

# Transformation of Innovation system in a Small Country – the Case of Finland

---

Pekka Ylä-Anttila\*

Tarmo Lemola\*\*

## ABSTRACT

---

The paper looks at the transformation of Finnish science and technology policy from the mid-1960s until today. Special emphasis is in the developments since the early 1990s. In a less than a decade the country has become one of the leading information societies and knowledge-based economies.

The resurgence from the deep recession of the early 1990s is in considerable part attributable to the developments in the information and communication technology (ICT) sector. Our particular research question is: how did Finland become a success story in ICT?

The basic argument of the paper is that, if there is a “Finnish model” of information society or science and technology policy, it was not created in the years of rapid growth of the 1990s. There was no “master plan” prepared in the early nineties to restructure the Finnish economy, rather a series of policy measures over a longer period that were working at the same direction and put into effect partly in the 1990s. There were also complementarities between policies, financial market liberalization, and legal restructuring. Hence, as a country Finland was relatively well positioned when the opportunity came.

**Key words:** science and technology policy, transformation, ICT, innovation system, small country, Finland

\* ETLA – The Research Institute of the Finnish Economy, email pekka.ylä-anttila@etla.fi

\*\* Ministry of Trade and Industry and Advansis Oy/Ltd, email tarmo.lemola@advansis.fi

We would like to thank Christopher Palmberg and Petri Rouvinen for useful comments.

## 1. INTRODUCTION<sup>0</sup>

---

During the ICT boom of the 1990s Finland became labeled as one of the leading information societies, a country showing economic dynamism and high level of social security at the same time. International comparisons ranked Finland as one of the most competitive economies and most technologically developed knowledge-based economies in the world<sup>2</sup>. While competitive technology-driven economy and high level of social cohesion are often seen as antagonist, the Finnish developments in the 1990s seem to indicate that they can be combined. Castells and Himanen (2002) introduce a concept of “informational welfare state”, i.e. the Finnish model of information society.

In the early 1990s the country's prospects seemed much gloomier. In 1990 Finland was hit by the most severe economic crisis in any OECD country since World War II. Real GDP dropped within three years by more than ten per cent and unemployment rate quadrupled to 17 per cent. The country that showed the lowest unemployment rate in OECD in 1989, was among the worst performers only a couple of years later (Honkapohja & Koskela, 1999, and Kalela et al. 2001). Numerous factors contributed to the crisis: downturn in the nationally vital forest-related industries; disruption in the country's sizable eastern trade with the collapse of the Soviet Union; speculative bubble in the domestic securities and real estate markets fuelled by uncontrolled credit expansion and favorable terms of trade; and mismanaged financial liberalization, eventually leading to credit crunch and excessive private sector indebtedness.

After the deep recession the country has experienced a strong recovery during which the economy and society have gone through a major restructuring at various levels. Overcoming the crises is a crucial turning point in understanding the transformation of the latter part of the 1990s.

The issue is adaptability and common acceptance of change. It seems that the country as a whole, its policy making, and major part of firms were able to adjust and make use of opportunities offered by new technologies, and hence turn the crises to industrial transformation and growth. The question is then raised, what has been the role of the interaction within the small national system and dense network relations. Is there something specific in the national innovation system that has produced success stories like Nokia and Linux? Did it all happen just in a decade? Do the Finnish experiences bear lessons to other countries?

In a decade Finland had gone from being one of the least information and communication technology (ICT) specialized countries to becoming the single most specialized one. In what follows we look at the phases of industrial development in Finland and ask what has been the role of science and technology policies (section 2). Our basic argument is that, if there is a “Finnish model” of information society or science and technology policy, one has to take a longer historical perspective than that of the 1990s to understand its emergency. There was no “master plan” prepared in the early nineties to restructure the Finnish economy, rather a series of policy measures over a longer period that were working at the same direction. Section 3 takes a closer look at science and technology policies. In

1 There are numerous reports on the Finnish economic and social transformation since the early 1990s. Some parts of this paper draw on Georgiou – Smith – Toivanen – Ylä-Anttila (2003), and Rouvinen – Ylä-Anttila (2003).

2 WEF – World Economic Forum ranks Finland in its 2003 report the second most competitive economy in the world, and The WEF Global Information Technology Report 2002-2003 the most developed IT society. IMD (Institute for Management Development World) Competitiveness Yearbook 2003 ranks Finland number one in the group of smaller countries. Global International Technology-Economy Index - GITEI (by Department of Computer Science, Stanford University) places the country second overall among some 50 countries surveyed worldwide



section 4 we discuss the structure of the Finnish ICT sector and the main elements of success and search explanations for the rapid resurgence of the economy and the spectacular growth of ICT cluster. Finally, section 5 concludes and asks how do we explain the “the Finnish miracle”. It also discusses the possible lessons to be learned. Our main conclusion is that the Finnish model cannot be replicated as such. There might be, however, some useful experiences that could benefit other, especially smaller countries.

## 2. PHASES OF INDUSTRIAL DEVELOPMENT – ROLE OF SCIENCE AND TECHNOLOGY POLICIES

---

### *From factor driven to knowledge driven growth - a historical backdrop*

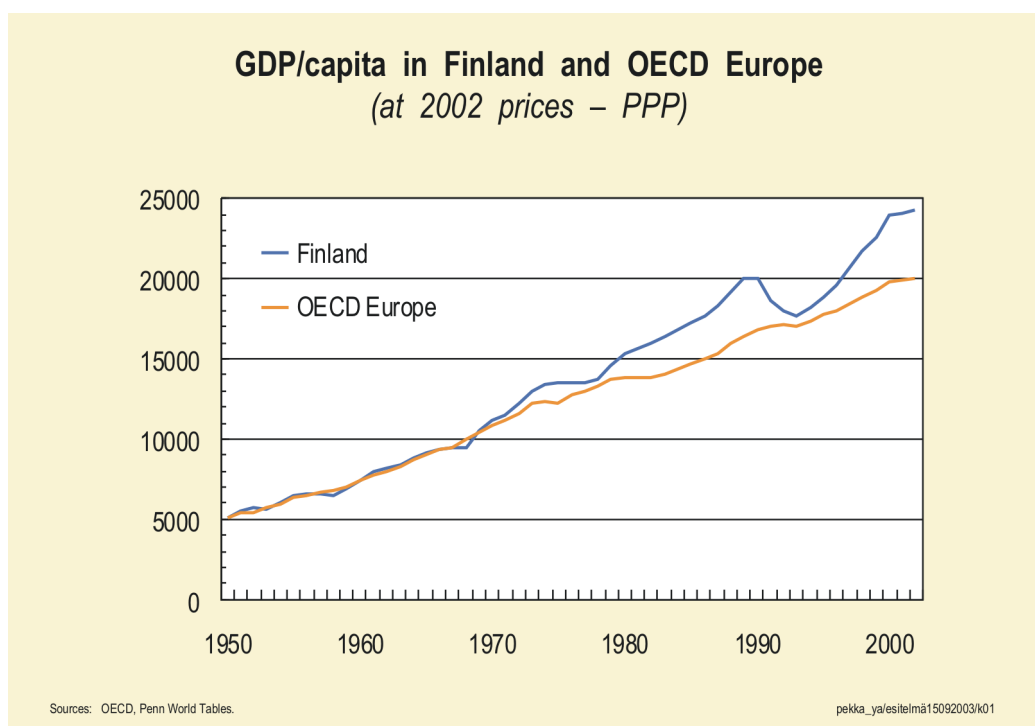
During the twentieth century Finnish GDP per capita grew at an annual rate of close to three percent, i.e., faster than in any other European country. Admittedly, as compared to the countries in the vanguard of the first industrial revolution in the late 1800s, the starting point was relatively low. Many of the basic preconditions for growth were nevertheless in place at that time. Institutions, like well functioning educational and banking system as well as good transportation infrastructure, were important in the take-off phase. Similarly, national identity and culture were strong enough to facilitate economic growth. After completing the liberalization of both internal and external trade by the end of 1870s, the path for industrial growth and new business activity had opened.

The role of institutions was important not only in the take-off phase of industrial growth, but also later when the economy moved from factor-driven to investment-, and later, innovation-driven stages of industrial development.

Finland's most important – and virtually only – endowment of natural resources, forests, proved to be the decisive factor in the take-off phase. Quick advancement in prosperity towards the end of the 1800s and in the early 20th century were based on rapidly growing exports of forest-related products, first sawn timber and later pulp and paper. From the late 1950s to the late 1970s the Finnish forest industry carried out massive investments and transformed itself gradually into a global technology leader with the most modern and efficient production capacity in the world (see Raumolin, 1992). By the late 1980s the forest sector had developed into a competitive industrial cluster that today provides high value added paper grades as well as forestry technologies and consulting services (Hernesniemi, Lammi, & Ylä-Anttila, 1996; Ojainmaa, 1994; Rouvinen & Ylä-Anttila, 1999).

The latest phase of forest cluster development is the integration of ICTs into pulp and paper making processes and maintenance services. The strong forest cluster with roots in traditional factor-driven industries is finding interfaces with the knowledge-driven ICT cluster. Furthermore, the global consolidation in pulp and paper as well as in other traditional industries has spanned new ICT markets, as new electronic means of integrating geographically dispersed activities are needed.

**Figure 1. GDP per capita in Finland and OECD Europe, 1950 – 2002, in 1995 prices and purchasing power parity exchange rates**



SOURCE: OECD, NATIONAL ACCOUNTS

### *Small Nordic Economy and Welfare State*

Finland's economic and social structure and institutions are similar to those of other Nordic countries. It can be appropriately characterized as a Nordic welfare state: an egalitarian country with relatively even income distribution, low class distinctions, and relatively high social cohesion.

Smallness is both an advantage and disadvantage. There is some evidence in the economic literature that smallness as such might retard economic growth. Small countries have less scope for utilizing scale economies in production and marketing. On the other hand, small home markets drive firms to specialize and seek foreign markets early on. Most small countries can be described as open economies with large exporting sector and high ratio of FDI to GDP. In Finland exports in relation to GDP is currently close to fifty percent.

Smallness and homogeneity of the society might also be beneficial for creation and diffusion of new knowledge in specific areas – like ICT. In the period of rapid technical change this could be a competitive advantage over larger countries (cf. Lundvall, 1998).

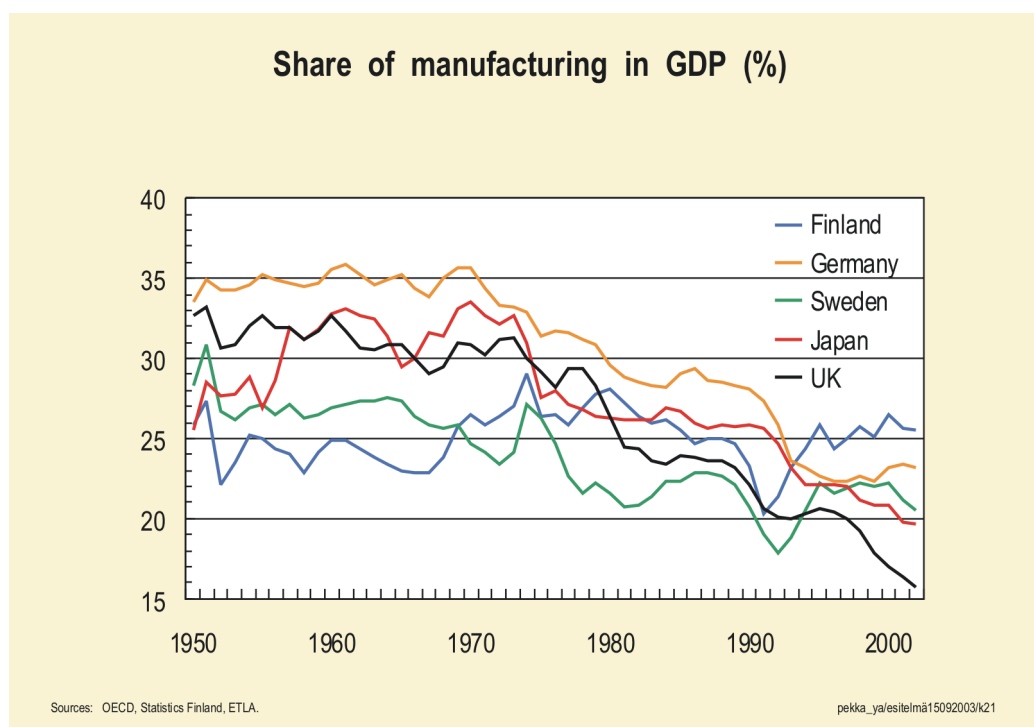
Smallness and specialization increase a country's sensitivity to external shocks. Small economies have developed various ways to cope with the problem including not only macroeconomic policy measures but also many kinds of formal and informal networks and social security systems. As argued by, e.g., Rodrik (2000), openness of the economy is often linked to social security systems designed to dampen down the risks arising from the high degree of exposure to the external environment.

The Finnish economy can be characterized as highly open, specialized, and networked. Networking and cooperation in society in general, as well as in the business sector and between industry and universities in particular, have proved to be important in developing new information and communication technologies in Finland (Romanainen, 2001). Of course, social networks (or social capital more generally), can become too tight and finally an obstacle for social change and industrial transformation, but so far the benefits of networking and cooperation have been an advantage rather than a disadvantage (cf. Castells and Himanen, 2002; Rouvinen and Ylä-Anttila, 2003).

Sometimes the risks related to the exposure and smallness might grow too big to be managed properly. This is highlighted by the case of the Finnish economy in the late 1980s and early 1990s when the overheating of the economy ended to a deep recession in 1991 – 93 – GDP fell by more than ten percent and unemployment rate rose to 17 percent cent. Such dramatic changes over a very short period of time would probably not happen in a larger highly developed country.

The latter part of the 1980s saw a series of deep structural changes in the Finnish economy. The strong economic growth was strengthened by booming international market, improving terms of trade, and deregulation of the financial market. In spite of the growing international market, exports grew considerably slower than domestic demand. The economy descended into severe structural problems. The export capacity was simply too small to support the late 1980s standard of living.<sup>3</sup> Manufacturing and exports in relation to total output had dropped dramatically throughout the 1980s (Figure 2) leading to huge external imbalance. Overheating of the economy and the subsequent recession of the early 1990s was partly due to external shocks and partly due badly designed deregulation of the financial markets.

**Figure 2. Share of manufacturing in GDP in selected countries, %**



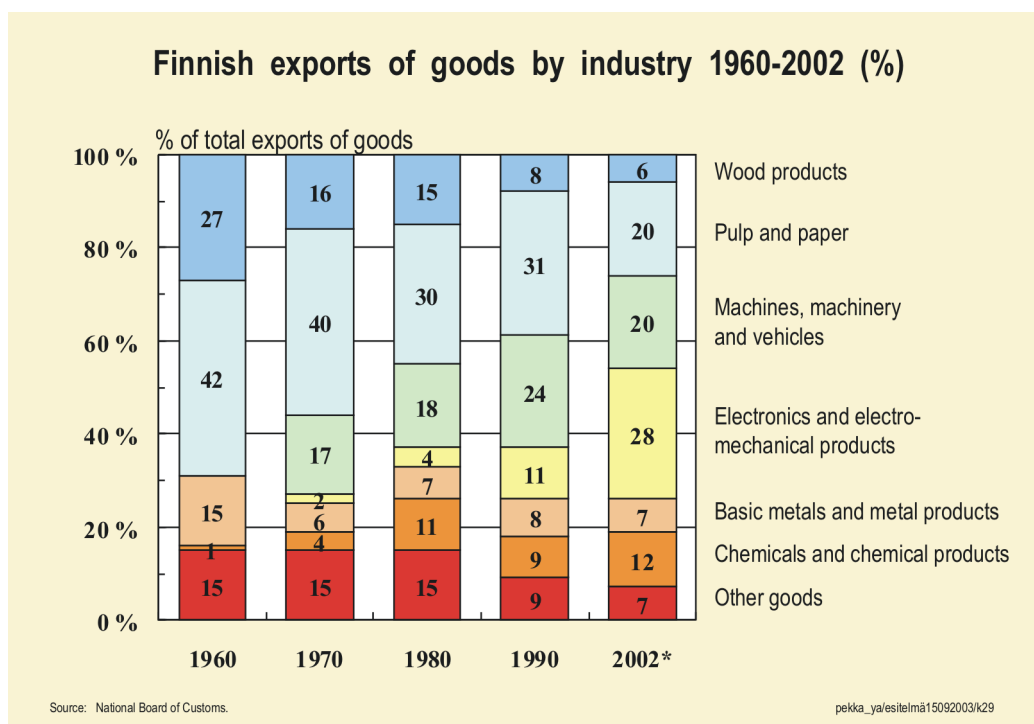
NOTE: THE DATA SOURCE IS OECD NATIONAL ACCOUNTS.

3 See Hernesniemi et al. (1996).

Nevertheless, the recovery from the recession was very strong and entailed both an era of both re-industrialization and rapid structural change towards a knowledge-driven economy. In 1990 wood, pulp and paper accounted for 40% of Finnish exports, slightly above the share of metal and machinery products at close to one third. During the 1990s Finland became a major exporter of electronics and other high-tech products, which by the year 2000 accounted for over 30% of exports (Figure 3) The structural change in production, exports and R&D were, indeed, very strong in international comparison. Only some newly industrialized countries have shown similar patterns of rapid structural transformation.<sup>4</sup>

At the same time when manufacturing has been performing well, many service industries have increased their output and employment only relatively slowly. Unlike in other OECD countries, manufacturing increased its share in GDP in the 1990s, while the share of services remained more or less constant. Consequently, the share of the services sector in total employment and production in Finland is still well below the OECD average.

**Figure 3. Share of exports by industry sector, 1990 – 2002, %**



### 3. SCIENCE AND TECHNOLOGY POLICY – HOW DID IT DEVELOP?

*Why is science and technology policy needed?*

High and sustained growth is among the most important goals of practically all policy makers. There is no doubt that new knowledge, innovation and technical change are the most important factor in

<sup>4</sup> See Knell (2003).

economic growth and competitiveness. Hence the policy issue is technological advance can be fostered and harnessed to producing product and process innovations that are competitive in the global market. There is growing amount of evidence, although mixed, that public R&D policies can have a positive contribution to overall R&D input and productivity.<sup>5</sup>

Technology policy is usually justified by market failure, i.e. market will fail to provide sufficient resources to R&D. Social return to R&D exceeds the private return, since R&D has characteristics of a public good. There are basically two types of market failures which policies aim to rectify. First, imperfections in the financial market (often due to informational asymmetries), and secondly market failures arising from knowledge spillovers.

Innovation outcomes are highly uncertain and the innovation process is inherently complex by nature. Innovation policy aims to manage the uncertainty and remedy deficits in firms or the environment in which they operate with the aim of increasing the rate of successful innovations.

There are basically two types of uncertainties in the innovation process – inside the firm, and in the relations between the firm and its external environment. Regarding the external relations the key finding is that firms very seldom innovate alone. Rather, they draw on knowledge generated within the education system, research institutes, other firms or elsewhere in the innovation system. Hence, there are knowledge spillovers both between firms and between firms and other agencies. This, the existence of external economies, is the main justification for government involvement in many countries today.

It is evident that characteristics of innovation system affect innovation performance. The evidence seem to suggest that the public support apparatus cannot consist of a single set of activities. In a similar way as innovation is complex process, the support system is characterized by complexity: there are different organizations with different functions and objectives that have, however, operate in a coordinated way.<sup>6</sup>

Looking at the S&T policy in Finland reveals a gradual change in policy thinking towards the more complex notion of innovation and a broader view of policies. Since the 1980s there has been a move from linear innovation model to an interactive and integrative model. In 1990 the national innovation system was introduced in the review of Science and Technology Policy Council as a basic framework for policy considerations. The important point is, however, that the use of innovation system approach has been very pragmatic and at a fairly general level.<sup>7</sup> The same applies to industrial clusters and cluster-based policies – adopted in industrial policy making in the early 1990s – although the policy reasoning relied heavily on the arguments provided by research.<sup>8</sup>

5 David et al. (2000) provide a review of R&D subsidy studies. For the most recent studies on R&D subsidies' impacts, see Guellec and Pottelsberghe de la Potterie (2003), who uses country level data from 17 OECD countries. Their most interesting result is that direct government funding of R&D performed by firms has a positive effect on business financed R&D. The subsidy elasticity of private R&D is of the order 0.07. Ali-Yrkkö and Pajarinen (2003) use firm-level data on Finnish metal, engineering and electronics firms. They receive similar results. Public R&D funding increases private R&D input.

6 See Georghiou et al. (2003)

7 See Ormala (2001) for a detailed description of policy organizations and practices.

8 See Jääskeläinen (2001) who makes a strong argument that the research program on industrial clusters carried out in 1991-95 had a major impact on policy making. The results of the cluster studies are summarized in Hernesniemi et al. (1996) and in Rouvinen – Ylä-Anttila (1999).

The evolution of the Finnish science and technology policies can be divided into three major phases: (1) Building the basic structures (1960s and 1970s), (2) technology orientation phase (1980s), and (3) the era of building the knowledge-based society and national innovation system (1990s).<sup>9</sup> The shifts in policy design reflect the changes in industrial and technological specialisation and reactions to changing policy priorities in other OECD countries.

In the mid- 1970s Finland started to move from factor-driven to more technology-driven industrial growth. That coincided with increasing public R&D inputs, enhancing integration of science, technology and industry, and, finally, strengthening of technology policy organisations.

By the end of the 1990s technology policy had achieved most of the targets that were set in the 1970s and 1980s: more versatile industrial and export structure, lower dependence on raw material and energy-intensive industries, and a growing importance of high-skilled and high-tech industries. The economy as a whole entered a phase of innovation-driven growth. Today, the major policy challenge is to keep the position as one of the leading knowledge-based economies, and to foresee the changes that will reshape the policy environment, i.e. to pursue proactive policies.

#### *Phases of development*<sup>10</sup>

##### **The building phase of the 1960s and 1970s**

The institutionalisation of science and technology policy began in Finland in the early 1960s, and five important changes took place over the two decades.

- 1) The policy doctrines (conceptual fundamentals of science and technology policy) were created.
- 2) A ministerial committee on science, the Science Policy Council (from 1987 the Science and Technology Policy Council), was established in 1963 for the formulation and coordination of science and technology policy guidelines.
- 3) New mechanisms for planning, coordination, and financing of university research were created, including the Academy of Finland and universities,
- 4) Measures to improve the conditions for industrial R&D were implemented. These included the strengthening of VTT's (Technical Research Centre of Finland) activities for applied technical research and for research- and piloting services offered to the industry, financing of target research activities in nationally important technology development areas, and the direct support of firms' R&D by R&D loans and grants (MTI - Ministry of Trade and Industry, Sitra - National Fund for Research and Development). The Foundation for Finnish Inventions was set up in 1971.
- 5) The development of higher education in general played a significant role in the early years of science and technology policy.

9 See Lemola (2002).

10 Lemola (2002). See also Ormala (2001), which gives an extensive review of institutions and policy agencies as well the developments in the 1980s and 1990s. See Georghiou et al. (2003) for an evaluation of innovation support system.

### **The technology phase 1980s**

A key aspect in the beginning of the 1980s was to make technology policy increasingly target-orientated and systematic. To fulfil these tasks, Tekes (The National Technology Agency) was set up and some of the tasks of MTI (R&D loans and grants, appropriations to technical target research) were transferred to Tekes. National technology programs became a new and important instrument for implementing technology policies. The focus of Tekes' operations in the 1980s was in information technology. In fact two technology programs in information technology had already been initiated before the setting up of Tekes, in which Nokia had also played a large role. Towards the end of the 1980s the need for (technology) policy actions on a broad sectoral basis was recognized, and the development of technology programs towards traditional industries was started.

Another trend in the 1980s was technology transfer and the commercialisation of research results. A number of mechanisms for technology transfer, diffusion and commercialisation, such as nation-wide networks of science parks and centres of expertise, were created.

Economic growth in Finland in the 1980s was also faster than in most other industrialised countries. An important change in the industry was the diversification of the export industry and internationalisation. A key player in promoting exports and internationalisation was the Finnish Foreign Trade Association (later Finpro). The ratio of R&D expenditures to GDP in Finland had been one of the lowest in the OECD countries at the end of the 1970s. The real growth rate of R&D expenditures in the 1980s was about 10 percent annually, which was the highest in the OECD countries. This was largely due to increasing R&D spending by companies.

### **Era of the national innovation system**

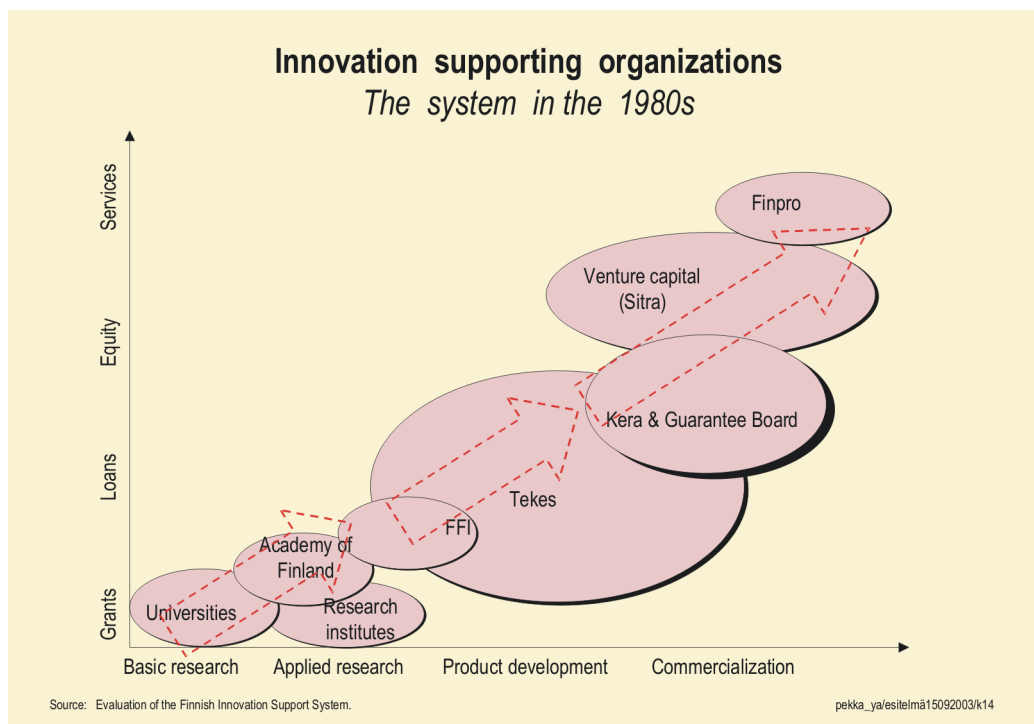
A new ideology initiated by the Science and Technology Council began to form at the turn of the 1990s, embracing the "national innovation system" and "knowledge and know-how" as central elements. This emphasized four viewpoints: creation and utilisation of knowledge and know-how, the R&D system at the core with education having an important role, the influence of the general atmosphere and environment on the development and take-up of new technologies, and the ability to cooperate both nationally and internationally. The concrete target was to increase R&D expenditures.

Finland was the first country to adopt the concept of a national innovation system as a basic element of science and technology policy.<sup>11</sup> That reflected the idea of looking at the innovation process and policies from a broad perspective spanning from education and science to innovative activities of firms and commercialisation of technological innovations. Cluster-based industrial policies also fit well to this line of policy thinking.

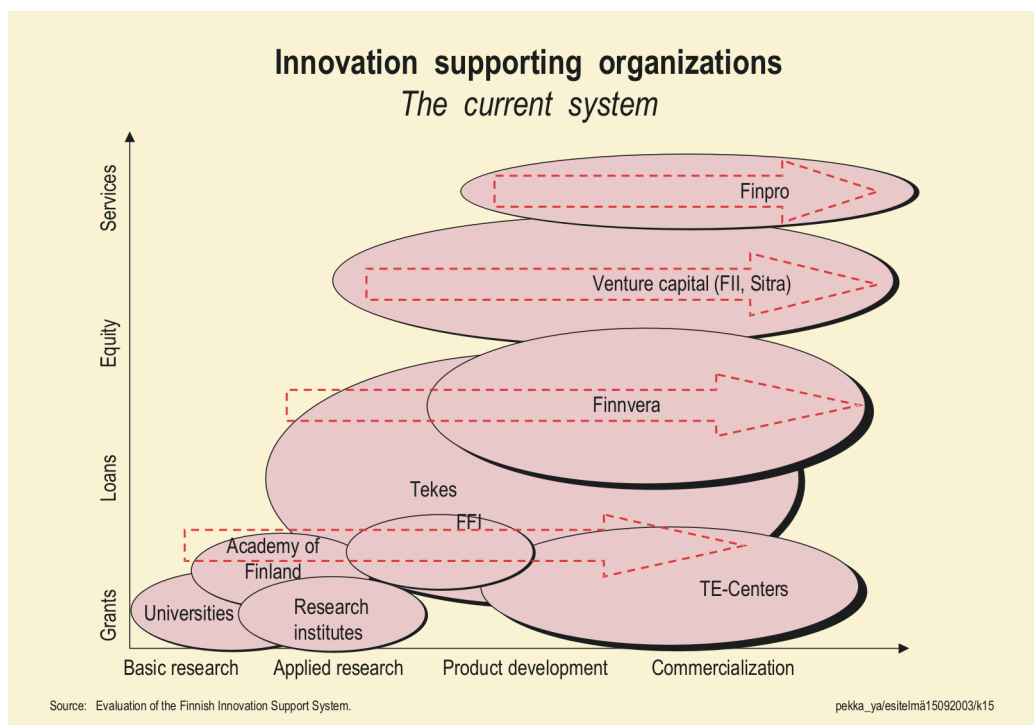
Towards the end of the 1990s, commercialisation of the results of R&D seems to have received increasing emphasis again. This applies to internationalisation too. The Finnish Foreign Trade Association (today Finpro) was reorganised in the late 1990s, and in part inspired by that, it began to look for stronger position as part of the innovation system. The system and the roles of various innovation agencies in the 1980s and today can be described as in the Figures 4 and 5.

<sup>11</sup> Miettinen (2002).

**Figure 4. Innovation supporting organizations – the system in the 1980s**



**Figure 5. Innovation supporting organizations - the system today**





The basic message of the arrows in figures 4 and 5 is to show that the innovation process has changed, and the policy agencies have recognized that in how they see their missions. The innovation process is seen both interactive and integrative. The important challenge of the current system is to prevent overlapping in the tasks of different organizations and to coordinate their functions.

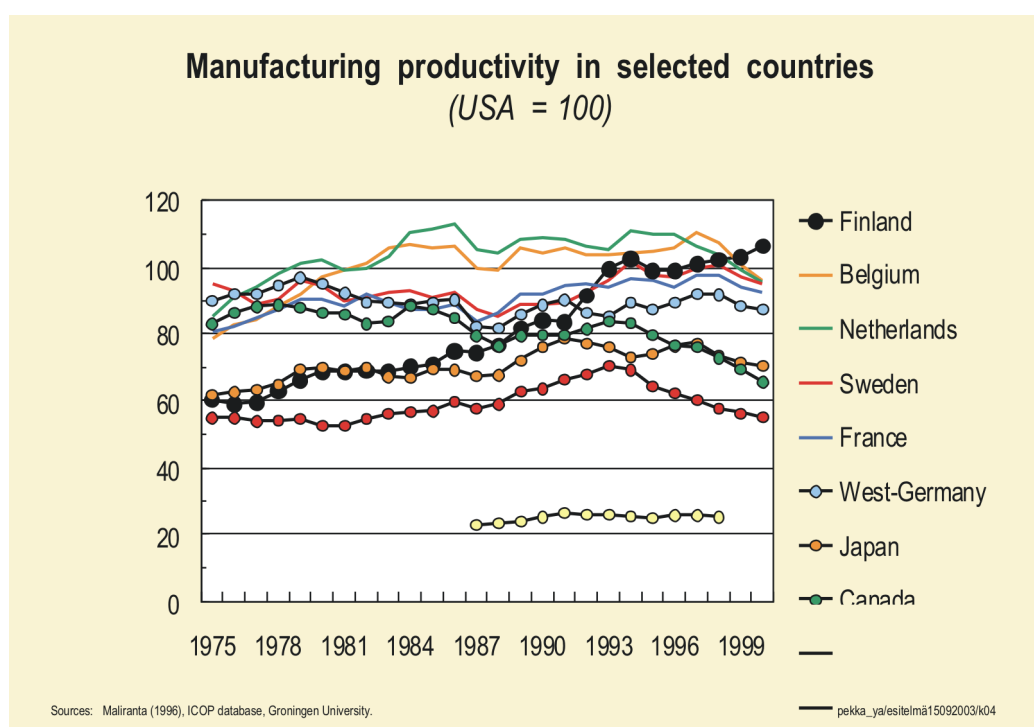
#### 4. THE 1990S – TOWARDS A KNOWLEDGE ECONOMY

The 1990s was then both an era of re-industrialization and rapid structural change towards a knowledge-driven economy. In 1990 wood, pulp and paper accounted for 40% of Finnish exports, slightly above the share of metal and machinery products at close to one third. During the 1990s Finland became a major exporter of electronics and other high-tech products, which by the year 2000 accounted for 30% of exports (Figure 3) The structural change in production, exports and R&D were, indeed, very strong in international comparison. Only some newly industrialized countries have shown similar patterns of rapid structural transformation.

The foundations of the Finnish transition to a knowledge-driven economy were laid in the course of several decades. The key factors were raising investment in R&D and commitment to education. In a few decades Finland went from being one of the least R&D-intensive OECD countries to being the second most R&D-intensive today. Even in the midst of the deep recession of the early 1990s overall R&D investment remained high and public R&D support even rose at the time when virtually all other public expenditures were cut.

The export-led recovery from the recession brought about not only a major industrial restructuring, but also a subsequent improvement in productivity performance of the manufacturing sector. Today manufacturing productivity is above the US level, while that of the total business sector is well below.

Figure 6. Labor productivity in manufacturing, selected countries (USA=100)

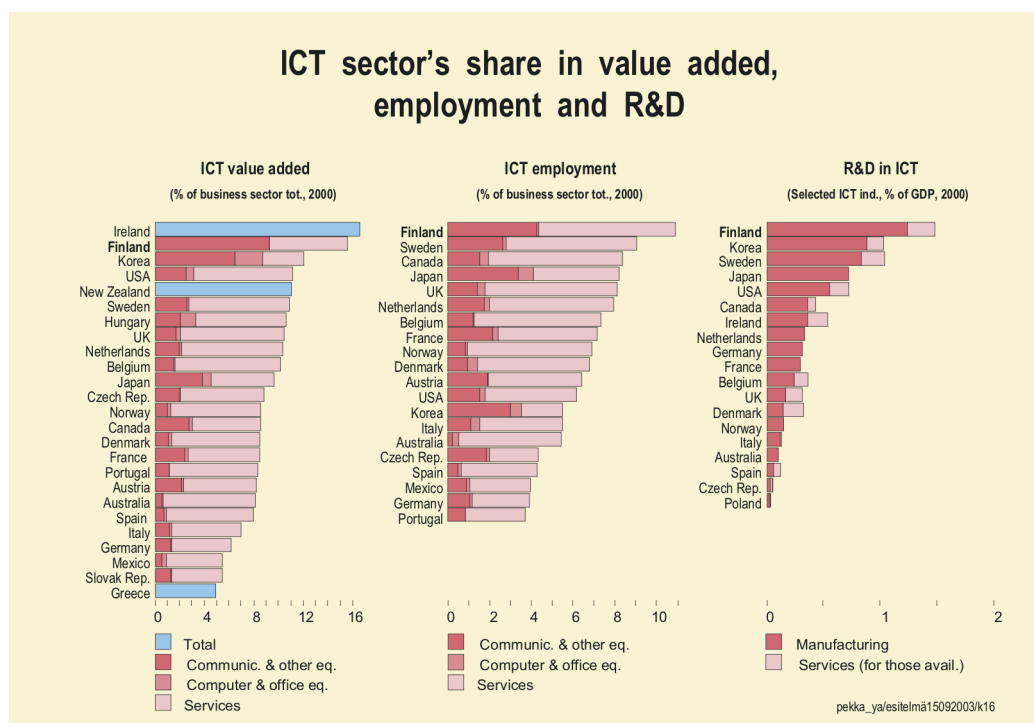


The rise in manufacturing productivity was mainly due to “creative destruction”, i.e., to major changes in plant, firm and industry structures. Strong plant-level restructuring cleaned low productivity and low technology plants, and new plants represented high technology and high productivity industries.<sup>12</sup> Hence, aggregate productivity increased, although productivity at plant level did not change much. The flip side of the high productivity performance is stubbornly high unemployment. Jobs have been destroyed in low productivity and often low technology plants, while practically all new jobs have been created in high-tech industries and plants. Maliranta (2002) shows that the productivity contributions of R&D, too, came through micro-level restructuring, i.e., plant-level restructuring was needed to reap the benefits of technological advance.

Although the restructuring of the 1990s was wide-ranging and covered practically all sectors in the economy, it was very much driven by the ICT sector, and by mobile telecommunications in particular. In the beginning of the 1990s Finland was one of least ICT specialized countries, today the most specialized. Such leapfrogging is rare, and very unlikely in an historical perspective<sup>13</sup>

Jalava and Pohjola (2002) show that macroeconomic effects of ICT in the late 1990s were quite similar in Finland and in the United States. As distinct from the situation of the United States, however, the effects in Finland are mostly mediated via ICT provision. ICT penetration rates are nevertheless quite high and the country is a leader in certain types of ICT usage, e.g., online banking and mobile payments. Although in most respects Finland is also an advanced user of ICT, it nevertheless seems that as a user it is not as exceptional as it is as a producer. This is somewhat alarming, as the long-run economic effects of ICT are mostly mediated via its use<sup>14</sup>.

**Figure 7. ICT specialization, selected countries**



12 Maliranta (2002)

13 See Koski – Rouvinen – Ylä-Anttila (2002)

14 See also Rouvinen – Ylä-Anttila (2003)

A specific feature of the Finnish ICT driven economy is the dominant role of one company, Nokia. Nokia accounts as much as some 80% of total exports ICT goods and services and more than that of ICT-related R&D. Nokia's share in the country's exports is one fifth, and share of industrial research and development about 60%. Hence the story of ICT-led growth of the 1990s is very much that of Nokia.

As discussed by Palmberg (2001), despite Finland's extraordinary and almost unique success in transforming its industrial structure towards high-tech industries, it is important to notice that a significant part of the Finnish economy continues to rest on manufacturing or service activities that are 'traditional' (in the sense that they are a long-standing part of the system). Finland continues to have an export specialization in pulp and paper and timber products, for example. Industries such as pulp and paper are often regarded as low technology, since their own R&D input in relation value added is low. Nevertheless, pulp and paper and timber industries are typical examples of sectors that are major users of knowledge generated elsewhere. These kinds of industries constitute an important part of the knowledge system where the flow of knowledge across industries and organizations leads to technological upgrading and increases innovation potential.<sup>15</sup> The big issue today is, how the front runner position in production of ICT can be transformed to efficient use of these technologies in traditional manufacturing industries and, especially, in services.

The 1990s was an important period, since it speeded up the process of structural change that had started already some 10 – 15 years earlier. Rapid structural transformation also enhanced the system thinking among policy makers – there was a need to get a comprehensive picture of the restructuring and its possible outcomes.

## 5. CONCLUSIONS

---

*How do we explain the 'Finnish miracle'?*

The performance of the Finnish economy in the 1990s was remarkable. It looked as though the economy had found a unique way to combine high social security, dynamism, and growth. Successful policies contributing to the Finnish success story were equated with a new economic model for the information society or knowledge-based economy.

While in hindsight the Finnish public policies of the 1990s were successful, the 'Finnish miracle' can only be partially explained by public policies pursued in the 1990s. The necessary policy changes had already been made in the 1980s, with some having come as early as the 1970s. Building competitive advantages takes time. There was no 'master plan' to restructure the Finnish economy and industry in the 1990s; rather an array of policy measures were working to the same end over an extended period of time.<sup>16</sup>

<sup>15</sup> Palmberg (2003)

<sup>16</sup> see Georghiou et al. (2003)

However, policies pursued since the early 1990s have had their role as well. There was a major shift in priorities as a consequence of European integration and changes in comparative advantages of the economy; focus shifted from short-term macroeconomic to long-term microeconomic policies. It is nevertheless true that sound but stringent macroeconomic policies contributed to the recovery. While joining the EU and EMU narrowed the scope of macroeconomic policies, it also brought new stability with moderate inflation, low real interest rates, and increasing predictability of fiscal policies.

Under these circumstances, the increased emphasis on microeconomic and especially innovation policies has been a successful choice. These new policies are based on indirect measures aimed at influencing firm behavior. Policies concentrate on rectifying market failures, promoting competition, and improving framework conditions. These types of 'enabling policies' fit well to the economic environment of the 21st century. The key priorities today are innovation policies and policies for enhancing the functioning of capital markets.

Although the 'high-road' strategy of innovation and technology has been emphasized only recently, it was initiated in the 1970s and 1980s. In the 1980s, long before the rise and fall of the 'new economy', Finnish technology policy began to give high priority to ICT. These policies were continued in the following decade and they undoubtedly contributed to the success story of the 1990s. Finnish R&D investment increased continually and networking between public and private actors was enhanced.

Finland was lagging behind the rest of Europe in industrial development after World War II. It consciously upgraded its skills and competencies and in half a century caught up with the leaders. Leapfrogging in the 1990s nevertheless involves many coincidental factors and good timing. Thus, Finland has been fortunate, but the fact that it was well-positioned when the opportunity provided by ICT revolution arose, had nothing to do with luck. Historically Finland has been a catching-up economy; now it is one of the leaders that is a much more demanding position.

### *Crises and creative destruction*

It has been pointed out by several scholars that small countries need and are often able to combine openness to the external world with internal cohesion.<sup>17</sup> That seems to have been true in Finland in the 1990s. Small countries usually experience more volatile growth and are sensitive to external shocks. Sometimes these lead to crises that cannot be managed by ordinary macro policies. That is what happened in Finland in the early 1990s. The country was hit by a deep recession that was followed by very rapid export-led growth and profound structural change. The economy opened further to the external world by lifting the remaining capital constraints and restrictions of foreign ownership. Finland was also in the forefront in liberalizing the telecom market that started in the 1980s and continued to full liberalization by the mid-1990s.

The economy took advantage of the booming global ICT market and increasing capital flows. There was an influx of capital to the country that facilitated the expansion of ICT firms. The economy that was among the least ICT specialized among the OECD countries became one of the most specialized just in less than a decade. This would probably not been possible without the internal cohesion and acceptance of economic and social changes that were strengthened by the crises.

17 See Bräutigam and Woolcock (2001), and Lundvall (1998).

The price of the spectacular growth and productivity performance has been a fairly high unemployment. During the post recession period jobs have increased predominantly in the high-tech industries and high productivity plants. Hence, attaining the top position in manufacturing productivity has mainly been a process of creative destruction. From now on productivity advances have to come from intelligent applications of ICT, i.e. more from use than production of ICT goods and services.

The crisis touched not only the national economy and its financial sector, but also the biggest corporation in the country. In the beginning on the 1990s Nokia was still a diversified multi branch company in deep financial crisis. In a couple of years it divested most of other industries and focused heavily on telecommunication equipments. By the end of the nineties it was one of the most profitable companies and the biggest producer of mobile phones world-wide (see Appendix 1 and 2). Interestingly, the country faced three major turning points at the same time and at different levels: global ICT revolution, national financial and economic crisis, and deep restructuring of the biggest industrial corporation. The key issue in the Finnish success story is adjustment and ability to turn these crises into opportunities and growth.

#### *Lessons to be learned?*

It is hard to say if there are any lessons for other countries to be learned. Economic and social models come and go.<sup>18</sup> It was no later than in the end of the 1980s when the Japanese economic and social model was celebrated as an ideal to the rest of the world. Today, it serves an example of an economy that is not able to make necessary reforms and where more flexible economic and social structures are needed.

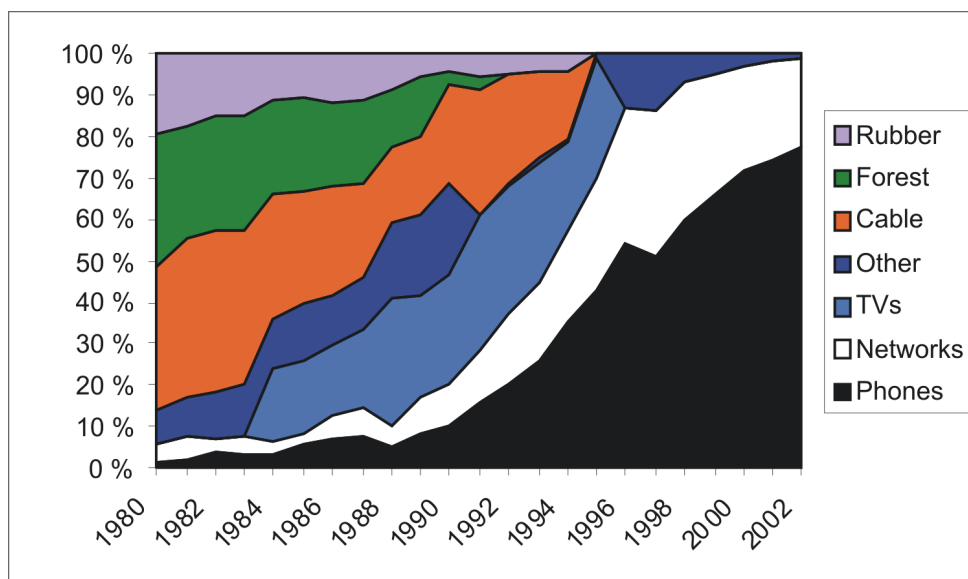
However, it might be an advantage of small countries to adjust more flexibly and create institutions more conducive to change. The Finnish experience suggests, at least, that a deep crisis often precedes considerable and lasting shifts in economic and social structures. It looks that small countries with greater homogeneity and closer interaction (networking) among economic agents may well be better equipped to cope with deep structural changes. They may also have an advantage in adjusting to new technologies and, hence, in generating long term economic growth.

The Finnish experience indicates that institutions matter. High quality institutions and social innovations matter in terms of managing exposure to global economy. Openness to the external world has to be combined with dense interaction and networking internally.

One indisputable lesson from the Finnish experience is that innovation policy 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.

<sup>18</sup> For a short review, see Ylä-Anttila (2003)

## Appendix 1: Nokia's Sales by industry, 1980 – 2002.



Sources: Derived by the authors from an earlier version by Pajja (2001, p. 27) with additional data from Häikiö (2001b) and Nokia's annual reports.

## Appendix 2. Nokia – A Big Company in a Small Country

Nokia is by far the biggest company in Finland. It accounts for one fifth of the country's total exports and close to three percent of GDP. But its role is even more important in strategically important activities like R&D and internationalization of business. Nokia's share in total business sector R&D is fifty per cent, and of total national research and development some forty per cent. Hence, as a performer of R&D, Nokia is bigger than the whole Finnish university sector. More than sixty per cent of Nokia's R&D (•3 billion in 2002) is conducted in Finland. Nokia's employment in Finland is 20,000, of which more than fifty per cent are in R&D.

Nokia's 2002 share in (Etla estimates)	
GDP	2.7%
R&D (GERD)	35%
Exports	21%
Employment	1%
Employment, manufacturing	5%
Market valuation of Helsinki Stock Exchange	60%

- Ali-Yrkkö, Jyrki and Mika Pajarinen (2003), Public R&D funding and its impact on companies – An analysis of the Finnish metal and electronics industry. (in Finnish “Julkinen T&K-rahoitus ja sen vaikutus yrityksiin – Analyysi metalli- ja elektroniikkateollisuudesta). ETLA Discussion Papers No. 846. Helsinki
- Ali-Yrkkö, J., Paija, L., Rouvinen, P., & Ylä-Anttila, P. (2003). Nokia: An Extended Company with Local and Global Operations. In P. N. Gooderham & O. Nordhaug, *International Management: Cross-Boundary Challenges*. Oxford and Boston: Blackwell.
- Bräutigam, Deborah and Michel Woolcock (2001), *Small States in a Global Economy. The Role of Institutions in Managing Vulnerability and Opportunity in Small Developing Countries*. UNU/Wider Discussion Paper WDP 2001/37.
- Castells, Manuel and Himanen, Pekka (2002), *The Information Society and the Welfare State – The Finnish Model*. Oxford University Press
- Georgiou – Smith – Toivanen – Ylä-Anttila (2003), *Evaluation of the Finnish Innovation Support System*. Ministry of Trade and Industry. Publications 5/2003. Helsinki.
- Guellec, Dominique and Bruno van Pottelsberghe de la Potterie (2003), *The impact of public R&D expenditure on business R&D*. *Economics of Innovation and New Technology*. Vol. 12(3), pp. 225-243.
- Hernesniemi, H., M. Lammi, and P. Ylä-Anttila. (1996) *Advantage Finland: The Future of Finnish Industries*. ETLA B 113, Sitra 149. Helsinki: Taloustieto.
- Jääskeläinen, Jari (2001), *Clusters – Between science and policy. From industrial policy to social policy* (in Finnish “Klusteri tieteen ja politiikan välissä. Teollisuuspolitiikasta yhteiskuntapolitiikkaan). ETLA Series A 33. Taloustieto Oy. Helsinki.
- Kalela – Kiander – Kivikuru – Loikkanen – Simpura (eds.) (2001), *Down from heavens, up from ashes. The Finnish economic crisis of the 1990s in the light of economic and social research*. Government Institute for Economic Research (VATT). Publications 27:6. Helsinki.
- Koski – Rouvinen – Ylä-Anttila (2002), *ICT Clusters in Europe. The great central banana and small Nordic potato*. *Information Economics and Policy* 14 (2002) 145-165.
- Lemola, Tarmo (2002), *Convergence of national science and technology policies: the case of Finland*. *Research Policy*, 31, 1481-1490.
- Lemola, Tarmo (2003), *Transformation of Finnish Science and Technology Policy*. Forthcoming in *Science Studies*.
- Lundvall, Beng-Åke (1998), *Nation states, social capital and economic development – a system's approach to knowledge creation and learning*. Paper presented at “The International Seminar on Innovation, Competitiveness and Environment in Central America: A Systems of Innovation Approach”, San Jose, Costa Rica, February 22 – 23, 1999.
- Maliranta, Mika (2002), *From R&D to productivity through micro level restructuring*. ETLA Discussion Papers No. 795. Helsinki.
- Miettinen, Reijo (2002), *National Innovation System – Scientific Concept or Political Rhetoric*. Sitra Publication series 252. Edita. Helsinki.
- Palmberg, Christopher (2001), *Sectoral patterns of innovation and competence requirements. A closer look at low-tech industries*. Sitra Reports Series No. 8. Helsinki.
- Rodrik, Dani (2000), “How Far Will International Economic Integration Go?” *Journal of Economic Perspectives*, Winter 2000.
- Romanainen, Jari (2002), *The Cluster Approach in*

Finnish Technology Policy, in Innovative Clusters – Drivers of National Innovation Systems. OECD Proceedings. Paris.

Rouvinen, P. and P. Ylä-Anttila. (1999), “Finnish Clusters and New Industrial Policy Making.” In OECD Proceedings, Boosting Innovation: The Cluster Approach. Paris: Organisation for Economic Co-Operation and Development.

Rouvinen, Petri – Ylä-Anttila, Pekka (2003), Little Finland’s transformation to a wireless giant, in Dutta – Lanvin – Paua (eds.) “The Global Information Technology Report 2003 – 2004”. Oxford University Press for World Economic Forum. New York.

Ylä-Anttila, P. 2003. The Information Society and the Welfare State—The Finnish Model (Book review). Research Policy 32, no. 8, pp. 1533-1534.