

Finland

as a

Knowledge Economy

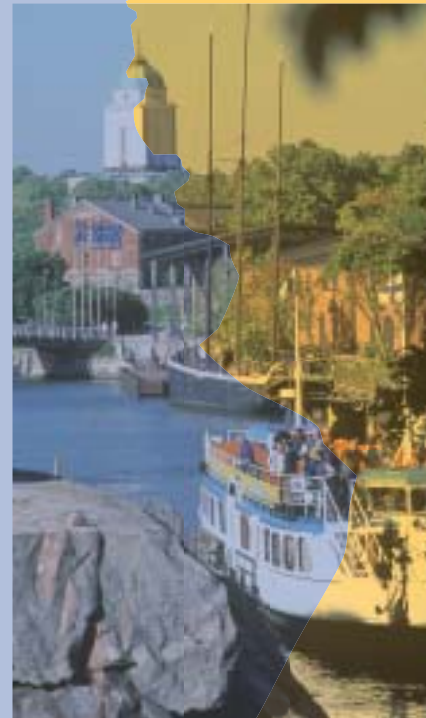
Elements of Success and Lessons Learned

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Knowledge for Development Program
World Bank Institute

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1818 H Street, NW
Washington, DC 20433

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Acronyms

EU	European Union
ADP	automatic data processing
ANBERD	(OECD database on R&D spending by businesses)
ATM	automated teller machine
CDMA	Code Division Multiple Access
CEPR	Center for Economic Policy Research
CIS	Community Innovation Survey
EEC	European Economic Community
EFTA	European Free Trade Association
EMU	Economic and Monetary Union
EPO	European Patent Office
ESIS	European Survey for Information Society Projects and Actions
ETLA	Research Institute of the Finnish Economy (Elinkeinoelämän tutkimuslaitos)
ETX	Electronics for the Information Society (TEKES Program)
EU	European Union
FDI	foreign direct investment
FEPOCI	(database)
FII	Finnish Industry Investment
FINPRO	Finnish National Agency for Corporate Internationalization
GATT	General Agreement on Tariffs and Trade
GDP	gross domestic product
GITEI	Global International Technology-Economy Index
GERD	Gross Expenditure on Research and Development
GSM	Global System for Mobile Communication
HSE	Helsinki Stock Exchange
ICT	information and communications technology
IIAS	International Institute of Administrative Sciences
IMD	International Institute for Management Development
IMF	International Monetary Fund
IOS	(publisher)
IP	Internet protocol
IPO	initial public offering
IT	Information Technology
KAM	Knowledge Assessment Methodology (WB database)
KE	knowledge economy
KEI	Knowledge Economy Index
KELA	Social Insurance Institute of Finland (Kansaneläkelaitos)
MTI	Ministry of Trade and Industry
NACE	Classification of Economic Activities in the European Community
NII	National Information Infrastructure

NMT	Nordic Mobile Telephone
ODM	original design manufacturer
OECD	Organisation for Economic Co-operation and Development
PISA	Program for International Student Assessment
PPP	purchasing power parity
PTO	public telephone operator
R&D	research and development
S&T	science and technology
SITRA	Finnish National Fund for Research and Development (Suomen itsenäisyyden juhlarahasto)
SME	small and medium-sized enterprise
SMS	text messaging
STAN	Structural Analysis database
STPC	Science and Technology Policy Council
T&E Centers	Employment and Economic Development Centers (TE-keskus)
TD-SCDMA	Time Division–Synchronous Code Division Multiple Access
TEKES	National Technology Agency (Teknologian kehittämiskeskus) of Finland
TLX	Telecommunications—Creating a Global Village (TEKES Program)
TT	technology transfer
UMTS	Universal Mobile Telecommunication System
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organisation
USPTO	United States Patent and Trade Office
VTT	Technical Research Center of Finland (Valtion teknillinen tutkimuskeskus)
W-CDMA	Wideband Code Division Multiple Access
WEF	World Economic Forum
Wi-Fi	wireless fidelity
WLAN	Wireless Local Area Network
WTO	World Trade Organization

Executive Summary

Knowledge has become one of the main driving forces of economic and social development in both industrialized and developing countries. Accelerated by rapid advances in information and communication technologies (ICTs), the knowledge economy (KE) offers possibilities to increase productivity and competitiveness, leapfrog development phases, and open paths toward more sustainable futures. The case of Finland shows that it is possible for a small and peripheral country to transform itself in a relatively very short period from a natural-resource-based economy into a knowledge economy. The elements of success and new challenges encountered in this process are the central points of this study. The lessons learned also encourage building an infrastructure for a knowledge economy such as investing in education and research as well as in information and telecommunications systems.

In the early 1990s, Finland went through watershed developments due to a severe economic recession, during which unemployment rates rose from 2 percent—3 percent to over 15 percent and GDP decreased by more than 10 percent. However, in one decade—the last—Finland became the most ICT-specialized economy in the world. Three times it has ranked number 1 in the World Economic Forum’s (WEF) competitiveness index. It also ranked highest in the OECD’s Program for International Student Assessment (PISA) studies of learning skills and educational attainment.

Infrastructure in place that facilitated the changeover

Even though the specific Finnish path toward the knowledge economy was shaped largely by the emergence and success of ICT production, the various other relevant elements were in place and contributed in a balanced way to the developments. These elements were the economic incentives, education, innovation, and the IT infrastructure. This study highlights particularly the changes in the economic and institutional regimes, industrial and innovation policies, and the education system, as well as intertwined developments in the forest- and ICT-based industries.

In terms of timing, changes in the economic and institutional regimes have favored the transformation of the Finnish economy through its various stages of industrialization. Following World War II, membership in the World Bank, the International Monetary Fund (IMF), and the World Trade Organization (WTO) contributed to rapid recovery. In the 1980s and 1990s, trade liberalization and participation in the European Free Trade Association (EFTA), followed by association and full membership in the European Union (EU), stimulated product and market diversification of Finnish exports. The financial system had been relationship-focused, debt-based, and dominated by deposit banks. During the 1990s, it was deregulated toward a system in which the stock market and venture capital gained in importance. Even though the rapidity and mismanagement of this deregulation contributed to the severe economic recession, they also supported the longer-term

transformation toward a knowledge- and innovation-driven economy and the emergence of the ICT industries. Finally, the Finnish telecommunications market has been more competitive and liberalization has occurred earlier than in most other countries, thereby benefiting Finnish ICT companies.

Industrial and innovation policies in Finland have contributed to knowledge-based economic activities both directly and indirectly. Since the early 1990s, the emphasis of industrial policy has been on providing framework conditions for companies and industrial clusters through supporting R&D and related innovative activities at the micro level. This emphasis is visible, first and foremost, in the rapidly rising R&D share of GDP. In terms of R&D intensity, Finland ranks among the top countries.

Likewise, the roles of various public organizations and other actors have been important. *The Finnish system of innovation is characterized by public-private partnerships, good public governance, consensus-building, and dense networking among companies, universities, and research organizations.* A goal-oriented and egalitarian educational system has been the foundation for the R&D-oriented strategy that Finland has followed. The law on common schools was passed in 1866, and, a few years later, attending common school became a basic right and common duty for everyone aged 7 to 12 years. Today, 40 percent of each age group complete tertiary-level education, which is among the highest percentages in the world.

Nonetheless, *the major impetus to knowledge economy developments has come from the actions of companies.* Finland has followed an atypical pattern of industrial development. In comparison to other countries, its transformation from an essentially natural-resource-based economy into one that relies heavily on high technology and knowledge has been unprecedented and quick. This rapidity has been due largely to the establishment of various linkages between sectors and industries throughout the Finnish economy. The forest-related industries provided the pioneering electronics and ICT companies in Finland with an important experimental home market, and thereby contributed significantly to knowledge economy developments in Finland. In turn, developments in the ICT sector can be attributed to the existence of a dynamic and competitive operators' market, knowledge complementarities, and collaboration—and to Nokia as the industrial engine. Today, the ICT industries constitute the third pillar of the economy, alongside the forest-related and engineering industries.

The future

Strong past performance according to various international competitiveness rankings does not guarantee future success. The fast-growth phase of the Finnish economy in the 1990s was based principally on the specific ICT-driven path toward the knowledge economy. The future challenges relate to the rapid aging of the population and to the likely decrease in steep productivity gains from the ICT sector. Finland also faces challenges that relate to the more efficient use of these technologies in traditional manufacturing industries as well as in public and private services. New growth opportunities are envisioned for ICT in combination with nanotechnology and papermaking technologies, that is, in combining traditional strongholds with new and emerging technologies. Presently, the overarching policy issue in Finland is whether the country can keep its Nordic welfare model and still compete successfully in a global economy.

Lessons

On a broad level, it is appropriate to reflect on what can be learned from the Finnish experience and what these lessons imply for developing countries.

The first lesson is that it is possible for a country to make a dramatic recovery in the level of GDP and at the same time, undertake a major restructuring, as Finland did. An important corollary is that a crisis can be turned into an opportunity. However, for this to happen, there may need to be certain preconditions as well as great flexibility in the economy.

A second lesson is that globalization is a double-edged sword and a demanding taskmaster. Finland has become the leading ICT technology because it has adopted the global ICT industry and produced for the global market. On the other hand, Finland is also struggling with the impact of globalization, which is putting pressure on it to improve its technology and education systems to stay competitive in a very demanding global environment.

The third lesson is the importance of flexibility or elasticity of the economy to react of changing opportunities, and the importance of a responsive education sector to facilitate this. It is perhaps the educational system that has played the most critical role. Finland already had a high level of educational attainment, which facilitated the necessary restructuring of the economy. In addition, the educational system was able to respond very quickly and flexibly to the new opportunities. Furthermore, increasing this flexibility is seen as a key priority to respond to the continuing challenge of the constant restructuring that results from globalization.

The Finnish experience also has several implications for developing countries.

The first implication is *the continued importance of the basic elements of the Washington Consensus.* These elements are essential to give the economies the flexibility they need to constantly redeploy assets to their most productive uses.

The second implication is *the imperative to develop vision and consensus-making mechanisms.* Reforms involve changing the status quo, and doing so usually does not happen unless there are major external or domestic forces pushing or demanding such changes.

The third implication is *the importance of developing appropriate knowledge strategies,* Finland had to increase higher educational attainment in general, and scientific and technical skills in particular. These challenges involved not only increasing R&D expenditure but also focusing on getting the fruits of R&D into the market. Finland's strong emphasis on the systemic approach to innovation evolved, including bridging the entrepreneurship and financing gaps to turn invention into commercial application.

These strategies have to be adjusted to the specifics of each country. For the majority of developing countries the focus needs to be somewhat different than Finland's. Because, in virtually all sectors, developing countries are still very far from the technological frontier, they still need to put priority on developing effective means of tapping the preexisting and rapidly growing stock of global knowledge.

A final implication for all countries is *the importance of focusing not only on what can be learned from the past (their own and other countries' experience) but on anticipating and preparing for the future.* This is one of the key lessons of the Finnish example and explains to some extent why Finland not only was able to make such a dramatic transformation to a knowledge-based economy but also why it has been able to remain so competitive.

Moreover, as can be inferred from the challenges that Finland is facing as a result of the rapid advances in knowledge and the continuous challenge of globalization, the world is not standing still. What worked in the past may not work in the future, and the prerequisites for being successful seem to be rising ever higher and becoming ever more demanding. Thus derives the importance of looking forward to see to what extent it is possible to be better prepared for future challenges and opportunities. Developing countries in particular need to monitor this aspect closely because there may be important new areas that can be exploited, and it will be necessary for them to be ready to move quickly to take advantage of them.

Foreword

Knowledge is fueling economic growth and social development in every region of the world. The forces of globalization such as migration, travel, trade, foreign investment, and communications are speeding the dissemination and use of information across boundaries. New ideas and innovation are spreading faster than ever. Knowledge-based growth and development offer opportunities for both developed and developing economies. Advancement in information and communication technologies (ICTs) has been a necessary condition for these new developments in the global economy.

ICTs provide the means for developing countries to accelerate their progress or even leapfrog into a more advanced phase of development and to enable their integration into the global economy. For developed countries the knowledge-based economy allows further specialization, improvements in productivity, and the achievement of sustainable growth: knowledge capital is the only asset that can grow without limits; and new knowledge increases the efficient use of resources that are in finite supply.

The Finnish experience in the 1990s is an example of how knowledge can become the driving force in economic transformation and growth. Although as recently as the 1970s Finland was relying mainly on resource-intensive industries, it is now the most ICT specialized economy in the world. This achievement is all the more remarkable considering the deep recession it experienced in the early nineties, with a major banking crisis that led to rapid worsening of public finances, unemployment, and the external balance.

Rapid structural transformation beginning in the mid nineties coincided with equally rapid improvements in macro balances. By the end of the decade the country's macroeconomic performance was one of the strongest in Europe. The Finnish experience shows that it is possible to make significant structural changes in a relatively short time. It also shows that long-term decisions that shape research and education are possible, and indeed necessary, during short term economic crisis, since they provide guidelines for longer-run growth and help create a sustainable competitive edge.

The study has been a joint effort by the World Bank Institute, the Finnish Ministry of Trade and Industry and Ministry of Foreign Affairs, Finpro—Finnish National Agency for Corporate Internationalization, and ETLA—the Research Institute of the Finnish Economy.

Although Finland has many characteristics that cannot easily be replicated by other countries, much of its experience in designing knowledge-based economic and social strategies is highly relevant. A key lesson is the importance of flexibility in responding to change, and the critical role of a responsive education system. Finland's experience also highlights the importance of developing a vision and a process for consensus-building. We hope that Finland's example of turning a crisis into opportunity provides inspiration to other countries forging their own path in today's global knowledge economy.

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Vice President
World Bank Institute

Acknowledgments

This book is the result of a collaboration among several organizations and individuals. The research was carried out by Carl Dahlman of the Knowledge for Development Program at the World Bank Institute (WBI); a small team headed by Pekka Ylä-Anttila at the Research Institute of the Finnish Economy (ETLA) including Ville Kaitila, Heli Koski, Liisa Leijola, Laura Paija, Christopher Palmberg, and Paula Tiihonen; and Professor Jorma Routti of Creative Industries Management (CIM), Helsinki. It was cofinanced by the World Bank Institute, Finnish Ministry of Foreign Affairs, and Ministry of Trade and Industry.

The authors would like to thank Pekka Hukka (Ministry of Foreign Affairs), Kari Janhunen and Seppo Laine (Finpro), and Matti Pietarinen (Ministry of Trade and Industry) for their useful comments on various drafts. We are also grateful to Kari Janhunen for mobilizing financial resources and managing the consultation process, and to Jean-Eric Aubert (WBI) for his valuable feedback and advice. Tuomo Nikulainen (ETLA) skillfully compiled the data and managed the databases that were so essential to our analysis.

The book was discussed at a World Bank Review Seminar in May 2005 chaired by World Bank Vice President Danny Leipziger. Comments by the discussants, Lauritz Holm-Nielsen, Alfred Watkins, and Vandana Chandra, and by the seminar participants also helped improve the final product.

We are also grateful to John Didier (WBI) for managing the publishing process, to Derek Chen (WBI) for proofing and correcting the final manuscript, and to Anuja Utz (WBI) for shepherding the book to completion. Alicia Hetzner's editing made the book more readable.

1

Introduction

Carl Dahlman, Jorma Routti, and Pekka Ylä-Anttila

1.1 The knowledge economy

Knowledge has become the major driving force of economic and social development all around the world. Coupled with globalization and accelerated by rapid distribution and transfer of knowledge by information and telecommunication technologies, this development impacts all countries and regions, public institutions, the corporate world, and the lives and prospects of individuals.

The knowledge economy is based on the generation and adoption of new knowledge created by scientific research and technological advances; investments in education and research; adoption of best practices; and openness to social, economic, and cultural innovations. For advanced industrialized countries with high labor and infrastructure costs, the knowledge economy offers competitive advantages in high-technology product manufacture and efficient service sectors. For natural-resource-based economies it offers improved technologies and higher-value added products with closer customer linkages, as well as a path for sustainable development. For developing countries, knowledge offers possibilities to short cut development phases, leapfrog technologies, and more quickly integrate into the global economy by becoming more attractive to international investors.

As an example of knowledge economy components, we can mention the rapid development and adoption of information and communication technologies (ICT), such as wireless mobile telecommunication. It took more than 100 years to build the fixed-line telephone system in industrialized countries. In dramatic contrast, in 2 short decades, the number of mobile telephones worldwide recently reached 1.5 billion and now exceeds that of fixed-line connections. Bypassing the economic and quality of life costs of digging up metropolitan streets to install telephone cables and marring the countryside with telephone poles, wireless technologies have brought to most countries domestic and global connectivity as well as advanced digital services. These technologies afford information and knowledge access through the Internet to even the most remote, poorest, and most peripheral regions. ICTs also offer great opportunities to develop efficient business and public services in developing countries.

In recent years, the economic theories pertaining to the knowledge economy have been the subject of intensive research. They often are characterized by turbulent evolutions resulting in virtuous or vicious circles of development. For instance, high-technology industries differ significantly from traditional industries. Their products typically have short life cycles, short windows of opportunity, and diffi-

culty in accessing global markets quickly. Consequently, the high-tech industries are characterized by high research intensity and often also by high capital intensity. Their cost structures are dominated by development expenses and marketing efforts rather than by manufacturing and material costs.

The conversion of knowledge into economic and social benefits requires good innovation systems, including highly qualified personnel and efficient technology transfer (TT) and venture capital. However, equally and perhaps even more important than the creation of new high technology industries is to maintain and improve the performance and competitiveness of traditional industries by providing them access to high technology and knowledge.

The new knowledge environment offers many opportunities to active players. Rapid growth leading even to world market dominance is possible as illustrated by many success stories around the world. On the other hand, these same characteristics can lead to greater polarization between winners and losers. International competition is strengthening the demand for the most qualified people and for international investments. Hence, *the questions of social inclusion and avoiding the digital divide call for attention.*

1.2 The Case of Finland

Finland is a country that, in a relatively very short period, has transformed itself into a knowledge economy. In recent years, it has been consistently ranked among the top performers in international competitiveness rankings. Measured by many indicators related to the knowledge economy, it has been ranked first.

This achievement is quite remarkable especially when considering Finland's economic situation in the early 1990s. The country went through a severe economic recession characterized by a major banking crisis, unemployment rates that rose from 5 percent to over 15 percent, and the accumulation of government debt from modest levels to over 60 percent of GDP that were approaching international lending limits (box 1.1)

These difficulties were caused and exacerbated by an uncontrolled deregulation of financial markets and a rapid increase in foreign borrowing, which led to an overheated domestic economy. High inflation pushed up interest rates and overburdened the public sector due to smaller tax revenues and larger unemployment and welfare costs. Furthermore, the collapse of the Soviet Union wiped out 15 percent of Finland's foreign trade with that country and the attractive barter arrangements. This drastic drop in income left some traditional Finnish industries, such as clothing and footwear, with less competitive technologies and cost structures, and without market access.

Finland's difficulties were amplified by its not being well prepared for economic integration and globalization, efforts to comply with the regulations for membership in the European Union and European Monetary Union, and the lack of export diversity. Exports were dominated by the forest-related industries, which still play an important role in the Finnish economy. However, they have greatly strengthened their position as a result of consolidation and the emergence of a few multinational companies with advanced technologies and market approaches. In earlier times, the competitiveness of the forest-related industries was often secured by frequent

**Economic crisis
in the early
1990s was severe**

Box 1.1 Recession of the early 1990s

In the last two decades of the twentieth century, Finland's economy experienced turbulent change. It underwent overheating, depression, recovery, and boom—followed by an abrupt economic slowdown at the outset of the new millennium. This period witnessed fundamental changes in the regulatory environment, economic policy thinking, and industrial structure and organization (chapter 4).

Finland's began the deregulation of its financial markets in the mid-1980s, resulting in a lifting of constraints on private foreign borrowing and controls on domestic interest rates. However, the fixed exchange rate policy was left intact. The consequent lending boom and massive foreign capital inflow overheated the economy. Much of the excessive supply of funds found its home in real estate and other assets and inflated their prices to unprecedented levels.¹

The boom ended abruptly in 1990. Real GDP growth plummeted from a pace of some 5 percent in 1989 to -0.3 percent in 1990. The economy contracted by an additional 6.5 percent in 1991. The downturn continued in 1992 and 1993, when GDP declined at annual rates of 3.8 percent and 1.2 percent, respectively. GDP decreased in 1990-93, in total by more than 10 percent. Finland's depression—the deepest experienced by any OECD country since World War II—has been described as “a story of bad luck and bad policies.”² The bad luck stemmed from four shocks in international trade:

1. An economic downturn in the OECD economies
2. The abrupt decline in Finland's exports following the collapse of one its main trading partners, the Soviet Union
3. High interest rates in Europe resulting from German unification
4. Slowing growth throughout Europe.

The reference to “bad policies” relates to the mix of pro-cyclical fiscal policies and the fixed exchange rate policy. The government's attempts, and eventual failure in 1992, to defend the fixed currency led to record-high interest rates and a sharply devalued domestic currency. A wave of personal and company bankruptcies resulted in a banking crisis that eventually cost taxpayers an estimated 7.5 percent of GDP.³ The unemployment rate reached 17 percent in 1993, that is, almost 15 percentage points higher than in the pre-depression level.

Finland's economy began to recover in 1994. The shock had contributed to fundamental restructuring of different elements of the economy. The business sector, for example, underwent a wave of reorganization as unproductive firms left the market and more efficient ones stepped into the breach.⁴

The employment structure also changed, although leaving the new “natural” unemployment rate at a significantly higher level.⁵ Indeed, unemployment has come down slowly in recent years from the high of 17 percent, but in 2004 still stood at almost 9 percent.

Finally, and most importantly, the structure of industrial output and exports changed, as the ICT industry emerged and joined the traditional forest and metal-related industries to become one of Finland's most important sectors (figure 3.3). Finland became a member of the EU in 1995 and adopted the common European currency a few years later. By 2000, as a result of industrial restructuring, Finland had become the world's most ICT-intensive country in terms of R&D, employment, and exports. It stood second behind Ireland in ICT value added. Finally, by the standards of international research institutions, it ranked among the most competitive countries in the world.

¹ See Honkapohja and Koskela 1999 and Kiander and Vartia 1998 for detailed analyses of the 1990s crisis.

² Honkapohja and Koskela 1999.

³ Honkapohja and Koskela 1999.

⁴ Maliranta 2001.

⁵ Honkapohja and Koskela 1999.

devaluations of the currency in response to the cyclical nature of the international pulp and paper markets. Today, in the euro regime, this is neither possible nor desirable, because of the resulting inflation and increase in foreign debt.

Thus, the diversification of exports has been mandatory to improve the performance of the Finnish economy. This diversification has been due largely to the emergence of new knowledge-based industries and the adoption of knowledge economy

**R&D spending
was increased to
3.5% of GDP**

concepts throughout the whole society. Research and development (R&D) investments by government and primarily the private sector have more than doubled to reach levels equivalent to 3.5 percent of GDP, which is above the EU average of less than 2 percent and the OECD average of approximately 2.5 percent. This increase in R&D investments required a great

deal of political wisdom and courage during times of high unemployment when an easier path would have been to generate immediate employment rather than build up longer-term strengths. This increased R&D has been helped partly by national strategies designed for various fields in society. Also helpful was consensus building, for example, by organizing economic policy programs attended by practically all members of the Finnish Parliament and other decision makers from the public and private sectors, media, and labor market organizations.

The Finnish innovation system also has been successful in converting the R&D investments and educational capacity into industrial and export strengths in high-technology sectors. The share of high technology in total exports has grown from 5 percent in the late 1980s to approximately 20 percent, resulting in a significant trade surplus. Telecommunication exports today are almost as high as those of the forest-related industries, and the Finnish Nokia Corporation has grown into a world leader in mobile communications. Hundreds of other smaller high-technology companies also have been established, and many have become world leaders in their niche markets. The growth performance also has been remarkable over the longer run. Following the Second World War, Finland's GDP growth has been among the fastest in Europe.

The success of Finland is remarkable not only in light of its earlier economic difficulties. It is interesting to see that knowledge economies can be successfully built in a small and rather peripheral country. Finland is a relatively large country covering an area similar to that of the United Kingdom or Japan, between latitudes 60° and 70° North extending beyond the Arctic Circle. Although more than half of the people in the world living this far north are Finnish, the total population of the country is only five million. Furthermore, the Finnish language is spoken only by Finns. While this is an asset for a strong national culture, it makes international communications difficult.

The case of Finland shows that it is possible for an economy to transform itself from one based on natural resources and investment into one driven by technology and knowledge. It also shows that it is possible to do it in a small country far away from principal economic and market centers. It is also important to observe that this transformation occurred without sacrificing basic economic security and other elements of the welfare system but, rather, by developing the economic and social aspects in parallel.

Of course, Finland has its challenges, as do all countries in the global economy. The responses to these challenges are the subject of active study and debate in Finland today and will be briefly covered also in this study.

1.3 Structure of the book

This volume is organized as follows. In *chapter 2* we take a look at Finland as a knowledge economy today. We give some basic facts on the economy and highlight the most recent knowledge-based developments.

Chapters 3 and 4 are narrative discussions of how Finland has become a knowledge economy. We first take an historical perspective and describe the structural transformation from a factor-driven (investment-driven), resource-based economy to one that is primarily knowledge based. Special emphasis is given to structural changes since the early 1990s, which have formed the basis for the current innovation-driven stage of industrial development. One of the basic messages of *chapter 4* is that *institutions matter*. We discuss in particular the significance of social institutions.

In *chapter 5* we examine policies toward enhancing investment in knowledge creation and diffusion, that is, education and science and technology policies. The chapter gives perspective on the mechanisms of industrial transformation and the role and functioning of policy organizations and instruments is described. The aim of the chapter is to explain how Finland has become one of the world's leading knowledge-based economies.

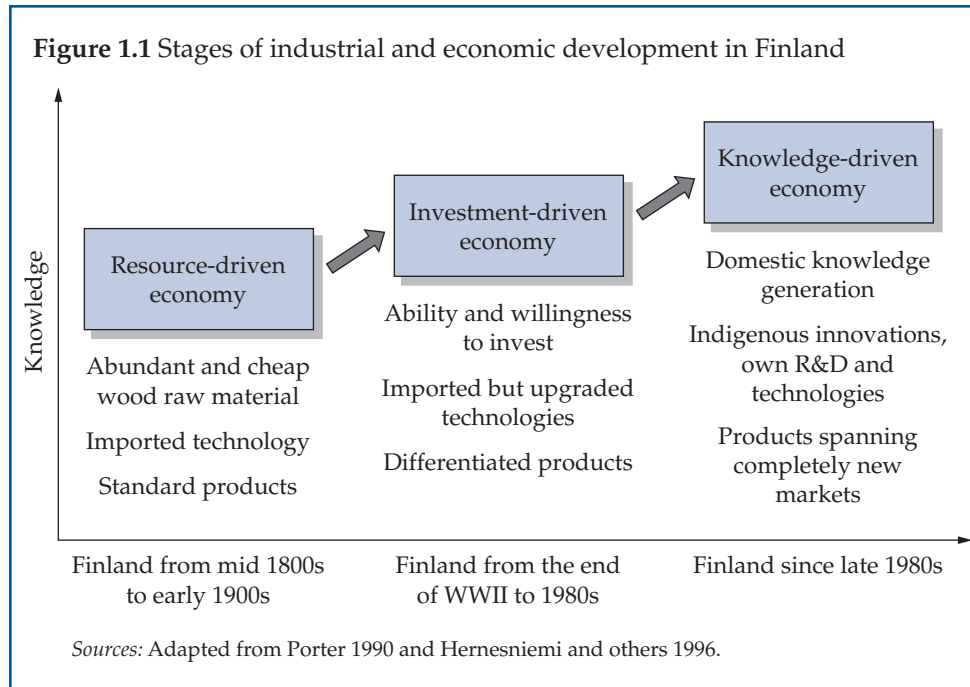
Chapter 6 looks at the knowledge economy from a sectoral perspective. We review the two most important Finnish industrial sectors—the forest-related industry and information and communication technologies sector—in more detail. Both are of vital importance to the economy, and there are important linkages between the two, even though one represents a traditional natural-resource-dependent industry and the other depends on almost purely intangible knowledge. Furthermore, globalization and international consolidation in pulp and paper-making, as well as other traditional industries, is likely to strengthen the linkages again in the future. Due to the need to integrate the geographically dispersed activities of global corporations, there is a growing demand for ICT-based products and services.

Finland certainly is an ICT-driven knowledge economy that has benefited from being an early producer of these technologies. Two of the greatest challenges facing its economy today are the need for more efficient and extensive use of these technologies and the impact of heightened competition from newly industrialized countries. *Chapter 7* addresses these and other topical challenges in the context of knowledge economy developments in Finland. It takes a look at the changes in the global ICT market and discusses internal factors such as aging of the population and the need to increase productivity in services provision to maintain the welfare society.

Finally, *chapter 8* discusses the lessons learned from the Finnish case. Are there lessons that can be replicated elsewhere? Or is Finland a unique case that can not be reproduced in any way?

1.4 Conceptual framework

The structure of the book derives from a simple examination of the historical phases of Finland's development. We look at the Finnish path to a knowledge-based economy, which comprised three stages of industrial development: the resource-driven, investment-driven, and knowledge- or innovation-driven stages (figure 1.1). The



framework is adapted from Porter (1990) and Hernesniemi and others (1996), and Ministry of Trade and Industry (1993).⁶

While describing the characteristic features typical of different development stages of the economy, the framework also gives insights into the different roles of policies in the different stages. Obviously, different policies are appropriate at different phases. The three stages cannot be strictly separated from one another. Rather, they overlap and certain features of each can be identified throughout, starting from the initial stage of early industrialization.

In the *factor- or resource-driven* stage of an economy, the competitive advantages of growing and internationally successful industries are based almost solely on the basic factors of production. In Finland, this factor-driven stage started in the mid-1800s and lasted until the 1930s. The factors of production included abundant timber resources, some minerals, hydropower, and waterways for transportation. There was very little national production of investment goods. Firms relied on technologies developed elsewhere; primarily inexpensive and widely available technologies were used. The transfer of technology from other countries was important, but only a few firms had direct contacts with end users and international customers. The economy was sensitive to fluctuations in the world commodity and capital markets. The basis for sustained productivity growth had just started to develop. However, Finland moved onto a path of relatively rapid growth driven by expanding exports of timber and wood products. The growing prosperity was channeled partly to nationally vital investments. This increase in export revenues

⁶ The description of the phases draws heavily from Ministry of Trade and Industry 1993 and Vartia and Ylä-Anttila 1992.

coincided with a strong commitment to build an economic infrastructure and institutions, such as educational and financial systems.

In the *investment-driven* stage, national competitive advantage is characterized by the willingness and ability of firms to expand their operations by investing aggressively in modern and efficient production technologies and facilities. The firms tend to acquire the best technologies available. Foreign technologies are not only applied but also improved for the firms' own purposes. Hence, firms are able to adopt and further develop innovations made elsewhere. However, firms still compete with relatively standardized products using efficient methods of production.

In Finland, this stage took place from the 1950s to the late 1980s. It involved, above all, investing in paper-making machinery, energy technology, and engineering industries to reap benefits from economies of scale and energy efficiency. A strong national consensus was needed to favor investment over current consumption and excessively generous distributive policies. Industry and economic policies were geared toward enhancing investment by channeling capital toward particular industries, providing tax incentives, and using aggressive exchange-rate policies to boost exports.

In the *knowledge-driven* stage, there is usually a wider range of internationally competitive industries and firms, even in smaller economies. However, a substantial portion of these industries and industrial clusters draw their competitive edge from traditionally strong sectors. Many innovative firms and industries emerge in fields that have strong linkages to traditional ones. Firm entries and entrepreneurship increase domestic rivalry. Innovation is spurred by increased competition in the product market. Self-created and sophisticated factors of production are crucial for competitive advantage. Firms compete in global markets with differentiated goods.

Finland's move to knowledge-driven growth was closely linked to the emergence of ICT in the late 1980s. However, in Finland, ICT had strong linkages to the traditional forest and metal industries. The electronics industry had started to develop in the 1960s by supplying process control, factory automation, and information technologies to the key export industries. An important aspect of this stage of industrialization also was the opening up of the economy, when the internationalization of production really took off.⁷ The role of policies changed dramatically during this time. Innovation and technology policies became the focus of overall industry and economic policies. The basic policy orientation shifted from traditional market interventions toward upgrading and creating sophisticated production factors and improving the overall business environment.

The narrative of this volume follows the "stages framework" just outlined. However, we start from the knowledge-driven stage by giving a short overview. The subsequent sections move chronologically to describe the road to the knowledge economy.

⁷ Mannio, Vaara, and Ylä-Anttila 2003.

2

Finland's Knowledge Economy Today

Pekka Ylä-Anttila

2.1 Foundations for a knowledge-driven economy

During the first few years of the twenty-first century, Finland has been ranked number one by several international competitiveness comparisons.¹ Since 2001, the World Economic Forum (WEF) Global Competitiveness Report has put the country in first place three times. The economy's competitiveness is not based on being rich in natural resources, large size, favorable climate, or abundant supply of labor. On the contrary, Finland is a small economy, located in the northern European periphery, and is rich only in forest resources. Geographically, Finland is approximately the size of Germany or the United States state of New Mexico. Yet, with only 5.2 million inhabitants, it is sparsely populated. The climate is cold, but not quite so harsh as might be expected in the second most northerly country in the world.²

Competitiveness indices predict relatively poorly the future growth performance of economies, but they may give useful hindsight on the various factors that have contributed to the competitive edge and well-being of nations. Undoubtedly, the most important factors include education, technology, well-functioning public institutions, openness of the economy, and its integration within international trade blocs. However, today, additional factors of growth performance, such as network readiness, research and creativity, equal opportunities for all individuals, and environmental sustainability, are becoming essential as well, as is discussed below.

An important issue is also adaptability to, and common acceptance of, change, as is typical in small countries.³ In the 1970s, the Finnish economy was characterized by factor-driven and resource-based features. In two short decades, Finland had gone through a major structural change and moved into a knowledge-based information society. The country produced such success stories as Linux and Nokia, which grew into global giants in less than a decade. In the 1990s, Finland completed the journey from being one of the least ICT-specialized countries to becoming the single most specialized one.

¹ WEF (World Economic Forum) and IMD (International Institute for Management Development) both rank Finland high in their competitiveness reports. As a matter of fact, Finland is the first European country that has ever been in the top of WEF's rankings. According to *WEF Global Information Technology Report 2002-2003* (Dutta et al., eds. 2003), Finland is the most developed IT society in the world. Global International Technology-Economy Index (GITEI) at the Department of Computer Science, Stanford University, places the country second overall among some 50 countries surveyed worldwide.

² For a short description, see Rouvinen and Ylä-Anttila 2003. For a longer story, Lewis 2005 gives an extensive geographical and historical overview.

³ See, for example, Lundvall 1999 and Ylä-Anttila and Lemola 2003.

Table 2.1 Basic facts of Finland

<i>Finland</i>	
Population:	5,236,611 (2004)
Governmental type:	Republic
Capital:	Helsinki
GDP per capita:	\$29,000 (2004)
GDP composition by sector:	<i>Agriculture and forestry 4.3%, industry 32.7%, services 62.9% (2004)</i>
Employment structure by occupation:	<i>Agriculture and forestry 8%, industry 22%, construction 6%, commerce 14%, finance, insurance, and business services 10%, transport and communications 8%, public services 32%</i>
Unemployment rate:	9% (2004)
Industries:	Electronics (ICT), engineering and metal products, pulp and paper, shipbuilding
High-tech exports as a share of manufacturing exports:	24% (2004)
Total expenditure on R&D as a share of GDP:	3.4% (2004)
Science and engineering enrolment ratio (tertiary-level students):	39%

However, the more traditional industries—including pulp and paper and engineering—also were renewed. There was a major structural change across and within industries and, although a good deal of re-employment took place, the unemployment rate remained high compared to previous crisis levels. The social safety net of a Nordic welfare state that had been built over the post-World-War-II decades was very helpful in dealing with this higher rate of structural unemployment.

Educational attainment also increased during the 1990s. Enrollments in universities and other higher education institutions rose significantly, and today Finland's younger generations are among the most highly educated by any standard. At the same time, the country exhibited extraordinary dynamism and high social cohesion. It was among the high performers in Western Europe by almost any economic and knowledge indicator.

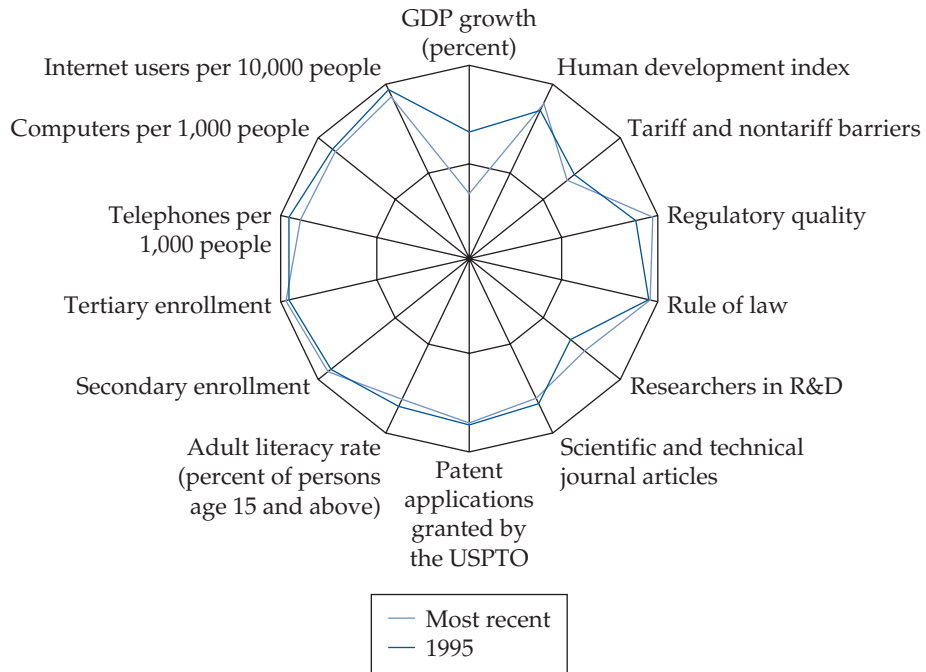
Focus is on longer-term policies

The structural transformations of the 1990s included not only sectoral shifts in production but also changes in policy thinking. Today, in acknowledgment of the underlying causes of the recession, Finland puts greater emphasis on longer-term *microeconomic*—as opposed to short-term macroeconomic—policies. The foundations of sustained national competitiveness are created largely at the micro level, that is, in firms, financial institutions, and various innovation policy agencies.

To illustrate the performance of the Finnish knowledge-based economy today, World Bank Knowledge Economy Assessment data are used. Figure 2.1 gives the country profile relying on the basic KE variables. With the exception of growth performance and trade barriers, the country is close to the frontier in all respects. Most of the variables are examined more closely in chapters 3 to 6, which discuss from a historical perspective how Finland achieved such high rankings.

The overall picture and comparisons with various regions and countries are given in figure 2.2, which—using the aggregate knowledge economy index (KEI)—

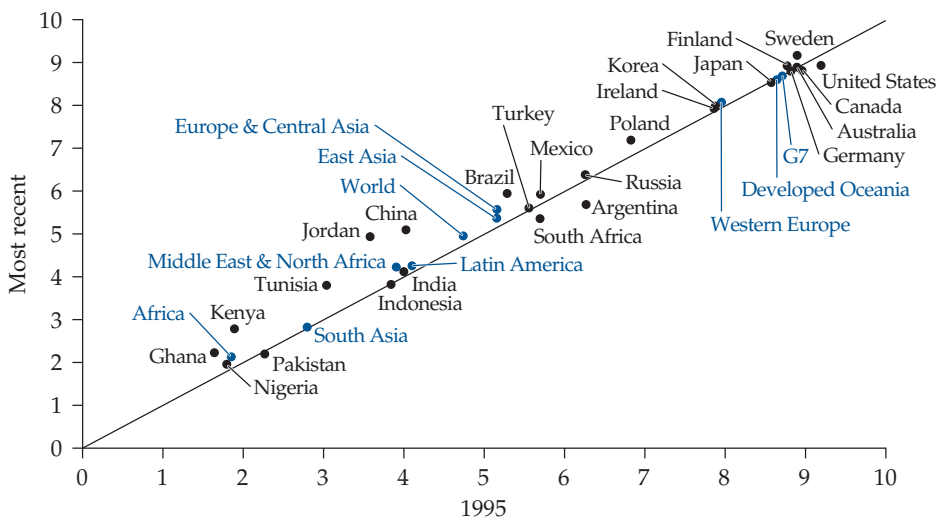
Figure 2.1 Benchmarking the Finnish knowledge economy



Source: World Bank. Knowledge Assessment Methodology, www.worldbank.org/kam.

Notes: Knowledge economy variables benchmark performance of 128 countries. Variables are normalized from 0 (worst) to 10 (best).

Figure 2.2 Global view: Knowledge economy index (KEI) by countries and regions (1995 and the most recent year)



Source: World Bank. Knowledge Assessment Methodology, www.worldbank.org/kam.

Notes: Knowledge Economy Index (KEI) consists of 80 structural or qualitative variables to benchmark performance of 128 countries. KEI is an aggregate of 12 key knowledge variables that are normalized from 0 (worst) to 10 (best).

ranks Finland at the top with other Nordic countries and North America. Figure 2.2 also suggests that there is strong persistence—at least over the medium term—in the group of advanced knowledge economies. However, taking a longer horizon, Finland also stands out as an example of rapid structural change—and even of leapfrogging, as discussed above.

In terms of R&D intensity, as late as the late 1970s, Finland was at the lower end of the OECD countries. Today, Finnish investment in R&D accounts for 3.4 percent of GDP, which is the second highest rate in OECD and the third highest in the world just after Sweden and Israel.⁴ Sectoral specialization is another indicator reflecting the high ranking in the knowledge economy (KE) comparison.⁵

However, what we observe today are outcomes of longer-term transformation processes. Specialization in high-tech and R&D-intensive production needs to be

KE pillars must be in balance

preceded by major structural changes in economic and social structures. Recent research seems to indicate consistently that, when poor countries become richer, they specialize in R&D, sectoral production and employment become more diversified or less concentrated. On the contrary, countries with high levels of income are characterized by concentrated sectoral specialization.⁶ What we see in a cross-section of countries today applies well to the development of Finland over the past few decades. It is significant that a knowledge economy is an ensemble of elements that must be in balance. It is not necessarily the lack of technological infrastructure or skilled engineers that restrains economic growth. It might equally well be the lack of entrepreneurs or proper economic incentives and opportunities. Various elements of the knowledge-based economies can be discussed by using the World Bank's KAM database. Figure 2.3 compares the basic elements or pillars of the knowledge economy across countries and regions.

Figure 2.3 supports the view that there must be a balance among the key elements of a knowledge economy: all countries ranked high in the overall index also are ranked high in all subindices. This finding reflects the need for balance in a broad range of activities to fully utilize opportunities for knowledge-based development and growth.

2.2 Economic incentive regime: Small open economy

In Finland, specialization of production, trade, and R&D in more knowledge-intensive goods and services has coincided with the gradual opening of the economy and deregulation of capital flows. Lifting the remaining restrictions on capital flows in the 1990s clearly promoted investment in general and the inflow of foreign capital in particular.

In the 1990s, Finland also shifted its industrial policies from subsidies to improving the “enabling environment.” Subsidies are still used in two areas: technology and innovation policies. Market failure is the main justification given for these policies.

Early liberalization of the telecommunications market is the main explanation for the early and rapid diffusion of mobile telephony in Finland.⁷ In spite of almost full trade liberalization, some regulations and trade restrictions remain in the service sector as part of common European Union policies.

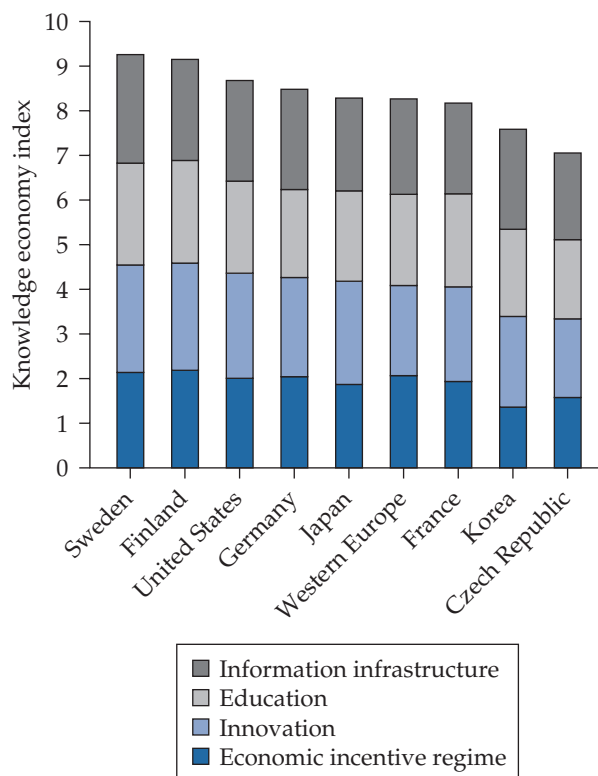
⁴ Ylä-Anttila and Lemola 2003.

⁵ Koski and others 2002.

⁶ Imbs and Wacziarg 2003 and Rodrik 2004.

⁷ Pajja 2001.

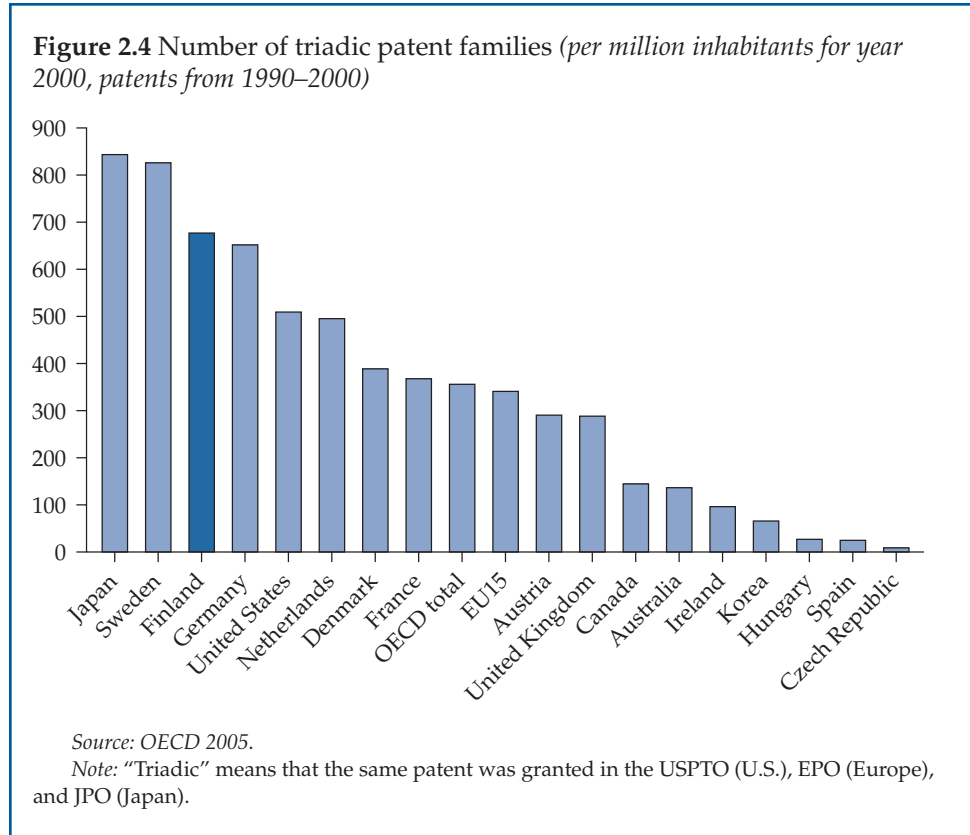
Figure 2.3 Knowledge economy pillars: KE Index in selected countries and regions



Country	KEI	Economic incentive regime	Innovation	Education	Information infrastructure
Sweden	9.24	8.49	9.62	9.16	9.68
Finland	9.16	8.73	9.65	9.21	9.07
United States	8.69	7.97	9.42	8.28	9.09
Germany	8.47	8.10	8.88	7.88	9.01
Japan	8.29	7.42	9.30	8.09	8.35
Western Europe	8.24	8.15	8.12	8.09	8.62
France	8.18	7.68	8.46	8.38	8.19
Korea	7.59	5.39	8.11	7.86	9.00
Czech Republic	7.03	6.26	7.05	7.07	7.73

Source: World Bank. Knowledge Assessment Methodology, www.worldbank.org/kam.

Note: The “unit of measurement” for Figure 2.3 and the accompanying table is based on the World Bank Knowledge Economy Index, which is valued from 0.0 to 10.0.



Issues related to deregulation and changes in incentive structures are detailed in chapter 4.

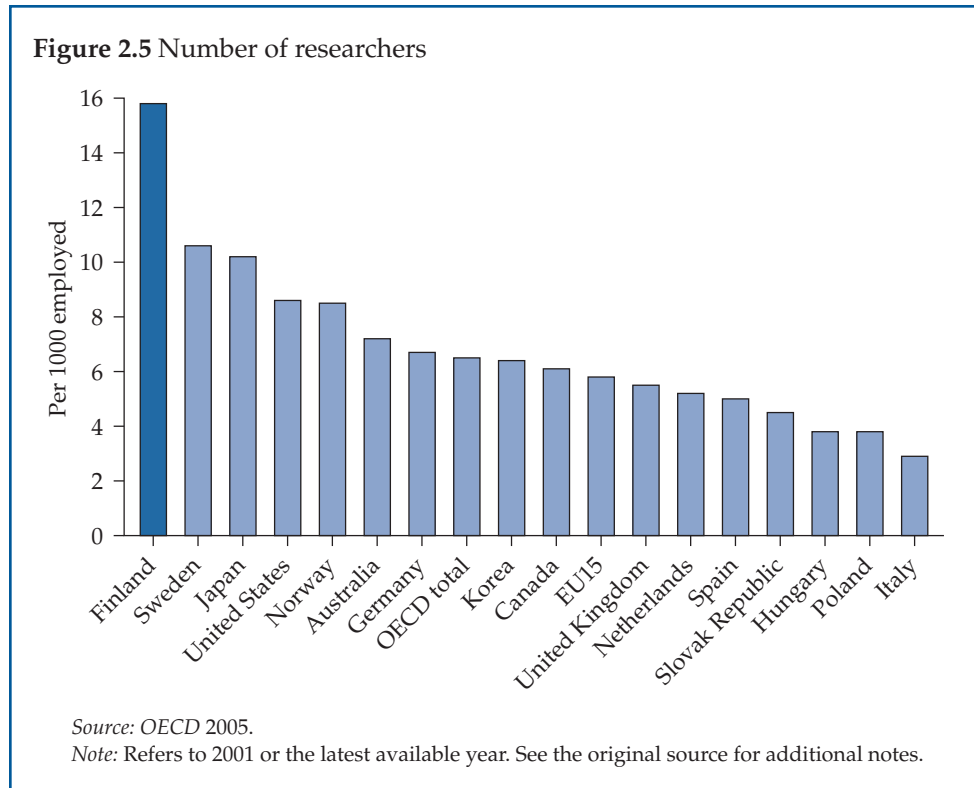
2.3 High performer in technical-driven innovation

For example, as measured by patent indicators or various innovation scoreboards, Finland's innovation activity has increased continuously since the mid-1990s.⁸ According to the European Community's 2004 Innovation Survey, Finland ranks second among EU countries in overall innovativeness.⁹ Patent indicators give roughly the same picture (figure 2.4). The country does well in technical, and especially in ICT-related innovations, but seems underperform somewhat in organizational innovations and commercialization.

Finland has been quite creative in its technology and innovation policies. It was the first country in the world to introduce the concept of a National Innovation System as the frame of reference in policy formulation. The systemic view fits with the current policy approach, which emphasizes facilitation instead of direct market intervention. The innovation model of policy makers has moved from the old linear model toward a systemic one, that is, the phases of the innovation process increas-

⁸ See, for example, European Innovation Scoreboard. EU Commission, <http://www.cordis.lu/innovation-smes/scoreboard/home.html>.

⁹ <http://www.cordis.lu>.



ingly are seen as simultaneous, rather than sequential. The innovation system and policies are discussed further in chapter 5, and from the perspective of the forest-related and ICT sectors in chapter 6.

The innovation and education systems are closely linked. Innovation is, in most cases, an outcome of research efforts carried out in private enterprises. However, it is the public sector that is mainly responsible for educating researchers. Since the mid-1990s, the number of researchers in both the private and public sectors has risen faster than ever before in the country's history and ranks first in the world when compared to total employment (figure 2.5).

2.4 Education: Quest for equity and quality

Education is the key element of a knowledge-based, innovation-driven economy. It affects both the supply of innovation and the demand for it. Human capital and skilled labor are complementary to technological advances: new technologies can not be adopted in production without sufficient workforce training and education. On the other hand, the demand side also is important. Innovations may not take place due to a lack of demanding customers and consumers.

Innovation is matter of supply and demand

In the OECD's recent Program for International Student Assessment studies (OECD 2001 and 2004), Finland came out on top in terms of learning skills among 15-year-olds in mathematics, science, and reading literacy. Other high performers included Southeast Asian countries: Hong-Kong China, Japan, and Korea. What is unique in the Finnish case is the low variation among

schools and across students. Furthermore, the low performing group in Finland did better than the average of all of the 40-some countries surveyed.

In the Finnish system, the local authorities are largely responsible for organizing basic education and schooling. The basic principle is one of equality among social groupings, between genders, and across various parts of the country. The Finnish education system and policies are discussed in detail in chapter 5.

2.5 Information infrastructure: Finland as an ICT-driven knowledge economy

The core of the Finnish knowledge economy is the Nokia-driven ICT cluster. The broadly understood cluster—from digital content provision and packing via network infrastructure, equipment manufacturing and operation, to end-user terminals and portals—is comprised of approximately 6000 firms, including 300 first-tier subcontractors of Nokia.

The GDP share of the ICT cluster has increased from 4 percent in 1990 to more than 10 percent today. Nokia's share is a bit less than 4 percent. The role of the ICT cluster is even more important in strategic areas such as R&D and the globalization of business. ICT-related research accounts for more than 50 percent of all industrial R&D.

The share of ICT products in Finland's total exports is close to 25 percent. Due to extensive exports of telecom equipment, Finland's trade surplus in high-tech goods is among the highest in Europe. In addition, there are significant spillovers from the ICT cluster to other Finnish export sectors.

3

Structural Changes in the Finnish Economy: From Agriculture to High-Tech

Heli Koski and Pekka Ylä-Anttila

3.1 From a resource- and investment-driven to a knowledge-based economy

Successful implementation of various policies—industrial and innovation, education, as well as a general trend toward market liberalization and deregulation—has contributed to the development of the Finnish knowledge economy over the past few decades. The selection and performance of these policies are closely linked to general socioeconomic developments and the specific features of the industrialization process in Finland. Therefore, we first outline these historical developments and then discuss each broad category of policies in detail.¹

Finland is very similar to other Nordic countries with respect to its economic and social structure and institutions. The Nordic welfare state model emphasizes egalitarian principles and is associated with a relatively even income distribution, low class distinctions, and strong social cohesion. The Finnish society is small and homogenous and, due to the economy's high degree of specialization, vulnerable to external shocks. This socioeconomic positioning calls for the presence of systems that buffer the risks for individuals, for instance, a social security system and various formal and informal networks.²

Finland's path from an agriculture-based society through stages of industrialization and then to a knowledge-driven economy involved various special features. By the end of the 1800s, Finland had good preconditions for the industrial revolution and new business activities. These preconditions were that internal and external trade had been liberalized; the educational and banking systems were well established; and the transportation infrastructure was good. The Finnish economy moved onto a path of rapid growth around the mid-nineteenth century—somewhat later than the countries in the vanguard of the Industrial Revolution.

Finland's first steps as an industrialized economy were based to a large extent on its most important natural resource: forests and timber. The country first produced sawn timber and later, toward the end of nineteenth century, added pulp and paper. The first ground-wood plant was built in 1860, based on German design. The first chemical pulp mill started up in 1880. The basic invention was adopted from Germany with a lag of only a couple of years. Seventy years later, Finnish

¹ This part is based largely on the report of Ylä-Anttila and Lemola 2003.

² Collaboration and networking have been of fundamental importance, for instance, in the development of new ICT in Finland. Romanainen 2001.

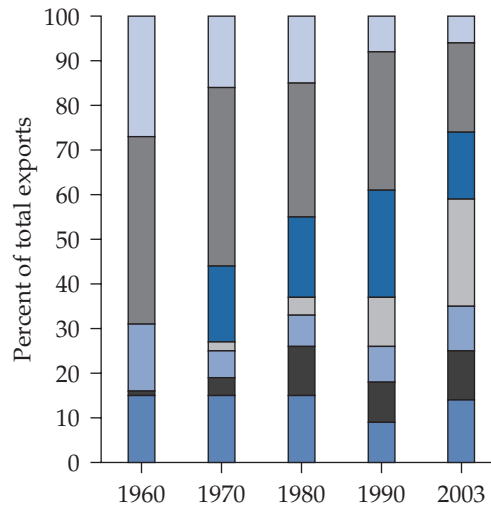
producers started to develop their own pulp and paper and sawmill technologies, which turned out to be two key elements in their globally competitive forest industry cluster in subsequent decades.

Finland's forest-related industry itself gained and maintained its international competitiveness, and actually became a global technology leader by continuously investing in new technologies (chapter 6). Nevertheless, in the early 1960s, the economy earned approximately two-thirds of its export revenues from wood products and pulp and paper. In 1990, just prior to the deep recession of 1991–93³ and the period of major industrial transformation that followed, wood, pulp, and paper accounted for as much as 40 percent of Finnish exports (figure 3.1).

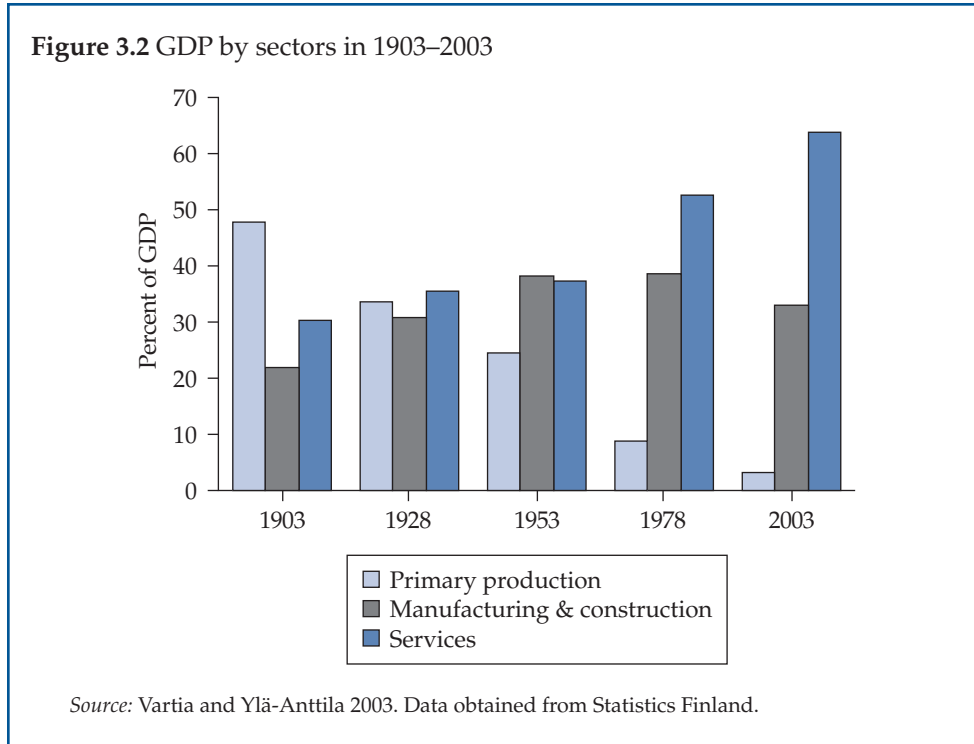
In the 1980s, Finland developed into a postindustrial service society (figure 3.2), but at the same time its production structure became unsustainable. Much of the growth in services output took place in the parts of the economy that were not subject to international competition (the sheltered nontradable sector), such as health services, in which costs rose more quickly than warranted by productivity. The open sector of the economy proved to be too small to dominate overall

³ During this recession, GDP fell by more than 10%, and the unemployment rate rose to 17%.

Figure 3.1 Exports of goods by industry sector, 1990–2003



Source: National Board of Customs.

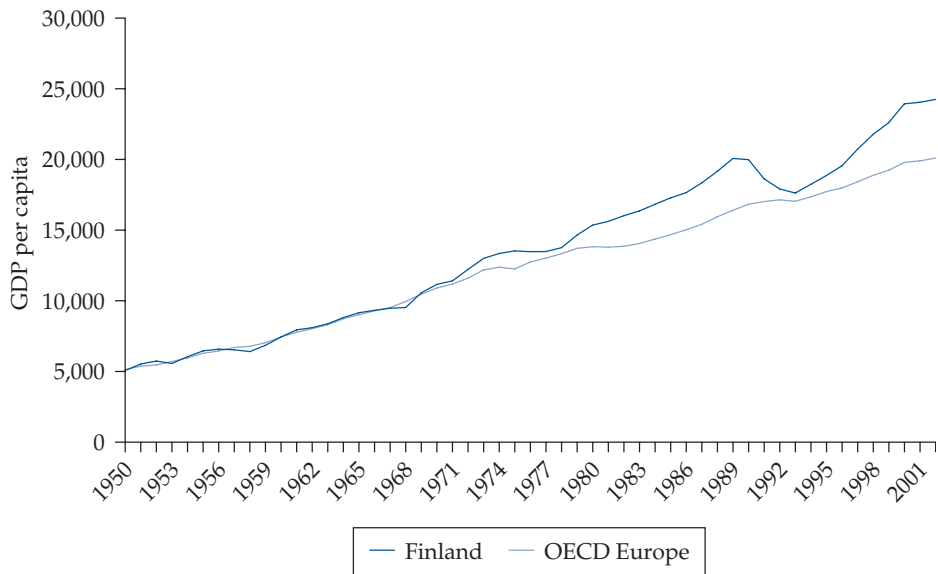


economic growth the way it had since World War II. However, the recession of the early 1990s changed this situation. The share of exports in GDP rose from 25 percent to almost 50 percent, and the share of manufacturing in total output started to increase rapidly.

Between 1997 and 2000, a new wave of exceptional growth was experienced worldwide. In Finland, the highly competitive ICT sector largely drove economic growth, which clearly outpaced the European average rate (figure 3.3). At the end of the period, the escalation of global expectations about ICT companies' future prospects culminated in a global IT bubble and in auctions for UMTS (third-generation mobile technologies) licenses in Europe. Leading telecommunications operators paid huge sums for the option to build third-generation networks in Europe. Increasing suspicion concerning heavily indebted operators' ability to meet their obligations and the slower-than-anticipated growth of the Internet and mobile service companies led rapidly to a bursting of the bubble. The rapid decline in ICT demand, together with the global economic recession, marked the end of an exceptional decade in Finland.

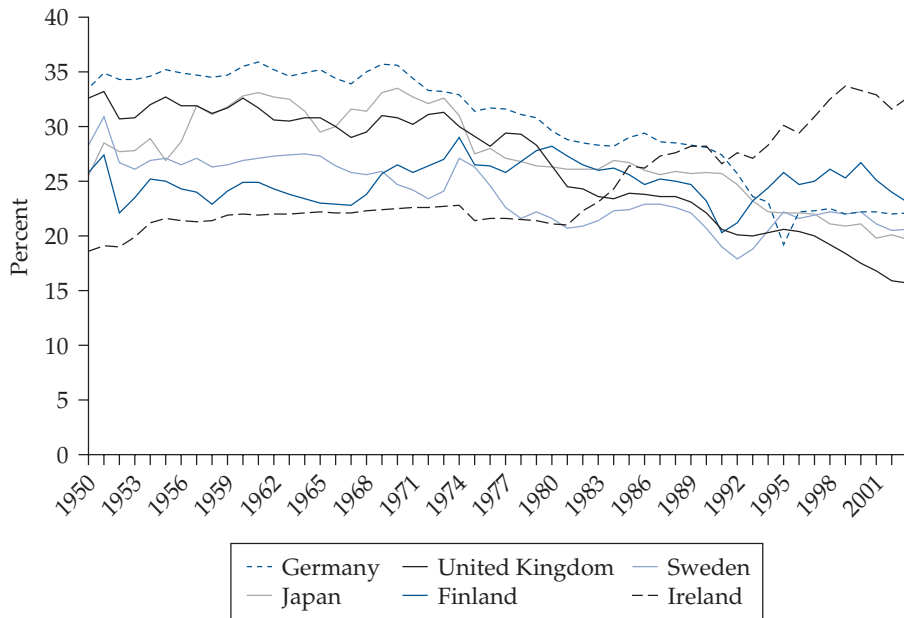
History of development of production and export. Figures 3.1–3.6 depict the changes that have occurred in the Finnish production and export structures during the past 100 years. In the 1960s and 1970s, exports still relied heavily on forest-related production, whereas high-tech goods accounted for only a marginal share. The 1990s was a period of rapid structural change and “re-industrialization.” Recovery from the recession was both rapid and strong. The production of electronics and other high-tech products was gaining a stronger foothold in the Finnish manufacturing sector. In 2003 their share of exports was almost 30 percent (figure 3.1).

Figure 3.3 GDP per capita in Finland and OECD Europe (1995 international dollars)



Sources: Rouvinen and Ylä-Anttila 2003; original sources: www.sourceOECD.org; Penn World tables: <http://dc1.chass.utoronto.ca/pwt/>

Figure 3.4 Manufacturing share in GDP in selected countries



Source: OECD, Statistics Finland, and ETLA calculations.

Interestingly, unlike most other OECD countries during the 1990s, Finland saw investments in the manufacturing sector increase relatively faster than in the service sector (figure 3.4).

3.2 ICT cluster: Fastest growing sector of the economy

The rapid emergence of the ICT sector as the third pillar of the Finnish economy is evident in figures 3.5–3.7. Starting around the mid-1990s, this sector enjoyed extraordinary growth, although the seeds for this development had been sewn decades earlier. The liberalization of world telecommunications operations and trade, together with a new mobile communications standard, unleashed the potential residing in the sector.

The expansion of the ICT sector, backed by innovation-oriented public policies, thus changed fundamentally the basis of national competitive advantage. Finnish expenditure on R&D in proportion to GDP exceeded that of the Japan and the United States; and, of the OECD countries, only Sweden has a higher share. In terms of ICT, however, Finland became the most R&D-intensive country. The public share of R&D expenditure went from 40 percent to 30 percent during the 1990s, but unlike in many other countries, its growth continued to stay positive even during the deep recession.

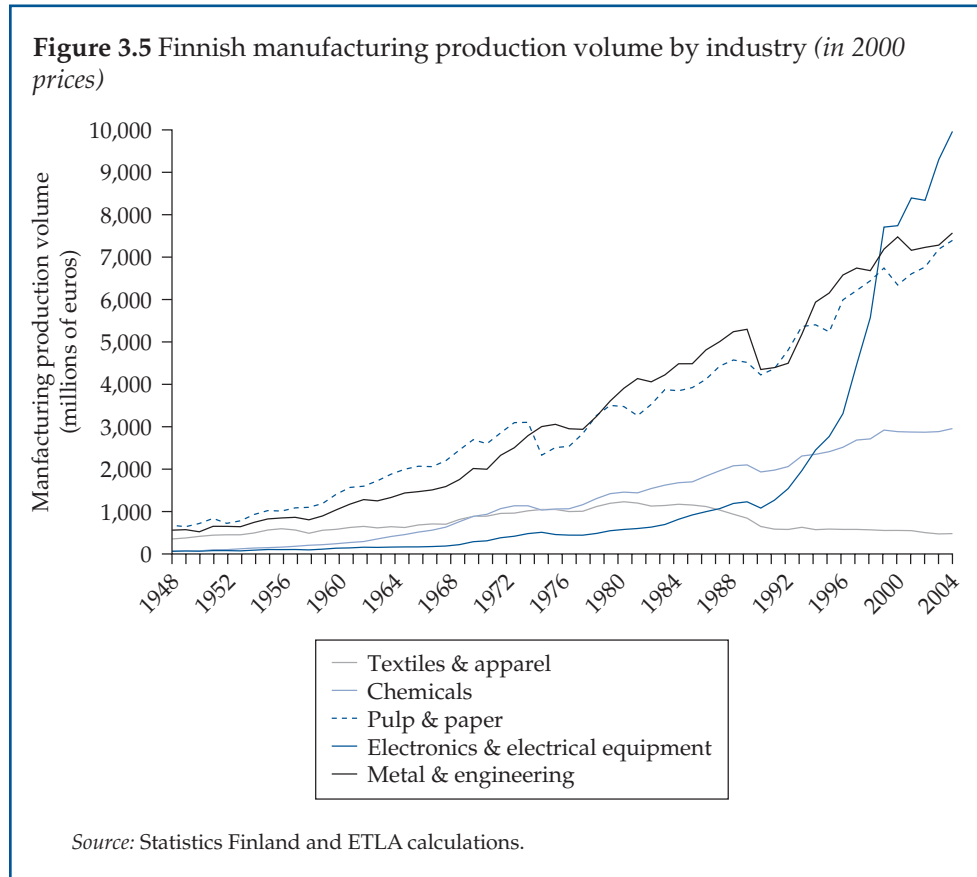
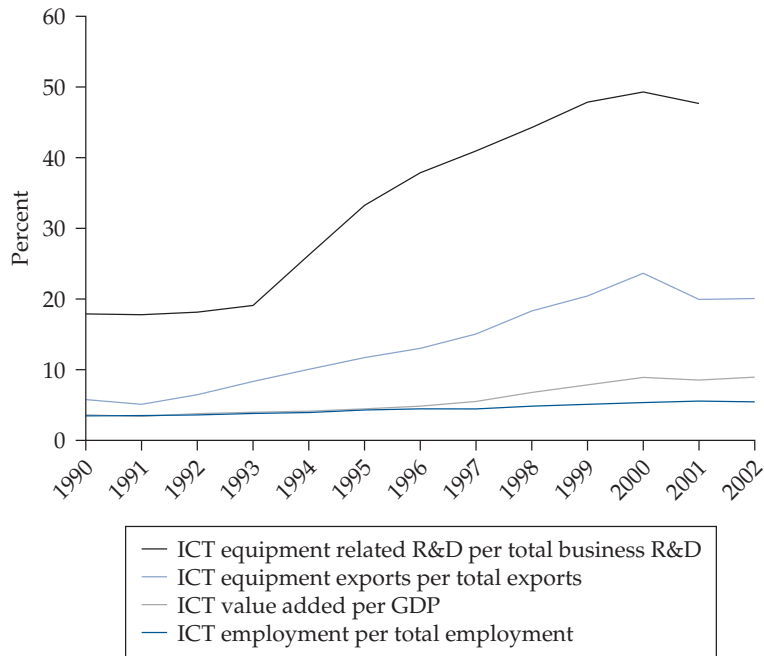


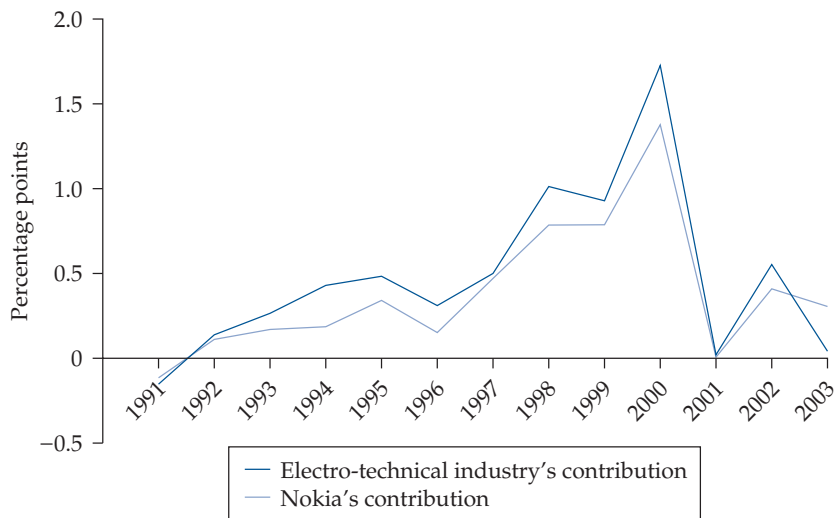
Figure 3.6 Importance of the Finnish ICT sector, selected indicators



Sources: OECD (STAN and ANBERD), ETLA.

Note: ICT sectors include the following NACE classes: 30 (office, accounting, and computing machinery); 32 (radio, TV, and communication equipment); 64 (post and telecommunications); and 72 (computer and related activities).

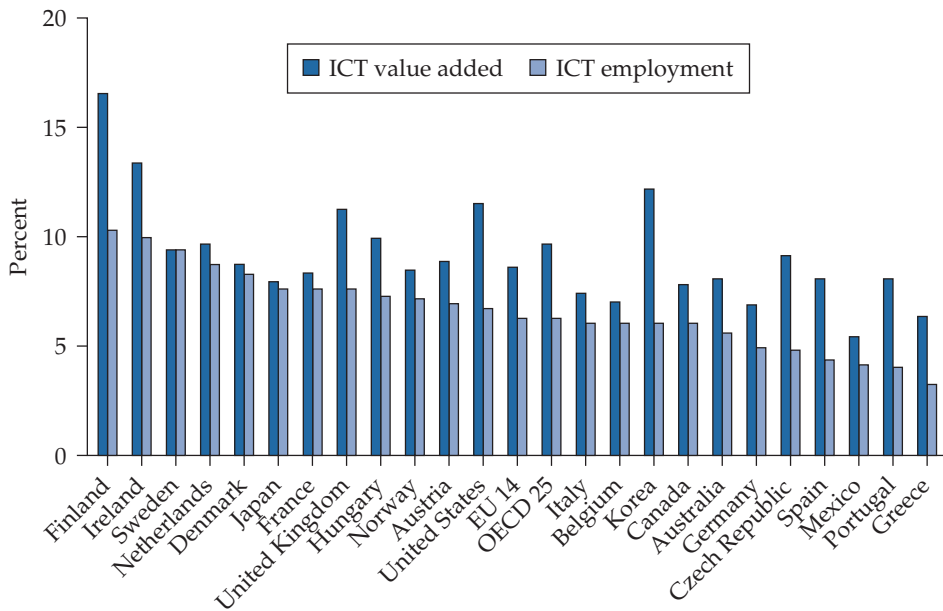
Figure 3.7 Contribution of electronics and electro-technical industries and Nokia Corporation to Finland's GDP growth



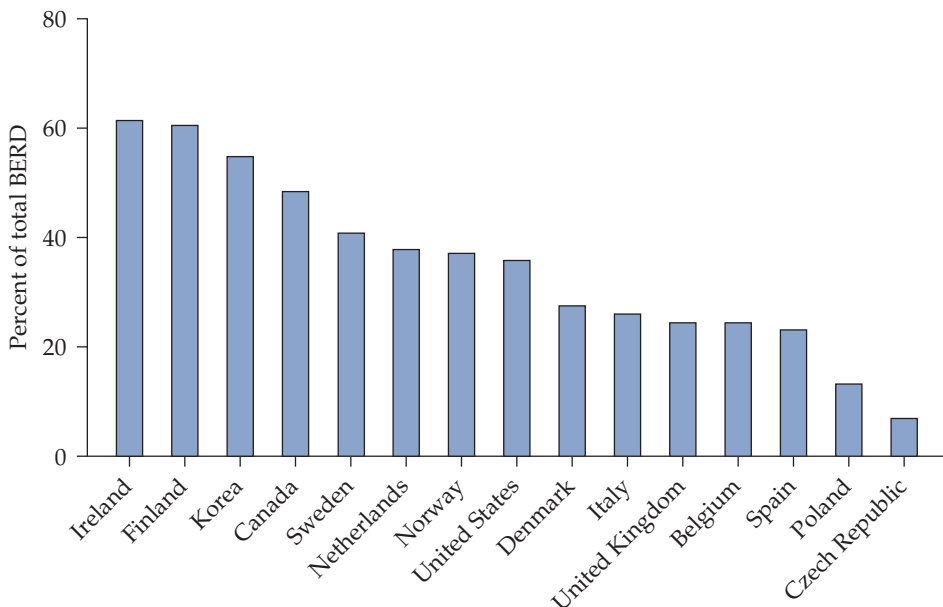
Source: Ali-Yrkkö and Hermans 2002, updated.

Nokia. It is important to realize that the substance of the ICT sector resides, to a great extent, in one individual firm, Nokia. Despite the fact that most Finnish ICT firms grew rapidly in the wake of the telecommunications boom, Nokia has remained, by all standards, in its own class (see figure 3.7). In 2003 the company accounted for basically two-thirds of the total turnover of ICT manufacturing and services located in Finland.

Figure 3.8 ICT specialization by country, 2001: ICT value added as a share of business sector value added and ICT employment as a share of business sector employment



Business R&D in ICT (2001 or latest available data)



Source: OECD 2002.

Nokia is by far the largest company in Finland, and it has a considerable impact on the small economy. In 2000, that is, the heyday of the ICT boom, its contribution to the 6 percent GDP growth was on the order of 2 percentage points.⁴ According to ETLA's estimates, in 2003 Nokia accounted for 3.7 percent of GDP, one-fifth of exports, 1 percent of total employment, and 35 percent of total national R&D expenditure.

To sum up, Finland has transformed itself from a country that in the early 1950s was still based largely on agriculture to the leading high-technology producer of the twenty-first century. The structural changes that took place in Finnish industries and the economy as a whole, particularly during the 1990s, have been exceptionally rapid in international comparison (see figure 3.8). The next chapter sheds a bit more light on this special phase of the country's economic development.

⁴ Ali-Yrkkö and Hermans 2002.

4

Changes in the Economic and Institutional Regimes

Ville Kaitila, Heli Koski, Jorma Routti, Paula Tiihonen,
and Pekka Ylä-Anttila

4.1 Deregulation and liberalization

The transformation of the Finnish economy through the various stages of industrialization also has been facilitated by various favorable changes in the regulatory framework and in market structures. The major changes are interlinked and mutually supportive, and relate to market liberalization and internationalization of business. Liberalization of trade and financial markets has had a tremendous impact on industrial and market developments, and lower capital constraints also have played an important role in the emergence of new markets. Deregulation of the telecommunications market, which has benefited the Finnish economy in many ways, was implemented earlier than in most other countries.

Trade liberalization and rise of the knowledge economy in the postwar era

Finland retained its system of market economy during and after the Second World War. In addition to recovering from the war, the country was burdened by the obligation to pay sizeable war reparations to the Soviet Union. While this was still proceeding, Finland joined the World Bank, which granted loans that were partly used to rebuild production and infrastructure after the war, and the IMF, both in 1948. Finland also joined GATT, the predecessor to the World Trade Organization in 1950.

As elsewhere in Europe, there was a shortage of hard currency after the war, and foreign trade remained regulated until the end of the 1950s in Finland. The liberalization of trade that then took place does not seem to have coincided with any change in the structure of exports. Almost 70 percent of exports at this time consisted of paper and wood thus corresponding to the country's traditional resource-based comparative advantage. The ratio of exports to GDP remained unchanged at almost 20 percent during these years despite deregulation.

The European Free Trade Association (EFTA) was formed in 1960. Finland joined as an associate member the following year; its full transition to free trade took until the end of 1967. This transition period coincided with an increased share of basic metals and metal products as well as of textiles and clothing in Finnish exports. However, the exports-to-GDP ratio actually declined a little during this period due to appreciation of the real exchange rate adjusted for unit labor costs, especially with respect to the important English currency (figure 4.1).

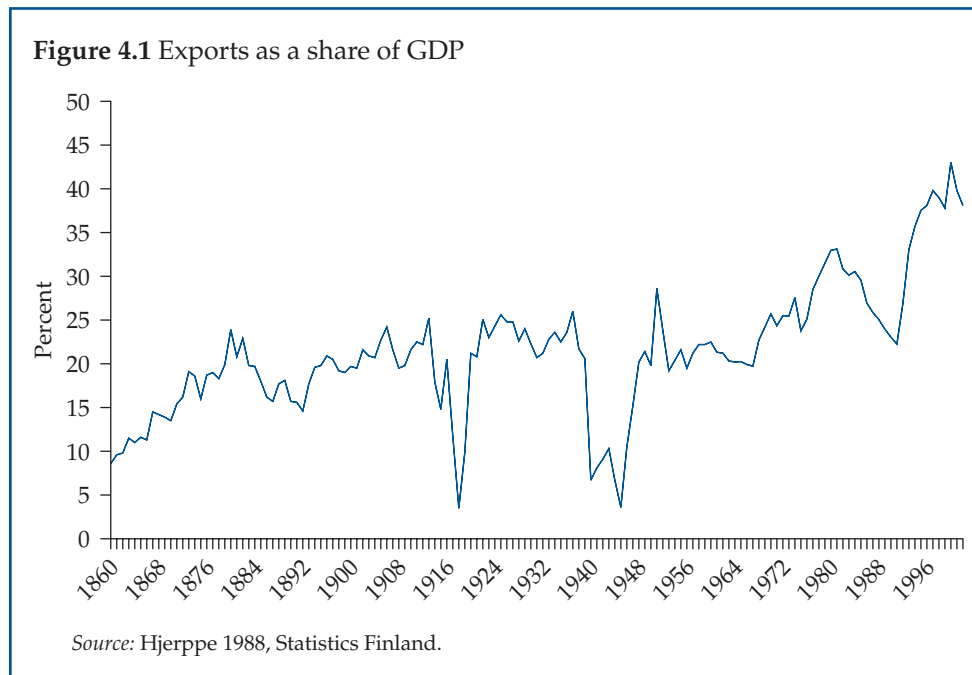
The exports-to-GDP ratio rose back above 20 percent only after 1967, when the Finnish currency was devalued. Finland joined the OECD in 1969.

From a trade-policy point of view, Finland's associate membership in EFTA was almost equivalent to full membership. Ultimately, Finland did not join EFTA as a full member until 1986 due to foreign-policy and foreign-trade constraints set by trade relations with the Soviet Union, to which Finland granted the same preferential trade treatment that it provided to its EFTA trading partners. Trade with the Soviet Union was based on bilateral clearing and averaged approximately one-sixth of Finnish foreign trade from 1950–90. Finnish-Soviet trade agreements were set for five-year periods with the principle that exports and imports should more or less balance each other.

In 1973 Finland concluded a free-trade agreement on industrial products with the EEC, which by then already had nine member countries. This time, the longest transition periods lasted until 1984 for some Finnish exports and 1985 for others. During this period, the share of machinery and equipment as well as of chemical products in Finnish exports increased, while the share of paper and wood continued to decline.

These developments reflected a move toward producing goods with a higher value-added and goods that did not directly correspond to the country's traditional resource-based comparative advantage. Between 1970 and 1990, exports to the EEC-EFTA region remained relatively stable at 12 percent–13 percent relative to GDP despite freer trade. One explanation is that the most important trading partners, that is, Sweden and the United Kingdom, were old EFTA countries with which trade already had been liberalized earlier.

When Finland applied for membership in the European Union in March 1992, the country was in the midst of its worst peacetime recession of the twentieth century. Central government debt and unemployment soared, and there was again



pressure to devalue the Finnish currency. Eventually, devaluation did prove necessary, and the external value of the currency plummeted.

In 1994 Finland joined the European Economic Area and thereby the EU internal market together with Austria, Norway, and Sweden. When EU membership entered into force the next year, the economy was already recovering from the depression, thanks primarily to rising exports and fast growth in the electronics industry, mainly telecommunication equipment. At this time, exports (as a share of GDP) to the EU15 countries jumped and exceeded the level of the 1970s and 1980s by 5 percentage points.

Since trade already had been liberalized in the EU-EFTA region by the 1980s, actual EU membership did not bring any large changes in this respect. However, access to the internal market and membership in the customs union supported commerce and investment. Since Finland is geographically remote from the major European markets, membership has increased awareness of the Finnish economy and Finnish companies. Success in many sectors, particularly electronics, also has had a positive impact. The Economic and Monetary Union has made interest rates and exchange rates more stable within Europe. In the long run, Finland will enjoy lower interest rates as an EMU member than it otherwise would, providing economic policies in the EMU area are sustainable and monetary policy is credible, among other things.

In addition, the internationalization of Finnish firms gathered momentum during the 1990s as all restrictions on foreign ownership of Finnish firms were lifted after 1992. Lifting the restrictions resulted in an influx of foreign capital into the Helsinki Stock Exchange and therefore also to greater foreign ownership of many companies, with Nokia the most significant symbol of the change.

For over 100 years, Finnish exports were based on wood, paper, and pulp (section 3.1). The rise in exports of electronic equipment, especially of telecommunication equipment, came at a time when free trade already ruled in the EU-EFTA region.¹ It seems that this rise in exports might have happened due more to Nokia's success in meeting the fast growth in demand for mobile phones with the type of products that have sold well than with trade liberalization per se.

On the other hand, the liberalization of the Nordic telecom market was very instrumental in the early development of Finnish expertise in mobile phones. The Nordic NMT 450 mobile phone network was put into operation in Finland and the other Nordic countries in 1981–82. In this sense, liberalization also was paramount in strengthening the role of mobile phones in Finnish exports.

Liberalizing and deepening the Finnish financial system

Traditionally, the Finnish financial system has been relationship-focused, debt-based, and dominated by deposit banks. The stock market has been small and illiquid. Relative to many other developed countries, Finland has had a bank-centered financial system.²

However, from 1980–2002, the structure of the Finnish financial system changed rather thoroughly, especially during the late 1990s. The transformation began with the liberalization of the capital markets and coincided with the period during which Finland transformed itself from a resource-driven to a knowledge-based economy.

¹ The share of telecommunications equipment in total exports grew from 2% in 1988 to 6% in 1994 to 21% in 2000, before receding to 18% in 2003.

² See for example Hyytinen and Pajarinen 2003.

The change was particularly rapid at the end of the 1990s. During those years, the Finnish financial system shifted from relationship-based debt finance toward a system in which the stock market gained in importance. The shift was due to the growth of the stock market and venture capital and the decline in financial institutions' corporate lending (relative to the size of economy).

The financial system matters

Hyytinen, Kuosa, and Takalo (2003) single out some drivers of this change, including the banking crisis of the early 1990s and the changes in the legal protection of creditors and shareholders (Hyytinen and Pajarinen 2003).

What have been the consequences of the structural transformation of the Finnish financial system?

1. Compared to the situation that prevailed in the 1980s, *the overall mobilization of Finnish households' savings has improved*. Mobilization has improved because the range of savings services that the Finnish financial system provides to households has broadened greatly. As an example, the range of available savings instruments has increased, implying that households can hold better-diversified portfolios of their financial wealth than before. Furthermore, thanks to the improved efficiency of banks during the late 1990s as well as an increase in the number of available credit instruments and nonbank credit institutions, households today are better able to smooth their consumption intertemporally than they were in the early 1980s. It is likely that these kinds of improvements have enhanced the formation of long-term capital available to Finnish firms.
2. *The structural transformation enhanced the efficiency of resource allocation*. The operation of Finnish banks is currently less connected to the maintenance of power structures in the Finnish economy, because the old "power spheres" have disappeared (Hyytinen, Kuosa, and Takalo 2003). Indications of these changes are that the deposit banks' role as the direct owners of Finnish firms has decreased and that the number of various kinds of nonbank financial institutions has increased. The role of relationship-based debt has decreased, and the importance of the Finnish stock market has increased. In addition and integral to the recent financial development in Finland and elsewhere in Europe has been the growth of the market for risk capital to firms (the venture capital market). For these three reasons, the Finnish financial system is now better positioned to allocate resources to innovative ideas and projects.
3. *The ability of the Finnish financial markets to exert corporate control has improved* during the past 20 years, specifically during the 1990s. Both the integrity and transparency of the capital markets as well as the protection of (minority) shareholders have improved. Overall, the Finnish system of corporate governance has taken a major step toward the British-US corporate governance model. A prime example of these changes is that the boards of directors of large Finnish companies are no longer "insider boards," which used to consist mainly, if not entirely, of top management. Furthermore, the role of banks in monitoring Finnish firms has changed. Previously tight relationships have loosened, and opportunities for multiple banking relationships have increased. These changes have made loan pricing more sensitive to the risk of the project and reduced many of the adverse effects of relationship lending.

Inward and outward capital flows

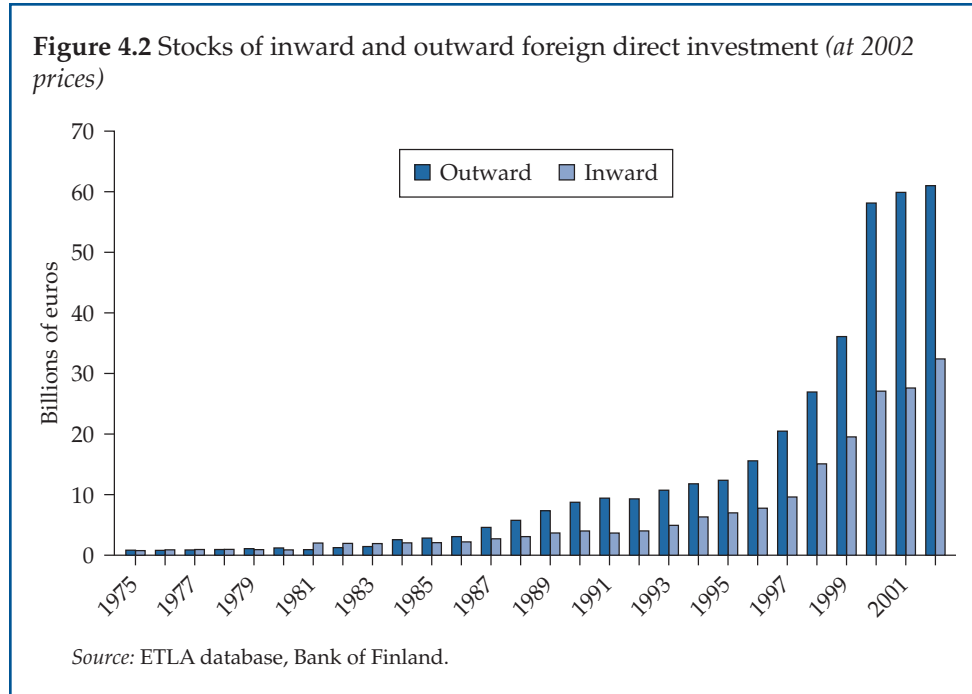
Remaining restrictions on capital movements and foreign ownership were lifted from the beginning of 1993. The removal of these restrictions has increased both portfolio and foreign direct investment (FDI). Foreign ownership of Finnish firms also has grown. Today, over one-third of the top 500 companies in Finland are subsidiaries of foreign corporations. The number of foreign financial institutions operating in Finland also has increased. All of these changes, as well as the improved access of Finnish firms to international capital markets, contributed to the favorable financial development that coincided with Finland's transformation to a knowledge economy. The importance of this recent financial deepening cannot be overemphasized, for it has enhanced both the accumulation of capital and the rate of technological innovation.

Chronologically, the liberalization process occurring in the Finnish financial market was boosted by the removal of the remaining restrictions on cross-border capital flows beginning in the late 1980s, and on foreign ownership finally in the early 1990s. Liberalization especially influenced private-sector foreign borrowing. However, as the Finnish currency depreciated in the early 1990s, the cost of foreign borrowing increased considerably, and the volume decreased. At the same time, the public sector started to finance public deficits partly by issuing foreign bonds. Later, as the currency recovered and Finland joined the European Monetary System (EMS), the public sector's borrowing strategy proved quite successful.

When the inflow of foreign capital started to increase in the early 1990s, a major part of foreign investment in Finnish securities was in bonds. Foreign investment in Finnish shares began to increase in 1993—after all the restrictions on foreign ownership had been abolished. The increase in subsequent years was quite rapid and coincided with the start of the technology boom. No doubt, foreign investment in both bonds and shares had a major role in financing the growth of new technology intensive business, including Nokia. Foreign capital flowed into the Helsinki Stock Exchange (HSE) as the economy rapidly recovered from the recession and moved toward technology-driven growth. The number of initial public offerings (IPOs) increased in the late 1990s, and a number of new ICT companies were listed on the HSE. This development halted when the global stock market bubble burst in 2000, but the share of foreign ownership remained relatively high. In 2004 it was approximately 50 percent as measured by market value, making the Helsinki Stock Exchange still one of the most internationalized markets by this measure. Foreign investors are mainly institutional, such as mutual and pension funds. Foreign ownership is high in most of the larger and internationally operating companies; in Nokia it is even more than 90 percent.

There are few doubts regarding the benefits of foreign investment in Finnish shares. Foreign investment has increased the market value of listed firms, and turnover of shares also has increased. However, the HSE is a relatively small market. To receive more reliable valuations of their shares, many of the fast-growing Finnish high-tech SMEs (small and medium-sized enterprises) prefer listing on foreign stock exchanges. This process is just beginning.

Some concerns have been raised regarding Finnish high-tech SMEs being acquired by large foreign multinationals in the early stages of their development. There is some evidence that large patent portfolios increase the probability of SMEs being acquired by foreign companies (Ali-Yrkkö, Hyytinen, and Pajarinen 2004).



There is, however, little, if any, reliable information on the consequences for the domestic economy of these types of mergers and acquisitions. Some of the firms continue their rapid expansion at home and obtain new marketing channels. In some cases, the knowledge is used in foreign locations.

Figure 4.2 illustrates the development of outward and inward FDI. Both inward and outward stocks have grown fast since the late 1980s. Growth accelerated in the late 1990s, when technology boomed and the pace of globalization intensified. The development resembles that of many other smaller countries, except that the FDI flows started to expand in Finland relatively late. There is also a clear imbalance between outward and inward stocks, with the former almost two times larger than the latter.

One explanation for the imbalance is that Finnish firms have invested abroad mainly in manufacturing while foreign companies have invested in Finland primarily in the trade and services sectors. The average size of outward FDI obviously has been larger than that of inward FDI. Today, policies emphasize the need for attracting more foreign capital, particularly FDI, to the country. For example, a recent report to the Prime Minister, "Finland in the Global Economy," recommends increasing resources to the Invest in Finland Office to attract more foreign investment.

Liberal telecommunications markets

Telecommunications networks are a key infrastructure in the knowledge economy, and their good coverage and efficient provision of communications services enable a well-functioning society. The Finnish telecommunications markets were opened to competition relatively early by international comparison. All parts of Finland's

fixed-line telephone service provision (local, long-distance, and international calls) were liberalized by 1994, whereas the European Union's deadline to liberalize these market segments was 1998.

Finland's regulatory approach to telecommunications policy is based on pro-competitive policies, light-handed regulation, and technology-neutral competition. The market is subject to general competition and consumer protection legislation. The telecommunications authorities pursue a minimum interference policy, intervening mainly in cases of insufficient competition. The approach can be described as less interventionist than in many other OECD countries. Finland has enforced some mandatory EU requirements rather reluctantly, as they are considered to be going against the liberal functioning of markets.³

Early liberalization of telecom market contributed to success of Finnish ICT cluster.

Finland has the policy objective of enhancing high-speed transmission capacity. Nevertheless, in 2000 the government decided—unlike Sweden, for example—not to directly provide infrastructure to ensure technology neutrality and free functioning of the market. In line with its liberal policy principles, Finland granted third-generation mobile network licenses competitively but free of charge, being among the few countries to date to support free distribution of new technology.

As outlined in this section, during the 1990s Finland undertook a major removal of the barriers of trade and capital movements. Trade liberalization of industrial products had begun decades earlier with the EFTA and EEC. However, EU membership brought Finland access to the internal EU market, and the liberalization of capital markets improved access to foreign capital and risk capital, a essential sources of financing for innovative start-up companies. Altogether, these developments meant that in the late 1990s the business environment was quite different from previous decades. It also seems that Finland's strong phase of liberalization coincided with its fast development toward a knowledge-based economy.

4.2 Social institutions and innovations

Various publicly funded institutions have initiated and executed projects fostering the development of the Finnish knowledge economy. There are some indications that Finland has been more active than, for instance, the other EU countries in carrying out projects supporting the adoption and innovative use of ICT technologies. At the beginning of 2001, more than 10 percent of a total of 1,942 information society projects in EU countries that were reported to the European Survey for Information Society Projects and Actions (ESIS) database were undertaken in Finland.

The Finnish government also facilitated ICT usage and diffusion by investing in ICT equipment and providing public services on the Internet. Between 1997 and 2002, total expenditures on information technology by all government ministries and the Cabinet Office grew approximately 57 percent—from approximately 340 million euros to 535 million euros. By the end of 2002, approximately 90 percent of the government agencies had launched their own websites, and 75 percent of them offered electronic forms on the Internet (Ministry of Finance 2003).

³ Ministry of Transport and Communications 2000.

The following section discusses special features of certain Finnish social institutions, particularly the role of good public governance, that have contributed to the creation and development of the knowledge-based society.

Politics: For or against new things?

Politics in this context basically concerns values, attitudes, atmosphere, opinion building, and, most importantly, opinion leading. A relevant example from the core of Finnish political institutions that proves that Parliament can take an active and innovative role in building up a knowledge society is the Committee for the Future (box 4.1). The task of the committee is to conduct active and initiative-generating dialogue with the government on major future problems and means of solving them. The Committee for the Future also undertakes technology assessment and, in this task, uses studies from research institutes or think tanks to support its work. The committee has taken its place in the Finnish parliamentary system as an innovative political body, and, over the years, it has created a new forum that works at the core of the parliamentary system. Topics at the core of information society developments that the Committee for the Future has highlighted include the future of work in Finland, the future of the Finnish knowledge society and regional innovation systems.

Box 4.1 Committee for the Future

The Committee for the Future is one of the Parliament of Finland's 15 standing committees. The committee has 17 members all of whom are Members of Parliament and represent different political parties. The committee is the only of its kind in the world. Its task is to conduct active and initiative-generating dialogue with the government on major future problems, including knowledge economy developments. The committee has been given the special task of following and using the results of research on future trends.

The idea of conducting policy work on the future in Parliament came from the floor. In 1992 a large majority of Parliament members accepted an initiative that called for the government to submit a report to Parliament on Finland's long-term prospects and options. In 1993 Parliament established a temporary Committee for the Future to prepare responses to the policies outlined in the government's report. In 2000, in connection with Finland's constitutional reform, Parliament decided to make the Committee for the Future a permanent committee.

Its tasks include:

- Assessing the social impact of technological development and serving as the parliamentary body responsible for assessing technological development and its consequences for society
- Issuing statements to other committees on matters related to the future when asked to do so
- Discussing issues pertaining to future development factors and development models
- Analyzing research regarding the future

The Committee commissions studies from research institutes to support its work.⁴ The Committee for the Future publishes various papers as well as reports on technology assessment projects and conferences. See www.parliament.fi/FutureCommittee.

Source: Parliament of Finland.

⁴ See for example Himanen 2004.

Good public governance

For years, good governance and corruption have been the topics studied by international development organizations, and recently these two issues have been strongly connected to the notion of a knowledge economy. Good governance plays an invaluable role in the Finnish society, particularly in its knowledge economy. Institutions, both administrative and political, do matter. This section presents illuminating examples from the administrative and political sides of the Finnish story.

How important is good governance for KE?

Finland has generally been ranked high in international ratings of good governance⁵ and is known as one of the world's least corrupt societies.⁶ In competitiveness surveys, a good public infrastructure and an efficiently functioning administration have been valued very highly, with Finland achieving top positions in these rankings as well. What are the reasons for this good position? A discussion of the reasons and causes of good governance leads inevitably to an examination of the political system, because public administration is so closely connected to it. The political culture and political institutions determine the level of corruption.

Taking into consideration surveys on freedom, political rights, and civil liberties broadens the picture of corruption. Every year the Freedom House rates these factors of democracy. A.T. Kearney/*Foreign Policy Magazine* globalization index measurements undertaken annually since 2001 indicate that a clear correlation exists among globalization, freedom, and good governance without corruption. More globalized countries have more civil liberties, political rights, and equality, while less globalized countries score poorly. It is also interesting to discover that many of the less corrupt countries are at the same time the most environmentally friendly countries.⁷

We can argue about the methods used and the overall sensibility of ranking countries "good" or "bad," but one thing seems evident. The same northern, uncorrupted countries are ranked highest in every index of good quality of life.

Nevertheless, it is significant that, in practice, corruption statistics and surveys can tell with certainty only something about corruption at the individual level. Crime, primarily bribery, is an act between persons. However, especially when considering Finland as a clean society on the one hand and as a welfare society on the other hand, it is valuable to discuss the possibility of making mistakes at the institutional level.⁸ This discussion leads us to investigate some structures of the Finnish consensus model, the tripartite incomes negotiation system (the unions and the government), and the structure of the power elite.

Corruption. Certain elements may explain why corruption is seen so seldom in Finland. These reasons also explain why good public institutions matter. First, Fin-

⁵Transparency International has published the Corruption Perceptions Index since 1995.

⁶Article on good governance of Finland in *History of Corruption in Central Government*, International Institute of Administrative Sciences 2003.

⁷In the Environmental Sustainability Index, Finland has been first, followed by Norway, Canada, and Sweden.

⁸The analysis should include the role of the media and opinion leaders as well. These factors are not normally analyzed when we talk about corruption. Evaluation of institutional corruption in Finland including, for instance, maladministration, problems of favor within a centralized power structure, closed clubs, and formal and informal networks, might not position Finland very far from other countries in corruption rankings.

land is *an egalitarian society*. Finland was the first country in the world to accept universal suffrage—allowing women not only to vote but also to run for Parliament in 1906. Welfare services have expanded from the 1960s. The main elements of the welfare society are basic old-age pensions for everyone over 65; and free basic education, e.g., kindergarten and higher education; and health care for all. There is also a relatively good unemployment benefits system. *All of these factors have reduced the necessity of bribing civil servants or the need for civil servants to demand bribes.*

Legal structure and public administrative culture. Qualities of the Finnish legal structure and culture of administration that do not foster corruption are:

- No clear political posts⁹
- Low hierarchical structure¹⁰
- Individual autonomy
- Individual responsibility in administration
- Transparency as well as strong publicity on administration.

Openness has always been a main principle in Finland. Everything in the public administration is public and open for criticism by other civil servants, citizens, and the media. According to the Constitution, three of the most important guarantees of good governance are the right to be heard, the right to receive a reasoned decision, and the right of appeal. All the diaries and records kept in the public administration also are open to everyone. The tradition is quite the opposite from that in many other EU member countries.

Adequate compensation of civil services careers. The career of civil servant has always been highly regarded as providing sufficient benefits to cover basic living expenses, and the consensus has been that through education anyone can make a good career. Furthermore, the Finnish population and administration are so small that, if one loses respect in society, s/he has lost a great deal. The risks of getting accused and being left out of the normal circles of life are greater than in large countries. For these reasons, cases of individual corruption have always been very rare indeed. Furthermore, political parties have received public funding since 1967, reducing financial pressures on the parties and thus potentially the likelihood of corruption.

Collegial decision making has been a tradition in Finland since the seventeenth century. When decisions are made by a collegial body, corruption becomes much more difficult and uncertain, although not impossible. *The referendary or a reporting system*—an old pillar of legalism in the Finnish administration—decreases opportunities for corruption. A referendary is a civil servant of lower rank than the decision maker or politician. The referendary researches the matter under advisement, presents alternative proposals, and suggests a final proposal. A minister can make a political decision that differs from the referendary's proposal, but the decision is not legally binding unless the referendary signs it.

In addition, Finnish administrative culture embodies the idea of continuous checking of the limits of corruption in practice: "What is a bribe today?" The Finnish governmental tradition has been, on the one hand, very legalistic but, on the other

⁹ Finland does not have a political cabinet system or a system of political state secretaries.

¹⁰ Most civil servants deal with their matters throughout the decision making process without the interference of their superiors. Civil servants are responsible for their actions in the vertical and horizontal dimensions, and they must inform others about their actions and their tasks.

hand, practical and flexible. Importantly, the Supreme Court—the highest body for clarifying and examining values in legal and administrative affairs—from time to time clarifies what are intended to be the norms. This mechanism controls the behavior of the political elite and the top civil servants. Because this periodic re-examination affects the lower levels of administration, all employees are reminded of the limits and correct interpretation of the norms. In handling most legal problems very practically, Finnish administrative culture may be part of the explanation for the absence of corruption. Its rules are old, short, clear, strict, and taken seriously.

The regulation of firm entry, as well as cost of doing business, varies greatly across countries basically according to their legal systems (Djankov and others 2002). Contrary to many other European countries with civil-law systems, such as the English common-law countries, Nordic countries, including Finland, have low levels of regulation and bureaucracy. A low level of bureaucracy usually is associated with a low level of corruption and corrupt economic activity (Djankov and others 2002). In Nordic countries, the civil-law system is combined with trust and substantial social capital created by various consensus-building mechanisms, which enable modest regulatory burden for business.

Consensus building in economic policies and national strategies

Economic Policy and National Strategy programs organized for key decisionmakers in Finland have contributed in an important way toward its knowledge economy by building consensus in domestic economic and social policies and in wider international arenas. There is a growing interest by development practitioners in sharing these experiences with many other countries.

Reaching consensus in economic and social policies is neither easy nor desirable at the expense of open debates. The policy objectives related to economic growth and employment often conflict with the policy objectives related to budget and trade balances and low inflation. In the short term, growth and employment gains can be obtained at the expense of trade balance and inflation. However, in the longer term, such perceived benefits are quickly lost. Furthermore, the priority of the objectives is a matter of political preference. A young person entering the labor market prefers growth and employment, while a retired person with fixed income favors stability and small inflation. *One principal lesson from Finland's experience is that economic policy is a policy of trade-offs, and one important result is the emphasis on long-term structural investments.*

Since 1977, management programs on economic policy management and national strategies have been organized by SITRA, the Finnish National Fund for Research and Development. More than 1,500 policy makers have attended these programs. The participants include most members of the Parliament during their first terms and other decision makers in the public sector, industrial and economic leaders, and labor market and media leaders (box 4.2).

The length of the management programs is one to two weeks, including visits to relevant organizations. Programs are structured to define the policy objectives; and to choose the policy instruments, such as taxation structures, distribution of resources in different sectors, investments and incentives, and interest and currency policies, which before the recent euro currency regime were of great importance on national level.

Some 20–30 lectures are given by the best domestic and international experts and are followed by thorough discussions. This lecture series commences with fiscal and

Box 4.2 SITRA: Building bridges among research, economy, and policy

The Finnish National Fund for Research and Development (SITRA) was established in 1967 to celebrate the 50th anniversary of the Finland's independence. Initially, SITRA was placed within the Central Bank of Finland. Since 1991, it has been operating as a public foundation directly under the Parliament.

The idea underlying SITRA was that there was a need on the public side to have an instrument by which to experiment and start new activities without the budgetary delays and political commitments needed to carry out these immediately on a broad front. Such piloting requires sufficient economic means, preferably as an endowment, and flexibility in the decisionmaking.

Initially, the endowment came from the surplus of the Bank of Finland. This amount was increased a number of times, in particular, on the 75th anniversary of Finland with a sizable amount of government-owned Nokia shares, whose value multiplied by a factor of hundreds in the following years. This fortunate development and generally successful portfolio management has increased SITRA's endowment today to the level of 500 million euro.

SITRA has played a pioneering role in many areas. One of the first investments was the acquisition of supercomputers and making available their capacity free of charge to universities and research institutes. This action significantly expedited the introduction of computational methods benefiting both research and industry. In many areas, such as environmental studies, energy research, and technology funding, successful pilots by SITRA later resulted in the establishment of dedicated permanent organizations.

An important development was SITRA's launching of venture capital investments in the 1980s. Initially, SITRA concentrated on capitalizing the results of publicly funded research. Technology transfer organizations were established jointly with the universities to systematically scan the investment opportunities. Investments in leading foreign venture funds opened avenues to train people, to obtain international funding for technology companies, and to attract venture funding in Finland. Eventually, most of the venture capital activities were spun off from SITRA to establish privately run funds, for which the private sector supplied the great majority of the capital.

The unique position of SITRA directly under the Parliament with its Board composed of the highest level representatives of central ministries puts it in a strong position to couple research to policy formulation. Studies conducted and funded in collaboration with the best domestic and international experts on economic and social perspectives, integration, and globalization, and the general development of the information and knowledge society have been instrumental in steering the policies toward successful results.

monetary policies, proceeds to structural questions in different sectors, and concludes with discussions of long-term development options.

The most important part of the program is the common exercise of defining the policy objectives and the budgetary and other instruments to reach them. This exercise takes the form of government work as a shadow cabinet including the ministerial posts held by the participants. The exercise is supported by competent economists and simulation models of the national economy, typically, the same models used by the Ministry of Finance and the Bank of Finland.

The above objectives are only one means of ensuring more general societal goals, such as quality of life, equal and fair opportunities, wealth generation and distribution, balance between competitiveness and social security, environmental aspects, and sustainability. Here legitimate differences in opinions remain and are encouraged, but it is important that there is a reasonable common understanding of causes and consequences.

Since Finland joined the European Union in 1995, many policy issues have become more international, and the horizons of the Finnish corporate world have become global. In response, the economic policy management programs have been complemented by distinctively internationally oriented programs. Issues of European integration and its currency regime, international organizations, World Trade Organization and World Bank issues, and developments in China, Japan, Russia, and the United States have been the focus. The programs include largely international speakers and include studies and visits to the organizations and countries mentioned.

The beneficial experiences of the economic policy and national strategy programs in Finland are of interest to many other countries. Today, these same topics are the focus of good governance issues in public and private sectors in many countries.

5

Innovation and Education Strategies and Policies in Finland

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5.1 Industrial and innovation policies

Clusters and industrial policies

The basic idea of cluster-based industrial policies is that firms and industries are experiencing growing interdependence due to the increasing knowledge and information intensity in all economic activities. Increasingly, the economy is characterized by knowledge spillovers, innovation linkages, value chains in production, and network-type organizations. All of these call for policies that promote collaboration, networking, and enhancing the internalization of external economies within the cluster.

In 1993 the Ministry of Trade and Industry published the National Industrial Strategy White Paper,¹ which strengthened the focus of industrial policy toward developing and promoting a national innovation system in the context of industrial clusters. That was the start of “new industrial policies.” The policy document envisioned the ICT (or telecommunications) cluster as one of the future strongholds of the economy—well before the phenomenal growth of the sector in the late 1990s.

However, it is important not to infer that the “new industrial policies” and the systemic view that was adopted that Finland has followed a “master plan” in which the government played a strong leading role. Rather, the system’s view was concretized through an emphasis on responsive longer-term policies to improve the general business environment for firms and industries, especially regarding knowledge development and diffusion, innovation, and clustering of industrial activities. The system was formulated through various public-private partnerships involving economic research organizations, industry federations, and firms; and anchored in broader economic policy circles. Notably, the current policies are rooted in the 1970s and 1980s, when decisions to strengthen the science and technology (S&T) base, as well as the S&T institutions, were made.

The “industrial cluster” can be used as a conceptual framework and policy tool to cope with the challenges arising from the increasing role of knowledge spillovers. An “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 to

¹ Ministry of Trade and Industry 1993.

spur continuous innovation and upgrading of products and processes. The policy challenge is to promote both competition and networking, and seek to balance the two.

Industrial clusters can be seen as collective assets that reduce transaction costs by internalizing transactions. Hence, policy measures should attempt to strengthen the common knowledge base within the cluster toward rectifying the market failures implied by the existence of externalities. At best, industrial clusters—including both public and private agents—can be entities with built-in mechanisms to correct market failures.

The basic guidelines for industry policies adopted in early 1990s can be summarized as follows.²

1. *Industrial policies must be broad in scope.* Their primary targets should not be industries and business firms, and the reallocation of existing resources. Instead, they should *focus on creating advanced production factors and on shaping future factor conditions.*
2. As a corollary, public expenditures on R&D, education, and technological infrastructure are the most important channels through which the public sector can influence national competitiveness.
3. Government's role can be seen as an intermediary and an information provider. A role assigned to industrial policies could include creating a clear vision of potential competitive edge and restructuring needs, and the communication of that vision to all actors in the economy.

The 1993 White Paper set out these three points. It included a short review of future competitive clusters that served as rough guidelines for innovation and industry policy formulation. It also included guidelines to improve framework conditions for business firms by increasing public R&D funding, improving communication infrastructure, and further upgrading the education system. It is significant that, while the White Paper presented government's vision for the future of industrial potentials and transformation, the paper was not an attempt to have rigid planning control. The paper also recognized the risk that government policies could fail.

The White Paper's vision of future competitive industrial structure was based on an extensive research program carried out in 1992–96 at ETLA (Research Institute of the Finnish Economy). The Ministry of Trade and Industry commissioned a private (nongovernmental) institute to carry out the research necessary to reformulate policies. Their relationship is an example of the public-private partnership typical of many Finnish projects and policy initiatives.

With hindsight, the policy choices made in the early 1990s have been evaluated as highly successful.³ The developments toward the knowledge economy have elucidated the interaction between the basic business environment and more sector-specific policies. Industrial policies are understood as measures to enhance industrial growth and improve the microeconomic business environment, rather than to subsidize ailing industries or handpick the winners.

This view of industrial policies is well in line with *cluster analysis*, which has a factor-endowment flavor but emphasizes the role of business firms themselves as

² Rouvinen and Ylä-Anttila 1999, Hernesniemi and others 1996.

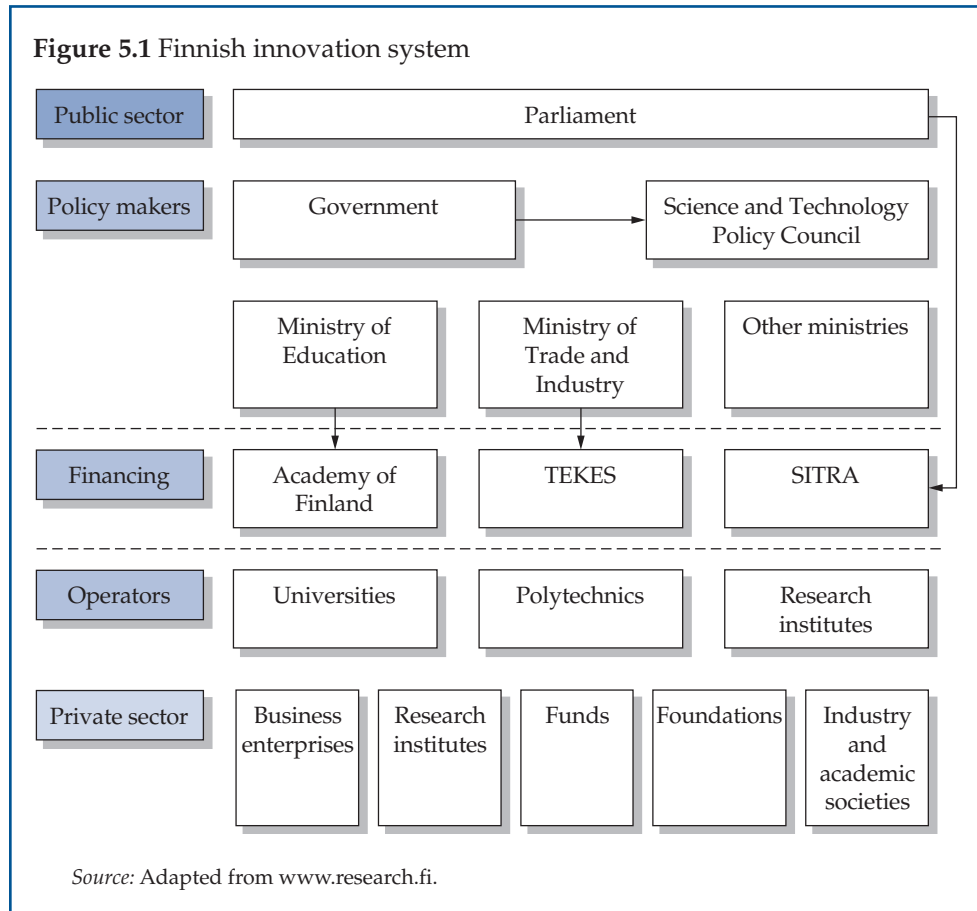
³ Jääskeläinen 2001 and 2005.

the creators of their competitive edge. The creative foment of the 1990s exemplifies this. The industrial development in that decade proved quite different from what had been expected in the mid-1980s. In the 1990s, rapid reactions of firms were needed, but, at the same time the government provided a strong knowledge infrastructure and increased the supply of ICT scientists, engineers, and technicians from public universities to meet the demands of the emerging information economy.

Science and technology policy

Figure 5.1 depicts the main actors in the Finnish innovation system. At the top is Parliament, which decides the total public resources to be used for innovation activities. As a governmental organization, the Science and Technology Policy Council (STPC) plays an important role. Among the funding institutions, the Academy of Finland is responsible for funding basic research, while SITRA (National Fund for Research and Development) and the TEKES (National Technology Agency) fund applied research and development projects. SITRA also functions as a major think tank.

Of course, the private enterprises are the most important players within the system. Among the other actors, at the regional level, the Employment and Economic Development Centers (T&E Centers) coordinate regional actions. There are 21 universities, 31 polytechnics, and 21 research institutes in different parts of the coun-



try. Among the technical research institutes, the Technical Research Center of Finland (VTT) is the most important and largest. Additionally, the system of innovation includes science and technology parks, regional centers of expertise programs, and industrial parks and incubators. Each of the public sector organizations is described in more detail in boxes 5.1–5.4.

The role of S&T policies has been important for several decades.

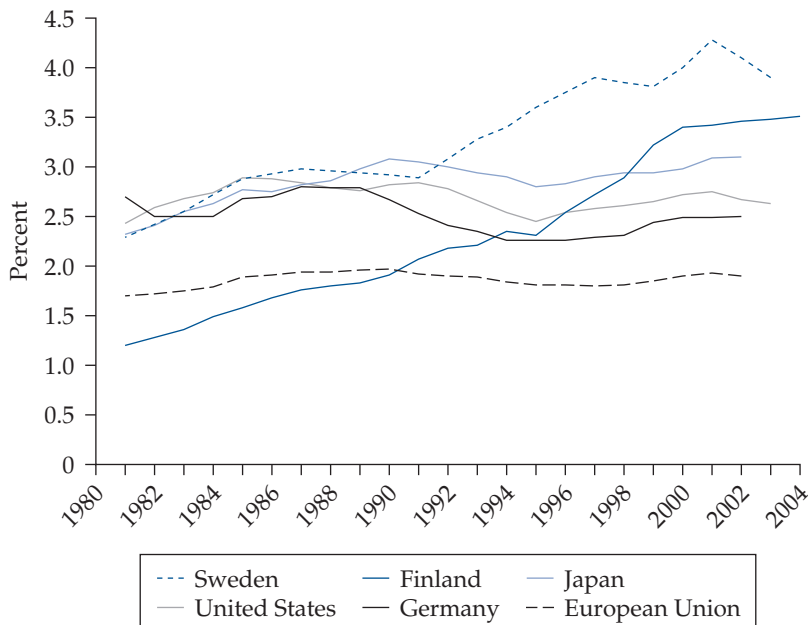
The roots of the current science and technology policy in Finland reach back to the 1960s and 1970s, when its basic structures were built.⁴ Science and technology policy established its position among government policies in 1963, when the Science Policy Council (currently the Science and Technology Policy Council) was set up to formulate and coordinate Finnish S&T policy (box 5.1).

The 1980s saw noticeable changes in Finland's economic policy priorities. More emphasis was given to technology and innovation policies with the aim of diversifying the industrial base and export structures. This new emphasis was reflected in relatively rapid increase in overall R&D intensity as a consequence of growing research and development inputs both in the private and public sectors (figure 5.2). Science and technology policy played an important role in designing new policies.

Establishment of the council was followed 1980s by an orientation to technology, which mimicked the general policy trends of other OECD countries. In 1983

⁴ For a detailed discussion of the evolution of Finnish science and technology policy, see Lemola 2002.

Figure 5.2 Ratio of R&D expenditure to GDP



Source: OECD.

Box 5.1 Science and Technology Policy Council of Finland

The strategic development and coordination of science, technology, and innovation policies in Finland are the responsibilities of the Science and Technology Policy Council (STPC), an advisory body to the government. In comparison internationally, while not unique as a top-level assembly, the Finnish STPC's composition is distinctive in certain respects.

First, it involves a wider range of sectors than similar councils elsewhere, and thereby reflects the tradition of policymaking characteristic to Finland. In addition to the government, academia, and industry, which are commonly members of corresponding national advisory councils, in Finland labor organizations also participate in the STPC's work.

Second, the chairmanship of the Prime Minister underpins the top-level status of the Finnish STPC, and thereby distinguishes it from most of its international counterparts.⁵ Other members of the Cabinet with a statutory membership include the Ministers of Education and of Trade and Industry, who are the vice chairs and responsible for implementing science and technology policy⁶; and the Minister of Finance. Up to four other ministers also may be appointed by the government. The rest of the STPC's membership consists of 10 members expert in R&D or technology.⁷

The history of the STPC dates back to 1963, when it was established as the Science Policy Council, following the example of neighboring Sweden. The council was to deal with issues related to promoting scientific research in Finland, which clearly lagged behind the OECD average at the time. The objective to increase national R&D intensity was readily accepted by the national innovation system, and the council provided a numeric expression to this national goal (Lemola 2001).⁸

In 1986, as the need for coordination between science and technology policies was recognized, technology was included in the sphere of responsibilities of the newly organized Council. The integration of science and technology policymaking put an end to an era of separation between the science and industry sectors, which originated largely from the political atmosphere of the late 1960s and 1970s (Lemola 2001). In its present form, the STPC mediates the society's technological and economic objectives with science policy.

The range of tasks assigned to the STPC has expanded over time. Recently, the STPC also has broadened the issues on its agenda. For example, in its 2003 Review, STPC calls for *social* innovations in addition to technical innovations, and *regional* innovation policies to function alongside national innovation policies.

⁵ In Japan, the recently established Council for Science and Technology Policy also is chaired by the Prime Minister.

⁶ Approximately 80 percent of public R&D funding is channeled through the offices of these two ministries. The main organizations in charge of resource allocation are TEKES and the Academy of Finland.

⁷ These must include representation from the Academy of Finland, the National Technology Agency (TEKES), universities, industry, as well as employers' and employees' organizations.

⁸ The STPC's policy review of 1973 recommended increasing the gross domestic R&D share of GDP from the <1% level of that period to 1.7% by the next decade. However, owing to the worldwide recession of the 1970s, the attainment of this goal was delayed until the mid-1980s. In 1982 the target level for the R&D intensity was raised further to 2.2% by 1992, and in 1996, the goal was set at 2.9%, which meant ultimately reaching the top level worldwide. Despite the abrupt economic depression of the early 1990s, these goals were reached as scheduled. In 2000 the GDP share of R&D exceeded 3%. It is estimated that by 2007 public R&D spending will have to be increased by 300 million euros over the 2002 level.

the National Technology Agency, TEKES, was established, and its technology programs became a major new instrument to allocate funds for innovation (box 5.2). Commercialization of research results, technology transfer, and internationalization also were among the key topics in the 1980s.

From the early 1990s, the Finnish government has focused technology policy on developing a “national innovation system” accompanied by the promotion of new knowledge creation and knowledge-based production and services. The basic idea has been to engender favorable conditions for innovation creation and adoption of new technologies in private firms and universities rather than involve direct participation of the public sector (box 5.3). At the industry level, the implementation of new policy ideas created cluster-based industrial policies. A special target of the Finnish technology policy since the 1990s has been to promote investments in R&D. Partly due to this policy focus, the share of researchers of employed population is over 2 percent, the highest among the OECD countries (Naumanen 2004).

In Finland, a major policy means to enhance innovation is *direct R&D subsidies*. More than one-fourth of government R&D appropriations were targeted to industrial production and technology in 2004. Unlike in other industrialized countries such as the United Kingdom and the United States, firms undertaking R&D do not

Box 5.2 TEKES: National Technology Agency

The National Technology Agency (TEKES) was established in 1983 to function under the Ministry of Trade and Industry. It was granted a major role to formulate Finnish innovation and technology policy by allocating funds for research and development in private firms and research organizations as well as in universities. In 1984 TEKES had a budget of less than 50 million euros to fund R&D activities. Twenty years later, its budget had increased 8-fold to over 400 million euros, approximately 28 percent of the government’s total R&D budget.

TEKES employs more than 300 hundred people, almost half of whom are technology and business experts. The majority of the staff work in the headquarters in Helsinki. TEKES also has technology units at 14 regional Employment and Economic Development Centers. TEKES maintains six offices abroad: in Beijing, Brussels, Tokyo, San Jose, Silicon Valley, Shanghai, and Washington, D.C. The major aim of the foreign offices is to manage international contacts and collaboration and to promote international R&D cooperation with TEKES’ technology programs.

The major financial instruments of TEKES include industrial R&D grants and loans to firms and grants for applied (technical or technology-related) research in public organizations. Research grants typically are allocated via *technology programs* planned in collaboration with firms and research institutes. The technology programs launched by TEKES set priorities for specific sectors of technology or industry and define the allocation of money for R&D in different fields.

The technology programs are organized as follows: Each program has a coordinator, a steering group, and the TEKES program manager responsible. The funding of the programs varies between 20–150 million euros, and the work is spread over 3–5 years. Typically, TEKES covers approximately half of the costs of the programs, and the participating companies the other half. In 2004 TEKES spent more than 170 million euros for its technology programs. In 2005 there were 22 extensive national TEKES technology programs in operation.

TEKES funding has been quite influential in promoting entrepreneurial innovation. It has been evaluated that from the mid-1980s to 2000, approximately 60 percent of major Finnish innovations involved TEKES funding (PalMBERG and others 2000).

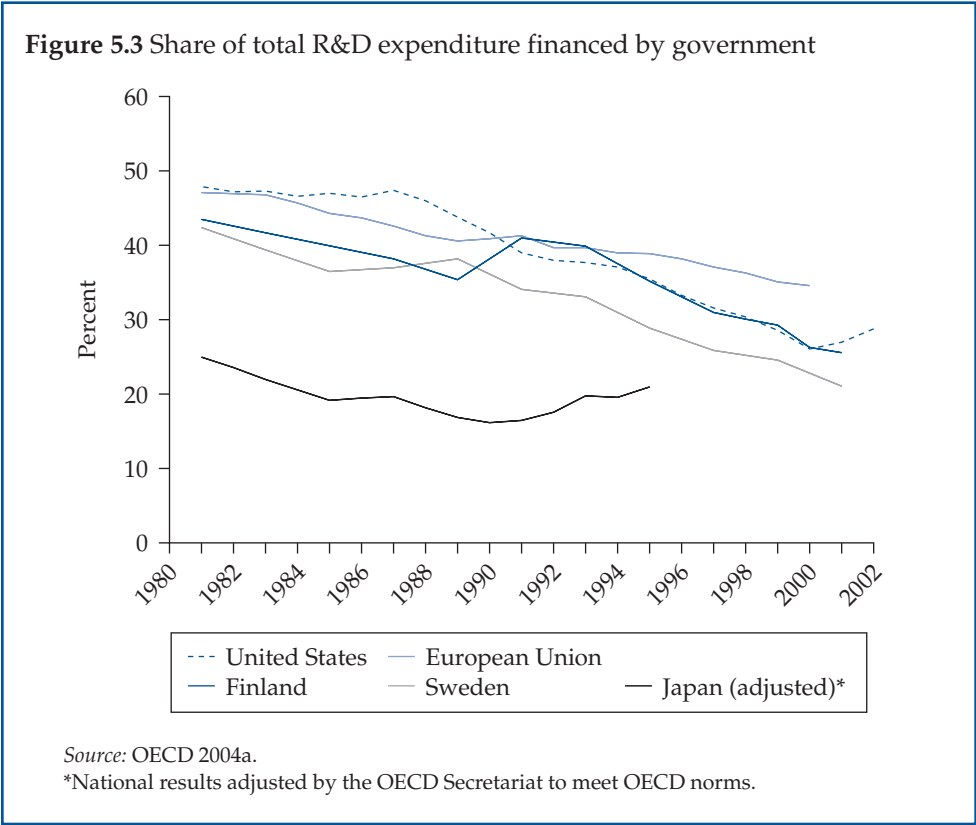
Box 5.3 Regional innovation policy, including EU framework policies

Special policies also have been implemented at the regional level. The centers of expertise program was launched to enhance the regions' international innovative competitiveness by helping them to choose their priorities and focus their resources on innovation in these fields (Lievonen and Lemola 2004). The basic idea of the centers of expertise is to invite all local experts in fields related to a particular field to interact and contribute to create innovations in that field. The first phase of the centers of expertise program took place from 1994–98 supporting 8 (13 from 1995 onward) selected centers of expertise. The second phase of the program was launched for 1999–2006, and in 2004 there were 22 centers of expertise in the program (19 local and 3 national networked centers). A committee appointed by the Ministry of the Interior leads the program and submits the proposal on the regional allocation of funds to the government, which makes the final decision. In early 2004, the government allocated over 9 million euros to the program, to be allocated over three years of the program via regional councils to the centers.

receive any favorable tax treatment, that is, *Finnish technology policy does not provide tax incentives for R&D*.⁹

Although government's financing of R&D has increased substantially during the past decades, its relative share of total R&D has decreased during the same period. Investments in R&D increasingly are privately funded (figure 5.3).

⁹ Finland also has experimented with a tax credit scheme to enhance innovation. A tax reduction scheme was implemented during 1983–87 but abandoned as part of a major taxation reform 1987.

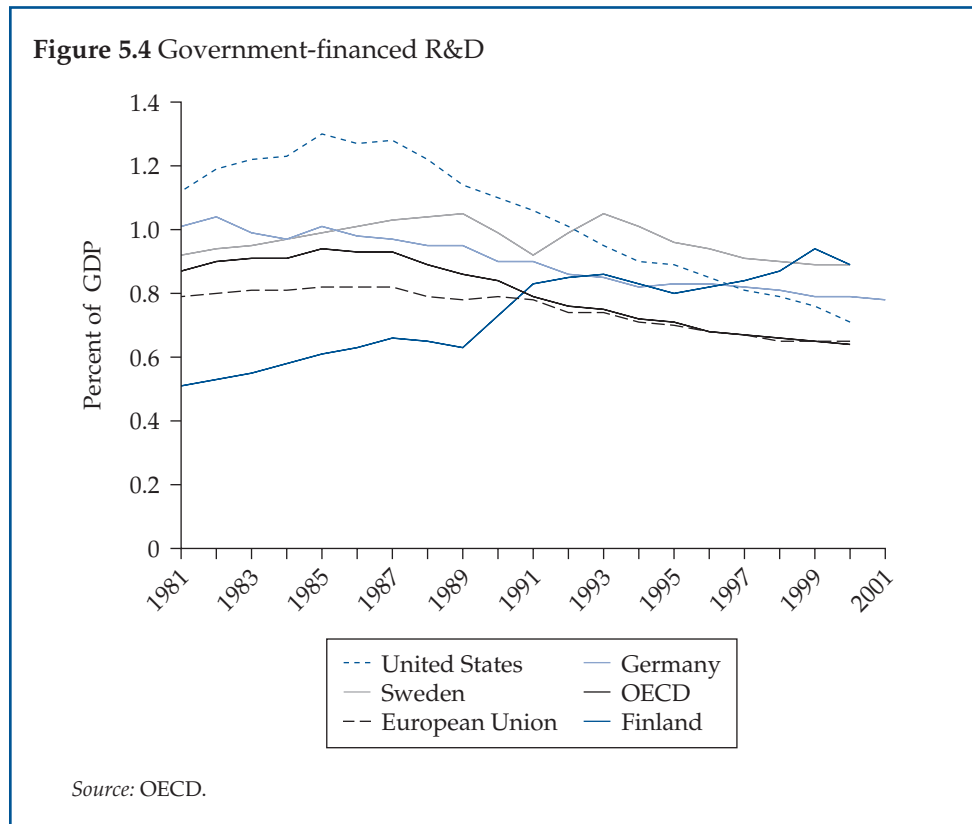


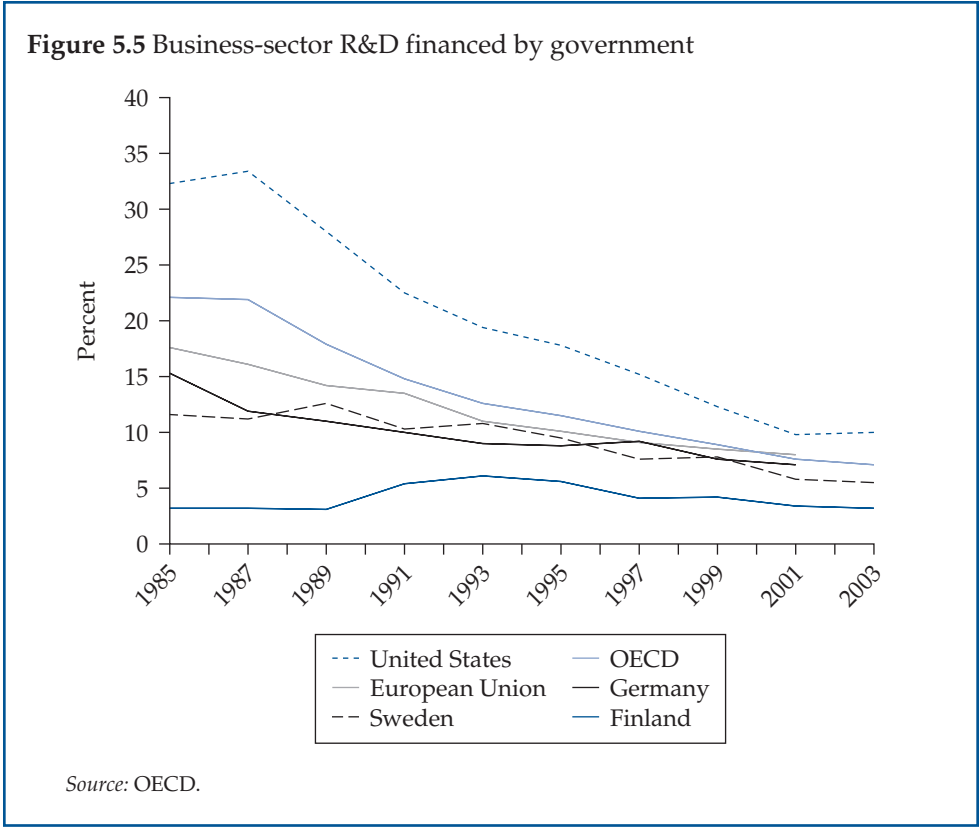
The relative contribution of the public sector to financing and performing R&D has decreased since the early 1990s, and by 2002 it had sunk below both the EU and OECD averages. In the early 1980s, the Finnish government financed over 40 percent of gross expenditure on R&D (GERD), whereas in 2004 public contribution covered only approximately 25 percent of GERD. However, the involvement of the Finnish public sector in subsidizing R&D in relation to GDP seems to be the highest among the EU countries because overall spending on R&D to GDP in Finland increased so significantly over the period. In 2003 the Finnish government's rate of R&D appropriations of GDP was close to 1.0 percent in contrast to the EU average of 0.75 percent (figure 5.4).¹⁰

Although the relative importance of direct government involvement in business sector R&D activities has declined (figure 5.5), Finland has experienced a notable increase in total R&D investments. Since 1994, Finnish R&D expenses as a share of GDP has exceeded both the EU and OECD averages. In 2004 the total annual R&D expenses in Finland were approximately 5 billion euros, or approximately 3.5 percent of GDP. This relative R&D investment share is among the highest in the world.

It is noteworthy that direct government funding of business-sector R&D has been low but, compared to most other countries, relatively stable. Another important feature is that government kept its commitment to increase its R&D funding in the period of economic crisis in the early 1990s (cf. figure 5.5), although it cut prac-

¹⁰ Statistics Finland, http://www.stat.fi/tk/yr/ttba_t4_en.html





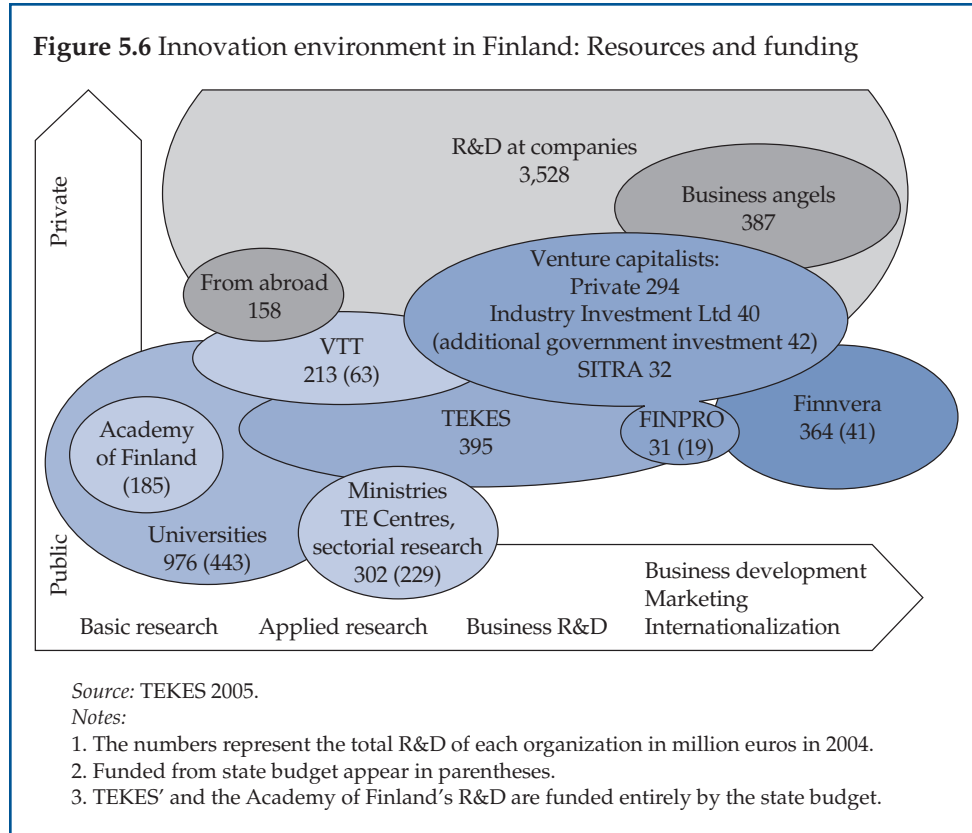
Box 5.4 VTT: Northern Europe's largest applied polytechnic research organization

The Technical Research Center of Finland (VTT) was established in 1942. It has become the largest applied polytechnic research organization in Northern Europe. It is an integral part of Finland's innovation system. By developing new technological solutions and applied technologies, VTT helps its customers to improve their competitiveness. VTT also promotes technology transfer (TT) by participating in national and international research programs and collaboration networks.

VTT's multidisciplinary research organization covers the following polytechnic research areas: biotechnology, energy, pulp and paper, digital information systems, telecommunications, industrial systems, microtechnologies and sensors, materials, and building. With a staff of some 2,700 and unique research facilities, VTT can provide a wide range of applied high technology, solutions, and know-how to its domestic and international clients and partners. VTT's involvement in international and national innovation networks strengthens its potential to contribute to cooperation, partnering, and technology transfer. VTT's revenue in 2004 was 218 million euros.

tically all other public expenditures. That sustained government commitment increased both the predictability and credibility of technology policies.

The relative role of more conventional (not technology-related) public funding has diminished. As a consequence of financial market development, ever less public intervention is needed, and market imperfections also have decreased. On the other hand, R&D funding may be even more important because it complements financial development. Social returns to innovation policy are likely to increase with the financial system's ability to commercialize innovations and new technologies and,



hence, support firm growth. Overall, the roles and missions of public innovation agencies gradually have been adapted to changes in business environment (box 5.5).

According to a recent evaluation, the innovation support system functions relatively well. However, there is still need for increased coordination among policy agencies, and for partial overlap between public and private sector provision of both finance- and innovation-related services.¹¹

Finnish R&D subsidies tied to networking. A very interesting feature of the Finnish R&D subsidy system is that, typically, a firm can receive R&D funding (from TEKES) *only* on the condition that it applies for funding for a R&D project that is *networked*. In other words, *R&D funding is tied to projects that are performed in collaboration with other companies, research institutes, and/or universities*. This policy no doubt contributed to the 2003 finding of the European Innovation Scoreboard: among EU countries, Finland had the greatest share of SMEs participating in R&D cooperation (figure 5.7).

EU Innovation Scoreboard data also shows extensive innovation collaboration among firms and universities in Finland (figure 5.8). Interestingly, these documented internationally high R&D intensity and extensive R&D collaboration in Finland support the basic policy conclusion of the economic theory on research joint ventures: *research collaboration is likely to produce more R&D than competition*.¹²

¹¹ Georghiou and others 2003

¹² Pioneering study by d'Aspremont and Jacquemin 1988.

Box 5.5 Four public players-plus-one in development and commercialization of innovations

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

Finnish Industry Investment (FII) is a state-owned equity investment company administered by MTI. FII's task is to improve the conditions, particularly for SME operations, by investing equity in venture capital funds. FII also can make equity investments directly in 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.

Employment and Economic Development Centers (*T&E Centers*) are public offices under ministerial supervision, comprising a network of 15 regional offices with business departments. The task of the business departments is to serve the needs of SMEs by providing business support services and consultation and advice, as well as financing. In addition, the centers serve as a regional network for the programs of other ministries and channel their services to the regions. About half of the financial support for the T&E Centers comes from EU Structural Funds and is directed to the EU objective areas.

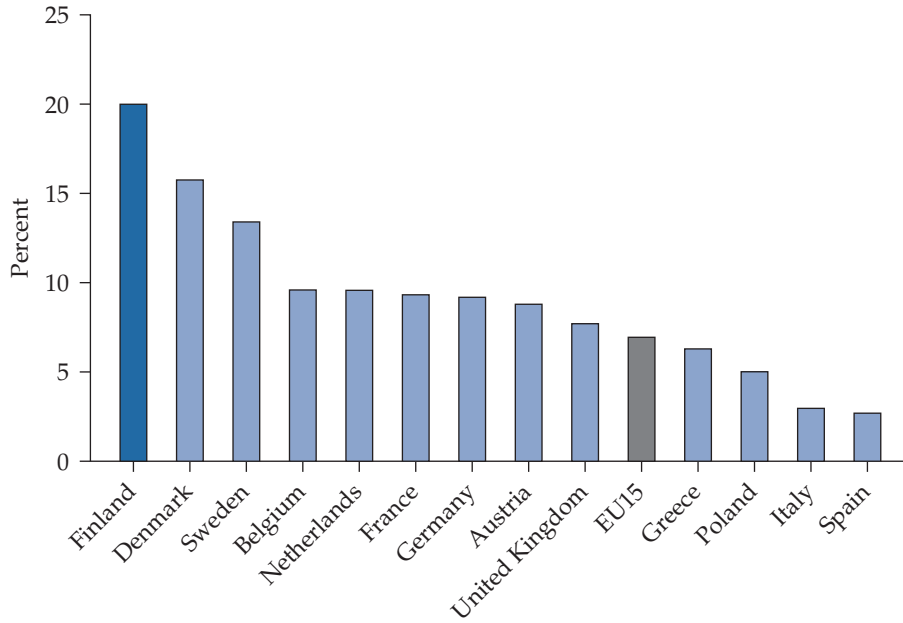
Finpro provides internationalization expertise for Finnish companies. *Finpro* is an association founded by Finnish industry in 1919 and has grown into a professional consulting organization. It is supported by MTI through a public-private partnership. *Finpro* is a member organization consisting of some 600 companies, the Confederation of Finnish Industries, the Finnish Entrepreneurs Organization, and Technology Industries of Finland. The mission of *Finpro* is focused on accelerating the internationalization of Finnish companies while assisting in managing the risks involved. The services are targeted at small and medium-sized companies (SMEs). *Finpro* carries out this national task in close cooperation with other service organizations, such as the National Technology Agency (TEKES), local employment and development centers, *Finnvera*, *SITRA*, and the other players in the Finnish National Innovation System. Finnish companies' access to overseas markets is accelerated through *Finpro*'s 50 Trade Centers in more than 40 countries. These trade centers are strategically located in markets in which Finnish companies have a special competitive edge and which represent about 90 percent of Finnish exports.

Finpro Marketing, Ltd., was recently incorporated. It functions as a private corporation and does not receive government support. From it firms can purchase services for their international marketing needs.

Finland's ICT sector, particularly electronics production, has become the major R&D performer. In 2001 almost 50 percent of Finnish business enterprises' R&D was undertaken in the electronics industry sector. Only a decade earlier, ICT was only approximately 17 percent of R&D (OECD 2004a). By and large, the electronics industry firms accounted for the growth of Finnish R&D activities during the 1990s and early 2000.

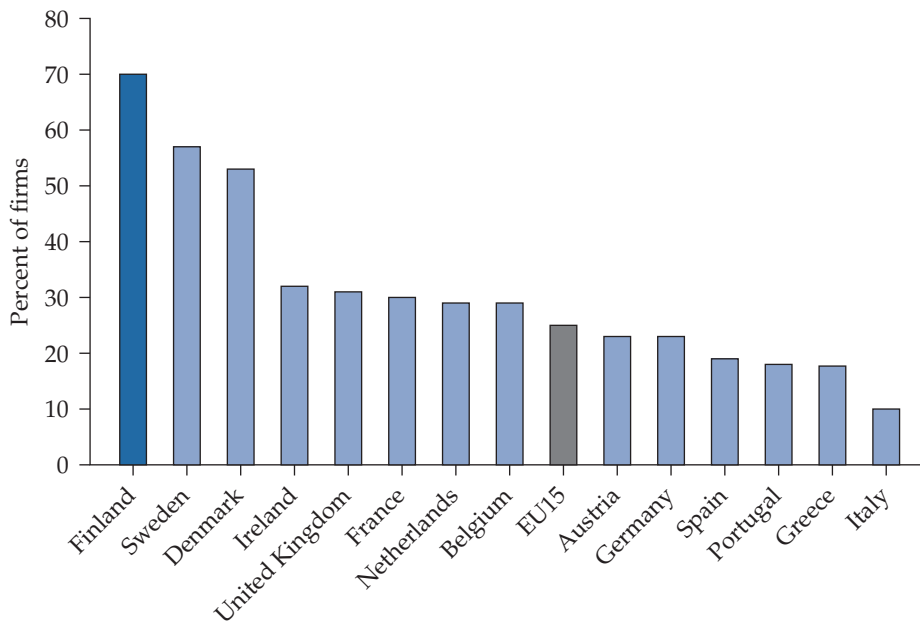
Here, the role of an individual firm, *Nokia*, needs to be mentioned. In 2002 *Nokia*'s share of gross expenditures on R&D was more than one-third (Rouvinen and Ylä-Anttila 2003). However, it is worthwhile to mention that in *Nokia*'s success, too, public R&D funding played a role. In the early 1990s, approximately 7 percent of *Nokia*'s

Figure 5.7 Share of industrial SMEs participating in R&D cooperation



Source: European Commission. European Innovation Scoreboard, 2004 database.

Figure 5.8 Share of firms collaborating with other firms and universities during innovation



Source: EU-CIS Community Innovation Survey 2001.

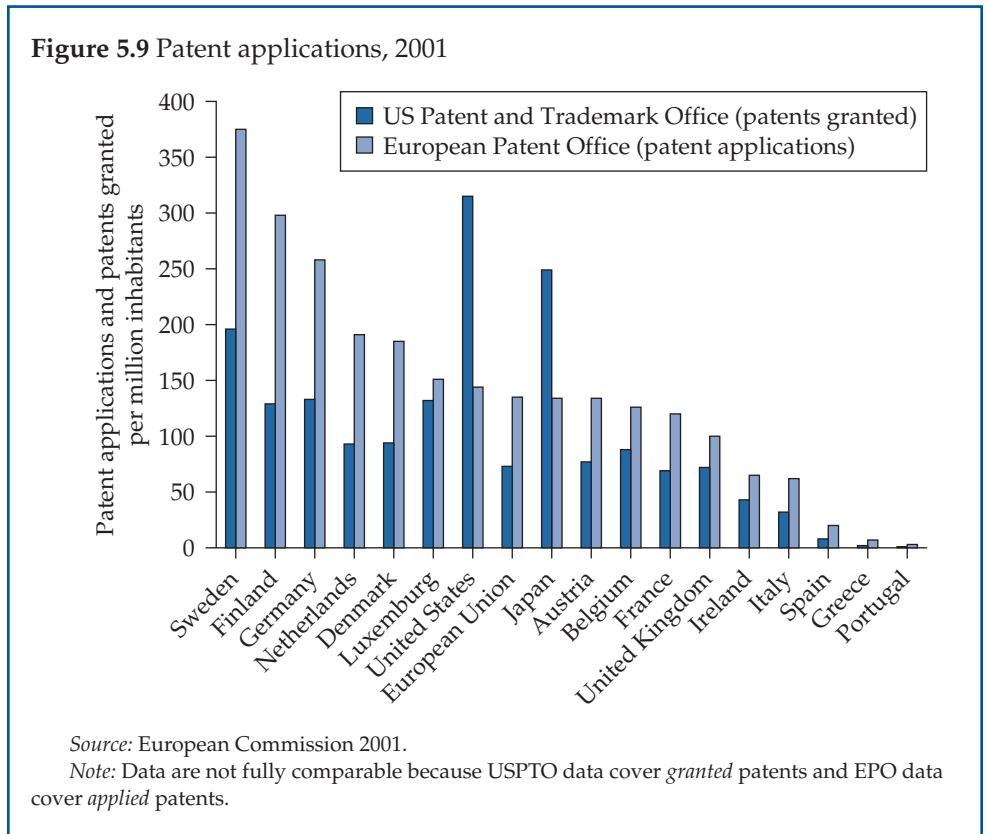
R&D expenditures were covered by public R&D subsidies allocated by TEKES. By 2002 this share had diminished to only approximately 0.3 percent (TEKES 2002).

Although technology policy is only one factor determining firm-level innovation, it is interesting to see how innovation patterns and performance in Finland differ from those in other countries. The 2004 Eurostat study indicates that, in 2000, the share of Finnish enterprises undertaking innovative activity—45 percent—was slightly smaller than the EU average—47 percent.¹³ As is typical among the EU countries, innovative activities in Finland are concentrated in the large firms. In Finland, 74 percent of large companies take part in innovative activities, whereas the corresponding percentage among the small firms is 40 percent.¹⁴ The proportion of Finnish enterprises engaged in innovative activity that had received public funding was 42 percent, clearly higher than the EU average—29 percent. The Finnish SME firms are the government’s target group in promoting entrepreneurial innovation: in 2000, more than 50 percent of R&D funding of TEKES was allocated to SME firms.¹⁵ The Eurostat survey indicated that approximately only one-third of European small firms with innovative activity had received public funding.

¹³ Enterprises with innovative activity are defined as “enterprises that introduce new or significantly improved products (goods or services) to the market or enterprises that implement new or significantly improved processes.”

¹⁴ EU-CIS Community Innovation Survey (2001)

¹⁵ In 2003 SMS firms’ share of R&D subsidies from TEKES reached almost 60%. <http://www.tekes.fi/tekes/esittely>.



Patents provide one key measure of innovation output. Finland was one of the top European countries in the number of patents applied for per capita recorded in the European Patent Office (EPO) as well as in the number of patents per capita granted by the United States Patent and Trademark Office (figure 5.9).¹⁶ The Finnish industrial structure—the importance of the ICT sector that has a relatively high propensity to patent—provides part of the explanation for these patent statistics. In 2002 approximately 37 percent of all the EPO patent applications originated from the electronics industry.¹⁷ According to the 2003 Eurostat, among EU members, Finland is the leader in ICT patenting. In 2001 it had 136 ICT related patent applications per million inhabitants submitted to the EPO.

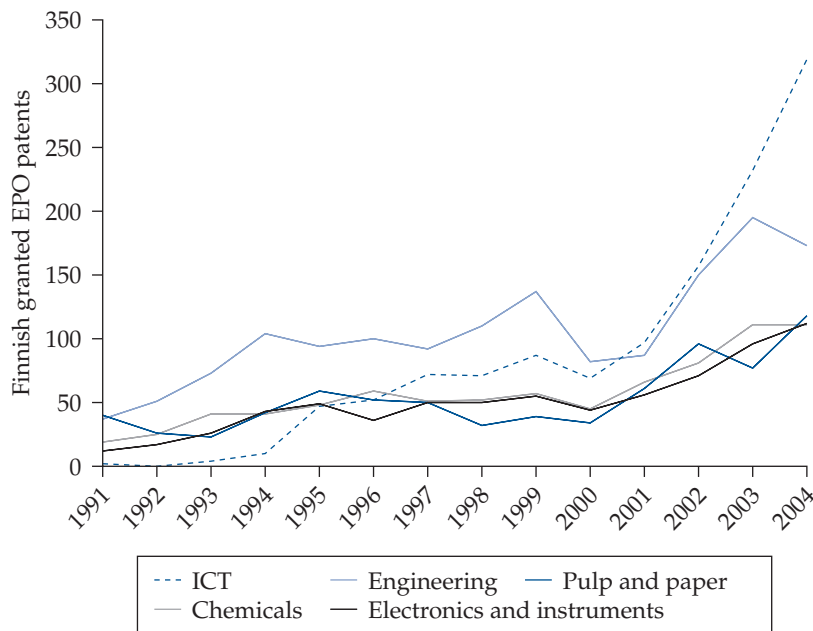
On closer inspection of the structure of patenting at the EPO, the dominance of ICT is quite striking (figure 5.10). However, patenting has picked up in other technology fields as well. Finland's strong focus on forest-related industries is also visible. These patents refer primarily to pulp and papermaking and the related machinery, which explain a large part of the high-level and growth in engineering patents since the early 1990s as Finnish firms started to patent at an increasing rate.

Thus, it appears that Finland's *science and technology policy that emphasizes direct subsidies to collaborative R&D projects* has been quite successful in facilitating private R&D efforts.

¹⁶ The data here regarding patent activities in Europe and in the United States are not totally comparable, because USPTO data cover *granted* patents whereas EPO data concern *applied* patents.

¹⁷ Statistics Finland. www.stat.fi.

Figure 5.10 Composition of patents granted by the European Patent Office, 1991–2004



Source: ETLA's FEPOCI database 2005.

Policies aiming at the creation of a knowledge economy

Despite the fact that many policies—especially industrial and innovation policies—have implications for the development of a knowledge economy, Finland has a track record of policy initiatives with an explicit objective of creating the Finnish knowledge economy. In the early phases, these initiatives focused on the diffusion and application of early computers in the Finnish public sector. These initiatives trace back to the 1960s, when important computer-related inventions were being made mainly in the United States. Finland’s first initiative was the Automatic Data Processing (ADP) Committee, which was set up in 1960, based on similar committees in Denmark, Norway, and Sweden. The first task of the ADP Committee was to review the ADP requirements of the public sector and suggest steps toward fulfilling these.

One concrete outcome of the work of the ADP Committee was the establishment of the State Computer Center. At the time, this center had practically a monopoly position in supplying the public sector with ADP hardware, software, and services. Nonetheless, an explicit national information society policy was formulated later, in the 1970s. This society contributed to the international debate on the benefits and threats of information technology to the economy and society as a whole.¹⁸ The policy discussion was institutionalized in the form of two roundtables. The ADP Advisory Board was established in 1975 under the Ministry of Finance, and the Technology Council was appointed in 1979 by the Council of State.

Both fora produced a series of progressive memoranda in which they predicted many of the development trends of the 1990s, such as the potentials of ICT harnessed to the everyday life of citizens. One such memorandum was directed to SITRA and the Ministry of Trade and Industry. It emphasized the importance of public R&D funding to develop ADP software. The importance of education in the field also was emphasized, at both the secondary and tertiary levels. Later, in 1983, after TEKES was founded, ADP software and ICT became prioritized fields for public R&D. Nonetheless, these early recommendations did not yet materialize into explicit knowledge economy strategies. At that time, even though it was widely acknowledged that the possibilities provided by ICT were not to be missed in the development of national competitiveness, the anticipated negative implications of automation for employment dominated the public debate.

A new course in the information society discourse was set forth in the United States, where, in 1993, Vice President Albert Gore, Jr., introduced the National Information Infrastructure agenda, which proclaimed information as “one of the nation’s most critical economic resources.”¹⁹ This US initiative encouraged the EU to formulate its strategy. In 1994, the “Bangemann Report” was introduced to guide national information society strategies within the EU.²⁰ In the same year, an OECD country report on Finland remarked the absence of a national information technology strategy.²¹ The report pointed out that this absence was in marked discrepancy with Finland’s leading position in computer and mobile penetration rates.

¹⁸ Manninen 2003.

¹⁹ National Information Infrastructure 1993.

²⁰ Europe and the Global Information Society, 1994. (eds. Bangemann, M.) <http://europa.eu.int/ISPO/infosoc/backg/bangeman.html>

²¹ Huuhtanen 2001

Consequently, the Finnish government authorized the Ministry of Finance to frame a national strategy. The agenda, which followed the main international guiding principles set forth in the United States and the European Union, was regarded as a strategy to get out of the contemporary economic and social crisis.²² It called for *efficiency in the use and production of ICT, and networking as the mode of organization of societal activities*. It also *highlighted the importance of education and R&D* as the foundations for improved national competitive advantage.

The roots of an explicit knowledge economy policy can be found in the recommendations drafted in the “TIKAS reports” in 1993 and 1994. These reports proclaimed Finland as a networked information society and front-runner in ICT production and usage. In 1995 the importance of a national knowledge economy strategy also was endorsed at the governmental level. In 1996 the government formed the Consultative Committee on the Information Society. In 1997 SITRA was given the task to draft an explicit information society policy, thereby elevating SITRA to an important stakeholder for information society and knowledge economy developments in Finland. Furthermore, the government’s “Futures Report of 1998” highlighted policies that would increase R&D expenditure, build up Finland’s status as an “information society laboratory” within the European Union, and create a system for lifelong learning. After approval from the Parliament, these policies were consolidated in the memorandum of the Committee for the Future.

Finally in April 2003, the guidelines for the Information Society Policy Program²³ were included in the government’s agenda. The Information Society’s program objec-

Box 5.6 eGovernment

According to the EU Commission’s 2004 eEurope study, online public service provision in Finland was the fifth most sophisticated of all of the EU countries in terms of the extent to which services are provided electronically.²⁴ The general objective for public online services is full electronic case handling; the ultimate aim is paperless procedures. The Finnish government comprises a total of approximately 170 service entities, accessible through a main portal, *Suomi.fi* (literally, *Finland.fi*).

Of the 20 evaluated public services, over 60 percent are provided fully electronically by the Finnish authorities.

Electronic identification is a prerequisite for many Internet-based services. An electronic ID card was launched by the government in 1999 but it has not gained popularity among Finns owing largely to the relatively high cost of acquisition and a limited number of accessible services.²⁵ In 2004 Finnish authorities decided to adopt the electronic ID system that has been used successfully in Internet banking services, which is based on personal identification numbers. This electronic ID system is also extendable to mobile services.

Finland will test electronic voting in the 2006 presidential elections and envisages voting through the Internet or by mobile phone the following year. In 2006 individual taxpayers will be sent a pre-filled-out tax return form, and they can send their amendments to the tax authorities via the Internet.

²² Manninen 2003.

²³ Government Strategy Document 2003. www.valtioneuvosto.fi/tiedostot/pdf/en/42828.pdf.

²⁴ Finland was outscored by Sweden, Ireland, Denmark, and Austria.

²⁵ The total cost of an electronic ID card, requiring also a reader and a software package, amounts to 80-90 euros.

tives drew largely from the common EU goals, stipulated in the “Lisbon strategy” and “eEurope Action Plan of 2005.” By appointment of the government, the Information Society Council (which replaced the Consultative Committee on the Information Society) steers the development of the information society by coordinating cooperation among administrative branches, and among the administration, organizations, and business life. It (and several other authorized bodies) also follows up and reports to the government on progress in the implementation of the program.

The Information Society Council operates under the chairmanship of the Prime Minister. The council involves the economy’s main users and producers of services and the infrastructure, as well as the ministers in the administrative fields of transport and communications, education, finance, and defense. The government expects collaboration between public and private sectors in the implementation of the program. In addition to the government’s program, several ministries have their own agendas to promote the development of the information society, and knowledge economy more generally, in their respective administrative branches.

In hindsight, by international comparisons, Finland was a relatively early mover in stressing the importance of ADP, the information society, and knowledge economy. Nonetheless, information society and knowledge economy policies initially were quite technology focused and marginal, because the full societal relevance of these policies was not acknowledged by the governmental until the mid-1990s.²⁶ Instead, knowledge economy developments were the by-products of the general emphasis on R&D and education, especially in the field of ICT. It can be concluded that knowledge economy policies were subordinated to industrial and innovation policies well into the late 1990s.

5.2 Education system and policy

The education system and policy play a key role in the knowledge economy, in which literacy skills as well as the ability to gather, process, and produce information form the fundamental bases of human capital. The following sections outline the history and development of the Finnish education system and policy, then briefly discuss how they have responded to the changing needs of the knowledge economy.

**Finland’s
emphasis on
education has
long history.**

History of Finnish education system

Since the early nineteenth century, Finnish education policy has exhibited the principle of equality in the development of the education system. The law to allow creating common schools was passed in 1866. The connection between educating the population and economic growth also was acknowledged early on. In addition, educating the common people served as tool in nation building prior to Finnish independence in 1917. Shortly after this, legislation on school districts and equal access to school further strengthened the system. In 1921, attending common school was made a basic legal right and duty of everyone aged between 7 and 12. By the 1960s, everyone received 6 years of common education. In addition, five years of middle school, and 5 years of gymnasium (upper secondary) were available for

²⁶ Manninen, 2003.

those with talent and generally from wealthier families. In the 1960s and 1970s, a reform of the education system was initiated to further improve the equality in educational opportunity. The result was the basic education system: 9 years of schooling for everyone. Gymnasiums evolved into the current upper secondary schools, and vocational education began to take its current shape.

In higher education, however, the economic trends and demand for certain skills have played a significant role in education policy, and the expansion of Finnish higher education system has followed and supported the course of economic development (Lampinen 2000). In the 1940s and 1950s, elevating the general education level of the people was relevant. The 1960s and 1970s witnessed the establishment of the Finnish welfare system, and higher education institutions provided the economy with social sciences graduates and public employees. In the 1970s and 1980s, providing graduates for the private sector took over. Toward the 1990s, further development in technical fields and the emerging ICT sector increased the popularity of and investment in higher education in these fields.

Structure of Finnish education system

The Finnish education system begins with basic education in comprehensive schools, which is compulsory for everyone aged 7–16.²⁷ It includes primary school and lower secondary school, and takes nine years to complete. Before primary school, many children receive preprimary education in day care facilities or schools, but this is not a legal requirement. Figure 5.11 presents the structure of the current education system in Finland.

At the secondary level, there are two kinds of schools. Upper secondary schools provide education that prepares students for the matriculation examination and studies at tertiary level. It takes 2–4 years to complete upper secondary school. Vocational schools offer study programs that provide the students with professional qualifications. On average, they take 3 years to complete. All secondary level education grants eligibility for education in institutions of higher learning.

There are two types of institutions of higher learning: universities and polytechnics. Universities are traditional academic institutions, with close connections between scientific research and teaching. Lower (bachelor's) and higher (master's) academic degrees, as well as further education leading to licentiate and doctoral degrees, are offered. The average time to complete a master's degree is six years, but no time limit is enforced. There are 20 universities in Finland. Ten of the universities are multidisciplinary institutions, and the other 10 consist of 3 technical universities, 3 schools of economics, and 4 schools of arts.

Polytechnics emphasize their connections to work and practice. The research conducted in polytechnics involves cooperation with private and public enterprises and often assists in regional development (Ministry of Education 2003b). There are 29 polytechnic institutions in Finland. The degrees awarded are professional higher-education degrees, equivalent to bachelor's degrees from universities. The

²⁷ Unless stated otherwise, the description on the education system is based on Ministry of Education 2003a: The Finnish education system. http://www.minedu.fi/mined/education/education_system.html.

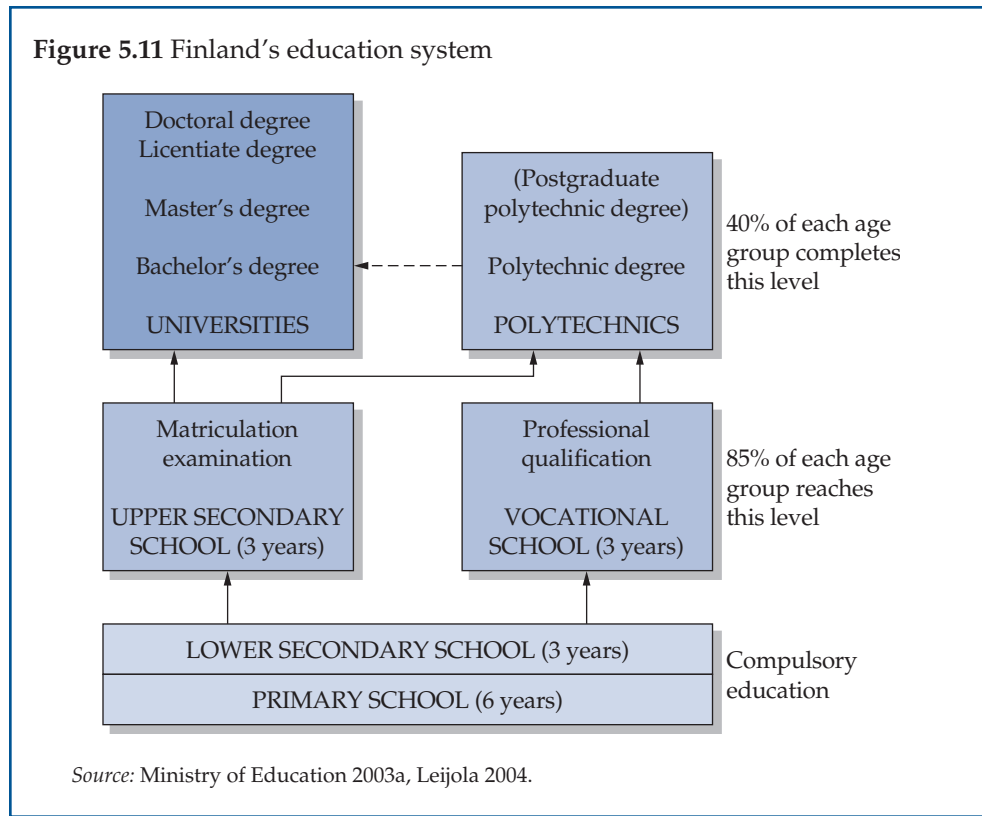
polytechnic programs usually take four years to complete. Currently, postgraduate studies leading to a master’s degree are available in some fields in polytechnics.

According to the adult education survey by Statistics Finland (1999), 50 percent of the working-age population attends some kind of adult education. Adult education takes place either informally or within the vocational adult education system. Informal adult education involves open colleges, workers’ institutes, and other organizations whose courses people attend at their own expense and on their own time. Some of these institutions receive public funding, but their curricula are not regulated by government education policy. Formal adult education takes place in universities, vocational schools, and evening programs of upper secondary schools. Adult education policy aims to improve employment and provide employees with abilities to deal with the demands of the modern working life. Employer-sponsored training is the fastest growing form of adult education. Information technology and computer skills are the most popular subjects in employer-sponsored education and training.

Adult education policy supports employment.

Financing the education system

The education system in Finland is publicly funded and run, and thus free of charge to students. Municipalities are responsible for providing preprimary and basic education and upper secondary schools. Lunch is served at school every day, and after-school activities are available for young pupils finishing school early in the afternoon. In basic education, books, and supplies also are provided by the schools.



Vocational education is cofinanced by the government and local authorities. Universities are state-owned institutions with constitutional autonomy. Polytechnic institutions are funded mainly by municipalities and foundations. There are no tuition fees in higher education. Students usually pay the membership fee (60–100 euros per academic year) to the student unions of their institutions and receive several student benefits in return. These benefits include: student cafeterias serve meals at subsidized prices; students receive discounts in public transportation; and there are student health care facilities that charge only nominal fees.

The Social Insurance Institute of Finland (KELA) administers the financial aid system for students in secondary and tertiary level. Financial aid includes three components: study grants, housing supplements, and student loans guaranteed by the government. A university student can receive up to 650 euros per month in financial aid. Of this amount, 260 euros are a study grant; the housing supplement can be 170 euros at its maximum; and a student can take out a loan guaranteed by the government of 220 euros per month (KELA 2003).

In Finland, investments in education have been relatively large in proportion to the size of the economy. According to the 2000 OECD comparison, educational expenditures were over 5 percent of GDP exceeding the OECD average. Since the late 1990s, the share of funding from private sources has increased in higher education. Universities cover approximately 35 percent of their expenditures with external funding sources, for instance, via contract research (KOTA 2004). The comparison of education expenditures among the OECD countries implies that although Finland has witnessed a clear increase in spending on educational institutes during the second half of the 1990s, investment in education per student is at the average level within OECD.

Education policy and the development of the education system

Equality by gender, region, and socioeconomic background are fundamental principles of the Finnish education policy (Ministry of Education 2003c). Everyone receives the same basic education. Furthermore, it is the goal of the educational system

**Equality is
foundation of
education**

that no one relies on basic education alone. Previously, equality was considered on a quantitative basis and the distribution of schools and access to them were measures of equality. Nowadays, equality in the quality of education for everyone is the goal, and individual learning results are the measure of interest (Jakku-Sihvonen 2002). The social security

system in Finland exerts strong incentives for young people to continue educating themselves after the lower secondary school, since one has to be over 18 to be eligible for unemployment benefits. In addition, since 1997, applying for and/or accepting secondary education or training appointed by the unemployment agency has been a prerequisite for unemployment benefits for young people aged 18–24.

Currently, the Finnish education system, and its higher education in particular, are entering a period of reform. The financial aid system and the degree structure are being remodeled to increase the effectiveness of higher education. In addition, the Finnish system of university and polytechnic education is being harmonized with the systems of other European countries. The aim is to shorten the years of study of Finnish higher education students and to improve the employment rate by

Box 5.7 Academy of Finland

The major body allocating money for scientific research and making science policy in Finland is the Academy of Finland, which functions under the Ministry of Education. The roots of the Academy of Finland and Finnish science policy go back to 1918, when the first state science policy board was founded. In 1948, the “old Academy of Finland,” made up of 12 academicians, 8 scientists, and 4 artists, was established to enhance the development of science and arts. In addition, a grant system to finance scientific research—as well as a separate grant system for the artists—was established. Two years later, the Research Council for the Natural Sciences and the Research Council for the Humanities were founded to form the Central Board of Research Councils, the official body responsible for issuing the research grants. In the early 1960s, there was a reorganization of the council organization into the six more specialized units: natural science, medical research, agriculture and forestry, technology, humanities, and social sciences.

In 1970 the Academy of Finland in its current form was established around research councils whose major task was to coordinate research funding and fund high-quality research. Furthermore, the system of fixed-term posts for the research professors (currently called Academy Professors) of the academy was established. Currently, there are 4 research councils with 10 members and a chairperson in each:

1. Research Council for Culture and Society
2. Research Council for Natural Sciences and Engineering
3. Research Council for Health
4. Research Council for Biosciences and Environment.

The academy’s highest decision-making body is the Board of Directors, which is led by the academy’s president. Six of the board’s other member members comprise the chairs of the 4 research councils plus 2 experts appointed by the Council of State.

The Academy of Finland focuses on financing basic research. Its main instruments include “research project funding that is open for general application, research programs, center of excellence programs and posts for Academy Professor and Academy Research Fellow.”²⁸ International collaboration and work and training abroad are stressed in the Academy-financed projects.

Among the most important instruments that the Academy of Finland uses to allocate money are the research programs. Typically, a research program defines a broader topic of research interest and then provides “an umbrella” for various interrelated research projects for 3–4 years. Various research programs financed by the Academy of Finland have been targeted to promote research in ICT-related fields. One of the most prominent of them has been Telectronics (I and II), whose funding totaled 7.77 million euros over the years 1998–2003:

“Telectronics research programs were part of a national public research funding effort aimed to strengthen the position of Finnish electronics and telecommunications research at the international forefront. . . . The original themes covered in the program included i) telecommunications electronics, ii) embedded telecommunications software and information systems, and iii) the requirements of new telecommunications techniques, and the prospects they open for telecommunications-based business activity chains. Broadband data transfers were another central theme. In the second phase the program concentrated on issues that either had been left in the previous programs without adequate research or which were estimated to become bottlenecks of technological development and extensive use.” (<http://www.aka.fi>)

²⁸ <http://www.aka.fi>.

facilitating faster transition to the labor market. Shorter times to degrees also can be argued to improve the match between education policy and economic development with respect to fields of study and numbers of graduates. For example, there already are signs of excess supply of graduates in engineering. Being able to anticipate the developing fields in the knowledge economy and improving the cooperation among the industrial, higher education institute, and education authorities may prove essential for the future success of the Finnish knowledge economy.

Box 5.8 eLearning

The vision of lifelong learning lies at the heart of the Information Society strategy of the EU, outlined in its eLearning Program. In Finland, the government has conveyed its objective to lead the way in the development and use of virtual education methods. A major driver for rapid fulfillment of this objective resides within the public administration: during the next 10 years approximately half its employees will retire. Network-assisted training has been suggested as a means for flexible and efficient “change of generation.”

A survey on the current status of network-based personnel training in public administration shows that there is a large record of related development projects. Yet, to date, only an estimated one-third of public organizations have utilized networks purposefully for educational purposes. The survey report notes that the know-how gained from various development projects has remained “at the source” and thus is somewhat scattered across individual organizations. Most projects also seem to have remained experimental rather than produced effective educational procedures. Common standards in techniques and content provision also are called for to improve progress in eLearning in the public administration.

On the whole, the development efforts on Internet-based schooling have produced a range of virtual learning environments. There are an estimated 100 public sector organizations that develop and/or offer digitally distributed learning services, and approximately 150 private enterprises providing contents, services, or technologies for eLearning.²⁹ Most digital teaching materials, which cover all educational levels and related information for teachers, are organized under a common portal.³⁰ The material conforms to the framework curriculum and thus can be used as substitutive or complementary to traditional teaching material. However, large differences exist among and within municipalities in the use of information technology in schools.

For the development of online tertiary level education, the *Finnish Virtual University* (www.virtuaaliyliopisto.fi) was established in 2001 as a cooperative project organization among all 21 Finnish universities. Its goal was to harmonize universities’ information systems and to share services to benefit students, teachers, researchers, and administrators. The organization has initiated the development of a national database for virtual courses, and that includes online student counseling. The teaching staff, in turn, is provided online access to tools, materials, and support for the design and implementation of virtual courses. The ultimate aim of the Virtual University project has been to establish operating models and services as part of permanent activities of universities.

By the same token, *Finnish Virtual Polytechnic* (www.virtuaaliyamk.fi) has been established as a cooperative organization among the Finnish polytechnics to develop and promote on-line training.

²⁹ Markkula 2003.

³⁰ www.edu.fi.

Education policy that responds to needs of the knowledge economy

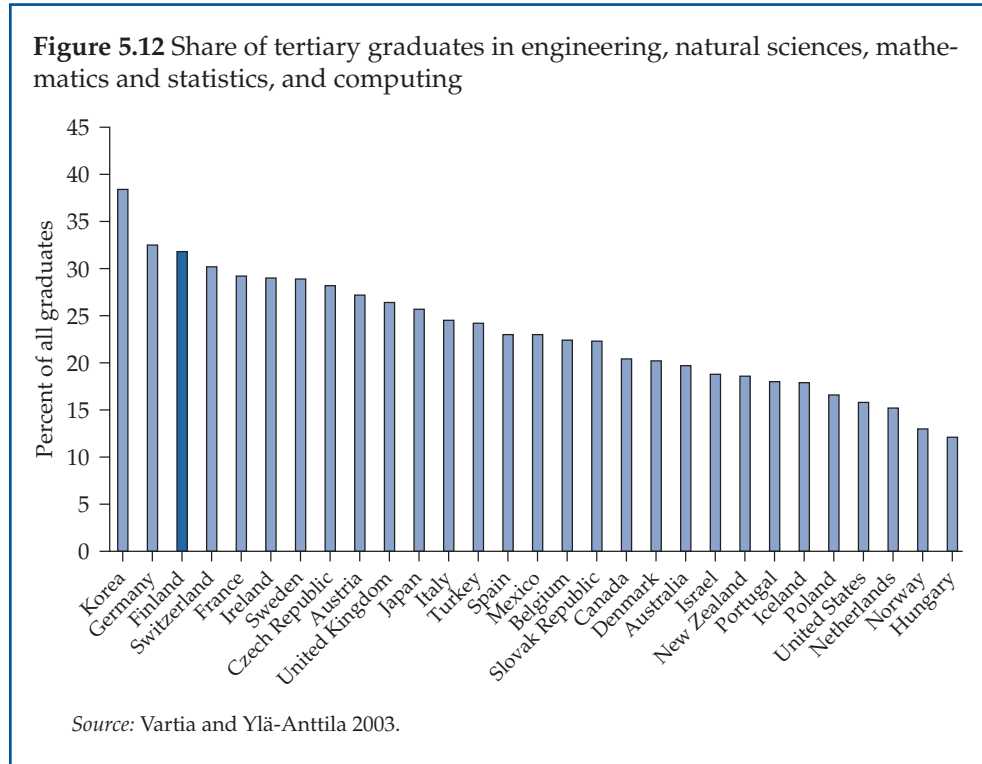
In the Program for International Student Assessment (PISA) study administered by the OECD in 2000, 15-year-olds in basic education were given standardized tests in reading, mathematics, and science. The Finnish students scored the highest in reading literacy skills, and scored among the top five countries in the other tests. Furthermore, variation in scores was smallest among Finnish students. It is also noteworthy that the effect of students’ socioeconomic backgrounds on performance was among the smallest in Finland (Väljjarvi 2003).

In the knowledge economy, the majority of the jobs involve information gathering, processing, and production. Thus, proficiency in basic literacy skills forms the foundation for the efficient functioning of the society. Basic education provides the basis for developing these skills. Equal opportunity to acquire education has been offered as the explanation of the success of Finnish students, despite the average scale of investment in education and per-student spending in basic education.

In the 1990s, the ICT industry influenced education policy with respect to KE. Various associations and federations promoting the interests of ICT firms such as the Federation of Electronics and Electrical Industry published surveys that indicated that the education in the information industry fields was lagging far behind ICT companies’ future recruitment needs (Jonkinen 1999).

ICT industries influenced direction of education

Consequently, during the 1990s, enrollment increased dramatically in the institutes providing higher education in the information industry fields. To illustrate this growth, in 1993 the universities and polytechnics admitted approximately 3,400 new students to the programs in ICT-related



fields. By 1998 the universities and polytechnics had admitted approximately 7,700 new students to the same programs—approximately 126 percent growth in 5 years. As a result of this Finnish educational policy, Finland has one of the greatest share of engineers among the EU countries: 20 percent or more of total graduates from tertiary education compared to approximately 10 percent in the UK and Belgium (Figure 5.12).

In 1998 the Finnish government adopted a program to further increase education in the information fields during 1998–2002. This program was implemented in collaboration with the firms in the ICT industries. ICT firms contributed to primarily publicly funded education providing internships for the students. They also shared know-how by having their experts teach in polytechnics and universities and by donating equipment and computer programs to educational institutes. In addition, the government has been allocating resources to provide more possibilities for professional upgrading in vocational institutes and to expand the supply of continuing education and apprenticeship training in the information industry fields.

6

Sectoral Perspectives on the Finnish Knowledge Economy: From Forest-Related Industries to ICT

Laura Pajja and Christopher Palmberg

6.1 From forest-related industries to engineering, electronics, and ICT

The forest-related industries have been identified as the first pillar of the Finnish economy since from the late nineteenth century. Since then, the engineering and ICT industries have emerged to comprise the second and third pillars. On closer analysis, it becomes clear that this development from forest-related industries via engineering and electronics to ICT has been an atypical pattern of industrialization.¹ There are very few, if any, other examples of essentially natural-resource-based countries that have managed to transform their industrial structures to high technology and knowledge-intensity so rapidly and successfully as Finland. At the same time, these developments in industry illustrate the progression of the Finnish economy from the resource- and investment-driven stages, to the knowledge-driven stage. The various forward and backward linkages that these industries have created at various points in time have been of key importance in this context. In this sense, one can identify the origins of the Finnish knowledge economy in the forest-related industries more than three decades before the breakthrough of the ICT industries in the mid-1990s.

Today, Finland's forest-related industries constitute a well developed and coherent industrial cluster around the core product groups of high-grade pulp and paper and various types of plywood. Important related and supporting industries are chemical pulp and paper bleaching, machinery, and related automation, within which Finnish firms also have developed significant global market shares.

The contribution of the forest-related industries to the Finnish economy is still significant. Even though only the core industries of the cluster are included—wood products, pulp, and paper—they accounted for as much as 5 percent of GDP in 2002, close to 20 percent of total industrial production, and slightly more than 25 percent of total exports (table 6.1). Indeed, *a remarkable aspect of the forest cluster has been its ability to transform itself in response to technological and market developments.*

The gradual development of indigenous forest-related industries was a natural consequence of the fact that Finland possessed comparative advantages in the field. Finland is located in the midst of the Northern Coniferous Zone and has the highest level of forest resources per capita in Europe. In addition, there are extensive hydropower resources and cheap transportation routes along the numerous rivers running into the Baltic Sea.

¹ Raumolin 1992.

Table 6.1 Forest-related industries in the Finnish economy

	1980	1985	1990	1995	2000	2002
Percent of employment	4.5	3.8	3.4	3.4	3.1	2.9
Percent of GDP	6.6	3.3	4.5	6.5	5.9	4.8
Percent of mfc. output	23.4	18.8	19.0	25.0	24.0	19.8
Percent of exports	42.4	36.2	37.6	33.7	26.1	25.4

Source: Lindström and others 2004.

However, the decisive factor was the close cultural and geographical ties that Finland had developed with Germany and Sweden, the early centers of forest-related innovation in the second half of the nineteenth century. Technology transfer and adoption of these innovations in its nascent forest-related industries enabled Finland to harness its comparative advantages. They also paved the way for its gradual rise from a peripheral exporter of forest raw materials and simple sawn goods to a global leader in the field of high-value-added paper brands, papermaking machinery, and related process control and automation systems.

Four major phases in this transformation of the Finnish forest-related industries might be identified:

1. Import phase—up until the end of World War I and the declaration of independence in 1917
2. Import-substituting phase—until the late 1950s, during which an indigenous and diversified industrial base emerged
3. Phase of technological and productivity gains—in the 1960s and 1970s that supported further export growth
4. Ongoing *fourth phase of internationalization, consolidation, and globalization*.² This ongoing phase also has recently brought opportunities and bottlenecks related to the Finnish knowledge economy to the forefront in the strategic orientation of firms in the forest cluster.

Import phase: Preconditions for the forest-related industries

The first pulp mill in Finland started production as early as 1860 in the vicinity of Viipuri, a town in the eastern part of the country close to the Russian border that was lost to the Soviet Union during World War II. This, and other newly founded, sawmills imported machinery from Germany, Sweden, and the United Kingdom. Germans came to play an especially important role in consultancy during this *first import phase* of the development of the nascent industry, due not least to the fact that the Finnish educational system was developed based on the German model. Many of these early mills also were run by German foremen, even though they were owned by Finnish entrepreneurs. By the turn of the nineteenth century, this German expertise had also started to spill over to Finnish universities. As a result, new scientific disciplines emerged in related fields such as geology, chemistry, and botany, with technical training in applied wood and paper technologies.

² Raumolin 1992.

The rise of Finland from a peripheral exporter of forest raw material and simple sawn goods into global leadership in diverse, high-value-added product groups was, above all, due to the close integration that was achieved between the pulp and paper and engineering industries. As suggested above, this pattern of industrial development was atypical when compared with many other natural-resource-based countries.

Several early preconditions for this atypical pattern can be identified. Finland prohibited the acquisition of forest land owned by peasants. Instead, Finnish entrepreneurs acquired old iron works with connected machine shops to get hold of the large forest possessions that came with these acquisitions. The fact that the main transportation routes across the Baltic Sea were frozen during large periods of the winters meant that maintenance and repair of the imported machinery and equipment often had to be dealt with in-house. The numerous ships, boats, and other floating equipment that had to be used in river and lake transportations also demanded maintenance as a side activity of the forest sawing and milling business. Thus, even though this import phase still essentially represented the primary example of the resource-driven phase of industrialization in Finland, this phase also started to stimulate indigenous engineering activity.

Import-substituting phase: Toward integrated production

During the second import-substituting phase of the transformation, although through harsh means, the World Wars during the first half of the twentieth century proved pivotal in strengthening the indigenous pulp and papermaking and related engineering knowledge base of the Finnish forest-related industries. World War I essentially stalled engineering imports from Germany, while Western export markets were lost. Following World War I, the revolution in Russia closed down the Eastern export markets and enforced significant consolidation of the forest-related industries in Finland. This consolidation was given additional impetus by Finland’s newly gained independence in 1917 and strivings toward national self-reliance through heavy state involvement in the economy.

During this period, the Finnish pulp and papermaking and engineering companies increasingly became engaged in import-substituting activities because importation and adaptation of foreign machinery proved overly difficult. Likewise, Finnish scientists and engineers in these fields sought to consolidate their activities with the help of supportive governmental initiatives. A forestry research institute was established that began an inventory of forest resources in Finland. New legislation was passed to avoid the depletion of forests, and new chairs in forest-related sciences were inaugurated in the universities. These developments were paralleled by the general development of national self-reliance in science and technology, through, among other things, the founding in 1942 of the Technical Research Center of Finland (VTT). It remains an important organization in the Finnish system of innovation today.

The consolidation of the emerging forest-related industries was largely the result of economic nationalism, whereby state-owned companies were established in a market protected by high tariffs. The acquisition and nationalization of the Norwegian-owned Gutzeit Company was an important step in this direction, since this company owned significant

State-owned companies consolidated forest-related industries

amounts of land in eastern Finland. The state also established Veitsiluoto, a company to exploit large state-owned forests in northern Finland. Other companies merged, and exports were supported through the establishment of an export cartel to avoid price competition.

This consolidation, together with the upgrading of the scientific and technological base, created favorable conditions for the further development of pulp and papermaking machinery. Metals companies diversified into engineering by acquiring foreign-owned firms, and pursued what might be called “an intelligent followers strategy.” The large new state-owned pulp and paper mills started to procure machinery and equipment from domestic firms at an increasing rate, even though the technology typically still was licensed from abroad.

However, the advances that had been made until the mid-1940s were abruptly hindered by the subsequent wars from 1939–1945. A concrete effect of the wars was the loss of important forest resources through the Soviet accession of the northeastern Petsamo district and Karelia. Both import and export opportunities were curtailed, and Finns painfully felt once again the importance of national self-reliance.

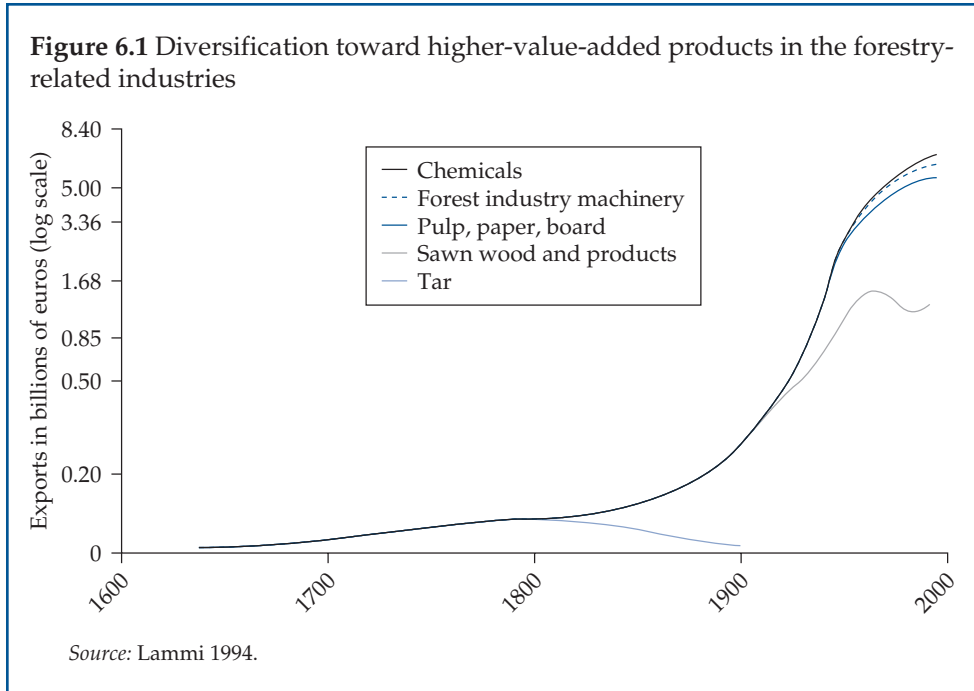
In addition, Finland had to pay heavy war reparations in the form of exports. However, even though the war reparations burdened the economy in the short term, these reparations also contributed in important ways to the long-term developments of indigenous engineering capabilities in Finland. The reparations consisted mainly of large quantities of heavy engineering industry products, some of which had not been produced in Finland before.

In the pulp and papermaking machinery industry, the leading companies shifted to the development and manufacturing of large integral machines, which enabled both mechanical (sawn wood) and chemical (pulp and paper) refinement of wood at the same geographical location. This shift also supported further consolidation. Meanwhile, new engineering consultancies were founded to serve the growing skills requirements of pulp and papermaking, and to facilitate increasingly close user-producer interactions between the pulp and paper and related engineering industries in Finland.³ Gradually, toward the end of the 1950s, export volumes reached the prewar levels. Exports also covered a broader range of products, including newsprint paper, plywood products, and larger, integral, pulp and paper machines (figure 6.1).

Phase of technological and productivity gains

The *third phase* of the transformation of the forest-related industries from the late 1950s until the late 1970s was, above all, characterized by *technological and productivity gains* and related strong growth of exports. During this time, Finland achieved global prominence in the field of high-value-added paper brands, papermaking machinery, and subsequently also in related process control and automation systems. Finland thereby significantly reduced the competitive lead that countries such as the United States, Germany, and Sweden had achieved. This third phase contributed in important ways to the early developments of the Finnish knowledge economy as we know it today and can here be taken to illustrate the investment-driven phase of industrialization in Finland.

³ The well-known forest consultancy company Jaakko Pöyry was founded in 1958.



Again, industrial transformation in the forest-related industries was spurred by international developments. Following the years of enforced national self-reliance, the liberalization of international trade, membership in the European Free Trade Area (EFTA) discussed in chapter 4, and the postwar economic boom contributed to the opening up of the Finnish economy. In response to this, the newly founded and merged Finnish pulp and paper conglomerates decided on massive capital investments to spur productivity in existing product segments, while also shifting their attention toward higher-value-added products to conquer new markets.⁴ The ambitions of companies also partly concealed an outspoken policy aim to rapidly industrialize Finland. The increasing export orientation was reflected, above all, in the increasing average size of pulp and paper mills and further consolidation and coordination of wood sourcing, production, and marketing activities. However, a peculiarity was the dual nature of developments, whereby export-oriented activities coincided with continued import-substituting activities, especially in the field of pulp- and paper-related engineering industries.

Trade liberalization was incentive for capital investment

The import-substituting activities were nurtured further by the close interactions that had been developed between pulp and paper companies, machinery developers and engineering consultancies as a result of the increasing integration of mechanical and chemical wood production, and spatial clustering of activities in Finland. Productivity gains were mainly sought through the development and adoption of process control and automation systems to optimize value chains as the key aspect of competitive integrated production. Initially, the process control and automation

⁴ Lammi 1994.

hardware and software were imported. By the late 1960s, however, indigenous adaptation and development especially of the software was initiated. This incremental development typically occurred in-house at the pulp and paper mills of the larger conglomerates. As the knowledge intensity of production increased, the loci of innovation has gradually shifted from the mills toward the machinery producers and engineering consultancies. The outsourcing of these activities through corporate venturing and start-ups also was quite common (box 6.1).

The accelerating adoption of process control and automation systems in the forest-related industries during the late 1970s also should be understood in a broader socioeconomic context. The Finnish government actively followed the general discussion on the effects and challenges associated with automated data processing (ADP) and computerized production, especially at the OECD and within the EU. While the possible pervasive effects of these technologies on employment were acknowledged, there was consensus that their adoption was a crucial prerequisite for the future competitiveness of Finland (chapter 5).

Linkages forged among forest-related industries, engineering, and ICT

In this context of increasing awareness of the importance of ADP and computerized production, as the first pillar of the

Box 6.1 Case of Ahlström and Altim Control Ltd.

Established in 1851, Ahlström originally was a multibranch company that diversified from wood products to pulp and paper, and further to paper machines by the late 1960s. Simultaneously, it also moved toward indigenous integral production. The latter development was set in motion by the adoption of computerized production in 1969 at the paper mills in the small rural town of Varkaus in the eastern part of Finland. Early on, the process control and automation system was procured from Honeywell, the global leader in the field at the time. However, the logic of integrated production also demanded in-house skills in maintenance. Following extensive learning by doing and using on the production floor, the automated data processing (ADP) maintenance department, Altim Control, was founded. While initially intended as a maintenance shop, the activities of the department soon spilled over to various related fields. As a consequence, the decision was made to establish synergies among these fields through the explicit aim of developing a complete system to replace the one procured from Honeywell.

This bold decision proved successful, and a few years later, the first “Alcont process control and automation system” was put in use. During the 1980s, Altim Control expanded rapidly through sales to other Finnish pulp and paper companies, and gradually also through exports. In 1991 Altim Control was renamed Ahlström Automation.

However, the effects of restructuring, consolidation, and globalization during the 1990s also were felt in this small rural town. Ahlström refocused in the direction of specialty paper brands. In 1992 the automation businesses at Varkaus were “sold back” to Honeywell as part of the outsourcing of noncore activities. Nonetheless, the ownership change did not relocate R&D and production away from Varkaus. Quite the contrary, the favorable concentration of know-how in this small town led to further expansions through start-ups and a decision by Honeywell in 2002 to concentrate its R&D activities in the field in Varkaus. This decision by a market leader is a concrete example of the global-level expertise in the forest-related industries that Finland possessed due to accumulated R&D, engineering capabilities, and high-level education.

Source: Jääskeläinen and Lovio 2003.

Finnish economy, the forest-related industries were perfectly placed as a testing ground for the developers of these new technologies. Accordingly, the development of forest-related process control and automation systems became a business area for the emerging electronics and ICT sectors in Finland. The electronics pioneers A.G. Strömberg, Valmet (originally a state-owned producer of avionics), Suomen Kaapelitehdas (a cableworks company that subsequently merged into Nokia's electronics and telecommunications divisions), and others partly diversified toward the forest-related industries. Simultaneously, new start-ups entered related fields. These forward linkages from the forest-related industries toward engineering, electronics, and, eventually, ICT-related fields represent important historical snapshots of developments that contributed to build up the Finnish knowledge economy.

Ongoing phase of consolidation and globalization

Following the oil crisis and the subsequent global recession of the late 1970s, the export-oriented capital investment peaks of the 1960s and 1970s were temporarily reversed. Nonetheless, by that time, the forest-related cluster of supporting industries, consultancies, and research organizations already had achieved a certain degree of coherence, a self-sustained dynamic, and growth.

The *fourth and ongoing phase* of the transformation of the forest-related industries thus might be contrasted with the earlier phases as one of *further consolidation of the forest cluster, followed by its internationalization and globalization*. The internationalization trend was a direct consequence of the partial restructuring of the global economy following the 1970s recession. That recession was marked by depressed raw-material prices that hit hard countries with abundant raw materials, such as Finland. In addition, the newly industrialized countries in Southeast Asia entered the global competition with new raw material qualities and cheaper production facilities. Additional challenges were the increasing awareness of sustainability issues and the need for environmental control in forest-related production, as well as closer integration with the EU, in which Finland gained full membership in 1995.

The new competitive and regulatory constellation facing the Finnish forest cluster provided renewed incentives for capital investments. Microprocessors, ICT, and modern biotechnology created new technological opportunities for productivity gains and product diversification, so R&D activities intensified. Environmental regulations also induced innovation in new fields, especially in pulp bleaching. This R&D typically was of the collaborative kind and frequently involved the main pulp and paper conglomerates, machinery and equipment suppliers, universities, and the Technical Research Center of Finland. However, the cost of these continued investments forced the companies to take on excessive debt and eventually to restructure. The restructuring also was a necessary response to increasing competition in Europe following the formation of the Single Market and a common currency. The last two effectively ended a Finnish track record of devaluing its currency to boost forest-related and engineering exports.

The restructuring was set in motion by a number of domestic mergers and acquisitions. By the mid-1980s, only four major pulp and paper conglomerates remained: Kymmene, Enso-Gutzeit, United Paper Mills, and Metsä-Serla. Increasing emphasis also was given to integrated and computerized production to save costs associated with rising stumpage prices of wood and energy consumption. The

supporting pulp- and papermaking machinery companies streamlined their businesses through domestic mergers and foreign acquisitions, and increasingly came to focus on their core areas.

The restructuring also was driven by the serious recession that Finland experienced beginning in the late 1980s. Internationalization soon followed. It was a direct response to the general globalization of the market place and the entry of new countries in competition. However, internationalization also was a necessary consequence of the rise in the value-added of the end-products that occurred throughout the 1970s and 1980s. The development and production of new specialty newsprint, specialty paper brands, and complex integral machinery required close collaboration with customers abroad.

It is interesting to note that the patterns of internationalization differed between the pulp and paper and the machinery companies. The former sought mainly to outsource their production to Europe to save transportation costs, while the latter expanded to Sweden, and especially to the United States, to circumvent tariff barriers.

In recent years, Asian markets have gained attractiveness, and among others the newly merged United Paper Mills-Kymmene and StoraEnso have set up production in China as a major emerging market. This internationalization has been achieved primarily through mergers and acquisitions, or joint ventures. In terms of investments, the share of foreign investments of the total made by forest-related companies has grown significantly—from roughly 25 percent in the mid-1990s to almost 80 percent in the early 2002. Meanwhile the R&D-intensity of the Finnish forest cluster has risen, albeit not in the same proportion. Today, United Paper Mills-Kymmene and StoraEnso are among the largest pulp and paper companies in the world, along with Metsäliitto, the third largest in Finland (figure 6.2)

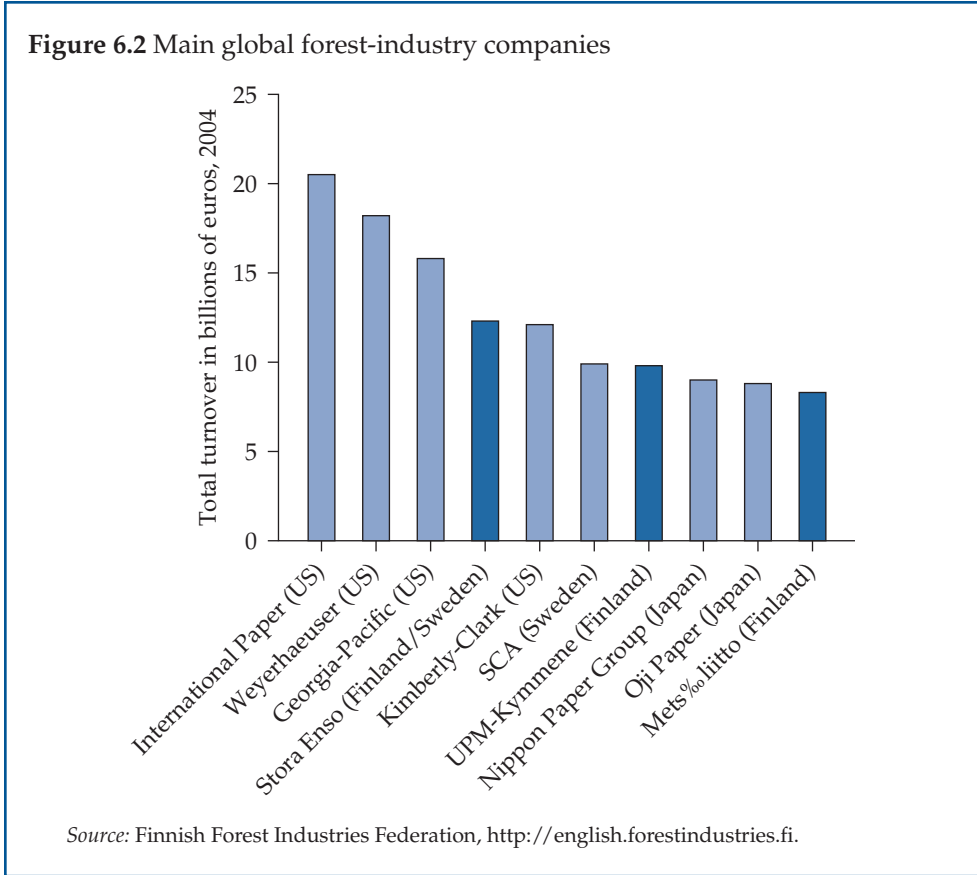
Changing division of labor

Despite the present completeness and coherence of the forest cluster, increasing global competition and internationalization have brought new challenges. The consolidation of the major companies also has implied that the traditional division of labor within the cluster is changing. User-producers relationships among pulp and paper producers and the developers and the related machinery and equipment companies are weakening as each company seeks to specialize further and establish its unique competitive advantage. As a consequence, noncore ICT functions are being outsourced to the knowledge-intensive business service sectors in Finland and globally. This outsourcing is occurring even though R&D expenditures related to ICT-based services are increasing for the cluster as a whole. The adoption of cutting-edge ICT is now a competitive necessity for Finnish forest-industry companies as they seek to optimize the management of their global value chains, including logistics, customized production, and after-sales services.⁵

6.2 ICT as the core of the Finnish knowledge economy

The post-World War II transformation of the forest-related industries illustrates the atypical resource- and investment-driven phases of industrialization in Finland.

⁵ Lindström and others 2004.



Although a clear shift toward higher knowledge-intensity is also evident in the forest-related industries by the 1980s, the emergence of the ICT industries thereafter represents the clearest example of the knowledge-driven phase of industrialization. The early market for process-control and automation that the forest-related industries provided in pioneering electronics and ICT firms in the 1960s and 1970s was an important one. It stimulated technological experimentation and innovativeness, and also demonstrated the industrial applicability of these new technologies. Even though this was an important prerequisite, the subsequent diversification of the electronics industry toward ICT, and the success that Finland has experienced in ICT more recently, is due to a range of additional factors.

Today the ICT industries in Finland also can best be described as a well-developed and coherent cluster, although the ICT cluster is of more recent origin when compared with the forest cluster. However, even though the ICT industries have benefited from certain basic circumstances which also mattered in the transformation of the forest-related industries—e.g., sufficient supply of qualified labor, a tradition of close collaboration between users and producers of technology, and an advanced home market—it is worth noting that the different character of ICT demanded new types of initiatives and developments. By and large, it seems that the responsiveness of the Finnish economy toward the ICT-revolution was of crucial importance. The most important elements related to the development of a *dynamic and competitive operators market, knowledge complementarities and collaboration*

between key firms and other public and private sector actors, and the role of Nokia as the industrial engine especially in the later phases of development starting from the 1990s. Together, these elements have thereby also shaped the specific ICT-oriented path of Finland to a knowledge economy.

Dynamic and competitive operators market

The development of the Finnish ICT industries originates from telephone operation rather than equipment manufacturing, and ultimately led to the breakthrough of

Dual operator telecommunication market fostered balanced competition

Nokia in the 1990s. Unlike in most countries, telephony was never a state monopoly. In addition to a public telephone operator (PTO), which was primarily and exclusively in charge of long-distance and international operation, licenses were held by a large number of private companies that operated local networks.

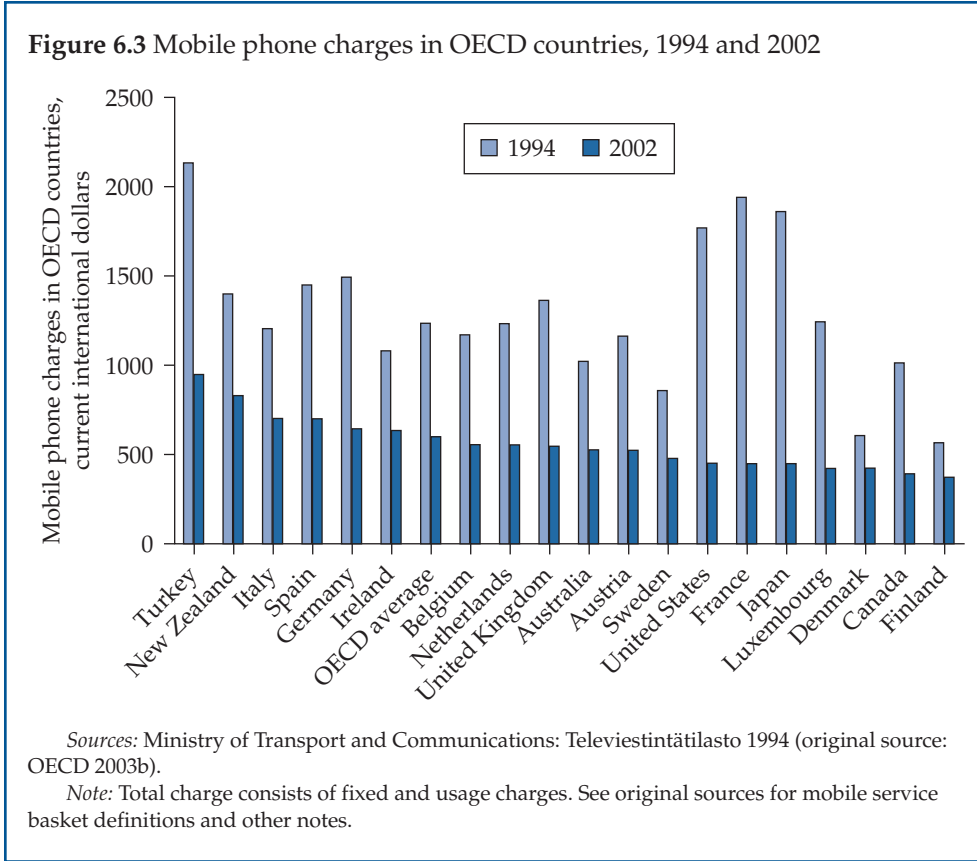
The exceptional market structure had originated in the 1880s, when the Finnish Senate circumvented the regulations of the Imperial Russia, which ruled Finland at that time. The multioperator market structure not only strengthened the independence of the semiautonomous Finnish grand duchy at the time but also had far-reaching implications for the future development of the Finnish ICT industries.⁶ This dual market structure consisting of the associated private companies and the PTO created “creative” tension between these two camps. During the first decades of network construction, the PTO used its mandate as a regulatory body to take over poorly performing private operators. This threat induced technical competition and upgrading of the private network. However, it should be noted that there was no actual market competition among operators because their licenses granted them a local monopoly.

Starting from the 1960s, the private telephony sector intensified its demands for the liberalization of new telecommunications services (telex, facsimile, and, later, analogue mobile services), which were under the monopoly right of the PTO. Between 1987 and 1994, a series of amendments to the telecommunications regulations made the Finnish market one of the most liberalized in the world.

Market competition started in 1988, when the private operators decided to challenge the PTO by constructing a mobile network without a license in the hope of eventually receiving one. They chose the newly developed digital global system for mobile communication (GSM) standard, which was not yet commercialized anywhere in the world. After intensive political debate on the viability of parallel networks in a small country, in 1990, the license was granted. Finland’s digital mobile service was inaugurated the next year. It was among the very first in the world.

From the outset of liberalization, the long tradition of a dual operator market structure provided the basis for balanced competition. Transitory regulation to induce equitable competition between the incumbent PTO and the entrants was not needed in Finland. Further competition was introduced when the association of private operators started to bring in service providers (network renters). Foreign

⁶ Finland gained independence from Russia in 1917. During the first decades of independence, there were several attempts to nationalize private telephony to harmonize the infrastructure, but these attempts failed in the lack of political coherence and public funds.



companies also entered the market with competitive price offerings. Liberalization lowered rapidly and significantly the general price level of telecommunications (figure 6.3). Finnish mobile services were the least expensive in the world. Together with more affordable portable phones, which gradually replaced car phones, mobile telecommunications started to take off.

The state share of ownership of the PTO gradually was reduced to enhance the possibilities of the PTO to compete on liberalized telecommunications markets. Nonetheless, the semipublic PTO (*Sonera*) was not spared from excessive and risky investments in third-generation telecom (3G) licenses and other unprofitable ventures during the heyday of the “dot.com” boom. At the end of the day the company was merged with neighboring Sweden’s PTO *Telia*, and the focus of service development was redirected to local market in 2002.

In addition to the dual market structure, there was another distinguishing feature in the Finnish telecom market: equipment provision in Finland was open to foreign manufacturers from the early beginning. Unlike in countries with an equipment manufacturing monopoly, for instance, France, Germany, and Sweden, there was no public interest in protecting domestic supply. Despite catching up gradually with foreign suppliers in technical know-how, domestic equipment manufacturing, still in its infancy, was not able to meet local demand. Independent operators were free to choose among different suppliers, and thereby put small local manufacturers under competitive pressure.

The multi-operator market attracted leading foreign equipment manufacturers such as *Bell*, *Ericsson*, and *Siemens*, to Finland to test their latest technologies. Private companies, usually cooperatives, generally were attracted to state-of-the-art technology, and for some it also may have had status-enhancing value. In any event, operators acquired the advanced technical know-how required to integrate competing suppliers' equipment in their systems. These knowledgeable customers proved valuable for the emerging domestic equipment industry when it took its first steps in the development of telecommunications technology.

Knowledge complementarities and collaboration

Finnish telecommunications equipment manufacturing was initiated around 1920 in three separate firms. After a long, complex process, these companies were completely merged in 1987 under the management of Nokia. Today Nokia is the core company in the Finnish ICT cluster. The clustering process had its roots in the early 1960s and included both collaboration and competition among companies in the industry. It involved experimentation, inventiveness, and entrepreneurship among pioneering inventors and engineers; collaboration between the public and private sectors; market competition; crises; and timely focusing on the GSM standard as the most widely diffuse mobile telecommunications standard in the world (box 6.2).

Until the late 1960s, radio technology was mainly the interest of a few keen individuals who studied a range of electric and electronic technologies on the sidelines of the firms' main activities—and often under the suspicion and opposition of conservative colleagues. The application of foreign technologies, gained through licensing and resale agreements, provided valuable technical knowledge that gradually was enhanced by own experiments and R&D. At the time, R&D activities were driven by enthusiasm and thirst for knowledge rather than by business ambitions.

In the 1970s, Finnish *radiophone manufacturing* had gained a major market share in the Nordic countries. By the 1980s, it had established a strong foothold in, for instance, Asia and the United States. In *network systems*, development was intensive and progressive but yielded little sales revenue. In fact, until the late 1980s, it was other *electronics applications* such as TV sets, computers, and process control and automation systems that dominated the commercial electronics offerings. However, the *adoption of semiconductor techniques* as early as the 1960s served as the basis for expansions into the field of electronics. Pioneering product development based on *digital transmission and digital signal processing* produced know-how that proved pivotal for later success in digital telecommunications.

Indeed, despite the relatively sluggish start in the commercialization of the accumulated knowledge, the technical know-how was high and even pioneering in certain domains. For example, Finland was among the first countries in the world to offer tertiary-level education in radio technology, for which a professorship was established as early as in 1924.

The role of universities and the Technical Research Center (VTT) in the absorption of knowledge also was decisive from the early beginning and intertwined tightly with private R&D

Education's absorptive capacity was critical to ICT growth

Box 6.2 Emergence of Nokia

The 1967 merger of Nokia, originally a wood-grinding mill, Suomen Kaapelitehdas (Finnish Cable Works), and Suomen Gummitehdas (Finnish Rubber Works) may be seen as the birth of the current Nokia Corporation. *Although the forest-based company lent the name, the cable company provided the core knowledge base to the new entity.* In 1960 it had established an electronics department reselling computers, providing computing services, and manufacturing some of its own electronic devices. The cable company also assumed an important role in educating its own staff—and Finns more generally—in digital technologies.

Nokia was still pursuing a conglomerate strategy in the 1980s and made several sizeable acquisitions in consumer electronics (television companies such as Swedish Luxor in 1984 and German Standard Elektrik Lorenz in 1987), information systems (Swedish Ericsson Information Systems in 1988), and other fields not directly related to telecommunications. Indeed, Nokia was the biggest manufacturer of personal computers and color TV sets in the Nordic countries and was among the top 10 in Europe.

However, the conglomerate strategy was not a success story. Together with managerial and ownership problems as well as the recession in the early 1990s, that strategy led to a deep crisis. The company almost went bankrupt in the early 1990s, primarily as a consequence of its overly ambitious and costly acquisition and internationalization strategy. *In 1992 the company changed course and divested activities outside mobile communications.* Divestiture was completed by the late 1990s.

Since then, with the exception of UK-based Technophone, Europe's second largest mobile phone manufacturer in 1991, Nokia has not made major foreign acquisitions. *It retreated from its acquisition strategy almost completely after the early 1990s.*

In contrast, *alliances were important from early on.* In handsets, Nokia established joint ventures with American Tandy and did private labeling with Tandy-owned Radio Shack, AT&T, and others. On the network side, it initially partnered with Alcatel (France) and AEG (Germany) to provide GSM solutions.

In the 1990s, Nokia's challenge was to manage rapid organic growth. In the new millennium, the challenge has been to manage the slowdown. Clearly, *Nokia's growth was aided by its agility and lack of bureaucracy.* Although the company has Finnish roots, *Nokia's orientation has been distinctively global.* While Nokia has had its share of problems and challenges, what seems to set the company apart from many other gigantic corporations is *its ability to react quickly and improvise in a moment of crisis.*

In late 2003 and early 2004, Nokia's global market share dropped rapidly by some 5 percentage points to approximately 30 percent—far below the announced target of 40 percent. To an outside observer, it seemed that three things came together at once:

1. The company implemented a major organizational change at a time of exceptional market turbulence.
2. The company stubbornly tried to “educate” the market: that is, it seemingly refused to offer the increasingly popular clamshell designs, was slow to include cameras in its mid-range models, and introduced its models for the next generation of mobile networks surprisingly late.
3. The company chose to fight the operators by not letting them customize the phones to their customers' needs or introduce cobranding.

Nevertheless, price cuts in early 2004 and product introductions in late 2004 enabled the company to secure its market position.

efforts.⁷ The responsiveness of the education system was especially important prior to the GSM breakthrough in the mid-1990s, and the growth in the number of tertiary degrees in electronics and ICT is clearly visible in educational statistics. The number of tertiary degrees today clearly surpasses that of the forest- and engineering-related degrees, even though Finland remains a major global educational center for forest-related fields.

Apart from the early importance of the forest-related industries, public and technologically demanding procurement by the national defense, the telecommunications administrator, and the state railways had major influence on the companies' product development efforts. Furthermore, the advanced operators also had a central role as procurers of advanced technologies. While there was no reason to favor domestic equipment suppliers at the cost of quality, compatriotism played a certain role in the success of these technology procurement projects. Another key market was the neighboring Soviet Union, which was an important source of both sales revenue and product development projects.⁸

A decisive event that supported the commercialization of the knowledge base in mobile telecommunications was the development project of the analogue Nordic mobile telephone (NMT) network, initiated in 1969. The NMT initiative was coordinated by the Nordic post and telegraph administrators (Denmark, Finland, Norway, and Sweden). Despite engaging the Nordic equipment industry in the development process, the administrators also invited producers from third countries to make offers. The primary objective of the administrators was to develop an open standard to induce competition and thereby ensure efficient pricing and supplier independence. Via the inauguration of the network in 1981–82, the Nordic countries created the largest mobile telecommunications market of the time.

The NMT became a widespread standard beyond Europe and provided the Nordic companies with a head start in a rapidly expanding market. The NMT also laid the basis for the pan-European agreement signed in 1987 to develop the fully digitalized GSM standard, which was the next opportunity for the Finnish telecommunications industry to put its accumulated knowledge to full use. Even though the standard was developed by a large group of leading European actors, eventually, in 1991, Nokia was the first to supply a complete GSM system. In the mid-1990s, the unprecedented global diffusion of the GSM standard also contributed directly to the Nokia's international breakthrough.⁹

The existence of complementary technical knowledge and skills in the various firms and public organizations, coupled with resource-demanding R&D activities, also led to intensive collaboration early on in R&D, production, and marketing. Especially noteworthy joint ventures include those in the field of NMT mobile phones and digital switching. Both were founded in the late 1970s. They involved Nokia and were important for consolidating limited resources in a competitive industry.

⁷ For example, some development tools that were readily used by Nokia in the pan-European GSM standard project in the 1980s were originated in VTT.

⁸ Palmberg 2002.

⁹ For the case of GSM, see Palmberg and Martikainen 2005.

Role of NMT and GSM standards was decisive

However, Nokia was a highly diversified conglomerate up until the mid-1980s, when it started to increase the share of consumer electronics at the expense of its strongholds in more traditional fields such as cable and forest- and rubber-based products. Yet, at the time, the company's strategic focus and heaviest investments were directed to the TV and computer sectors with the intention to become the leader in Europe. Nokia's ambitious undertakings, coupled with certain important changes in the economic environment (chapter 7), almost destroyed the company. By the late 1980s, Nokia was, in fact, on the verge of bankruptcy. The company took a bold decision to focus on the GSM standard while divesting the more traditional industries. Consequently, by 1995 Nokia had turned into a 100-percent telecommunications company.

Nokia as the engine of ICT cluster development

Even though there are other telecommunications equipment companies in the market, there is no doubt that today the hard core of the Finnish wireless communications know-how resides in Nokia. Judged by size, it has no peer in Finland. Nokia accounts for 70 percent of the total of 43 billion euro turnover of the 250 biggest firms in ICT manufacturing and services located in Finland. In the top 20 Finland-based ICT companies, there is only 1 other genuinely Finnish technology provider, *Electrobit Group*, a provider of original design manufacturing (ODM) for brand owners.¹⁰ Other firms in the list include operators and other smaller network construction and maintenance companies, subsidiaries of foreign companies, and equipment wholesalers, as well as Swedish-Finnish merger companies.

As suggested earlier, the role of Nokia in the Finnish economy is also very significant. In 2004 Nokia accounted for 3.7 percent of GDP, 30 percent of total business sector R&D, and approximately 20 percent of total exports.

With its parsimonious portfolio of strategic focus activities—R&D, brand, and logistics management—Nokia is dependent on its suppliers and, as such, a Finnish paragon of the networked production paradigm. Hence, Nokia describes itself as an “extended company” and an “orchestrator” of the partner network. It has been the industrial engine of the ICT cluster and benefited the many other Finnish firms both through knowledge spillovers and as an important lead customer and promoter of exports.

In this context, the role of technology programs funded and coordinated by the National Technology Agency (TEKES) also should be highlighted. Although technology and industrial policies have played only an indirect facilitating role in the emergence of the ICT cluster, Nokia's importance has been acknowledged in policy initiatives. The Science and Technology Policy Council of Finland—with its important role in policy making—has invited high-level representatives from Nokia to advise the council. Many technology programs funded and commissioned by the National Technology Agency also have been tailored around the needs of Nokia, especially in

Technology programs in ICT have been important

¹⁰ Tellabs (ex-Martis), ranked 12th, is Finnish of origin but was acquired in 1993 by Tellabs US. According to the company, the integrated access and transport network solution, originally developed by Martis, is still Tellabs' “flagship product in the business and mobile services segments, and the key platform for future product developments.”

Many suppliers also extended their services to the locations of Nokia's foreign units. Despite its advanced outsourcing strategy, Nokia nevertheless retained an important share of in-house production. The test-bed conditions, including a leading-edge network infrastructure and a local knowledge base, also attracted leading foreign companies to intensify their R&D in Finland. Above all, the 1999 decision by *Hewlett-Packard* (US) to establish an innovation center (*eBazaar*) in Finland was regarded as a testimony of the country's competitiveness in ICT.

Despite the role of Nokia as the industrial engine, there are other examples of inventiveness and entrepreneurship outside the technological core of the Finnish ICT cluster. These examples have been encouraging with respect to future Internet-related developments in the ICT sector. A distinctive characteristic of Internet-related inventions in Finland is that they have been driven by motives that are ethical and social—such as community membership and freedom of expression—rather than commercial.

The early adoption of the Internet in Finland was achieved by students who contacted the US Internet developers to connect the Nordic network to the US network. *In 1988 the Nordic countries were the first to introduce the Internet outside the US.* Nonetheless, the best-known example of noncommercial pursuits is the open source software *Linux*, which today challenges the predominance of *Microsoft*. The development of the revolutionary operating system, which today includes contributions of thousands of programmers, was initiated in 1991 by a 22-year-old Finnish student Linus Torvalds. Torvalds' original objective was to understand the task-switching operation. Later, Linux was combined with US-based open source software named GNU to produce a completely free operating system. The widely spread Internet application, the real-time chat environment (Internet Relay Chat, or IRC), also originated in a Finnish university classroom.

Another example of Finnish technological inventiveness is the first Internet information browser with a graphical user interface. It was created by a group of Finnish students in 1992, one year before Mosaic was released by the *National Center for Supercomputing Applications* at the University of Illinois, US. However, the students shelved the software for lack of business interest.

Despite the noncommercial motivations of Finnish Internet-based inventions, some have grown into successful businesses. Even so, the most successful internationally operating Finnish companies in these fields are still small or medium-sized enterprises (SMEs), and a new international breakthrough of the magnitude of Nokia does not seem very likely, at least in the medium term.

6.3 ICT production and usage

In the new millennium, Finland is maintaining its top position in international knowledge economy comparisons. In particular, performance indices that weight technology-related factors as *knowledge society indicators* produce high scores for Finland. In terms of technological sophistication, infrastructure investments, and innovation, Finland usually outperforms most countries.

Finland also scores high in terms of *networked readiness indicators*, which measure how prepared an economy is to capture the benefits from ICT developments. This high score might give an indication also of the future potential of knowledge economies. Hence, a discussion of the development and challenges of ICT production and usage is called for to round up the sectoral analysis in this chapter and set

the context for a discussion of challenges in the next stage of industrialization in Finland.

Finnish comparative advantage in technology- and skill-related elements of the knowledge economy mirrors the country's historical background. On the whole, the Finnish path to a knowledge-based economy has been remarkably technology driven. The predominant engine was the development of the ICT infrastructure (chapter 2), whereas in most countries, the construction of the network has had little more than functional value. For its part, the education system paved the way for the broad adoption of ICT equipment. Finally, the internationally high share of students in engineering and natural sciences reflects an innate interest in technology, and highlights the long-standing concern to promote technological upgrading throughout the society.

ICT infrastructures

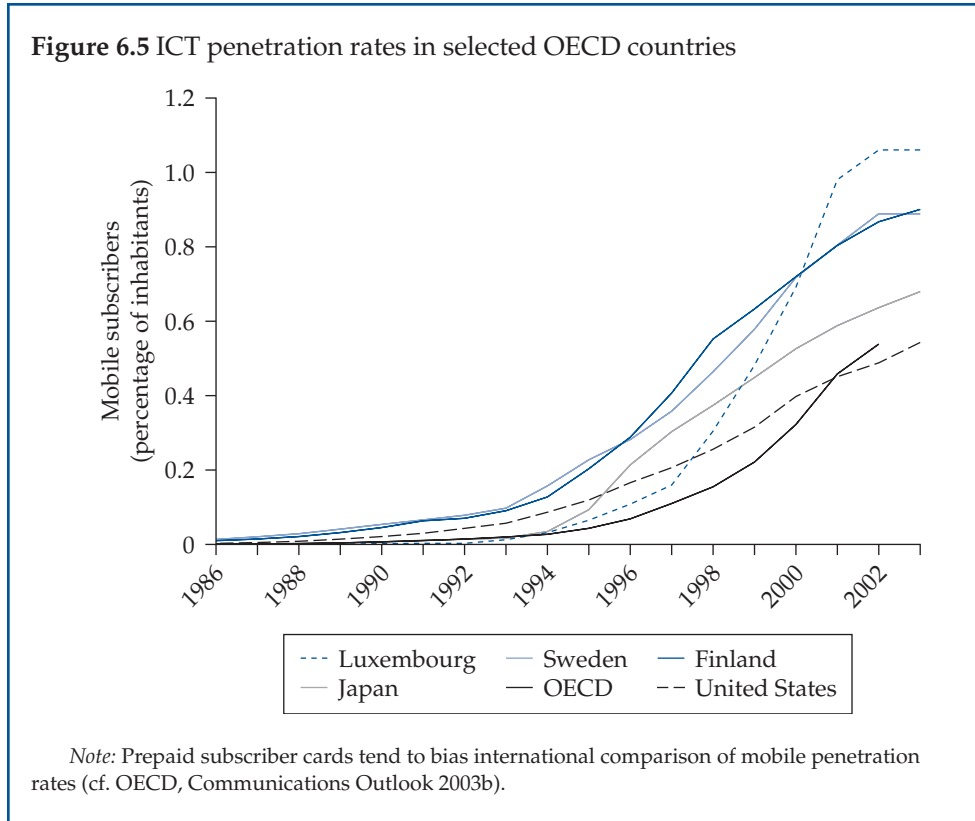
A major "migration" into Finland's knowledge economy took place from 1996–2002.¹¹ This migration is visible in various statistics on ICT infrastructure penetration rates, especially in penetration rates of mobile telephone and broadband subscribers. It is fair to say that mobile telecommunications and fixed broadband infrastructure networks today constitute the key ICT "backbone" infrastructures for the further development of the Finnish model of the knowledge economy. Due to its specific historical paths toward the knowledge economy, Finland appears to be well placed, especially in terms of mobile telecommunications infrastructures. However, despite a sluggish start, the penetration rate for broadband subscribers has also accelerated rapidly in recent years.

As suggested above, the development of the ICT cluster has benefited from the fact that Finland was an early experimental market for mobile telephony and related applications during the development and deployment of the first-generation network infrastructures. The dynamic and competitive operators market also has contributed to the rapid upgrading and modernization of mobile telecommunications infrastructures. This market paved the way for the Finland to be one of the first countries in the world to experience the inauguration of the GSM network (1991). As a consequence, in the second half of the 1990s, Finland became renowned as a "mobile wonderland," owing largely to the rapid diffusion of mobile communications (figure 6.5). To date, many European countries have caught up to Finland in mobile diffusion.

A major factor contributing to Finnish consumers' interest in mobile communications has been the low price level by international standards. Both households and firms pay 20 percent–30 percent less for fixed network services (including Internet access) than those in the OECD area on average.¹² In 1999 the number of mobile phones in Finland exceeded that of fixed lines, and today every third household relies exclusively on mobile technology in its telecommunications, and less than 10 percent lack a mobile phone. The share of commercial phones has remained

¹¹ Nurmela et al. 2003.

¹² OECD 2003b. Fixed-line prices refer to residential and business telecommunications tariff baskets, including domestic and international calls and calls from fixed to mobile networks. Internet access price refers to a service basket.



at approximately 20 percent since the late 1990s. Finnish mobile telecommunications took the ultimate step to the digital era in 2002 when it closed down the first-generation (1G) analogue mobile systems.

In 2004 the transition to the third-generation (3G) mobile technology, which enabled high-speed access to the Internet and, for instance, transfer of multimedia messages, was still in its infancy. The 3G operators, their infrastructures in place, were still holding back the launch of commercial service, waiting for increased supply of Universal Mobile Telecommunications System (UMTS) terminals.¹³ At the same time, the share of phones supporting enhanced GSM services (“2.5G” services) had grown to some 16 percent of mobile subscribers.¹⁴ These enhanced technologies enable the transfer of data, yet at a slower speed than 3G technologies.¹⁵

There are, nevertheless, regulatory aspects that are believed to slow down the diffusion of 2.5G phones in Finland. The use of advanced functionalities (color screen, enhanced data features, multimedia messages) requires a data service

¹³ UMTS is based on W-CDMA technologies.

¹⁴ These include color screen handsets with GPRS, WAP, MMS, and Java features. In 2003 the share of camera phones was only 2%; yet, it is estimated to grow to approximately 20% in 2005. Ministry of Transport and Communications 2004.

¹⁵ Ministry of Finance 1996. In the jargon of mobile systems, 1G refers to analogue and 2G to digital (circuit-switched) mobile systems. 2.5G as well as 3G systems provide packet-switched communication services that allow continuous connection to the Internet.

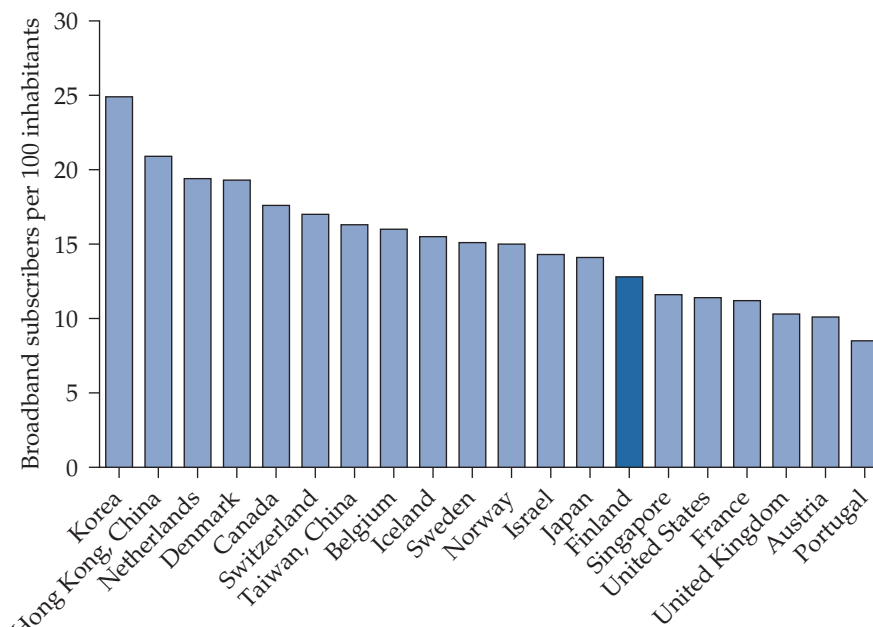
Moving toward next-generation standards

subscription and the activation of data service settings of a handset. In Finland, unlike in many other countries, the bundling of operator services and handsets is prohibited, which leaves the activation initiative to the consumer. In other markets, operators have lowered the threshold for 2.5G phone adoption by offering turnkey mobile phones for their customers. Another Finnish regulatory constraint on operators has been the prohibition to subsidize handsets. This potentially slows down the diffusion of enhanced mobile services in Finland relative to other countries.

Ultimately, Internet access at the workplace or other public domains does not allow sufficient societal participation as aimed for in national strategies. Hence, *the diffusion of PCs and the Internet to homes is an especially important prerequisite for the development of a knowledge economy*. The diffusion of broadband in Finland had a sluggish start by international standards but has been picking up in the very recent years. As of January 2005, Finland ranked fourteenth in broadband penetration, just below Israel, Japan, and Sweden (figure 6.6). It is to be expected that penetration will accelerate. Unlike in many other countries, the Finnish National Broadband Strategy leaves the choice of preferred broadband technologies to the market,¹⁶ while the government has reserved the right to supervise the efficiency of competition within and among all communications

¹⁶ Nevertheless, public funding is envisaged for regions that do not provide the basis for commercial services.

Figure 6.6 Broadband penetrations (top 20 national economies, January 1, 2005)



Source: ITU 2005, www.itu.int.

networks to support the supply of affordable high-speed telecommunications. In hindsight, this appears to have been a good strategy.

ICT usage

How and to what extent have sizeable investments in ICT changed Finns' lives? International studies imply that patterns of ICT *usage* are somewhat similar across ICT-intensive countries, while there are national differences in the relative *popularity* of different services and applications.

The evidence on Finnish ICT usage indicates that the technologies have become an integral part of Finnish lifestyles. Mobile telecommunications has spread extensively to households of all sizes and age structures, although relatively less to households of single elderly persons.¹⁷ Mobile telecommunication in general, and text-messaging (SMS) in particular, has fundamentally altered the volumes, practices, and overall culture of communication, even though usage patterns differ considerably among genres and age groups. The pervasive diffusion of mobile telecommunication relates ultimately to the social nature of human beings. According to a survey of Statistics Finland on the Finns' ICT usage, mobile telephony is regarded as an essential means of communication for families, and it has increased people's sense of security.¹⁸

Finland excelled in early use of mobile telecommunications . . .

Until 1999, the Finns led the way in adopting the SMS service, but later other European nations have become relatively more active SMS users.¹⁹ National differences are based largely on the pricing of mobile services, mobile penetration, and cultural characteristics. Particularly for people aged 15–30 years, who are the “heaviest” users of the service, text-based communication not only substitutes for (more expensive) calls, but also provides a novel means of creating and strengthening social bonds. However, the contents of mobile text messages do not differ markedly from any other types of communications. The service seems to be increasingly substituting traditional private “snail mail.” that is, letters and postcards. In 2002, two of three Finns had substituted traditional mail by digital message.²⁰

Finnish Internet users do not differ markedly from other leading Internet nations in service usage patterns. The most popular applications are (private) e-mail and information/free services. Also notably popular among Finns is Internet banking, which was pioneered by the Finnish banking sector in the 1990s. Electronic banking boomed in the mid-1990s, as the banking crisis forced banks to dramatically downsize their extensive office networks (figure 6.7). Alongside automated teller machines (ATMs), Internet-based banking was introduced in Finland in 1996 and was extended to mobile terminals in 1999 as the first in the world.

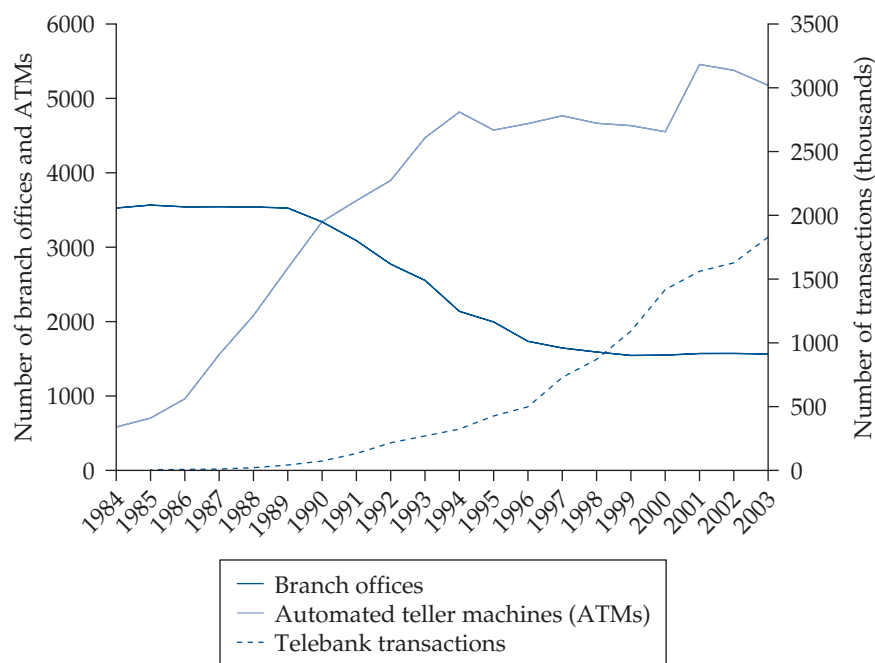
¹⁷ Nurmela et al. 2003.

¹⁸ Nurmela et al. 2003. Special mobile applications have been launched to parents of young children and to the relatives of elderly people. A service known as “positioning permit” enables location of persons who accept it.

¹⁹ In 2002 the Finns sent 27 messages per GSM subscription, compared with 45 messages sent by Norwegians. Denmark, Germany, and the UK also rank ahead of Finland in SMS traffic. Ministry of Transport and Communications 2003.

²⁰ Nurmela et al. 2003.

Figure 6.7 Development of branch office network and self-service in Finnish banking, 1984–2003



Source: Finnish Bankers' Association.

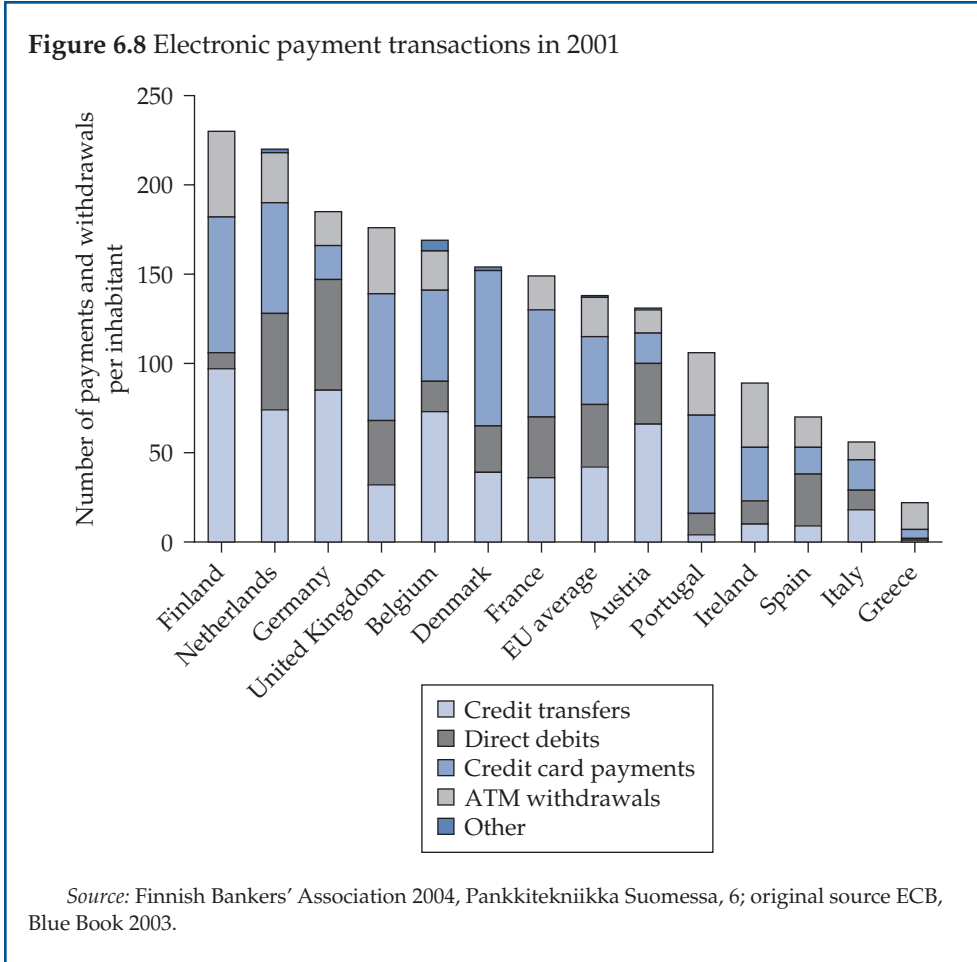
Note: ATMs include withdrawal and giro (depository) ATMs, and, since 2001, also multipurpose terminals in bank offices.

Supported by high penetration rates of ICT terminals, Finns rapidly became, in absolute terms, the most active users of Internet banking services in Europe (figure 6.8). Banks pushed rapid adoption of their electronic services through promptly extending online services and noticeable markups in their over-the-counter service prices.

Generally speaking, Finnish banks, together with operators, equipment providers, and credit card companies, have been actively developing applications for mobile banking and payment. However, mobile payment is still in the development phase while the interest groups are setting standards, defining operations models, and testing alternative techniques and solutions.

From the corporate viewpoint, the economic importance of electronic commerce is still small. For three out of every four firms, its share of total turnover is on the order of 1 percent. However, the Finnish turnover share of e-commerce is at the average EU level.²¹ The primary motivation among firms surveyed in 2003 was to set up an electronic sales channel is to improve their service and image. Increased operative and cost efficiency, as well as access to new markets were considered minor drivers. These findings are backed up by a recent study by Maliranta and Rouvinen (2004), who conclude that Finland is not, by and large, different by international standards in terms of the effects of ICT on firm productivity.

²¹ Eurostat electronic database. <http://europa.eu.int/comm/eurostat>.



With reference to the discussion earlier, a key question is also to what degree Finnish knowledge-intensive business service companies and other organizations can sustain and further develop these ICT services, innovations, and provisions, which the forest cluster needs to remain globally competitive. It seems that this ability of the Finnish knowledge economy will be heavily contingent on the degree to which creative new user-producer linkages can be established between this traditional first pillar of the economy and the new ICT-related third pillar of the economy. From a broader societal viewpoint, the role of Finland as a leading ICT producer involves an inherent opportunity to evolve into an important and advanced content producer. In effect, policies contributing to digital content provision have high priority in the government's agenda, which envisions Finland as a leading country in digital content provision.²² However, reproducing the leading position in content provision is a huge challenge in the face of international competition.

... but has not yet actualized the full potential of ICT

²² Information Society Council 2005.

Major domains for the development of ICT-based content and services are welfare and health care. The aging of the population, a common dilemma for most EU countries, will shift demand away from labor-intensive public services toward ICT-based ones. There have been numerous initiatives and collaborative development projects toward this aim between Finnish public- and private-sector organizations. ICT-enabled innovative solutions require fundamental changes in established systems, including organizations and processes. This is particularly true in the health care sector, in which private security and the processing of huge amounts of data pose extra challenges for the implementation of new and efficient ICT-based solutions. Nonetheless, despite high ambitions in terms of developing ICT content and increasing usage throughout various sectors, the ICT-producing core of the Finnish knowledge economy is also facing new challenges. These challenges relate to the convergence between a range of various technologies and the emergence of new Internet-related services and business models, as well as due to uncertainties regarding choices of next-generation wireless telecommunication standards. Issues related to globalization, and the relocation of ICT production and R&D to lower-cost countries, are also very much on the agenda in Finland.

7

Challenges to the Finnish Knowledge Economy: What's Ahead?

Pekka Ylä-Anttila

7.1 It's hard to get to the top—but even harder to stay there

The knowledge- and R&D-oriented “high-road” strategy that Finland has pursued since the early 1990s undoubtedly has been one of the European and global success stories. Putting sound macroeconomic policies high in priority, but gradually shifting the policy emphasis to micro policies has proved a wise choice. The competitive edge of an economy is, after all, created at micro level—in firms, innovation and policy organizations, and educational institutions.

Since 2000, the World Economic Forum (WEF) has ranked Finland the most competitive country three times (chapter 2). Production and rapid adoption of ICT have contributed to the high rankings. These are evidenced also by WEF's Network Readiness Index, which has ranked the country among the three best performers of 2001–2005.¹ The network readiness framework measures a nation's strengths and weaknesses with respect to ICT.

The country's stellar performance during the past 10 to 15 years is attributable in large part to developments in the ICT sector. Being one of the leading producers of a new generic technology has certainly created a strong competitive edge for the country. Consequently, many of the future challenges relate to ICT and the sustainability of competitiveness. Can the position gained be maintained?

Current competitiveness does not guarantee future success

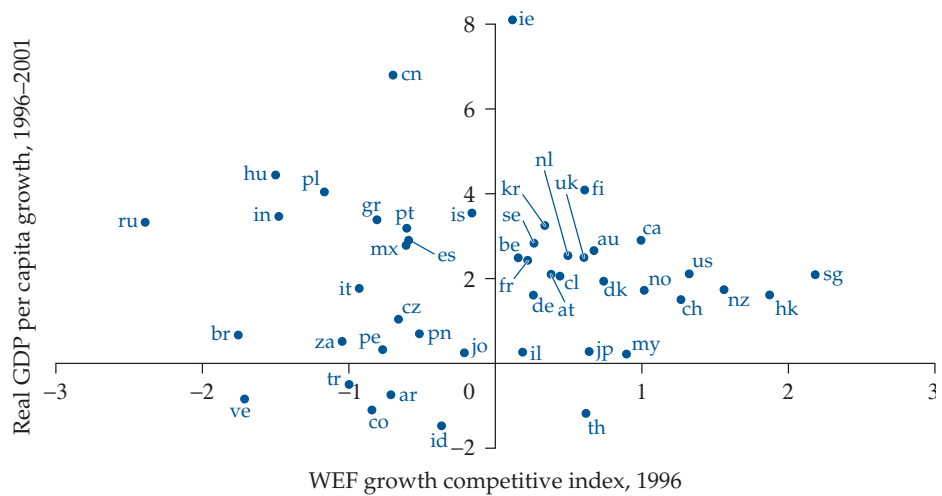
Finland's current competitiveness is not necessarily a guarantee of future growth (figure 7.1). Competitiveness rankings seem to predict future growth relatively poorly. Many of the Asian countries that were ranked high in the early 1990s bear out this statement. Success must be built on constant upgrading and renewal.

It is the use of ICT—not necessarily production—that is decisive for long-term economic growth. The production will gradually spread to new locations as the technology matures. The ICT revolution is by no means over, but parts of both technology and service production have started to relocate. The geography of ICT industry is reshaping similarly to previous breakthrough technologies.

At the macroeconomic level, in the latter half of the 1990s, the contribution of ICT to the private sector's labor productivity growth has accounted for an estimated one-third in Finland, and for two-thirds in the United States. However, in the two countries, there was a fundamental difference in the sources of

¹ Dutta and Lopez-Claros 2005.

Figure 7.1 Growth Competitiveness Index rankings in the mid-1990s and growth performance, 1996-2002



Sources: Rouvinen 2004.

Data sources: WEF Global Competitiveness Report 1996 and World Bank World Development Indicators.

Creative destruction spurs productivity

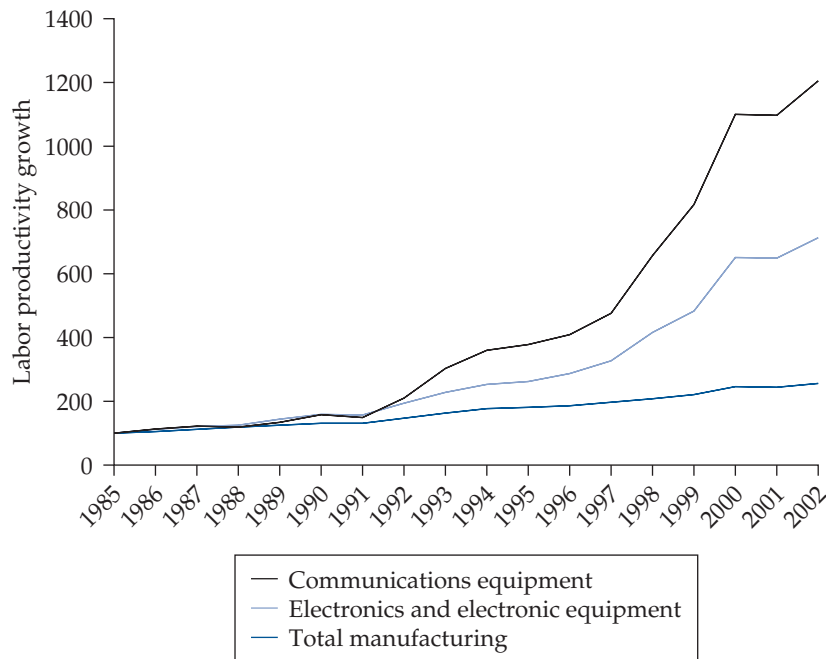
productivity growth: in Finland the growth stemmed from ICT *production*, while in the US productivity gains accrued from ICT *usage*.² The foundation of the Finnish information society, therefore, sometimes has been regarded as too narrow and unbalanced.

The general productivity growth in Finland has indeed been largely attributable to the ICT manufacturing sector, virtually to Nokia and its supplier network. Productivity in the sector increased 10-fold during 1985-2000, while, at the same time, in total manufacturing, it "only" doubled. An important part of realized productivity enhancement was due to rapid restructuring of the sector as new, more productive firms replaced inferior performers during the recession of 1990s and period of rapid recovery after that.

The great challenge today is to keep the *creative destruction* implied by the productivity-enhancing structural change going in the future. Another, equally important challenge is to promote usage of ICT in traditional industries as well as in the new emerging industries and businesses. A special policy problem is to increase the productivity of the public sector via intensive use of ICT. The need is urgent, since the population is aging; consequently, the demand for public welfare services is

² A common measure for economic performance growth is labor productivity, that is, value added per employee. Productivity of firms is determined by several factors, such as product range, work efficiency, intermediary products, scale economies, and organization. ICT potentially can have implications on all of these. However, many of the ICT's perceivable benefits (for example, convenience), as well as its drawbacks (for example, battle against viruses and spam, stress from continuous reachability) do not avail themselves for quantitative measurement. Koski, Rouvinen, and Ylä-Anttila 2002.

Figure 7.2 Labor productivity growth in communications equipment manufacturing and total manufacturing, 1985–2002



Source: Koski, Rouvinen, and Ylä-Anttila 2002, p. 44; original data source: Statistics Finland.
Note: 1985 = 100.

increasing. Financing of welfare service provision is becoming a major problem unless the productivity of service production increases in the near future. However, the potential is huge since many of the services can be standardized and digitized. To a large extent, it is a matter of learning to produce and use the services in new ways and forms, and applying technologies that basically exist already.

7.2 ICT industry in global transition

The issue of globalization has come to dominate the policy discussion in Finland, as in most other countries. Finland recognizes that the present phase of globalization differs from the past, especially due to the pervasiveness and rapidity of technological change, and the removal of barriers to trade and financial transactions. These two factors present specific challenges to small, open economies with limited absolute resources, such as Finland, that have to compete as locations of industrial activities on the global level. Finland enjoyed the advantages of being an early starter as an ICT producer and as being one of the countries that set the technology standards. Today, these advantages have lost part of their significance.

**ICT production
is moving to
new locations**

In the late 1990s, developed countries overinvested in virtually all ICT-related activities. Their investments were driven, among other things, by deregulation and

liberalization in major markets, uncertainties about future technological opportunities, and, of course, the commercialization of the Internet. What has occurred since is the leveling-off of demand and relocation of ICT production to new and more cost-competitive locations. These two trends apply also to the backbone of the Finnish ICT industry: the production of mobile handsets. New producers including South Korea, China, Hungary, and Mexico have gained global export market shares, while the early producers—the United States, Sweden, and Finland—have lost them (figure 7.3).

Figure 7.3 Changes in countries' global mobile phone market shares, 1996–2002



Source: Rouvinen and Ylä-Anttila 2005. Calculations are based on OECD International Trade by Commodities Statistics.

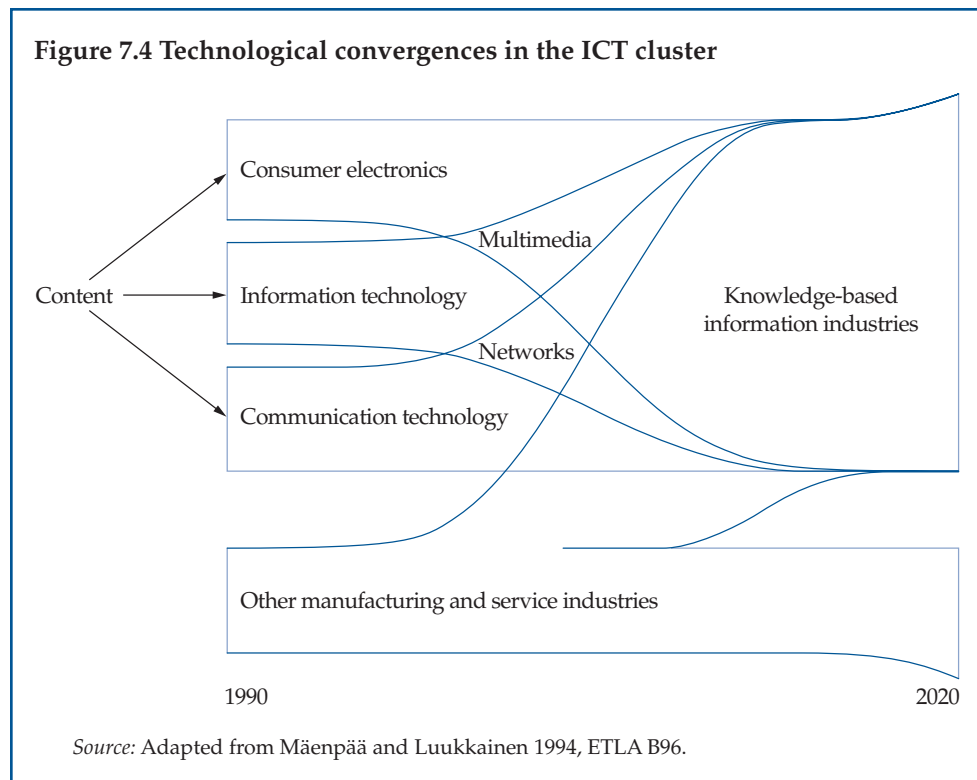
Notes: Here “mobile phones” refer to the International Trade by Commodity Statistics (HS96) code 852520 (Transmission apparatus for radiotelephony-incorporating reception apparatus). The total global export market is defined as the sum of the above 31 countries. The difference of the shares were calculated from the nominal US dollar values in 1996 and 2002. Export statistics unavoidably include some through-traffic so must be interpreted with caution.

China already has become a bigger exporter of mobile hand sets than Finland, and South Korea is catching up rapidly. It is a characteristic feature of the global economy that *the competitive advantage of a nation and that of its highly internationalized firms do not coincide*. While Finnish ICT giant Nokia, or Swedish Ericsson, might increase its (firm-specific) competitive advantages in the global market, its country of origin might be losing its (location-specific) advantage—or the other way around.

7.3 Technological convergence

One of the key challenges for the Finnish ICT cluster is the ongoing convergence of voice and data communications, information systems, consumer electronics, and digital content that are being tailored for these various channels and devices. Mobile Internet will introduce a new playing field with diverse and apparently different players. Indeed, producers in the respective industries already are competing in both handsets and networks, and this tendency will only strengthen as Internet protocols (IPs) increasingly form the bases for all electronic communication (see figure 7.4). *Over time, the producers' focus on equipment weakens as it becomes more diffused, and shifts to applications and content.*

From the viewpoint of small advanced telecommunications-oriented producers, there are risks related to the “all-IP” future. The all-IP world is not likely to favor the integrated and relatively closed architectures and business models of the telecommunications world. ICT companies will be competing in an ever more open and fragmented operating environment. This evolution is maybe more a challenge than new opportunity for the incumbents.



Box 7.1 Policy initiative to promote digital cultural content provision

Based on market growth expectations induced by digital technology, a major objective of the government's Information Society Program is to support the emergence of an internationally competitive content industry in Finland, "on the way marked out by Nokia."³ In this model, *the number of distribution channels of digital content increase, while technologies of content production, recording, and distribution converge*. Information technology and infrastructure have removed many technical impediments of content production and mass distribution, thereby allowing the entrance of new suppliers.

An example of a policy initiative to promote content is the digitization project of the Finnish cultural heritage—residing in museums, archives, and research libraries. Its aim is to provide citizens with access to digitized materials on the Internet, and support creation of new content based on the original substance.⁴ While a significant share of the cultural heritage has been catalogued electronically, only a small fraction of the material has been digitized. The target date for the digitization of the primary cultural heritage and its provision for public access is set for 2010.⁵

Information about the entire spectrum of Finnish cultural offering is accessible through the Internet, for example, through the links on the Ministry of Education's website.⁶ Finnish culture-related content in networks is still highly information oriented. Nevertheless, provision of digital cultural experiences is emerging in the form of, for instance, magazines, books, samples of museum collections, virtual art galleries, movie trailers, and, of course music, which is by far the most widespread form of digitally distributed cultural artifact.

³ Information Society Council 2005.

⁴ In 2000 the Helsinki City Library was awarded the first Access to Learning Award of the *Bill and Melinda Gates Foundation* for being among the first public libraries in the world to offer Internet access to the public.

⁵ Ministry of Education. <http://www.minedu.fi/>.

⁶ <http://www.minedu.fi/>.

7.4 Competing standards and technologies

Another well-known challenge is related to how the uncertainty over the next generation of networks is resolved.⁷ It is so far unclear which one of the three competing third-generation (3G) standards will be most widely used: W-CDMA (better known as UMTS, Universal Mobile Telecommunication System), CDMA2000 (promoted in particular by American Qualcomm), or the Chinese TD-SCDMA. While originally UMTS was regarded as the winning standard—favoring the European (Nordic) producers—today the other two also are showing strength.

Which are the winning ICT standards?

The main benefit of the first-generation digital (postanalog) system was *improved voice quality*. The key promise of 3G is *improved data communication*. So far, voice has been the key driver of mobile communication, although data is gaining ground. This shift is indeed taking place but, from the European point of view, somewhat unexpectedly. Whereas Europeans seem to have assumed that the mobile Internet would be an extension of mobile telecommunications, the US route of extending wire-line data communications architectures to wireless local area networks (WLANs, or Wi-Fi) seems to have an early market lead.

⁷ This section draws heavily on Rouvinen and Ylä-Anttila 2005.

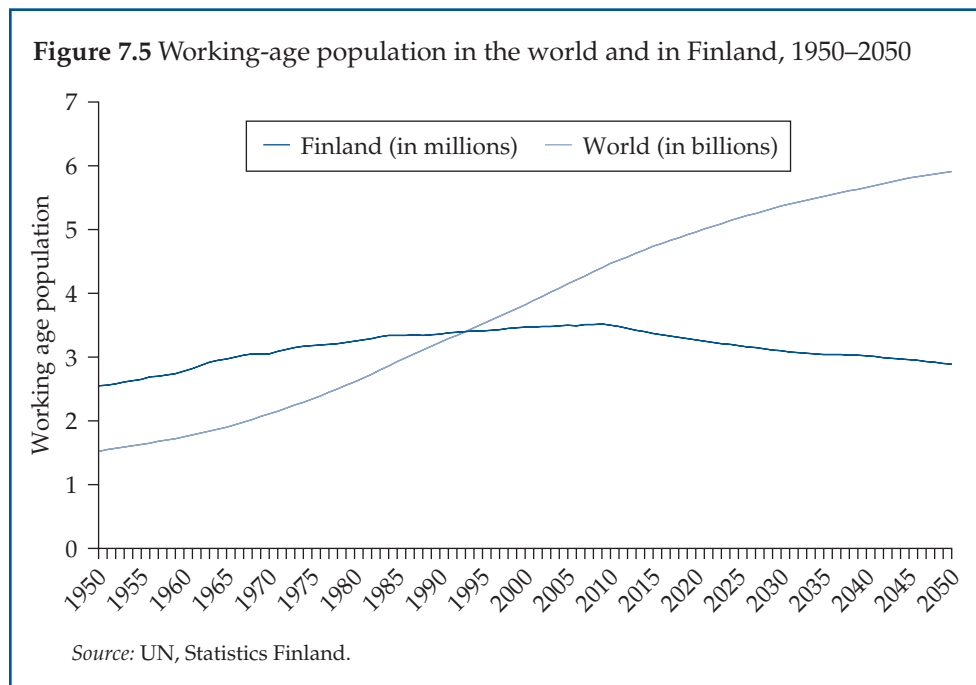
Many of the future prospects of the Finnish knowledge-based economy are related to how the future communication patterns are taking shape and what types of technologies will be used. Despite the heavy commitment to and specialization in mobile communication technologies, Finnish industry and society are relatively well positioned for the future. In the future, several parallel technologies are likely to be in use. The Finnish producers have already started to prepare for the world in which IP technologies play a bigger role relative to communication technologies.

7.5 Aging is an urgent challenge

The aging of the population in Finland is proceeding somewhat faster than in other European countries due to a relatively larger baby-boom generation after the war. Before 2010 the working age population (15–64) will start to decline sharply as the baby boomers gradually retire (figure 7.5).

The aging population will have several consequences for KE developments as well as for the whole society. On the one hand, the aging provides opportunities to develop ICT-based welfare services in the public sector, as well as new business opportunities (chapter 6). On the other hand, it implies a tough challenge to keep productivity growing fast enough. Productivity is the key to meet the increasing financing requirements of the welfare society. However, with the declining labor input and aging population, increasing productivity becomes more and more difficult. Furthermore, there is some evidence that the increasing average age of the work force affects productivity negatively and slows down adoption of new technologies.

The response to the challenge is to promote immigration and, in particular, to attract skilled labor to knowledge-intensive industries. In their investment plans, firms already anticipate the smaller work force. This reality might mean accelerating investment abroad, of which there are some signs in the horizon.



7.6 Policy challenges

Public policy had a curious role in the development of the Finnish KE. Seemingly, public policy became less important as the focus shifted from more traditional interventionist policies to promoting competition and efficient functioning of the market. On the other hand, in a Nordic welfare state, the basic foundations of a knowledge society are mostly publicly cultivated.

New policy thinking manifested itself as information society programs and as a shift in industrial policies toward knowledge creation and innovation. To advance the nation's knowledge base and enhance its industrial structure, neither did it rely on tax holidays or similar incentives as many other countries did. It did not try to attract business activities of multinational enterprises. Planning its approach to industry policy by concentrating on few national champions was not on the government's policy agenda.

Today, the big policy issue is whether the country can keep its Nordic welfare model and still compete successfully in the globalized world economy. Can both

Prepare for the future by seeking new consensus

the dynamism of the economy and social cohesion and welfare be maintained in the future? To address these issues, a high-level expert group, initiated by the Prime Minister and with representatives from various expert organizations and ministries, suggested in its report to *focus science and technology on creating a few world-class centers of excellence* (box 7.2).⁸

The report also recommended further increasing public R&D funding, but basically only for competitive research. The main idea of all of the group's recommendations was to pursue maintaining the competence base across the board, but increase it in selected focus areas by concentrating public efforts on them. The rationale of the policy shift is that a small country cannot be competitive on more than a very few sectors or industrial clusters in the global economy.

An integral part of the policy guidelines is to further increase the openness of the economy and society. Openness means attracting both foreign capital and foreign experts. Both are needed to solve the problems caused by the rapidly aging population and to strengthen the competence base of the selected focus areas in science and technology.

The policy recommendations also acknowledge the pressures coming from international tax competition. Tax incentives are probably needed to encourage entrepreneurship as well as to attract foreign experts to business and high-level researchers to universities. Tax incentives do not, however, mean to back off from the basic egalitarian values of the Nordic welfare society, but rather to employ new means to maintain Finland's internationally competitive, knowledge-based economy.

The challenges of the Finnish knowledge economy are summarized by figure 7.6. It looks back to the previous stages of development and asks how to keep the innovation- and technology-driven stage and avoid becoming a society based on accumulated wealth and unable to renew. Maintaining the edge is the key in all

⁸ "Finland's Competence, Openness and Renewability: The Final Report of the Finland in the Global Economy Project." Prime Minister's Office Publications 26/2004. <http://www.vnk.fi/tiedostot/pdf/en/91776.pdf>.

Box 7.2 “Finland’s Competence, Openness and Renewability” report

In 2004 the Prime Minister’s Office launched a project to investigate the challenges faced by Finland in the new phase of globalization. The aim was to assess how the ongoing transition in the world economy will affect various sectors and their employment prospects in Finland and how to meet the challenges of the changing business environment. The final report of this project was published at the end of 2004 and is entitled “Finland’s Competence, Openness and Renewability” (<http://www.vnk.fi/tiedostot/pdf/fi/91776.pdf>).

The report was based on numerous background studies commissioned from national think-tanks 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 was intended to feed into ongoing work to formulate a globalization strategy for Finland. Toward this end, the report proposes a compendium of measures, of which the main ones are:

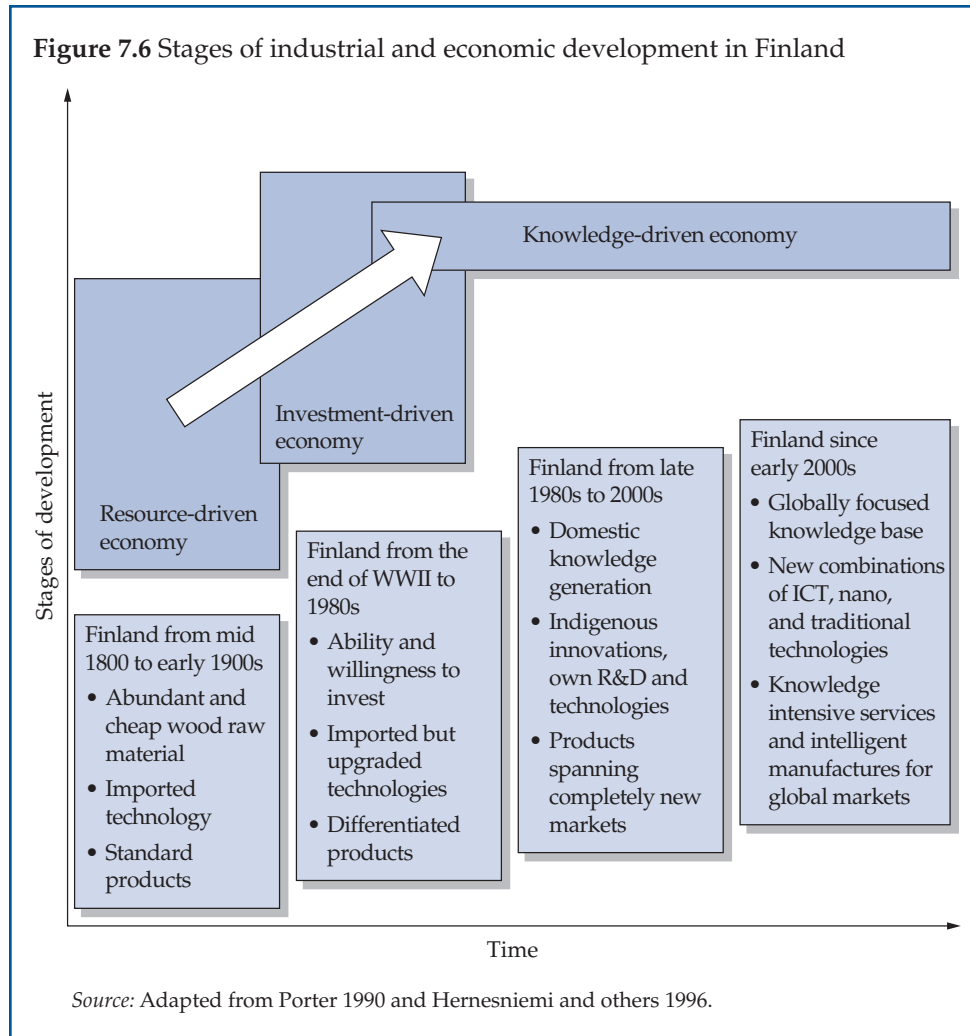
- *Improve the quality of the education system* through increasing the attraction of vocational education, enhancing the financial autonomy and incentive-based funding of universities, and increasing the efficiency and international attractiveness of polytechnic education.
- *Strengthen innovation policy* through catering to shortcomings in competence in 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 science and technology policy to innovation policy
- Increase the attractiveness of the *business environment* through further easing the taxation on labor in all income classes; increase employment-based immigration; develop new networks in emerging technology centers such as China, South Korea, and Taiwan; increase the exportation of public-sector welfare services and culture; and develop additional domestic and international transport connections
- Strengthen Finland’s *renewability* by raising the employment rate, develop a long-term business environment policy strategy, contract out public services, improve the productivity of the public sector, and increase the efficiency of the stock exchange
- Develop the *ground rules of the labor market* through enhancing work-time flexibility, narrowing the tax wedge with emphasis in the low-income end, and further developing the unemployment benefit system so that reemployment is encouraged through new incentive schemes.

Finnish policy initiatives launched during the past couple of years and reviewed throughout this volume.

7.7 Vision for the future

Finland has reached the stage of a knowledge-driven economy mainly by being one of the leading producers of ICT. The risk of moving to a “wealth-driven” stage of enjoying past achievements is real. Therefore, several initiatives have been taken to envision the future and prepare for challenges coming from the globalizing world economy. One of them is the Prime Minister’s Task Force (box 7.2); another is SITRA’s Innovation Management program (box 7.3).

The reports of both of these high-level expert groups address future production structures and potential growth sectors after the ICT boom.



Box 7.3 SITRA's innovation management program

In fall 2004, the National Fund for Research and Development, or SITRA, invited a high-level expert group to prepare a national innovation management program to find ways to make Finland one of the most innovative countries in the world. The group consisted of some 20 members ranging from university professors and presidents of TEKES and the Academy of Finland to representatives of the business community and research institutes.

The group came out with an influential report in spring 2005. The report suggests a more focused and specialized university system, measures to accelerate the internationalization of the science and technology system, promoting immigration, increasing public funding for competitive research and centers of excellence, and creating new incentives for knowledge creation and entrepreneurship. New possibilities are seen, for instance, in creative industries and making use of industrial design.

The point of departure for many recommendations is that Finland has not been able to fully utilize and commercialize its technology base in the global marketplace.

Proposals for action by the program were assigned to the agencies with authority to put them in force. The expert group is tasked with following up on the implementation of its work.

As emphasized in the previous chapters, new growth sectors are nearly always built on accumulated knowledge and skills in other related sectors and industries. Innovations spurring industrial growth usually emerge in the interfaces of existing technologies as new combinations.

Looking at the future of the Finnish knowledge economy, there are a couple of technology areas in which new combinations may lead to profound industrial renewal and possible new competitive growth clusters (figure 7.4). Finland has strong knowledge concentrations in forest-related technologies and industries as well as in ICT. Combining these two has already led to a new kind of service production targeted at globally operating forest-industry corporations. *Nanotechnologies* are a rapidly advancing area in Finland that also are seeking applications in forest-related industries. Combining the three—papermaking, ICT, and nanotechnologies—into new products is already on the horizon and is partly reality. Intelligent paper products and packaging may change not only global logistics systems, as they have been doing, but also consumption patterns of individuals.

8

Conclusions and Lessons from Finland's Knowledge Economy for Other Economies

Carl Dahlman

8.1 Introduction

Finland's rise from basically a natural-resource-exporting country to a technology-intensive knowledge economy is remarkable in the speed and success of the transformation. Finland went from the throes of a major financial and economic crisis at the beginning of the last decade of the twentieth century, when its GDP fell 10 percent, to being one of the most competitive and most knowledge-intensive economies of the world.

Drawing lessons for other economies is difficult because economies have differing characteristics and social and institutional contexts. Finland also has many special characteristics that make its experience unique and thus very difficult to replicate. This chapter will summarize some specific Finnish characteristics to help to distinguish what may be more unique to Finland from what may be replicable by other types of countries, and then will draw out some of the policies and institutions that may be relevant for other countries. Finally, the chapter will summarize the broader lessons of the Finnish case and conclude with some implications for other countries.

8.2 Some special Finnish characteristics

Finns have many specific characteristics that cannot be replicated easily in many other countries. Two of these are an independent spirit of self-reliance and a "can do" attitude, which have been tempered by Finland's weather, geography, and occupations. As the country that has 60 percent of the world's population living above the Arctic Circle, the very cold climate over generations has created a very hardy population. In the 1860s, for example, when two summers were too short for a growing season, 5 percent of the population starved to death. These difficult conditions over time have created a population who necessarily must plan ahead to survive. Before national independence in 1917, long periods under the rule of, first, Sweden and then Russia also created an individual independent spirit and strong national sense of self-reliance with the will to overcome difficult odds.

A second specific characteristic—shared with other Nordic countries—is a strong spirit of cohesiveness, high moral values, an emphasis on equality, and relatively

equal income distribution. There is also a low level of bureaucracy, a high-quality governance, and high levels of trust and social capital.¹ These assets probably are partly the result of Finland's history and quite homogeneous gene pool. Finland also may be strengthened by its unique language, which is distinct from the other Nordic languages, and forms an exclusive bond among the Finns and differentiates them from others.

A third characteristic is a willingness to interact with the outside world in an open but strongly nationalist way. Perhaps because of the country's geographic isolation, Finns have a natural curiosity about the outside world that has made them very open to outside ideas and technology. As noted in the sectoral chapter, they relied heavily on timber and sawmill technology that they obtained from their Nordic neighbors and the Germans in the 1800s. Finns also were among the first to introduce electricity and to use the telephone. They were very open to experimenting with different telephone technologies almost as soon as they were invented and to develop their own versions.

While several others characteristics may be somewhat unique to Finns, these three have been highlighted because they appear to be part of what has allowed Finland to built a successful nation state and, more recently, turn a major economic crisis into an opportunity. Above all, it has transformed itself from a somewhat marginal economy in Europe to the most competitive and knowledge-intensive country in the world in less than a decade.

8.3 What may be replicable

The elements of Finland's success story that may replicable are of two types. One is *economic policies*. The other is perhaps some *key institutions and procedures*.

Economic policies

Some of the key policies that are partially responsible for Finland's success are quite typical of the Washington Consensus.² Finland's policies include:

- Strong rule of law
- Strong governance and accountability
- Stable macroeconomic policy
- Strong financial sector (after the 1990s crisis)
- Openness to outside ideas and a free trade regime
- Strong focus on encouraging domestic competition.

Some of these elements—strong governance and accountability, strong rule of law, and strong tradition of encouraging domestic competition—are long-standing

¹ For comparative indicators on low bureaucracy and high government effectiveness, see *The Cost of Doing Business*. World Bank 2005.

² The Washington Consensus is a set of policies and reforms believed to be the formula to promote economic growth in developing countries. The term was originated by economist John Williamson in 1989 and intended for Latin America (www.en.wikipedia.org/wiki/Washington_consensus). For Williamson's concerns on the migrating definition of his term, see his 1999 IIE lecture. <http://www.iie.com/publications/papers/paper.cfm?researchid=351>.

Finnish cultural and historical characteristics and traditions. The strong openness to outside ideas and technology also dates back to the early development of the forestry industry in the nineteenth century and has been a marked feature of the development of the ICT industry. It is noteworthy that, even before joining the EU, Finland undertook significant trade reform to foster stronger competitive pressure to improve performance across many sectors of its economy.

Other characteristics, however, such as the strong macroeconomic policy and financial sector and the free trade regime, are relatively more recent and were strengthened as part of the commitments Finland made when it joined the European Union (EU) in 1995. It should be remembered that before it joined the EU and the European Monetary Union, Finland suffered from significant macro and exchange rate instability; and that the economic crisis of the early 1990s was a financial crisis not too dissimilar from those common in many developing countries. However, in contrast to many developing countries, Finland pulled itself out of its national financial crisis relatively quickly. In addition, the reform of the banking system and the strengthening of the capital market, venture capital in particular, after the 1990s crisis were important to make finances available for the growth of the new knowledge-intensive sectors of the economy, especially the ICT cluster.

An additional benefit was that the financial and economic restructuring that took place after the crisis involved breaking the traditional banking-led relationships, as had happened in Japan and Germany, which enabled a more dynamic and open financial system led more by stock market capitalization. The restructuring also included the liberalization of the capital accounts and the removal or restrictions on foreign investment, which did not occur until 1993, when Finland joined the European Economic Area, and which were fundamental in transforming the economy. By 2000, two-thirds of the shares of the Helsinki stock exchange were foreign owned as were more than 90 percent of Nokia's shares.³

Clearly, all these policies have been very important for Finland's success and may be considered necessary conditions, even if not sufficient, to explain its successful transformation into a knowledge economy. It should be emphasized, however, that *the very strong early focus on competition in the telecommunication sector in particular was critical in laying the basis for a very dynamic sector and strong domestic capability.*

Other policies are less typical of the Washington Consensus. These include:

- Strong welfare state, in particular, the very strong focus on education
- Strong focus on coordination of policies among key government agencies, and between them and the productive sector
- Strong focus on R&D and innovation
- New type of industrial policy
- Strong focus on the future.

The Nordic welfare state with a strong social safety net and a strong focus on free public education were important elements of Finland's transformation. The safety nets were

³ For more on the financial sector and foreign ownership, see Ylä-Anttila, Ali-Yrkkö, and Nyberg, "Foreign Ownership in Finland: Boosting Firm Performance and Changing Corporate Governance," forthcoming 2005.

particularly important for dealing with the jump in unemployment, which occurred during the crisis of the early 1990s. The focus on retraining people and linking unemployment benefits to getting additional education also were very important to help restructure the economy toward high-technology industries. A special characteristic of Finland's educational system, which differentiates it from the UK–US Washington Consensus, is that education is free all the way through the university level. Other notable characteristics of Finland's education system are its strong focus on equality measured by outcomes, tying welfare payments to training for young persons, tremendous openness, and focusing higher education on the needs of the productive sector.

Regarding the latter, it is very impressive that between 1993 and 1998, the admissions of students in universities nearly doubled, and those into polytechnics nearly tripled and were primarily in ICT-related areas. Currently, the tertiary enrollment rate in Finland is at 85 percent—one of the highest in the world. Consistent with the focus on the needs of industry, and the ICT industry in particular, is that Finland has one of the world's highest percentages of students enrolled in engineering and natural sciences. Another impressive aspect of the Finnish education system is its emphasis on life-long learning through its strong emphasis on adult education. According to the OECD, more than 50 percent of adult Finns are enrolled in some sort of course. In addition, the Finnish education system is structured with multiple pathways to higher and continuing education so that people can continuously upgrade their skills and advance to the limit of their abilities.

A second special characteristic of Finland's economic policy regime is the high degree of coordination across different parts of government, and between the government and society. One example is the economic policy management program highlighted below. However, a high degree of coordination of policies is evident in most areas. In the science and technology area, for example, it is notable, first that the Prime Minister chairs the Science Policy Council, expanded and converted into the Science and Technology Council in 1986; and second, that the council includes the key ministries of Finance, Education, and Trade and Industry, plus four more.

Besides the very open and egalitarian educational system, one of the special consensus-creating mechanisms is the economic policy management program, which has been given over more than 25 years for key decisionmakers, such as members of Parliament, media and labor leaders, academia and top civil servants, and industry and business leaders. Another consensus-builder is the Parliament's Committee for the Future, which as noted has now become a permanent institution. There also are numerous special multistakeholder task forces that produce reports of national interest, such as the government's Futures Report of 1998; as well as special multisectoral councils on special topics, such as the Information Society Council 2003 under the Prime Minister.

A strong commitment to R&D and innovation were already part of the Finnish government's mindset, as can be seen from the long history of institutions and efforts that predate the crisis (elaborated below). What is quite remarkable, however, is that *during the crisis, while the government cut back on virtually all expenditures, it increased its expenditures on R&D to support business R&D and to stimulate the transformation of the economy from natural resource based to knowledge based.*

That R&D support was the start of an industrial policy based on functional support and promotion of networks. A key element of this new industrial policy was that it did not target specific firms or winners. It was a more a functional type of

intervention to improve the key factors needed to support new technologies and technology-based firms, namely, R&D, higher education, venture capital, and advanced technological infrastructure. Two critical roles of the new industrial policy were to help create a vision of the potential competitive edge and restructuring needs of the economy, and to disseminate this vision throughout the economy.

These policies originated in the National Industrial Strategy White Paper (1993), which strengthened the focus of industrial policy toward developing and promoting a national innovation system in the context of industrial clusters. *An important element of this strategy was focusing on creating and strengthening networks among firms; and among firms, universities, and research institutes.* The strategy also aimed to promote both competition and networking. This strategy is well illustrated in the technology programs launched by TEKES (National Technology Agency), which have a coordinator or steering group and typically involve various firms and universities or research institutes.

Regarding its strong focus on the future, it is notable, for example, that as far back as 1960, the government created the Advanced Data Processing initiative to review information processing in the public sector. Then the government created the Advance Data Processing Board under no less than the Ministry of Finance to look at the implications of automation technologies for employment. By 1979 the Technology Council was appointed by the Council of State to look into this issue. In 1992 Parliament created the Committee for the Future to look into the impact of new developments on Finland's future. The committee was made permanent in 2000. More recently, the committee refocused from innovation more to globalization and competitiveness (see below).

Key institutions

Institutions are not fully independent of the broader cultural and social structure within which they are created. This statement is certainly true for the institutions discussed below. While other countries may not be able to replicate exactly any of these institutions, it is useful to highlight some of their key functions and to summarize why they have worked so well.

Some key technology and innovation institutions are described below in the chronological order of their appearance.

The Academy of Finland was established in 1918. It is an expert organization in research funding and science policy. The academy's objective 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. The Academy of Finland's operation covers all scientific disciplines. The academy operates within the administrative sector of the Ministry of Education and is funded through the state budget. Approximately 15 percent of all government research funding was channeled through the academy. It focuses on financing basic research; and its main instruments include "research project funding that is open for general application, research programs, center of excellence programs and posts for Academy Professor and Academy Research Fellow" (www.aka.fi).

The Technical Research Center of Finland, or VTT, was established in 1943. It has become the biggest polytechnic applied research organization in Northern Europe. It is an integral part of Finland's innovation system. By developing new technological solutions and applied technologies, VTT helps its customers to improve their

competitiveness. VTT also promotes technology transfer by participating in national and international research programs and collaboration networks. VTT's multidisciplinary research organization covers the following polytechnic research areas: Biotechnology, Energy, Pulp and Paper, Digital Information Systems, Telecommunications, Industrial Systems, Microtechnologies and Sensors, Materials and Building. With a staff of some 2,700 and unique research facilities, VTT provides a wide range of applied high technology, solutions, and know-how for its domestic and international clients and partners. VTT's involvement in international and national innovation networks strengthens its potential for contributing to cooperation, partnering, and technology transfer. VTT's revenue in 2004 was 218 million euros (www.vtt.fi).

The Science Policy Council of Finland was established in 1963. However, in recognition of the need to go beyond supporting science to support technology, in 1986 it was transformed into the Science and Technology Policy Council. Given its high priority to the government, it is chaired by the Prime Minister. Its function is to advise the government and its ministries on questions relating to science and technology. The council is responsible for the strategic development and coordination of Finnish science and technology policy and of the national innovation system as a whole. The membership consists of 7 other ministers and 10 other members, all well versed in science and technology (www.research.fi).

The National Technology Agency, or TEKES, was established in 1983 under the Ministry of Trade and Industry. TEKES was given a major role: to formulate the Finnish innovation and technology policy by allocating funds for research and development in private firms and research organizations as well as in universities. In 1984 TEKES had a budget of fewer than 50 million euros to fund R&D activities; 20 years later, its budget was more than 8-fold larger, over 400 million euros. This amount was approximately 28 percent of the government's total R&D budget. TEKES employs more than 300 people, almost half of whom are technology and business experts. The majority work at the TEKES headquarters in Helsinki. TEKES also has technology units at 14 regional Employment and Economic Development Centers in different parts of Finland. There also are six TEKES offices abroad—in Beijing, Brussels, San Jose, Shanghai, Silicon Valley, Tokyo, and Washington D.C. Their major aim is to manage international contacts and collaboration and to promote international R&D cooperation with TEKES' technology programs.

The major financial instruments of TEKES include industrial R&D grants and loans to firms and grants for applied (technical or technology-related) research in public organizations. Research grants typically are allocated via *technology programs* planned in collaboration with firms and research institutes. The technology programs launched by TEKES set priorities for specific sectors of technology or industry and define the allocation of money for R&D in different fields. Technology programs are organized as follows: they each have a coordinator, a steering group, and a responsible person from TEKES. The sizes of the programs vary between 20 million and 150 million euros and the work divided over period of 3-5 years. Typically, TEKES covers approximately half of the costs and the participating companies another half of the costs of the programs. In 2004, TEKES spent more than 170 million euros for its technology programs. In 2005, there were 22 extensive national TEKES technology programs in operation (www.tekes.fi).

The Employment and Economic Development Centers, or TE Centers, are public offices under ministerial supervision that provide various business-related services and financing. Established in 1997, TE-Centers are a network of 15 regional offices

with business departments tasked to serve the needs of SMEs by providing business-support services, consultation and advice, as well as financing. The TE Centers' business departments employ approximately 250 people nationwide. TE Centers provide advice for various business needs and can help businesses to find the right services and funding for each particular case. Furthermore, the centers offer subsidized business development services, which the centers outsource to private consultants. The centers also serve as a regional network for the other "key institutions" above and channel their services to the regions.⁴

While all of these institutions are specialized to serve different functions, their operational methods have certain similarities. It appears that all of these institutions (1) do a great deal of coordination of the different stakeholders and relevant actors, (2) have well-defined objectives and monitoring mechanisms, and (3) while they have a great deal of autonomy, ultimately, they also are very accountable to their respective higher authorities. The functions of these institutions serve as good examples of some of the specific needs that need to be addressed at a level beyond what is done by the individual private firms. Furthermore, many of their specific mechanisms such as competitive bidding, peer review, and incentives for cooperation across functional or firm boundaries are worthy of consideration for possible adaptation to the needs of other countries.

8.4 Broader lessons from the Finnish Experience

On a broader level, it is appropriate to reflect on what can be learned from the Finnish experience and what that implies for developing countries.

First lesson

It is possible for a country to make a dramatic recovery in GDP and undertake a major restructuring, as Finland did. An important corollary is that a crisis can be turned into an opportunity. However, for the opportunity to take flight, there may need to be certain preconditions, as well as great flexibility, in the economy.

Finland is not unique in turning a crisis into an opportunity. Korea turned its major 1997 financial crisis into an opportunity to undertake a major reform of its economic incentive and institutional regime. On the other hand, Japan did not turn its early 1990s crisis into an opportunity for major reform. Finland's case requires some reflection.

What made Finland's restructuring possible included the special characteristics already noted of a *strong "can-do" attitude* and *strong social cohesiveness*. These two were complemented by the *strong social and economic safety net of the welfare state*.

⁴ The tasks of the TE Centers is to promote specified areas of business activity, labor issues, and regional development by offering financial, training, development, and other services. Their tasks related to SME development are: "(1) to support and advise small and medium-sized enterprises at the various stages of their life cycles, (2) to promote technological development in enterprises and assist in matters associated with export activities and internationalization, (3) to influence and participate in regional development in general." TE Centers offer services through their 15 regional centers. TE Centers offer entrepreneurship grants to enable unemployed people to become self-employed. The centers also partially finance enterprise investment and development projects via direct aid. Almost half of the aid comes from EU Structural Funds and is directed to the EU objective areas.

Without these four preconditions, it is not clear that Finland would have been able to cope with the unemployment, which grew to almost 20 percent, and a wrenching restructuring process in which people were redeployed from declining sectors in the old economy to the new ICT sectors. *The already high educational level of the population and the very strong response of the tertiary education sector to expand and produce workers with the new ICT skills were the fifth and sixth important facilitating elements.*

Another *special element* was that there was a large conglomerate, *Nokia*, that was able to rise to the challenge. It is particularly noteworthy that, at the time of the crisis, Nokia was a large, diversified conglomerate that had been growing through mergers and acquisitions. Besides feeling the effects of the general economic crisis, it went through its own internal identity and management crisis *during* the 1990s recession. However, Nokia decided to divest most of its traditional businesses and focus on the ICT sector, and mobile telephones in particular. Its success in making this transformation is legendary and hard to explain.

Ultimately, Nokia's success probably must be attributed to its *new management* introducing new practices such as team-management and flexible and flat organization structures, which facilitated the exceptional growth. However, Nokia's success was facilitated not only by consolidating the capabilities in the ICT sector that had been developed by many of its acquired companies, but also by the government's strong vision of the potential of the sector, and by the flexibility of the economy in responding to this opportunity.

This response included the availability of high-level staff who had been idled by the collapse of other businesses; the strength of the university and research infrastructure; the quick response from the educational system to produce the new engineers, managers, and new skilled workers that were needed; the availability of foreign equity capital to fund the growth of the ICT sector; and the availability of venture capital and government seed funding to start up new high-tech enterprises that became part of the ICT cluster that grew up around Nokia.

Second lesson

Globalization is a double-edged sword. Globalization is the increased global interdependence of work through trade, capital, technology flows, and people flows. Globalization results in part from liberalization of trade and capital flows, in part from the technological advances that are reducing transportation and communication costs and creating a global market for knowledge.

Finland clearly has been affected by globalization. Part of the country's crisis in the early 1990s resulted from the global downturn of the forest-related industry as well as the collapse of its trade with the former Soviet Union. Part of the solution to the crisis also resulted from globalization:

- The dramatic development of the ICT industry is part of globalization.
- Finland's rapid growth in the ICT area was possible because of globalization both in terms of (1) producing for a world market⁵ and (2) its ability to access the foreign capital and knowledge that it required to develop the industry.

⁵ Among the 10 largest conglomerates in Finland, as much as 80% of revenues come from foreign sales, and over 60% of production and personnel are located abroad. Ylä-Anttila and others, 2004 and forthcoming, 2005.

On the other hand, Finland is also struggling with the impact of globalization, which in fact has become the major focus of the work of the Committee on the Future and the object of the 2004 Prime Minister's task force report.⁶ This report aptly notes that *due to globalization, production is being restructured in terms of the comparative advantages of different countries*. Developing countries increasingly are forming part of global production networks, primarily as producers of standard, labor-intensive products due to these countries' lower labor costs.

In addition to this new division of labor, the advances in *communication and information technologies are making it possible to produce services at a distance*, particularly back-office functions, such as accounting, but, increasingly, also more advanced technical services. The report also notes that countries increasingly are competing for foreign investment that brings advanced technology, that such investment demands skilled labor and a supportive technological infrastructure, and that Finland is not succeeding in attracting as much foreign direct investment (FDI) as its firms are investing abroad in search of global markets and access to high-level skills and knowledge.⁷

All this is putting pressure on Finland to improve its technology and education system to stay competitive in the forefront. The report notes that Finland still has an unemployment rate of nearly 10 percent and that, to face the challenge of globalization *"requires an economy and society that are capable of change and can make best use of their strengths."*⁸ To this end, the report proposes that *"a competence-based strategy requires continuous renewal from the economy. Reforms must apply not only to the weak points of the crucially important education and innovation systems, but also to the functioning of the markets for labor, goods, and services, and the public sector."*⁹ It then sets out a series of reforms to strengthen all these areas, even though, by most international comparisons, Finland is already doing better than most countries. All of Finland's concerns above emphasize just how much pressure globalization is putting on even the most competitive player.

Third lesson

A third, and perhaps the most critical, lesson is *the importance of flexibility or elasticity of the economy to react of changing opportunities*. Finland's case aptly demonstrates the importance of this flexibility in the way that it was able to significantly restructure its economic structure as a result of the crisis of the early 1990s. As noted, two critical aspects of that process of creative destruction were the very strong social cohesion and strong safety nets. However, *it is perhaps the educational system that has played the most critical role*. Finland already had a high level of educational attainment, which facilitated the necessary restructuring of the economy. However, in addition, the educational system was able to respond very quickly and flexibly to the new opportunities. Furthermore, as noted in the quotations above from the Prime Minis-

⁶ For a very instructive perspective on this, read the executive summary of the Prime Minister's Report, "Finland's Competence, Openness and Renewability: Summary of the Final Report of the Finland in the Global Economy Project," December 1, 2004.

⁷ Nokia, for example, has production facilities in 10 countries, R&D operations in 15 countries, and sales in over 130 countries.

⁸ Finland's Competence, p. 2.

⁹ Ibid.

ter's report on globalization, *increasing this flexibility is seen as a key priority to respond to the continuing challenge of the constant restructuring that results from globalization*. Fittingly, the key elements—Finland's economic system, education, ICT infrastructure, and innovation system—correspond very closely to the four-pillars framework of the knowledge economy outlined in the introductory chapter to this book.

8.5 Implications for developing countries

1. The first implication is *the continued importance of the basic elements of the Washington Consensus*.¹⁰ These elements are essential to give the economies the flexibility they need to constantly redeploy assets to their most productive uses. What is most important at any given point in time will vary depending on the specific situation of each country. However, as noted earlier, it is clear that globalization is putting a strong premium on countries' being able to constantly redeploy resources to their most productive uses, and that this imperative applies to all countries, no matter what their level of development.¹¹
2. The second implication is *the imperative to develop vision and consensus-making mechanisms*. Reforms involve changing the status quo, and doing so usually does not happen unless there are major external or domestic forces pushing

¹⁰ These elements are:

- Fiscal policy discipline
- Redirection of public spending toward education, health, and infrastructure investment
- Tax reform. Flattening the tax curve: Lowering the tax rates on proportionally high tax brackets (typically, above median income), and raising the tax rates on the proportionally low tax brackets (typically, below median income); lowering the marginal tax rate
- Interest rates that are market determined and positive (but moderate) in real terms
- Competitive exchange rates
- Trade liberalization. Replacement of quantitative restrictions with low and uniform tariffs
- Openness to foreign direct investment
- Privatization of state enterprises
- Deregulation. Abolition of regulations that impede entry or restrict competition, except those justified on safety, environmental, and consumer protection grounds, and prudential oversight of financial institutions
- Legal security for property rights. http://en.wikipedia.org/wiki/Washington_consensus.

¹¹ For the lowest-income developing economies, the implications may be somewhat different. They still need to get their economic and institutional regimes in order, but this is a tall order because, by definition, these are still very underdeveloped. It is important for these countries to give priority to improving governance and the effectiveness of government and basic public services, such as security, basic education, and health services. They also need to strengthen the rule of law and the basic framework conditions to provide a stable environment to develop productive activity. Beyond these, the lowest-income countries need to improve the basic market institutions including banking, an effective labor market, transportation, and other basic infrastructure. As they develop, they then need to strengthen the financial system, including the stock market, and increase openness to the outside world including trade liberalization, competition policy, middle and higher education, the research infrastructure, and the broader innovation system. However it is unrealistic to expect that they need to get all this right from the start. Instead, they need to complement the top-down reforms with bottom-up concrete pilots and to find mechanisms for scaling up the successful ones while they continue to work at the fundamental reforms. Piloting with concrete projects, to the extent that they are successful, also will help to create stakeholders and momentum for the top-down reforms.

or demanding such changes. Consensus mechanisms must be developed to sensitize the different actors to what is at stake for the country, rather than for only their individual positions or sectors. Sensitization is necessary for making trade-offs, both among different existing groups and across generations. An example of such trade-offs could be sacrificing current consumption for investment in the future such as increasing the saving rates or increasing expenditures on education. Creating this stakeholder awareness is critical to get the necessary buy-in for the reforms and actions so that they actually will be implemented.

3. The third implication is *the importance of developing appropriate knowledge strategies*. Finland was already a developed country operating at close to the world frontier of ICT at the time of the crisis. Thus, it had to take the more challenging road to development and concentrate on innovating at the world frontier. To do so, Finland also had to increase higher educational attainment in general, and scientific and technical skills in particular. Furthermore, these challenges involved not only increasing R&D expenditure but also focusing on getting the fruits of R&D into the market. In this way, Finland's strong emphasis on the systemic approach to innovation evolved, including bridging the entrepreneurship and financing gaps to turn invention into commercial application.

Relevance of Finland's KE strategies to developed, middle-income, and developing countries

For the larger and more technologically advanced countries with a critical mass of scientists and engineers, as well as a critical mass of R&D expenditures, the Finnish approach to the broad innovation system, including the creation of new knowledge and the commercialization of that knowledge, is relevant.

For middle-income countries, ever-increasing globalization, and in particular the increasing importance of technology and information, means developing effective strategies of tapping into the rapidly growing stock of global knowledge, also as Finland did and is still doing.

However for the majority of developing countries—and even for the more developed countries mentioned above—the focus needs to be somewhat different than Finland's. Because, in virtually all sectors, developing countries are still very far from the technological frontier, they still need to put priority on developing effective means of tapping the preexisting and rapidly growing stock of global knowledge.

In addition, developing countries should conceive of the innovation system quite broadly and include all of the relevant actors. However, these countries need to put more weight than they do now on understanding, acquiring, adapting, diffusing, and using existing knowledge, including indigenous knowledge. This priority includes putting in place basic technological infrastructure such as norms and standards, metrology, testing, and quality control, as well as strong dissemination mechanisms and institutions such as technical information centers, productivity organizations, and agricultural and industrial extension agencies. In addition, developing countries need to set up public research institutes that can help them access what global technologies may be relevant and help them adapt these technologies to their circumstances.

More importantly, utilizing their existing knowledge also involves creating technological capability in their productive firms and in getting them to invest in improving and eventually creating their own technologies in their most advanced sectors.

Developing nations also will have to pay more attention to all levels of education. To the extent that many still have very low educational attainment, they will have pay more attention to strengthening universal basic and secondary education for their citizens to become effective users of technology. They also will need to improve higher level secondary education and even higher education to keep up with and make effective use of the rapidly expanding technological frontier.

Developing an effective innovation system also involves attracting FDI that can bring in relevant new technology to advance local economies. Attracting FDI also includes getting into global value chains controlled by multinational companies and trying to move up those value chains. It also includes developing linkages and networks between domestic public and private research institutes and universities and foreign ones, as well as among all of these domestic institutions.

A final implication for all countries is *the importance of focusing not only on what can be learned from the past (their own and other countries' experience) but on anticipating and preparing for the future*. This is one of the key lessons of the Finnish example and explains to some extent why Finland not only was able to make such a dramatic transformation to a knowledge-based economy but also why it has been able to remain so competitive.

Moreover, as can be inferred from the challenges that Finland is facing as a result of the rapid advances in knowledge and the continuous challenge of globalization, the world is not standing still. What worked in the past may not work in the future, and the prerequisites for being successful seem to be rising ever higher and becoming ever more demanding. Thus derives the importance of looking forward to see to what extent it is possible be better prepared for future challenges and opportunities. Developing countries in particular need to monitor this aspect closely because there may be important new areas that can be exploited, and it will be necessary for them to be ready to move to take advantage of them.

Appendix 1

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Finland has been ranked number one for the fourth time since 2000 in the World Economic Forum's Global Competitiveness Index.

"...The country owes its strong showing to one of the most innovative business environments in the world, particularly critical to driving productivity in the country, given its advanced stage of development. This is coupled with a very healthy macroeconomic environment, at a time when many other industrial countries are struggling in this area. The willingness of Finnish governments to run budget surpluses, so as to be able to meet future social commitments linked to the aging of the population is particularly impressive. This approach to macroeconomic policy highlights a degree of political maturity in Finnish society worthy of emulation. Furthermore, Finland has an institutional environment that is among the world's finest: the business community operates in a climate of respect for the law, unusually low levels of corruption, and an openness and transparency which other countries would do well to study."

Dr. Augusto Lopez-Claros, Chief Economist and Director, Global Competitiveness Programme, World Economic Forum in *The Global Competitiveness Report 2005-2006*, Executive Summary, pages xiv-xv. Houndmills, UK: Palgrave Macmillan.