems view on industrial policy. This systems view on industrial policy could be described as an acknowledgement of the importance of interdependencies between research organizations, universities, firms and industries due to the increasing importance of knowledge as a competitive asset, especially in the case of small open economies with a well developed welfare system.

However, it is important to stress that a systems view on industrial policy has not implied that Finland has followed a 'master plan' in which the government would have played a strong leading role. Rather, the systems view was concretized through an emphasis on responsive longer-term policies to improve the general framework conditions for firms and industries, especially in terms of knowledge development and diffusion, innovation and clustering of industrial activities. It was formulated through various public-private partnerships involving economic research organizations, industry federations, and firms, and anchored in broader economic policy circles.[6]

The first definition of the systems view on industrial policy is found in the 1990 Review of the Science and Technology Policy Council, which made the concept of a national innovation system an important cornerstone for science and technology policy. The concept of a national innovation system originates from evolutionary economics. Its application in Finland thereby marked an introduction of new theoretical approach to policy practices which

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improving cost competitiveness of the economy. Hence, R&D, education, and technological infrastructure got more attention in policy practices. New policies also recognized that national competitive edge is, after all, created at firm level. The role of policies is to provide a favourable business environment for internationally competitive firms.

5 See Ministry of Trade and Industry (1993), and Hernesniemi, Lammi, and Ylä-Anttila (1996)

6 See Jääskeläinen (2001)

largely found their relevance in mainstream economic notions. However, the more significant and concrete consequence of this new systems view on industrial policy was the high priority given to R&D investments.[7] In hindsight, this prioritizing appears as a bold one given the severe economic recession that Finland was enduring at the time. It also exemplifies, again, the strong integration between technology and industrial policy.

In spite of relying on ideas from evolutionary economics, the conventional market failure argument has remained the main justification of industry and innovation policies. The argument has been widely adopted in the Finnish policy documents and statements. It is, however, not always clear to what extent market failure has served practical policy design and implementation. Most often policy makers refer to financial market imperfections, and less frequently to technological spillovers or externalities in general.

Availability of capital has, however, become a less severe problem since the early 1990s as a consequence of a rapid capital market development. The remaining shortcomings in finance relate to very early stage funding and still relatively undeveloped private venture capital industry.[8] Hence, the issue of technological spillovers is now increasingly becoming an outspoken guide for industry policy intervention. That is in line with central role given to innovation policy in overall industry policies. However, this externality-based policy justification, too, is more intuitive than based on studies and exact knowledge of the magnitudes and significance of external economies.[9]

BOX 2: The Science and Technology Policy Council of Finland

The Science and Technology Policy Council is a high-level council chaired by the Prime Minister. The main task of the Council is to draw general guidelines for the design of Finnish S&T policy. However, the more detailed implementation is delegated to the Ministry of Trade and Industry (MTI), and further down to the National Technology Agency (Tekes) and the Academy of Finland. This decentralization of S&T policy formulation is a specificity of Finland. In addition, the membership of the council consists of the Minister of Education and Science, the Minister of Trade and Industry, the Minister of Finance, and a couple of other ministers. In addition to them the membership includes ten other members well versed in science and technology. The members must include representatives of the Academy of Finland, the National Technology Research Centre of Finland (VTT), universities and industry as well as employers' and employees' organisations. The Council of State appoints the members for a three-year term. The Science and Technology Policy Council was established in March 1987. Below follows a list of the triennial policy statements of the council:

- 1987: Science and Technology Policy Review 1987
- 1990: Guidelines for Science and Technology in the 1990s
- 1993: Towards an Innovative Society: A Development Strategy for Finland
- 1996: Finland: A Knowledge-based Society
- 2000: Review 2000: The Challenge of Knowledge and Know-How
- 2003: Knowledge, innovation and internationalization

[7] See Lemola (2003)
[8] See Hyytinen and Pajarinen (2003)
[9] See Georghiou, Smith, Toivanen and Ylä-Anttila (2003)

Although the Science and Technology Policy Council – alongside the Economic Council – has had an important role in formulating broader guidelines the more detailed content of new industrial policy is defined by the Ministry of Trade and Industry (MTI). An important white papers in this context was the "National Industry Strategy for Finland", published in 1993. This white paper was significant since it redefined industrial policy along the lines of 'industrial clusters' as introduced by Michel Porter.[10] The Porterian framework found widespread appeal in Finnish economic policy circles for various reasons. Despite the heterodox theoretical foundation of cluster thinking it was broadly compatible with new growth theory in emphasizing the importance of human capital and knowledge spillovers. It is a broad framework which emphasizes the creation of advanced production factors, well in line with the national innovation system (NIS). As a matter of fact, the early adoption of the concept NIS as a basic framework of S&T policy facilitated the rapid diffusion of clusters and cluster analysis in industry policy.[11] Third, and as a corollary to the first and second, public expenditures on R&D, education and technological infrastructures are considered the most important channels for industrial policy.

This white paper drew on ongoing research on industrial clusters in Finland, undertaken by the Research Institute of the Finnish Economy (ETLA) and various other national economic research organizations.[12] It included guidelines for improving the framework conditions for business firms by increasing public R&D funding, communication infrastructures and the education system. The white paper also included a short review of existing and future competitive industrial clusters in the Finnish economy to identify areas of importance for the allocation of R&D funding and the design of other industrial policy measures. The ICT and health-care clusters were identified as potentially strongly expanding clusters, while forestry-related clusters were identified as relatively stable ones. Other significant industrial clusters in Finland included the basic metals, construction, energy and transport –clusters.

It is noteworthy that the new industrial policy acknowledged the potentials of ICT, even though the breakthrough of Nokia and other Finnish ICT firms occurred some years later in the mid 1990s. In the triennial review of the Science and Technology Policy Council from 1996 the recognition of the potentials of ICT was made more explicit through references to

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10 See Porter (1990)

11 In the 1990 Review – earlier than in any other country – the Science and Technology Policy Council introduced NIS as a basic framework of science and technology policy. Cf. Romanainen (2002), Jääskeläinen (2001), and Miettinen (2002).

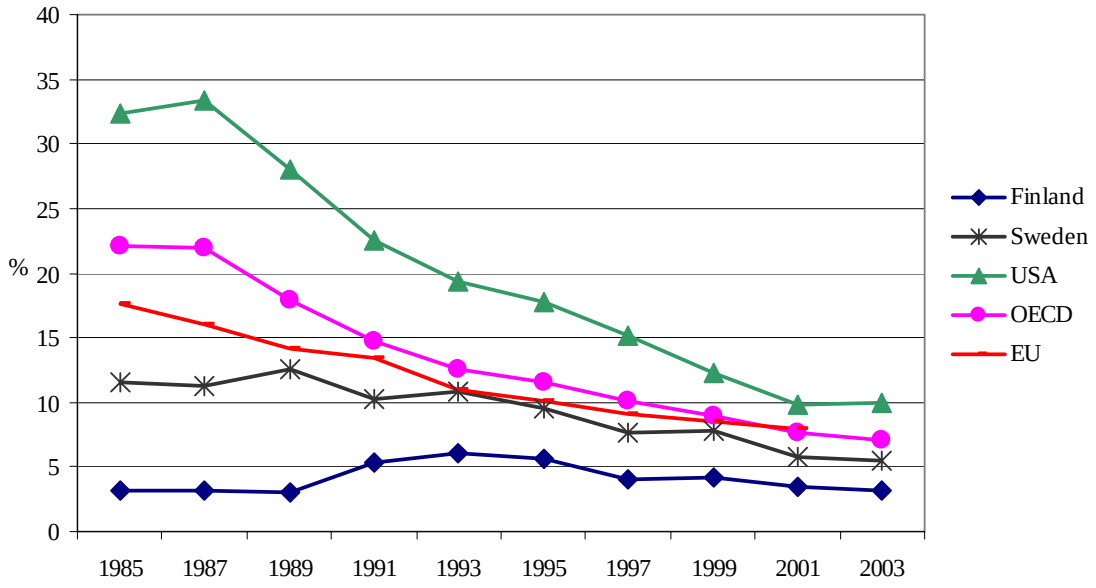
12 See Hernesniemi, Lammi, Ylä-Anttila (1996)

knowledge-economy concepts. The review drew on ideas presented in the so-called OECD Jobs Study, which underlined that macroeconomic policies alone would not ensure adequate preconditions for knowledge-intensive growth.[13] The unusually rapid development of the ICT-related industries in Finland – not least due to the breakthrough of Nokia – strengthened further the dedication given to R&D funding in a knowledge economy context. Further, the OECD Jobs Study also discussed the favorable linkages between knowledge-intensive growth and employment. This was considered as an especially important issue in Finland where economic recovery from the severe recession had not yet boosted employment (the unemployment rate in the mid 1990s was around 15 percent).

2.3 The organisational landscape of industrial policy in Finland

The increasing emphasis on R&D funding also implied that complementary R&D funding to firms from public sources increased in absolute terms throughout the 1990s, even though the share of public funding of the total R&D expenditures of firms in Finland has remained significantly lower than the OECD average (Figure 4 below). The absolute increase in public R&D expenditures throughout the 1990s is illustrative of the shift from macroeconomic to

Figure 4. Share of public funding in corporate sector R&D



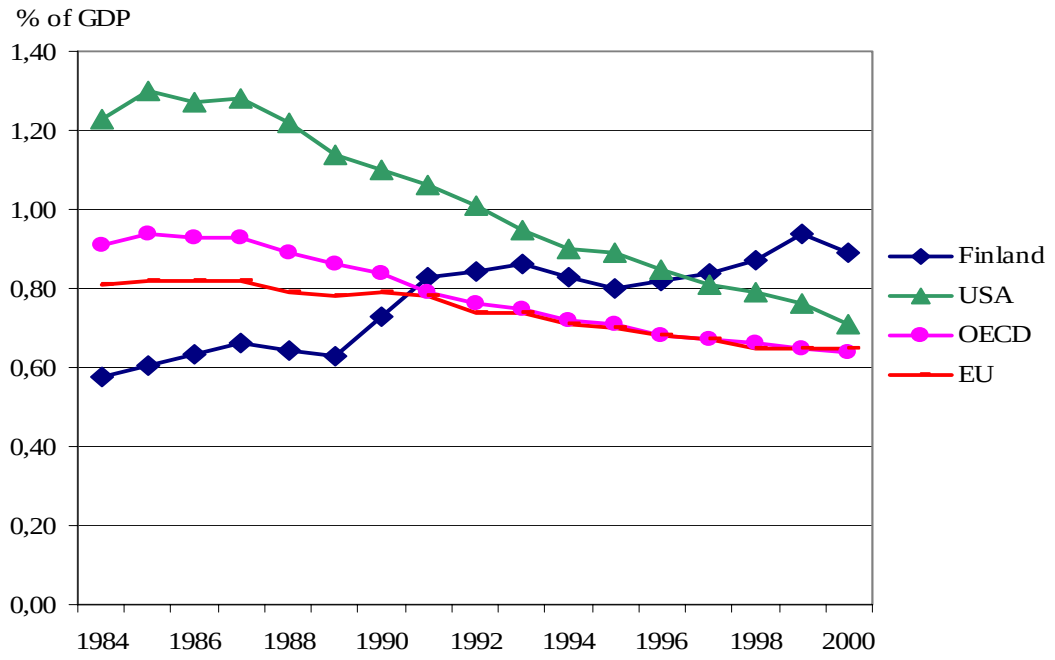
Source: OECD Main Science and Technology Indicators

[13] See Lemola (2003)

microeconomic industrial policies of a longer-term nature. It also complemented the increasing R&D expenditures in industry, and on par with the rapid emergence of ICT to become the third pillar of the Finnish economy by the late 1990s. [14]

The organizational landscape of industrial policy in Finland has remained relatively intact since the 1990s (see the appendix for the key public organizations in new industry policy formulation and implementation). The most noteworthy change is that the role of the National Technology Agency (Tekes) has grown in importance along with the increase in public R&D expenditures. Tekes is directly subordinated to the Ministry of Trade and Industry, but enjoys relative autonomy in setting up technology programs and in commissioning the R&D funds that it receives from the state budget. The role of Tekes became particularly pronounced following the 1996 governmental decision to increase public R&D expenditures by a total of 250 million euros for the years 1997-1999. This implied an increase of about 25 percent in the state's annual R&D budget from the 1997 level, with the outspoken aim to thereby raise the GDP-share of R&D expenditures in Finland to 2.9 percent. These developments in the 1990s are also visible as a significant increase in intramural governmental R&D spending in figure 5 below, also by international comparison.

Figure 5. Government-financed expenditure on R&D (GERD)



[14] As shown by recent studies, increasing public R&D funding has not crowded out private R&D. On the contrary, it has had a clear complementary effect. See Ali-Yrkkö (2004) for a micro-level econometric analysis.

As Figure 5 shows, the government – and Science and Technology Policy Council as a policy designer – kept their commitment to increase R&D funding also in the period of economic crisis of the early nineties, although practically all other public expenditure were cut. This increase foremost benefited the activities of Tekes, although the Academy of Finland also received additional funding for basic research at the universities. Other important industrial policy organizations in Finland include Finnvera, Finnish Industry Investment, regional TE-centers, and Finpro which provides business support services for internationalization. The Finnish National Fund for Research and Development (Sitra) has also been an important pub-

BOX 3. Major industrial policy actors in Finland

Finnvera is a State-owned specialized financing company administered by the Ministry of Trade and Industry. It is also Finland's official Export Credit Agency and acts as an intermediary between the European Union's financing programs and Finnish SMEs. It focuses on the promotion and development of SME operations as well as firm internationalisation and export operations, by offering financing services. Finnvera's business financing includes loans, guarantees and export credit guarantees.

Tekes is the main financing organization for R&D in Finland, established in 1983. Tekes provides funding and expert services for R&D projects at companies registered in Finland and at Finnish research institutes and universities, and promotes national and international networking. Tekes' services are also available via the network of the TE-Centres. In addition to funding, Tekes provides various expert services and organizes technology programs in selected strategic areas.

Finnish Industry Investment (FII) is a State-owned equity investment company administered by the MTI. Its task is to improve the conditions particularly for SME operations by investing equity into venture capital funds. FII can also make equity investments directly into target companies particularly in business ventures requiring long-term risk taking. Regional funds target companies in various growth stages in the fund's regions. FII also engages in direct investment together with other investors and financial institutions.

TE-Centers are public offices under ministerial supervision, consisting of a network of 15 regional offices with business departments, whose task is to serve the needs of SMEs by providing business support services, consultation and advice, as well as finance. In addition, they serve as a regional network for the other organizations and channel their services to the regions. Close to half of the aid comes from EU Structural Funds and is directed to the EU objective areas.

The Foundation of Finnish Inventions supports and promotes the development and exploitation of inventions. FFI's services and funding provide a chain of support for individuals and micro enterprises throughout the invention process up to commercialisation. Free information on the development of inventions, patenting, and commercialisation is offered through FFI's invention agents, and also through various invention fairs and events where FFI provides general advice. FFI can also help establish links with businesses locally and abroad, as well as provide legal and contractual assistance.

Finpro is an expert service organization, partly financed from public funds, providing business support services for internationalization, namely market information and advice, business development, consulting and marketing services, and organizing innovation programs. Firms can purchase services for their international marketing needs from the recently incorporated Finpro Marketing Ltd, which functions as a private corporation and does not receive government support.

The Finnish National Fund for Research and Development, *Sitra*, is an independent public foundation under the supervision of the Finnish Parliament. Sitra's tasks include providing research information on Finnish society for the basis of decision-making, organizing innovative operations to create new cooperative networks and training for decision-makers, media representatives and professionals, as well as providing corporate funding for the technology companies in the their early stages of existence

The Academy of Finland is an expert organisation in research funding and science policy. Its object is to promote high-level scientific research through long-term quality-based research funding, science and science policy expertise and efforts to strengthen the position of science and scientific research. Operation covers all scientific disciplines, and it subordinated the Ministry of Education.

lic actor during the development of the venture capital industry in the early 1990s. These major industrial policy actors are introduced in BOX 3 above.

This substantial increase in public R&D expenditures has volume-wise been the single biggest industrial policy initiative during the ongoing era of new industrial policies in Finland. Nonetheless, the changing content of policy should also be stressed. The clearest example of the new systems view on industrial policy put into practice was the initiation in 1997 of the so-called cluster program. The cluster program was jointly commissioned by the five main ministries (Ministry of Trade and Industry, Ministry of Education, Ministry of Transport and Communication, Ministry of Agriculture, and the Ministry of Labor) with the main aim to enhance the international competitiveness of firms within the industrial clusters identified in Finland. This aim was to be realized through promoting networks between public and private sector actors (firms). The program was running between1997-99, although some activities are still ongoing. Altogether it accumulated costs of some 100 million EURO, making it an important policy initiative of the 1990s.[15]

The cluster program is also evidence of a more significant shift towards the increasing regional emphasis of industrial policies. This shift stemmed from a new industrial policy rationale, which called for the creation of critical mass on the regional level to thereby enhance the competitiveness of Finland as a whole. The consequence of this shift is increasing emphasis on active regional initiatives, whereby the relevant authorities were promoted to support the development of competence centers and clusters based on the unique competitive strengths of the respective regions. This is compatible with the philosophy of the EU's Lisbon strategy for enhancing the competitiveness of the EU in global markets, and marks a partial change in previous policy in Finland which primarily defined industrial policy at the national level. Finnish EU membership in 1995 also provided access to the Structural Funds, whereby the regions had strong incentives to formulate industry policy strategies of their own.

Nonetheless, this is not to say that the increasing regional emphasis of industrial policy in Finland has shifted the attention of policymakers from the challenges of competitiveness, economic development and growth at the national level. Since the turn of the century it seems fair to say that the enthusiasm towards cluster-oriented policies is slightly fading. Despite the quick recovery from the severe recession of the early 1990s, the rapid growth especially of the ICT-related industries, as well as the high ranking of Finland in various recent competitiveness reports, new industrial policy challenges now hover in the horizon.

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[15] See Lemola (2001)

3 What is specific to Finnish industrial policy?

Looking at the shifts in Finnish industry policy since the 1990s, and at its current specificities, one can pick out three or four main elements which deserve a more detailed discussion. The first one is a strong integration of science, technology, and innovation policies. The second is early adoption of a systemic view to industry policies. Third, and corollary to the second, is the Finnish way realizing cluster policies – not by adopting picking the winners or creating and planning clusters, but rather by adopting a broad way of using cluster thinking in devising national industry policies.

In all these respects the policy practices involve features typical of Finnish policy making and appear as different from most other countries. All three are briefly discussed below.

3.1 Early integration of industrial, science and technology policies[16]

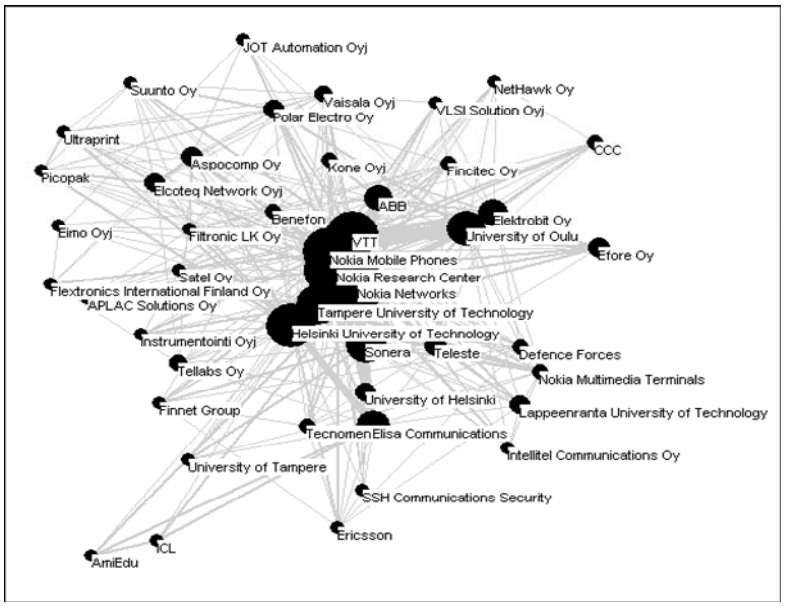
One of the strengths of Finnish industry policies is undoubtedly the strong linkages between industrial, science and technology policies, and the dense interaction and networking among business firms. In terms of policies, this is reflected in the establishment of the Science and Technology Policy Council in 1987, as well as in closer collaboration between Tekes and the Academy of Finland during the design and implementation of specific measures and programs. Collaboration is also institutionalized through the regular so-called 4DG meetings between Tekes, the Academy of Finland, Sitra and the Technical Research Centre of Finland (VTT).

Further, technology policies can be characterized having an “industry-pull” focus as opposite to “science-push” that was typical of policies pursued in the 1960s and 1970s. The main instruments used in technology policies are technology programs commissioned by Tekes that have a strong problem and industry orientation (technology programs account for roughly 40 percent of the total R&D budget of Tekes).

[16] In this paper we use concepts of science and technology policy, technology policy, and innovation policy throughout. However, innovation policy has more frequently been used only quite recently. Science policy has its roots in the 1960s, and S&T policy started show up more frequently in the policy discussion in the 1970s and 1980s. Establishing Tekes in the early 1980s emphasized the role and concept of technology policy. However, as discussed below, in practise the integration of science and technology policy has been the most important feature of policy making.

In technology programs a common practice has been vertical collaboration and networking of universities, research organizations, and SMEs with large firm as the industrial engine. Example of this is given in Figure 6 below, which illustrates the collaborative linkages in two electronics technology programs (ETX and TLX) commissioned by Tekes. In these programs Nokia has been the industrial engine.

Figure 6. Collaborative network in Tekes' ETX and TLX technology programs



Note: The figure includes both company ventures and larger research projects. Included are partners with minimum of three projects with Nokia Corporation. Information is based on the end reports of ETX and TLX programs. The figure is to be interpreted as follows. The more projects the organization is involved in, the larger is the circle and the closer to the centre. (Source: Ali-Yrkkö and Hermans (2002)).

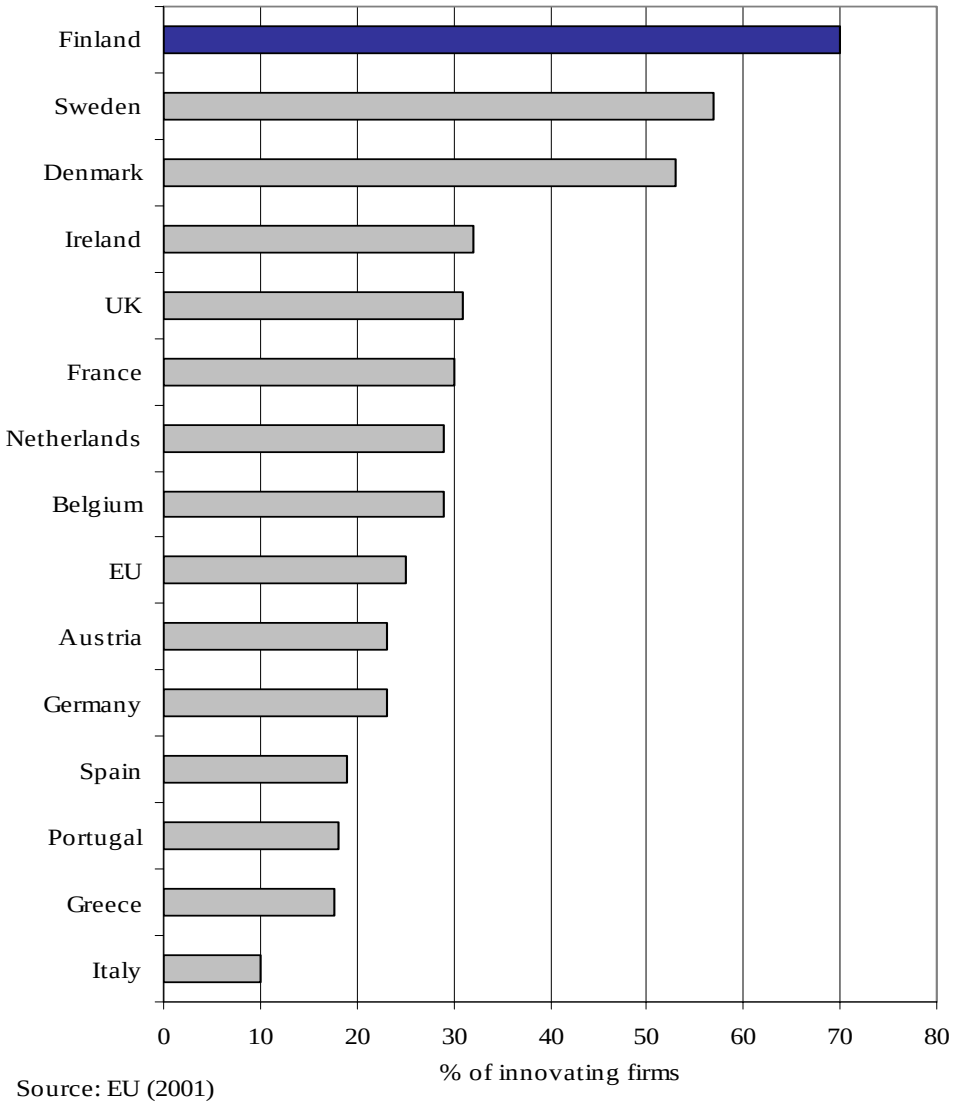
While emphasizing collaboration in R&D, it is important to note that funding both from Tekes (applied research and development) and the Academy of Finland funding (basic research) is competitive. Research institutes and firms are competing for funding in open bidding. That has had a major impact on allocation of funding and efficiency of publicly funded research and development, and underlines further the "industry-pull"-nature of technology policies.

Further, the Finnish economy and industry can be described as open, specialized and networked. Networking and collaboration in the business sector, and between industry and universities, have proved to be important in developing ICT.[17] In periods of rapid technological

[17] See Romanainen (2002), and Paija (2002).

change the smallness of the economy has proved to be beneficial in creation and diffusion of new knowledge in specific areas.[18] This is further evidenced by CIS (Community Innovation Survey) data which indicates that firms from small open European countries, and from those heavily specialized in ICT, are more likely to collaborate in their innovative activities than firms coming from larger countries as shown in Figure 7 below.

Figure 7. Extent of collaboration with other firms and universities during innovation



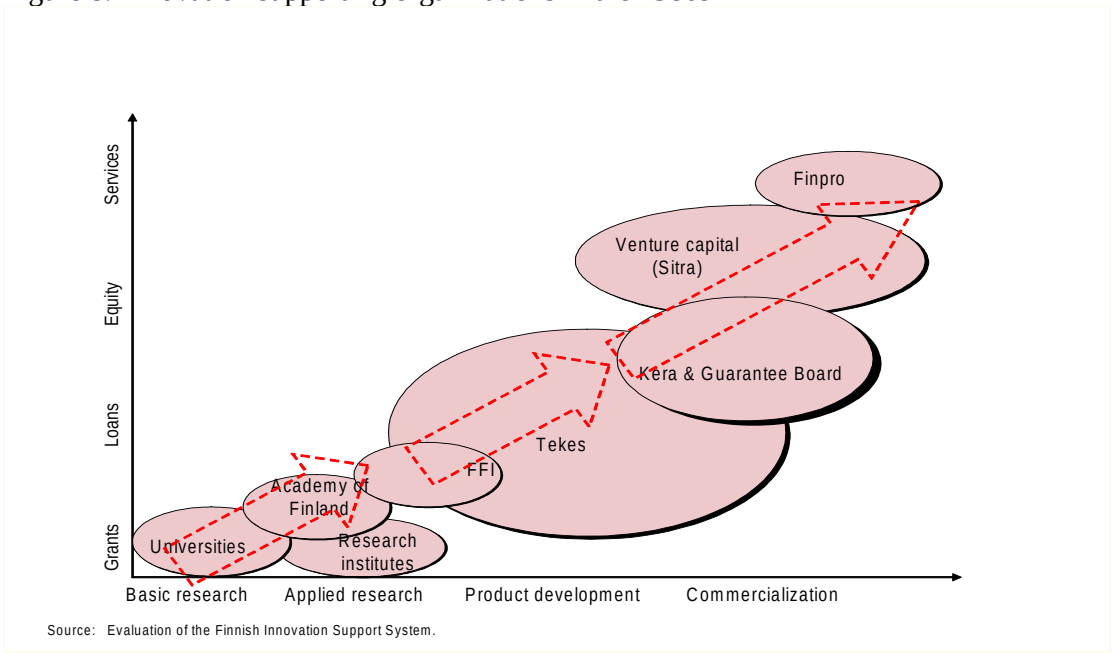
Source: EU (2001)

[18] See Palmberg and Martikainen (2005)

3.2 Early adoption of a systemic view on policy

The concept of national innovation system was adopted in the policy discussion and actual design in the beginning of the 1990s, only a couple of years after it was introduced in the literature.[19] However, policies emphasizing the research system as a whole, and interaction amongst the policy agencies, have their origin already in the late 1980s. This also fitted well with the new policy approach of shifting from intervention to facilitation. New policies and national strategies were called for in the midst of a deep recession and rapidly increasing globalization of the world markets. Technology policy became the most important part of industrial policies, where the focus was on enhancing specialization and international competitiveness of firms through innovation. The policies clearly took a longer term view motivated by structural problems underlying the recession.

Figure 8. Innovation supporting organizations in the 1980s

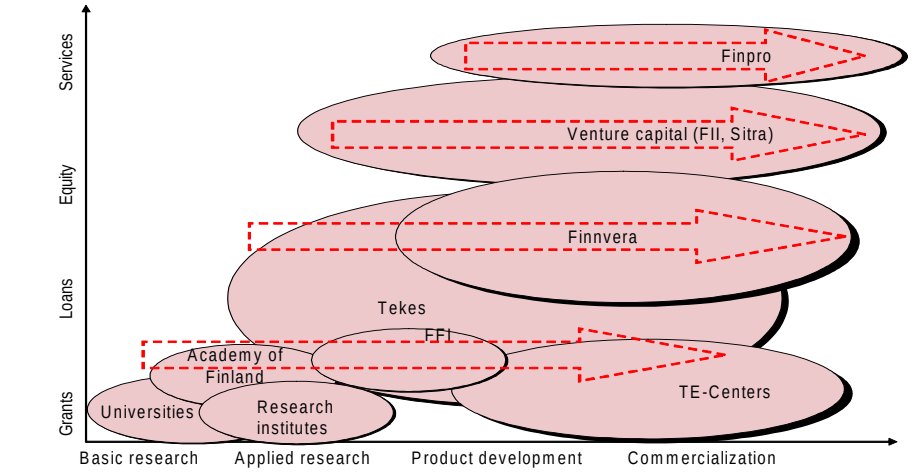


Source: Evaluation of the Finnish Innovation Support System.

There was also a shift in innovation policy thinking due to rapidly advancing technological change and shortening life cycles of products and technologies. Policymakers started to move away from the old linear model towards a systemic one, i.e. the phases of innovation process were seen as increasingly simultaneous, rather than sequential. Correspondingly, policy organizations started to coordinate their activities in new ways (Figures 8 and 9).

[19] See Freeman (1987) and Lundvall (1992)

Figure 9. Innovation supporting organizations – the current system



Source: Evaluation of the Finnish Innovation Support System.

Figures 8 and 9 depict, in a stylised way, how the policy organisations have perceived their functions over time. The division of work in the 1980s reflected the linear innovation model and associated policy rationales and objectives. Today, innovation is seen as having a systemic character which means that policy agencies, while serving their own specific function in the system, take into account functions of the others. As an example, Finpro (an organization to promote commercialization) has been establishing closer collaboration with Tekes whose basic function is to support R&D, and the other way round. This is especially important in industries where product life cycles have become very short (like ICT) and R&D and launching new products to markets is taking place almost simultaneously.

Industrial clusters accord well with this new systemic view on innovation policies. Cluster-based policies were introduced a couple of years after the adoption of NIS thinking in S&T policy. That is probably one of the reasons why clusters and cluster analysis were used differently in Finland than in many other countries.

3.3 Implementing cluster-based policies

The basic idea of cluster-based policies is that there is a growing interdependence of firms and industries due to increasing knowledge intensity of all economic activities. The knowledge economy is characterized by technology spillovers, innovation linkages, value chains in pro-

duction, and network type of organizations. All these call for policies promoting collaboration and networking and enhancing internalization of external economies within some technological or geographical entities.

Industrial cluster can be used as a conceptual frame work and policy tool to cope with challenges arising from the increasing role of knowledge spillovers and technological externalities. Industrial cluster can be defined as an agglomeration of producers, customers, and competitors that increases specialization, promotes efficiency and is a source of competitive advantage. The key is simultaneous collaboration and competition – collaboration is needed to enhance specialization, but rivalry is necessary for continuous innovation and upgrading of products and processes. The policy challenge is to promote both competition and networking. Again, Tekes' technology programs can be taken as an example – collaboration and networking are prerequisites for receiving funding from the program. In many cases such networking creates advanced intangible factors of production and common knowledge bases. Both are characterized by external economies and, hence, public policies are justified and often also successful.[20]

The Porter model and cluster approach include important industrial policy conclusions which have been adopted differently in different countries. Due to preceding ideas stemming from the innovation systems approach, cluster-based policies took a very broad view on clusters and also on policy making itself, as discussed above. Unlike in many other countries, in Finland there has been relatively little scope for cluster-specific policies which often have been used a substitute for previous policies based on a "picking the winners"-approach. National priorities, for example, in formulating technology programs have certainly played a role, but the basic idea has been that of creating framework conditions for new technologies and lines of business. The notion of government failure is clearly acknowledged in policy documents.

Knowledge on national strongholds and interdependencies across industries and industrial agglomerations is certainly needed. Hence, part of industrial policies is to create of a clear vision of potential competitive advantages and restructuring requirements, and communicate that vision to all actors in the economy.

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[20] See OECD (2001)

4 Concluding remarks and future challenges

4.1 Successfulness of industry policies – policies matter

In hindsight the policy choices made in the early 1990s have been evaluated as highly successful.[21] The developments towards a knowledge economy have further signified the role of conditions providing policies. In the current policy thinking industrial policies are understood as measures to enhance industrial growth and improve microeconomic business environment, rather than subsidizing ailing industries or picking the winners. It recognizes the freer movement of production factors and the significance of locational competition – and hence the role of policies in improving the business environment. These ideas are well in line with cluster analysis, which – while having a factor-endowment flavor – emphasizes the role of business firms themselves as creators of their competitive edge in the product markets.

The economic turbulence of the 1990s in Finland exemplifies this. The industrial development proved to be quite different from what was expected in the mid-1980s. Rapid reactions of firms were needed, but at the same time policies responded through supporting the development of a strong knowledge infrastructure and a highly educated labor force to meet the demands of the emerging knowledge economy. The rapid increases in public R&D funding in the 1990s have also turned out to be successful. They have been clearly complementary to private R&D and the estimates of rate of return on R&D investment as a whole seem relatively high.[22] One of the factors explaining the high returns is the simultaneous increase in educational inputs that have been complementary to R&D investment.

An indisputable lesson from the Finnish experience is that industry policies must have a long-term strategic perspective. Hence, policies must be consistent over the long-term and not dictated by short-term cyclical or political considerations. It is our overall judgment that the Finnish policies were able to find a proper balance between activism and non-interference. The role of government was that of acting strongly enough where the market is failing – i.e. in R&D and education – and creating and communicating a common vision of future national strongholds without intervening too much in the functioning of the markets. The restructuring of industries and the knowledge-driven growth of the Finnish economy during the past 10 – 15 years has undoubtedly been a European success story. It certainly was hard to get to the top position in international competitiveness, but it is probably even harder

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[21] See Jääskeläinen (2001,2005), Georghiou, Smith, Toivanen and Ylä-Anttila (2003)
[22] See Ali-Yrkkö (2004), and Georghiou, Smith, Toivanen and Ylä-Anttila (2003)

to stay on the top. In addition, it seems that competitiveness rankings do not necessarily predict future growth of economies.[23]

There is also recognition that Finland might be over-dependent on ICT and Nokia. Hence, the central policy challenge is to find a proper balance between high specialization in ICT production on the one hand, and diversification of industries on the other. Proactive policies and new instruments are needed.

4.2 New challenges in a globalising economy

The knowledge- and R&D-oriented, "high-road" strategy that Finland has pursued is now coming under increasing competitive pressure due to similar strategies of emerging countries, like those in Central East Europe or Asia. Recent research gives some evidence that Asian countries like Taiwan, South-Korea, and to some extent also China, are specializing in their exports in the same product groups as Finland. That applies in particular to ICT products. China has already become a bigger exporter of mobile hand sets than Finland, and South Korea is catching up rapidly.

As suggested above, the issue of globalization has now come to dominate the industrial policy discussion in Finland. There is recognition that the present phase of globalization differs from the past especially due to the pervasiveness and rapidness of technological change, and the removal of barriers to trade and financial transactions. This presents specific challenges to small open economies with limited absolute resources, such as Finland, which have to compete as location of industrial activities on the global level. This applies in particular to ICT. Finland certainly enjoyed the advantages of an early entrant in a network industry, and, at the same time, of a position of a standard setting country. These advantages have loosed part of their significance. There is also increasing concern about the comparatively low level of entrepreneurship in Finland, the unfavorable demographic structure of the population, and continued imbalances in foreign direct investments.

The issue of globalization took centre stage in the most recent triennial review of the Science and Technology Policy Council from 2003 entitled "Knowledge, innovation and internationalization". This review emphasized that internationalization has to proceed at the level of the Finnish innovation system as a whole. This emphasis is in line with the observed increasing internationalization of Finnish firms. The main guidelines provided in this review

[23] Rouvinen (2004)

concern the increasing utilization of technological and social innovations in business enterprises with a view to accelerate the renewal of the traditional industries, further increase of R&D resources budgeted to Tekes and the Academy of Finland, the utilization of research at the universities, education in the natural sciences, and the internationalize of the public R&D system. These broader guidelines are concretized in the recent report by the Science and Technology Policy Council published in November 2004 and entitled "Internationalization of Finnish Science and Technology".

The most recent and significant globalization initiative stems from the Prime Minister's Office and the Economic Council. The Prime Minister's Office commissioned a large project which started in January 2004 under the title "Finland in the global economy". The aim of this project was to assess how the ongoing transition in the world economy will affect various sectors and their employment prospects in Finland and what challenges the changing business environment will create in various areas of social policy. The final report of this project was published at the end of 2004 and is entitled "Finland's competence, openness and renewability". The project is intended to feed into ongoing work for the formulation of a globalization strategy for Finland.

BOX 4: The "Finland's competence, openness and renewability"-report

The aim of this project was to assess how the ongoing transition in the world economy will affect various sectors and their employment prospects in Finland and what challenges the changing business environment will create in various areas of social policy. The final report of this project was published at the end of 2004 and is entitled "Finland's competence, openness and renewability". It is based on numerous background studies commissioned from national think-thanks and experts, over 20 sectoral dialogues conducted between employers´ and employees´ organizations, and the work of the high-level steering group appointed for the project. The project is intended to feed into ongoing work for the formulation of a globalisation strategy for Finland. It proposes a compendium of measures towards this end, of which the main ones are the following:

- Improving the *quality of the education system* through increasing the attraction of vocational education, enhancing the financial autonomy and incentive-based funding of universities, increasing the efficiency and international attractiveness of polytechnic education.
- Strengthening *innovation policy* through catering to shortcomings in competence in early-stage productization and commercialization, increase public R&D resources by at least 7% per annum during the current decade, increase allocations to capital investment funds for pre-seed and start-up activities, and facilitate the further shift from S&T policy to innovation policy
- Increase the attractiveness of the *business environment* through easing further the taxation on labour in all income classes, increase employment-based immigration, develop new networks in emnerging technology centres such as China, South Korea and Taiwan, increase the exportation of public-sector welfare services and culture, and develop further domestic and international transport connections
- Strenghten the *renewability of Finland* by raising the employment rate, develop a long-term business environment policy strategy, putting public services out to tender, improve the productivity of the public sector, and increase the efficiency of the stock exchange
- Develop the *ground rules of the labour market* through enhancing working time flexibility, narrowing the tax wedge with emphasis in the low-income end, and developing further the unemployment benefit system so that re-employment is encouraged through new incentive schemes

4.3 Promotion of entrepreneurship - tax incentives as new policy instruments?

Low level of entrepreneurship has been identified as one of the key weaknesses of the Finnish economy. The innovation support system, as a central part of industry policies, should address in particular the problems of potential R&D-oriented entrepreneurs. This is all the more important, since poor performance in commercialization of technologies and shortages in business skills are seen as major bottlenecks of the Finnish innovation system. Hence, increasing number of start-ups could facilitate further commercialization of technological innovations and thereby enhance the overall performance of the innovation system.

To respond to these challenges, tax incentives as new policy instruments are proposed by the "Finland in the Global Economy" report.[24] In Finland, tax incentives have been used relatively little in innovation and industry policies. In that sense policy proposals of the report represent a new opening. In doing so, the report acknowledges the tax competition as a potential source of reshaping the European and global industrial landscape. However, tax instruments are just entering the policy debate, and it may take long time before any of them are adopted in actual policy making.

If the Finnish industry policy took a broad scope and started to adopt a systemic view in the 1990s, a new and, and perhaps even broader scope is needed in the 21st century in systems competition.[25] Countries and regions are likely to compete for increasingly mobile capital and production, also with their social systems and economic institutions. In the case of Finland, as a small open economy, this type of systems competition will require a further focus on centers of excellence policies in research and education, i.e. concentrating high level education and R&D to yet fewer locations to create critical mass. The justification is simply that in a globalised world economy a small country can be competitive only in a couple of areas in science and technology. To facilitate technology transfer and new entrepreneurship, more emphasis will also be put on the IPR (intellectual property right) system. Increasing economic and administrative autonomy of universities is also high on the new policy agenda. Here, again, putting the incentives right, is the key.

The systemic view and collaboration between different policy actors will remain the central feature of Finnish industry policies. That is also seen as one of the means to encourage entrepreneurship, but by incorporating new measures – like tax incentives – into the system.

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24 Prime Minister's Office (2004)
25 See Sinn (2003)

The emphasis has also been moving – although somewhat slowly – from technology to innovation and further to the commercialization of technologies. This will call for more collaboration and, especially, coordination among the industry policy actors. Collaboration and coordination of activities between policy actors, that have originally been established to serve their specific functions in industry policies, is hard to implement. Building up such a coordinated system – without creating bureaucracy – has a high priority in the policy makers' agenda today.

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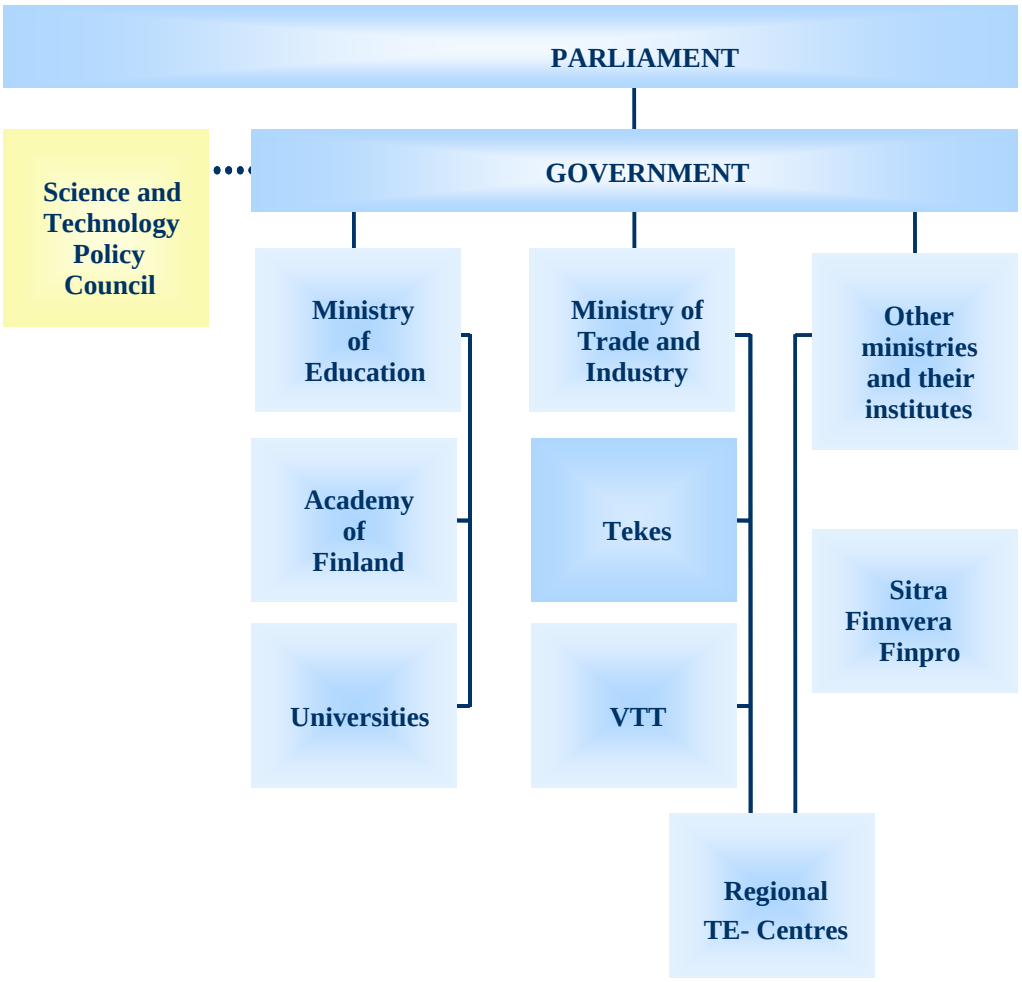
Appendix:

Key public organizations in new industry policy formulation and implementation



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