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Discussion papers

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DEVELOPMENT AND TECHNOLOGICAL TRANSFORMATION - THE COUNTRY STUDY FOR FINLAND*

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CONTENTS

		Page
I	INTRODUCTION	1
II	THE ECONOMIC AND TECHNOLOGICAL SETTING	3
III	GROWTH AND STRUCTURAL CHANGES IN THE ECONOMY	10
	1. Sectoral growth patterns	13
	2. Internationalization of firms	14
	3. Adjustment to oil crisis	15
	4. Recent developments in the financial markets	19
IV	DEVELOPMENT IN TECHNOLOGY-EMBODYING INPUTS	21
	1. Input growth and productivity	21
	2. Rapid increase in R & D expenditure	25
	3. Foreign trade of high-tech products	27
V	MANAGING THE DYNAMICS OF TECHNOLOGICAL TRANSFORMATION	30
	1. Role of the public sector and role of firms	30
	2. Role of education	34
	3. Development of technology policy	35
	4. Spill-over effects from the raw-material based sectors	38
	5. Some comments on economic policies in the post-war period	41
	5.1. Trade policies	41
	5.2. Experiences from demand management policies	42
	5.3. Income policies	45
	5.4. Exchange rate policies	45
VI	CONCLUDING ASSESSMENT	49
REFERENCES		53
APPENDIX		56

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ABSTRACT: The study reviews the main factors which have contributed to the relatively favourable economic development and the technological transformation of the Finnish economy in the period 1950-85, which was characterized by both large structural changes and rapid technological development. The role of the public sector and of firms in this process is discussed as well as education, technology policy, economic policies, and multiplier and spillover effects from raw-material based sectors. The study was prepared for the WIDER (World Institute for Development Economics Research) study programme "Development and Technological Transformation: The Management of Change".

KEY WORDS: Technological change, economic performance, post-war period, Finland

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TIIVISTELMÄ: Selvityksessä tarkastellaan tärkeimpiä Suomen kansantalouden suhteellisen suotuisaan kehitykseen ja teknologiseen muutokseen vuosina 1950-85 vaikuttaneita tekijöitä. Tätä ajanjaksoa luonnehtivat suuret rakennemuutokset ja nopea tekninen kehitys. Tarkastelun kohteena ovat mm. julkisen sektorin ja yritysten merkitys tässä kehitysprosessissa samoin kuin koulutus, teknologia- ja talouspolitiikka sekä raaka-ainepohjaisten alojen luottamat kerrannaisvaikutukset. Selvitys on laadittu WIDER-instituutin (World Institute for Development Economics Research) tutkimusohjelman "Development and Technological Transformation: The Management of Change" puitteissa.

ASIASANAT: Tekninen kehitys, taloudellinen kehitys, sodanjälkeinen aika, Suomi

I INTRODUCTION

Finland is a small[1)] country located in the northern coniferous forest zone of Europe. As an independent country she is young, but the present people already inhabited the country some two thousand years ago. For about seven centuries, since the 12th century Finland was a province of the Kingdom of Sweden. In 1809, Finland was ceded to Russia, and she became an autonomous grand duchy with her own institutions under the Czar of Russia. In 1917, with the great changes taking place in Russia-Soviet Union Finland declared herself independent.

Finland is a bilingual country, the majority of its present 4.9 million population has Finnish as its mother tongue, which language belongs to the small Finno-Ugric language group. The share of the Swedish speaking minority has dropped from almost 20 % at the beginning of the 17th century to about 6 % today but owing to, e.g., close links with Sweden the significance of the Swedish speaking population has historically been more important than is suggested by its share in the population.

Historically Finland's position has been peripheral by European standards, but its political and economic history has been closely connected to other European countries. Finland has also often been quick at adopting and implementing new cultural and technological impulses. Of course, nowadays Finland in many contexts should be

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1) Small by population but larger by size (338.000 $km^{2)}$).

included in the "semiperiphery" or even in the "centre". For example, in his study on the spread of Western science Basalla (1967) includes the Scandinavian countries among the small circle of Western European nations which provided the home for modern science during the 16th and 17th centuries. The majority of outside cultural impulses to Finland has come from Western European countries, but historically Finland also was an interesting case of an "interface periphery" between Western and Eastern Europe.[1)]

Industrialization of the country had not proceeded very far by the middle of the 19th century. In 1860 only 4 % of the labour force was engaged in industry, mainly in the metal and consumption goods industries.[2)] However, since the middle of the 19th century particularly increasing foreign demand for wood and forest industry products gave the country important growth impulses. Owing to, e.g., a high level of education Finland has historically been able to benefit from and create multiplier and spill-over effects of the raw-material based sectors on other sectors of economy. The historical role of the forest sector is briefly described in this study.

The good growth performance and rapid technological transformation after the Second World War are thus to a large extent due to the social institutions and technology already created before the period investigated in this study.

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1) For the analysis of Finland as an interface periphery between two large centers, Sweden and Russia, see Alapuro (1980).

2) See Heikkinen-Hoffman, Teollisuus ja käsityö, in Ahvenainen-Pihkala-Rasila (1982).

II THE ECONOMIC AND TECHNOLOGICAL SETTING

After the Second World War Finland was still a country where a large part of the population was dependent on agriculture. Owing to the common ownership and employment structure agriculture has traditionally had very close links with silviculture. Finland enjoys the highest amount of forests per capita in Europe. At the beginning of the period covered by this study (1950), the contribution of agriculture and forestry to GDP was about a quarter, but their share in the labour force was close to 50 % (see Fig. 1 and tables in the appendix).[1] Since that time the share of primary production has rapidly declined and particularly the share of service industries has increased.[2]

After the 1939-44 wars Finland was faced with the problem of resettling about 11 % of her population coming from the territory lost in the war. According to burdens imposed by the peace treaty she also had to pay war reparations, which in the years 1945-51 annually came up to about 2-6 % of the GDP and about 7-16 % of total state expenditure which in comparison with many other cases of war reparations are very high figures.[3] Shortages of practically all commodities including food had already during the war led to numerous regulations and rationing schemes which were finally lifted in the early fifties. The Finnish markka became convertible only in 1957.[4]

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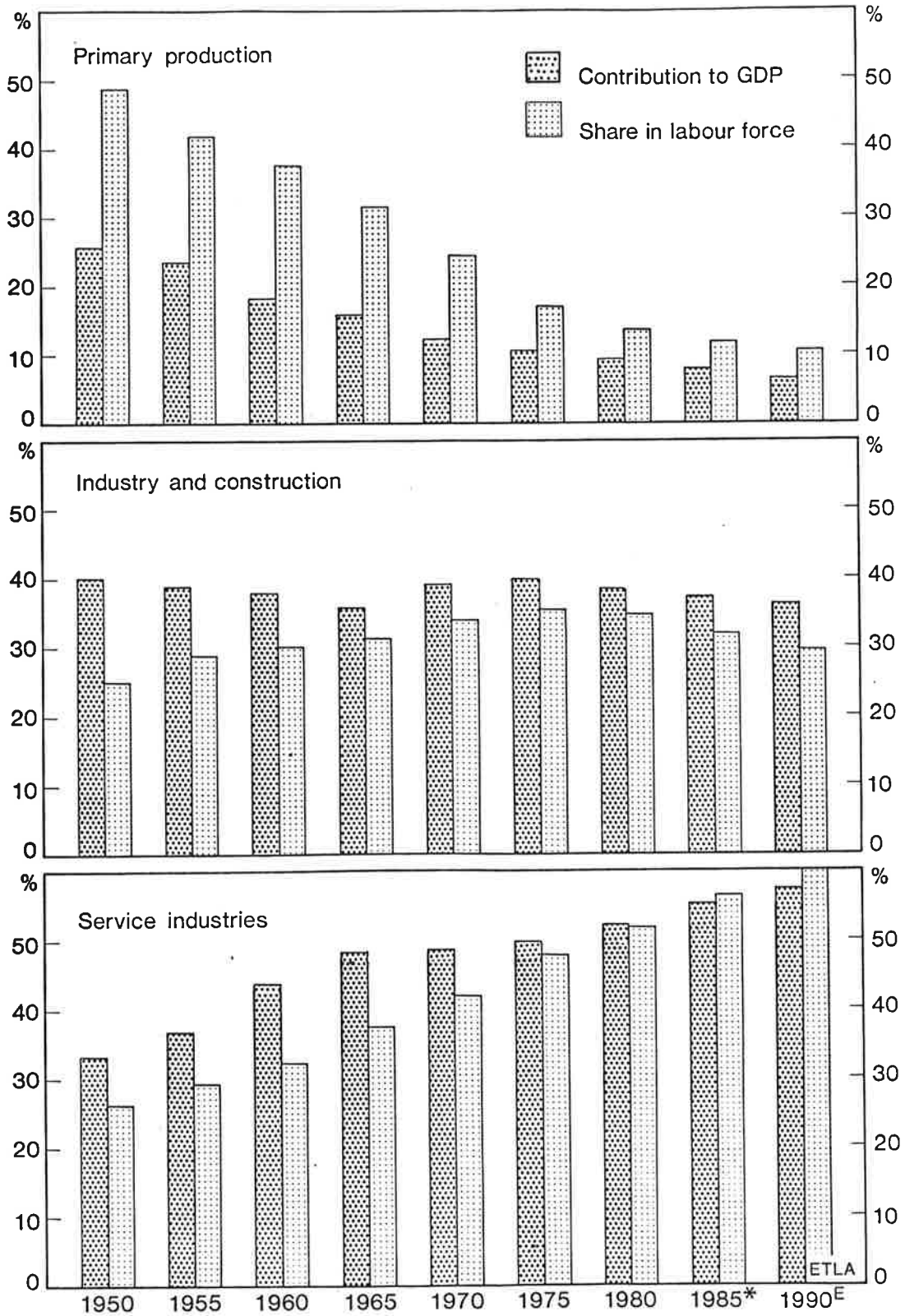
1) We have included in the Appendix all the tables suggested by WIDER in the outline for country studies.

2) Though the share of agriculture has declined, the level of output has exceeded domestic needs. Thus Finnish agricultural policies have had to cope with excess production and related subsidy problems typical in industrialized Western European countries.

3) See Suviranta in Jutikkala (1967).

4) It may be interesting to note that this was accompanied by large tariff reductions and a large devaluation.

Fig. 1. Contribution to value of GDP by, and share in labour force of, primary production, industry and construction, and service industries.



Particular difficulties were created by the fact that three quarters of the war reparations - which were to a large extent reparations out of current production - consisted of machinery and equipment, vessels and cables and only one quarter consisted of traditional forest industry products.[1] On the other hand, this directed more resources to the metal industry than would otherwise have been the case, which enhanced the structural change in industry.[2] The effects of the war reparations on Finland's growth and the role of intangible factors, such as national will to do so, in successful fulfilling of her obligations have recently been discussed by Kindleberger (1986) in a paper to WIDER.

Due to the continuity of the pre-war institutions and accumulated physical and human capital the country had, after all, a relatively good starting point compared with many other European countries. Foreign trade developed particularly favourably because the demand for timber and paper in the main export markets grew rapidly during the reconstruction period in Europe. In GDP per capita terms Finland had even been above the average European levels already before the war, and the pre-war output level of 1938 was reached in 1946.

After the Second World War many countries, including Finland, experienced a baby boom, which has had and will have strong effects on the age structure of the country. The large age cohorts of the late 1940's were, however, an exception in the decline of birth rates which

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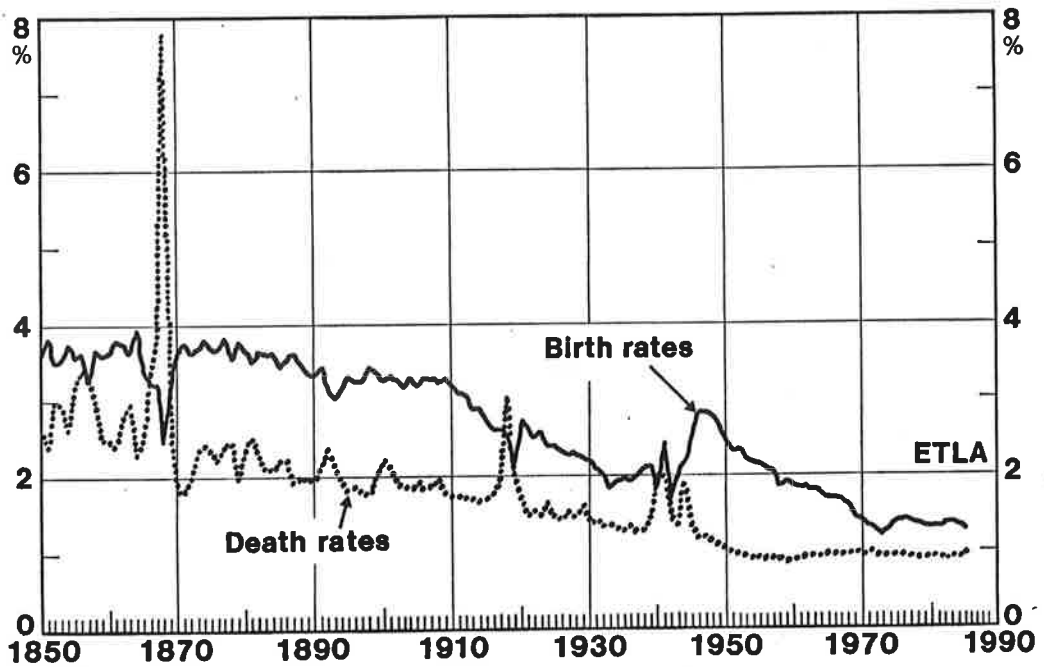
1) See Pihkala, Sopeutuminen rauhaan in Ahvenainen et al. (1982).

2) The share of the metal and engineering industry in total exports increased from 4 % in 1950 to 29 % in 1985, while the share of investment goods in total imports decreased somewhat between 1960 and 1985. The share of domestic investment goods in total domestic use of investment goods has remained fairly stable, at nearly 60 %, and thus the increase in domestic investment goods production has mainly been based on exports (see Appendix Tables 8 and 9).

Fig. 2. Development of birth and death rates in Finland.



Sources: Vattula (1983) and Statistical Yearbooks of Finland.

had already started in the middle of the 19th century (see Fig. 2). Reasons for the trendwise decline in the number of children per family are related to the structural and value changes in society, development of contraception techniques, an increase in the share of urban population[1)] and an increase in the participation rates of women in the labour market and in education. The participation rates of women in the labour market have traditionally been high (see Fig. 3), and even generally the role of women in Finnish society has been important. One example of this is that, when Finland in 1906 adopted universal suffrage, she was the first European country to give also women the right to vote.[2)]

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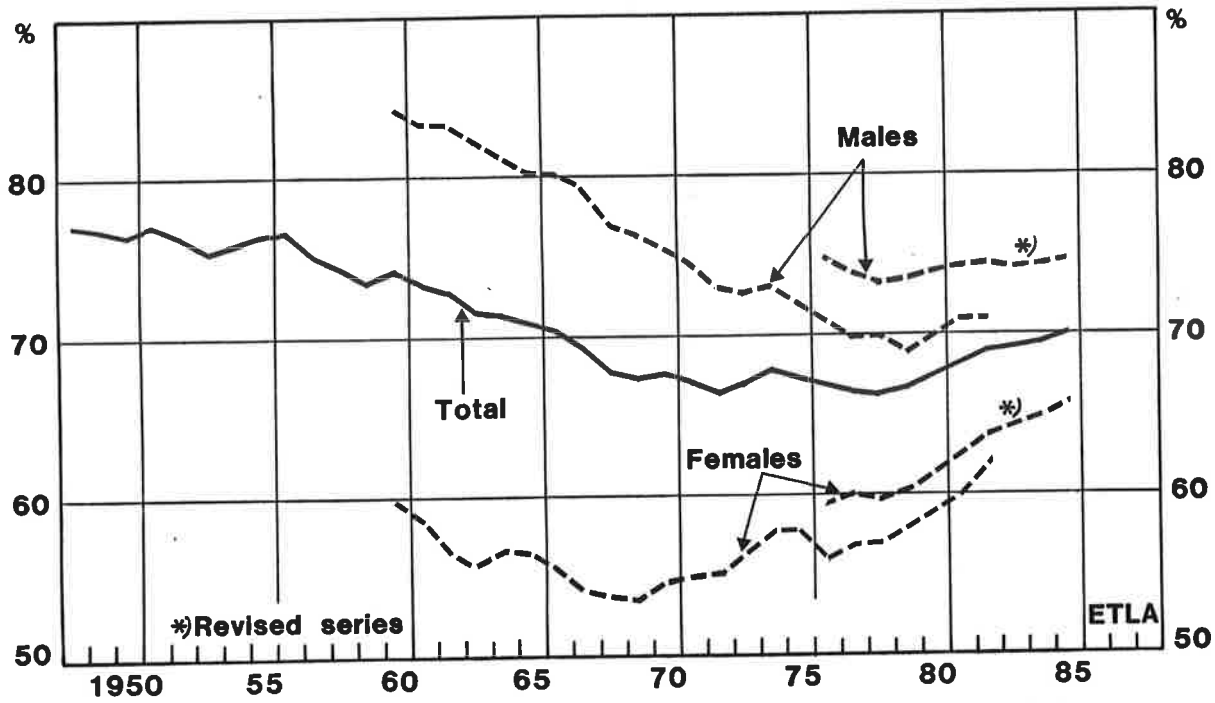
1) The urbanization process occurred relatively late in Finland. The actual figures of course depend on the definitions, but according to the classification adopted in the Statistical Yearbooks of Finland, the share of urban population in the total was still only 16 per cent in 1920, and did not reach 50 per cent until the end of the 1960's.

2) On the role of women in Finnish society see Unfinished Democracy (1985), and for related statistics, Position of Women (1980).

Fig. 3. Labour force participation rates, 1948-85, %.



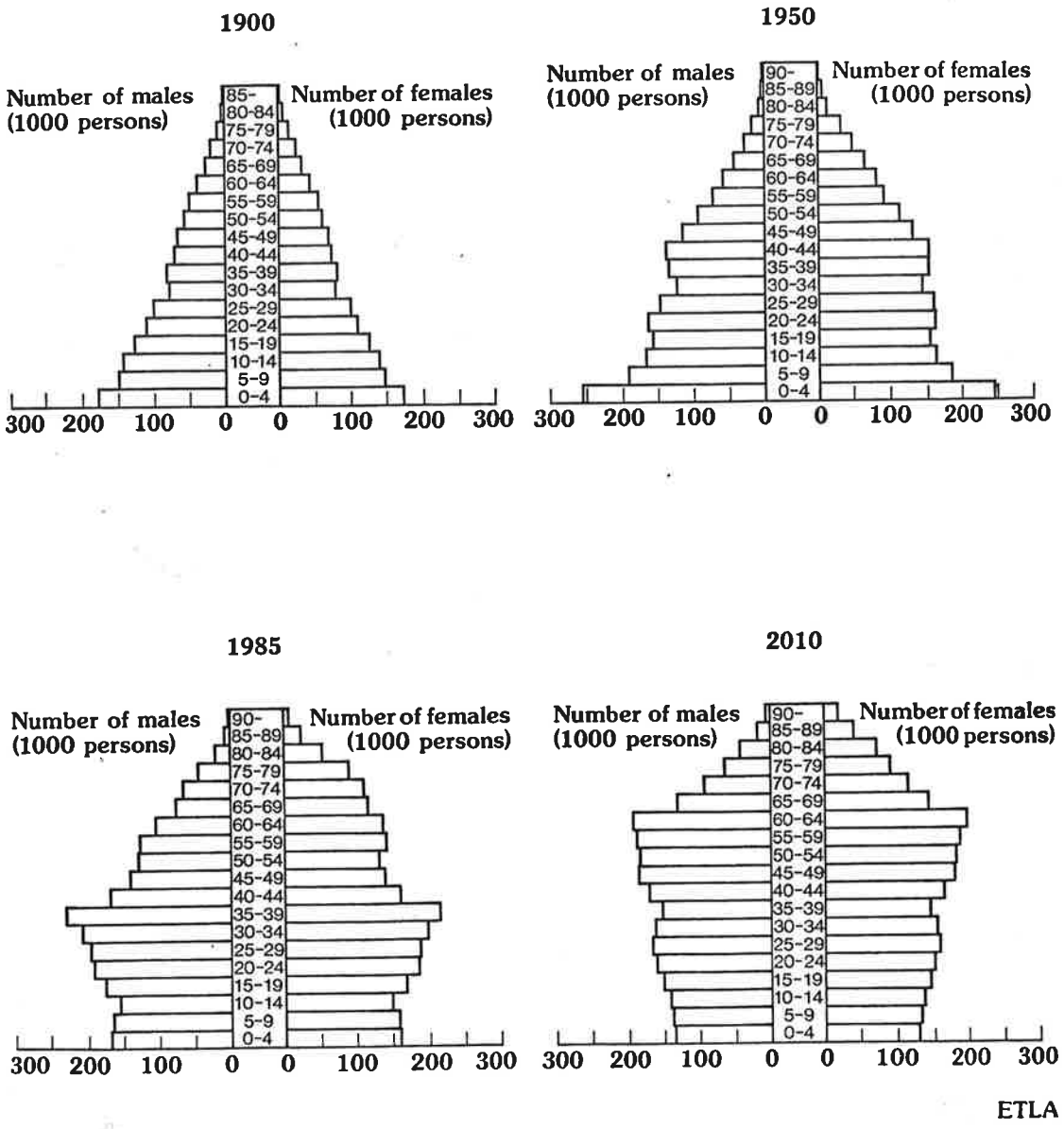
Sources: Ingberg and Lahdenperä (1985), Labour force surveys; Research Institute of the Finnish Economy.

Owing to the post-war baby boom the share of the working age population in the total population has been high since the end of the 1960's. Assuming the present fertility rates, a radical change is expected in 2010-2015 when large cohorts will enter the pensionable age (see Figure 4).

The long-term increase in the standard of living has been reflected in the consumption patterns of the households and in the reduction of working hours (see Figures 5 and 6).

Finnish financial institutions had a strong impulse in 1860 when Finland (during the autonomy period) got its own currency. National financial institutions were developed during the latter half of the 19th century and the early decades of the 20th century. At the beginning of the

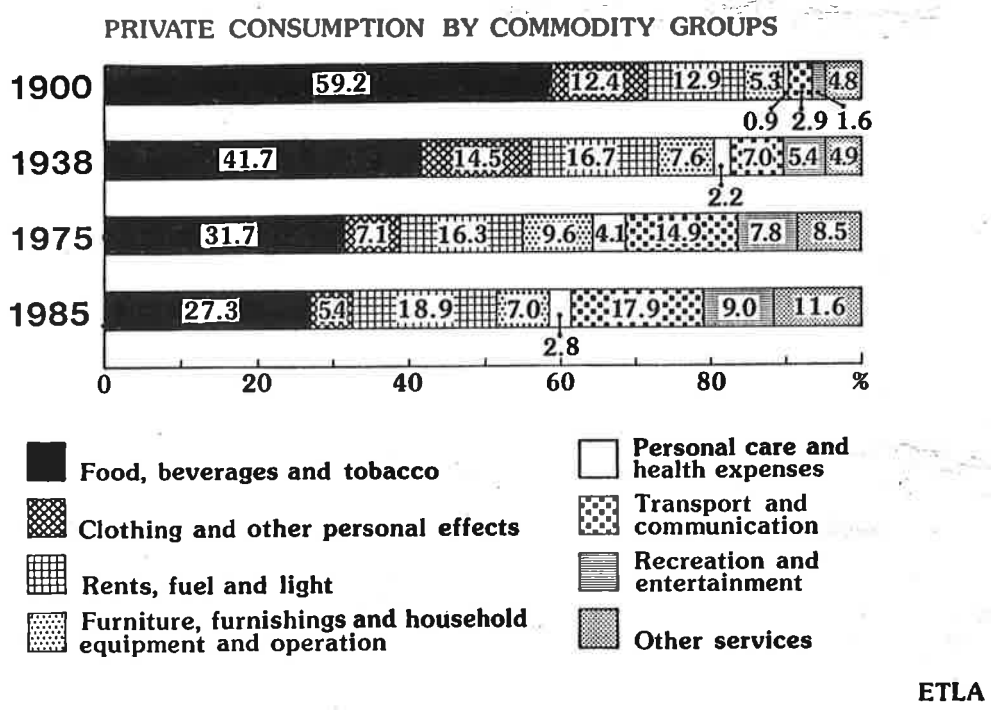
Fig. 4. Age pyramids for Finland in 1900, 1950, 1985 and 2010.



Sources: Hyppölä (1949), Statistical Yearbook of Finland, 1954, Kunnittainen väestöennuste 1984-2010.

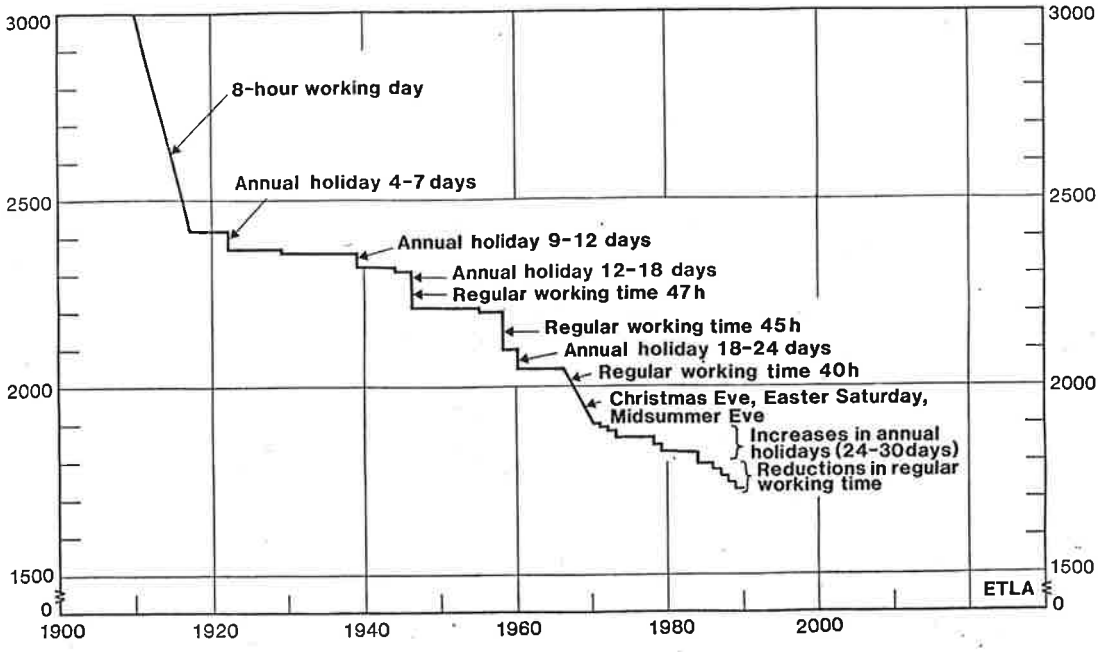
period covered in this study (1950) financial institutions had been developed to correspond more or less to the average level in industrialized countries. However, Finnish banks were not at that time actively engaged in truly international banking business, rather they served domestic firms with their foreign operations.

Fig. 5. Private consumption by commodity groups.



Sources: Laurila (1985) and National Accounts (1985).
Note. The figures for the earlier years are based on the old National Accounts and are thus not fully comparable to those for 1985.

Fig. 6. Annual working time in industry and measures affecting working time.

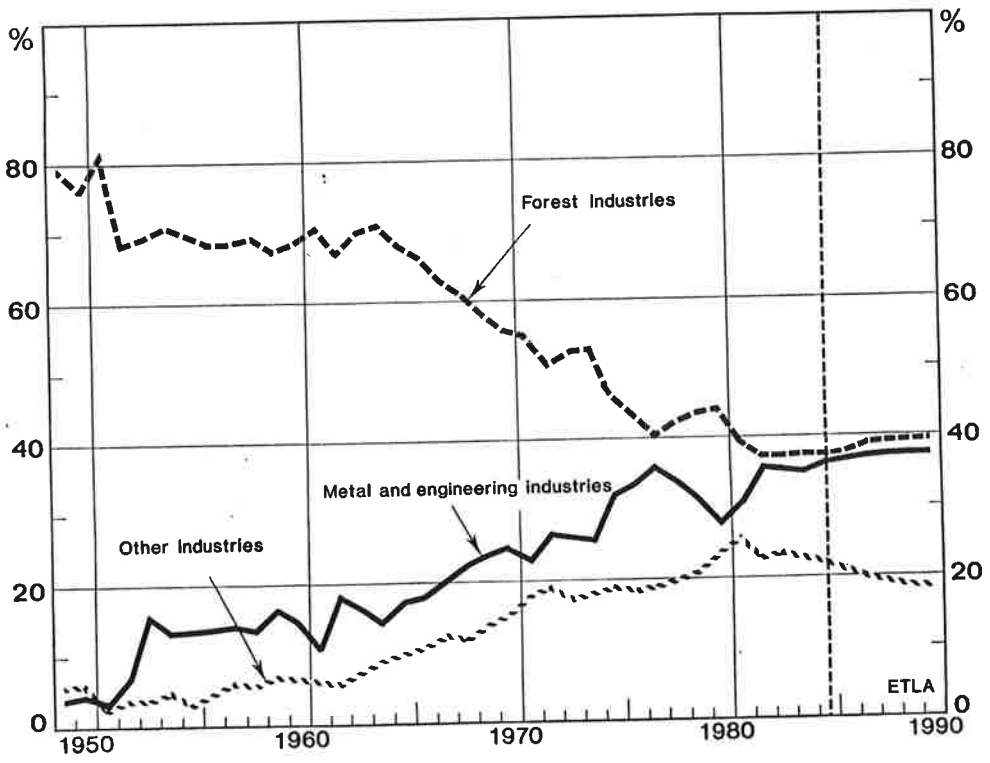


Source: Finnish Employers' Confederation.

III GROWTH AND STRUCTURAL CHANGES IN THE ECONOMY[1)]

One important feature about post-war economic developments in Finland has been the increasing openness of the economy.[2)] This has meant a growing participation in international trade and a greater opportunity to benefit from expanding world markets. From the standpoint of a small economy it is important to stress the dynamic aspects of participating in the international division of labour. Trade and international contacts have not only made imports of foreign goods possible, but also allowed the Finns to follow technological and scientific developments in other countries more generally.

Fig. 7. Commodity exports by industries, 1949-90. Per cent of total commodity exports.



1) Part of this section is based on DØR-ETLA-IFF-IUI-IØI (1984), and Vartia (1984).

2) Trade policies are summarized in section V 5.1.

The share of exports in GDP increased from 15-20 per cent[1] at the beginning of the 1950's to approximately one third in the early 1980's. The share of exports in industrial production has grown to about 40 per cent. At the same time, the composition of exports has rapidly changed, although the share of various forest products in total exports is still very large, almost 40 per cent (see Figure 7). The most important new branches, where particular expertise has been developed, are perhaps forest industry equipment, metallurgy and mining machinery, shipbuilding, and fashion clothing and textiles. In addition, the construction industry and consulting firms have made an important contribution to a notable increase in service exports.

The volume of Finnish commodity exports has grown in the post-war period by about 6.5 per cent p.a. on average and industrial production by approximately 5.2 per cent, or clearly faster than the total GDP. The increase in the share of manufacturing in total production - contrary to most other OECD countries - continued still in the late 1960's and early 1970's (Figure 8).

Important supply-side factors contributing to the extensive post-war export-led growth of industrial production have included a well educated labour force, the rather favourable cost structure of many industries and the gradually shrinking technology gap between Finland and its foreign competitors. The importance of these factors is, however, diminishing quite rapidly, and many manufacturing firms are facing the requirement of renewing their strategies under conditions

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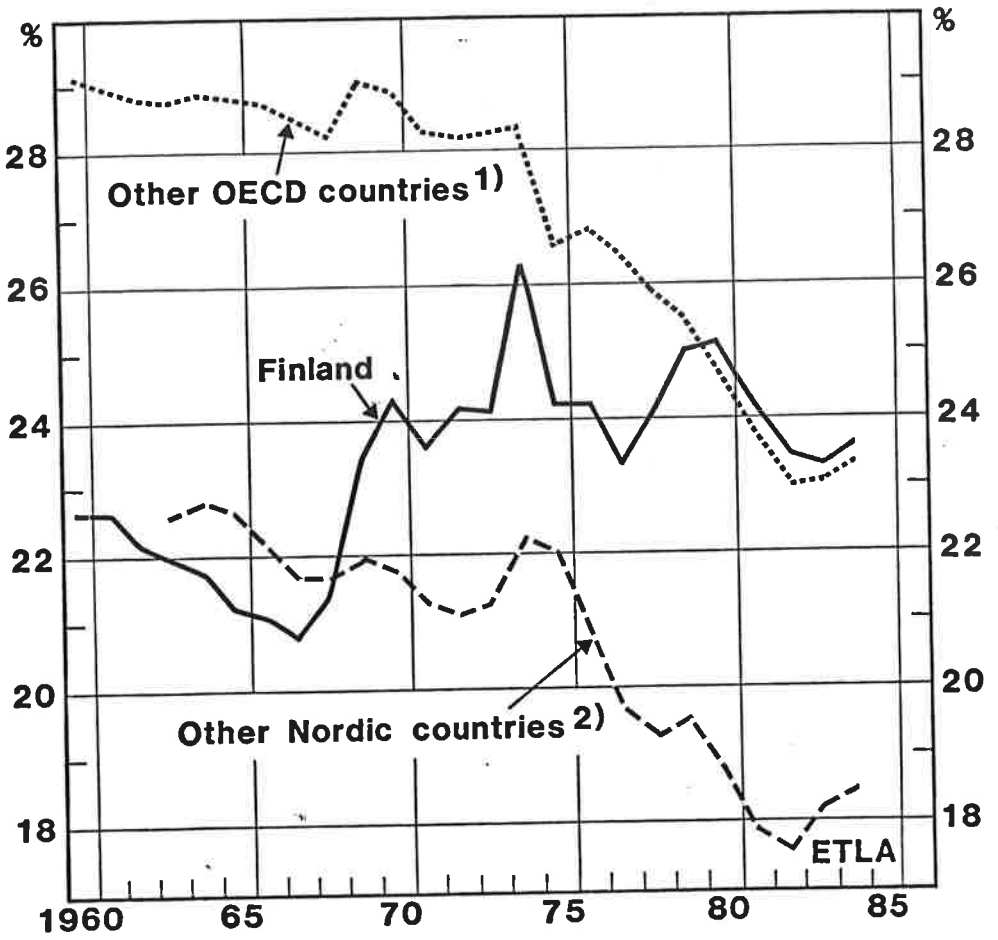
1) Somewhat higher levels had been reached already in the inter-war period.

Fig. 8. Share of manufacturing in GDP, 1960-84, per cent.



1) Average of Austria, Australia, Belgium, Canada, France, Germany, Greece, Italy, Japan, Netherlands, Portugal, Spain, Turkey, United Kingdom and United States.
2) Average of Denmark, Norway and Sweden.

where non-price factors are becoming increasingly significant in maintaining competitive positions. Low labour costs do not offer relative advantages to the Finnish producers any more. The Finnish GDP per capita in 1985 was about 11000 dollars, compared with the average of 10700 dollars for the OECD countries and the average of 7600 dollars for the EEC countries.

1. Sectoral growth patterns

In the period 1950-70 GDP growth was about 4.9 % per year on average, whereas it slowed down to about 3.3 % in the following 15-year period.[1)] In the 1950's there was a rapid expansion of both manufacturing industry and private services: both grew at an average annual rate of almost 6 per cent. These trends continued in the 1960's, when the growth rate in manufacturing reached almost 7 per cent and that in the private service sector slowed down only slightly. At the same time the growth rate of construction activities, which in the post-war period was rather high because of simultaneous needs for industrial buildings, housing and infrastructure, slowed down.

In the period 1950-70 the fastest-growing manufacturing industries were the chemical industries and the basic metal industry - which also have shown the fastest growth of productivity in the post-war period -, and above-average growth was also experienced in the paper and printing industry and the metal products industry. Relatively rapid output growth continued in the 1970's in the metal and engineering industries as well as in the chemical industries. In contrast, the share of consumer goods industries such as the food manufacturing and textile and wearing apparel industries in total manufacturing output has declined considerably in the post-war period.

These rather favourable average growth figures of course overlook the fact that there have been substantial fluctuations in the output development of some sectors. Thus there have been periods of severe problems

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1) For details of the growth figures see tables in the Appendix.

related to e.g. employment and the profitability of firms. Changes in the structure of production, while necessary in the longer term, have caused much frustration both for individuals and firms.

2. Internationalization of firms

During the independence period there have been very few important foreign firms in Finland and also the operations of Finnish firms abroad have been limited to conducting of foreign trade. The internationalization of Finnish companies thus started late compared with other western industrialized countries. Before the 1970's it was relatively rare for these companies to establish foreign production units. Instead, it was typical especially in the forest industries that the firms had common export organizations which were totally in Finnish hands. In the 1980's the direct foreign investments of Finnish firms have grown very fast, and the number of Finnish companies abroad is now about three times their number ten years ago (see Fig. 9). Nevertheless, the Finnish firms are still less internationally oriented than firms e.g. in Sweden.[1)]

About one quarter of total Finnish exports are executed via foreign subsidiaries, and this share is even bigger for exports to e.g. the United Kingdom, the Federal Republic of Germany and the United States. The international operations are very much concentrated in the large firms, and in 1984 some 50 per cent of the turnover of 70 Finnish-owned foreign subsidiaries was produced in the ones owned by the 10 biggest Finnish manufacturing companies. In turnover terms about one

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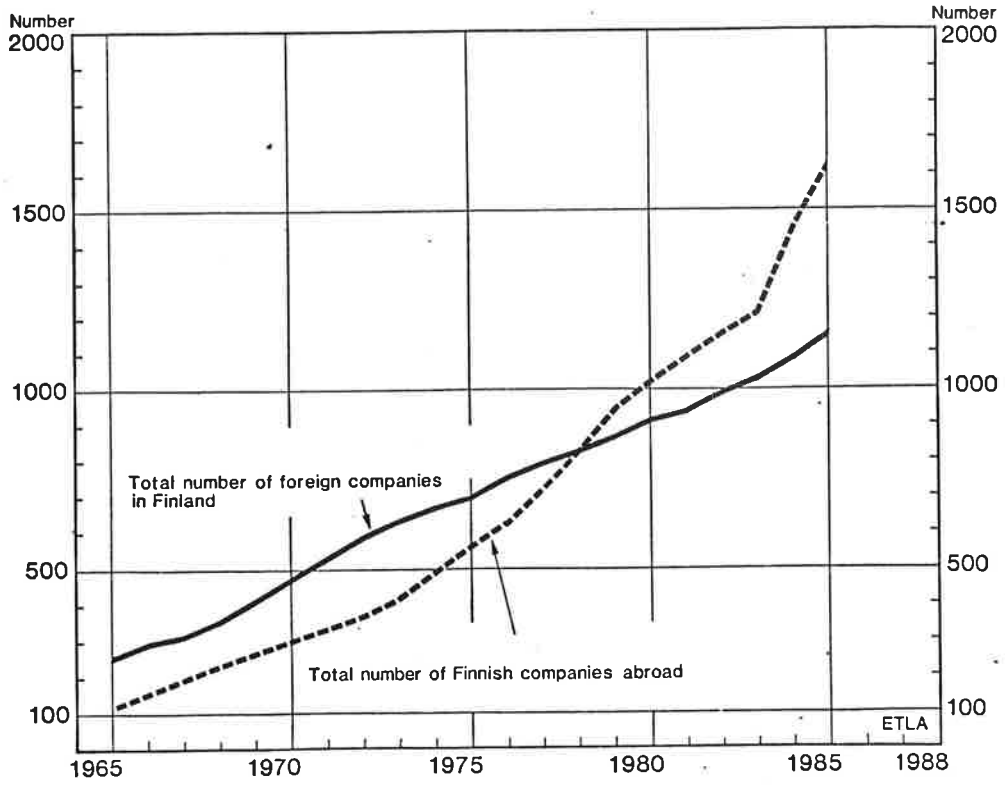
1) See Oxelheim, L., The Largest Nordic Manufacturing Companies, in DØR-ETLA-IFF-IUI-IØI (1984).

Fig. 9. Total number of Finnish companies abroad and foreign companies in Finland.



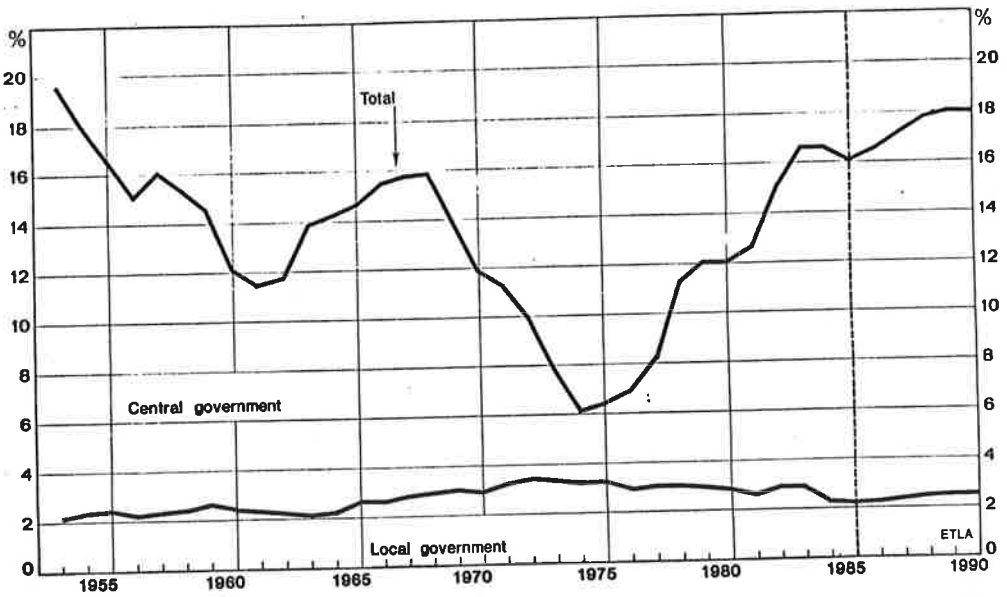
quarter of the foreign subsidiaries were in Sweden. Intra-Nordic trade as well as locating production and marketing units in the other Nordic countries have long traditions. This is facilitated i.a. by a common labour market in these countries. In recent years many acqusitions of companies in the same product line in other Nordic countries have taken place in each country, which has made possible the rationalization of production and marketing activities. With small domestic markets and tightening international competition the idea of Nordic countries as a "home market" has become increasingly important.

3. Adjustment to oil crisis

Following the mid-1970's Finland was affected by an exceptionally deep recession (four years of very low growth). In fact, the growth rates

in Finland in the middle of the 1970's were lower than in other industrialized countries for several years. During this period the unemployment rates rose rapidly, but on the other hand, foreign trade was brought into balance, the inflation rate decreased, and the competitive position of the country was improved by devaluing the Finnish markka. Faster growth rates in recent years can partly be explained by the extra room for more expansionary policies created during these years of stagnation. The subsequent recovery, which had partly been brought about through economic policy, was even faster than expected.

Fig. 10. Public debt, % of GDP.



The experiences of the mid-1970's in Finland concretely showed that it is very difficult for a small open economy to maintain economic activity at a higher level than in other countries and balanced foreign trade simultaneously unless the country is able, at the same time, to raise export production and the production that competes with foreign imports significantly, i.e., production in the open sector of

the economy. One central objective of the policy was thus to create conditions favourable for the expansion of the open sector of the economy. This policy line included several measures intended to increase the profitability of firms, by e.g., reductions in indirect labour costs, and it led to a rapid increase in the public debt, which, however, is still low by international standards (see Fig. 10). After the 1975-77 recession the growth of total output in Finland has largely been based on the increase in industrial output. This, in turn, has offered a possibility of increasing domestic demand and production in the sheltered sectors. This is also partly why no truly bad imbalance has developed in Finnish foreign trade. The external balance of the economy has improved structurally in recent years, e.g., since savings have been achieved in the use of imported inputs, such as energy.

Fig. 11. Finnish foreign trade by countries, 1960-86. Per cent of total exports and imports.

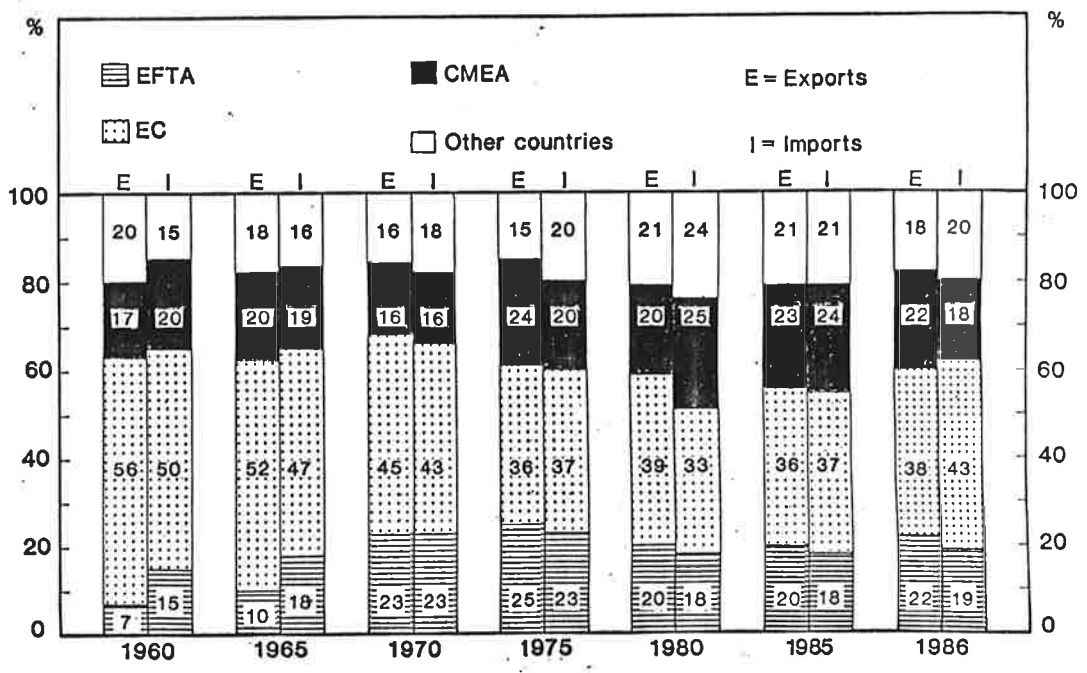
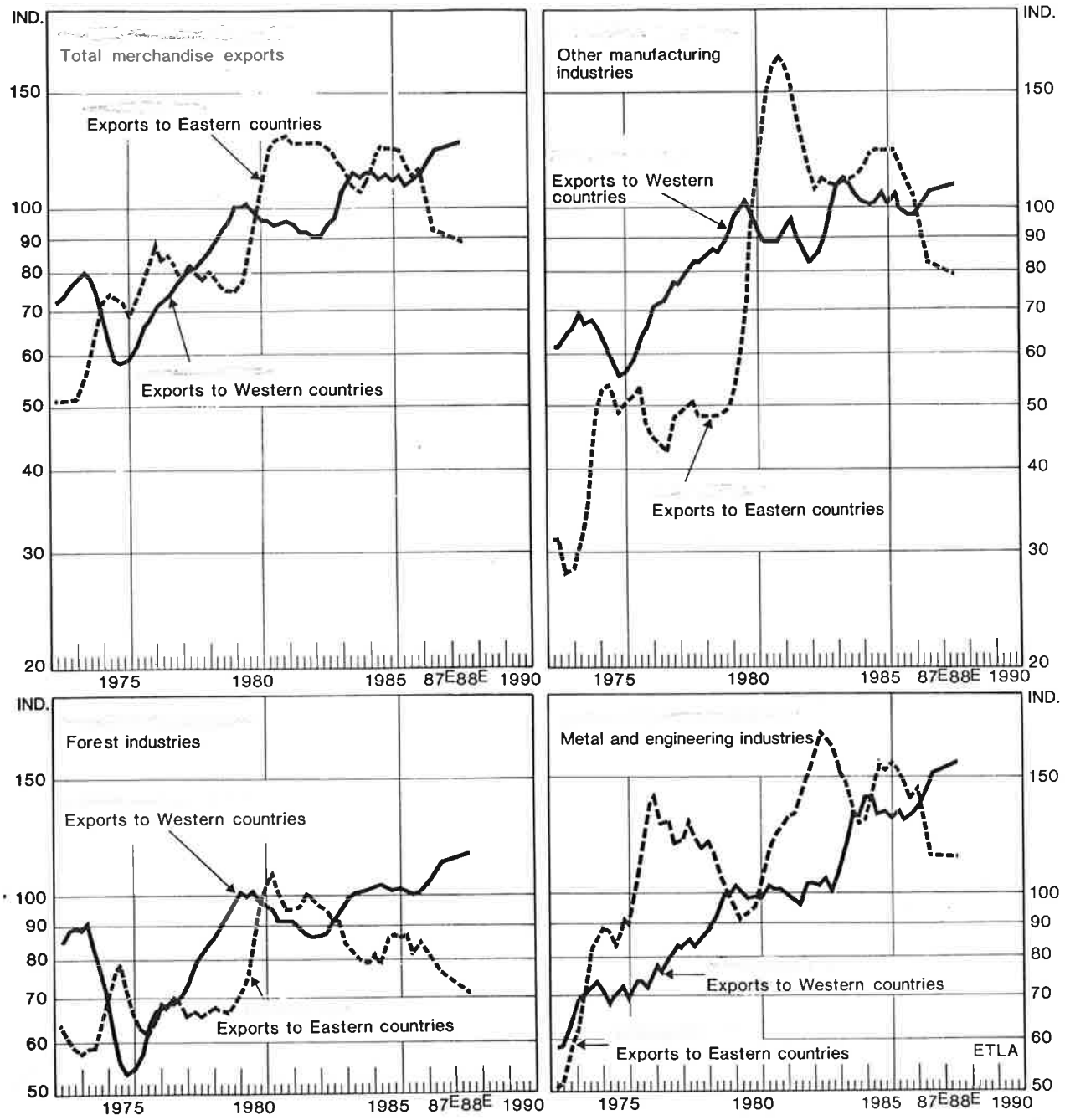


Fig. 12. Volume of merchandise exports to Western and Eastern countries (1980=100)[1)]



1) Four-quarter moving averages.

In addition to economic policy actions, one factor that has had a bearing on the growth of industrial output since 1974 has been trade with the Soviet Union. Finland imports most of her crude oil requirements from the Soviet Union. Increases in oil prices have been followed by growing exports to the eastern market, due to the bilateral nature of the trade (see Fig. 12), and the share of the Soviet Union in Finland's exports has grown since the mid-1970's. Otherwise, regional shifts in world trade have not affected Finnish exports significantly in the post-1973-74 period (see Figure 11). In the coming years, with lower oil prices, the share of socialist countries in foreign trade will decline.[1)]

Finland has not, at least so far, experienced a structural crisis similar to that experienced in many other Western European countries. The policy line adopted after the mid-1970's also meant a shift of emphasis from short-term stabilization towards a longer term structural policy. In order to maintain international competitiveness a more flexible exchange rate policy and a policy of fostering structural change through various measures have been adopted. The process of structural change has also continued in Finland in recent years, though no longer in the form of great shifts between sectors, as in the 1960's and in the early 1970's. The changes that have occurred have taken place more within than between the various industries.

4. Recent developments in the financial markets

For most of the post-war period, growth-oriented economic policies saw as the main role of the banks to provide cheap funds for industrial

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1) See Alho et al. (1986).

investments. This was supported by interest rate ceilings on the average lending rates of the banks. The difference between Finnish and foreign interest rates was made possible by control of capital flows by the central bank. Stock markets have until today remained very thin because of, i.a., tax reasons.

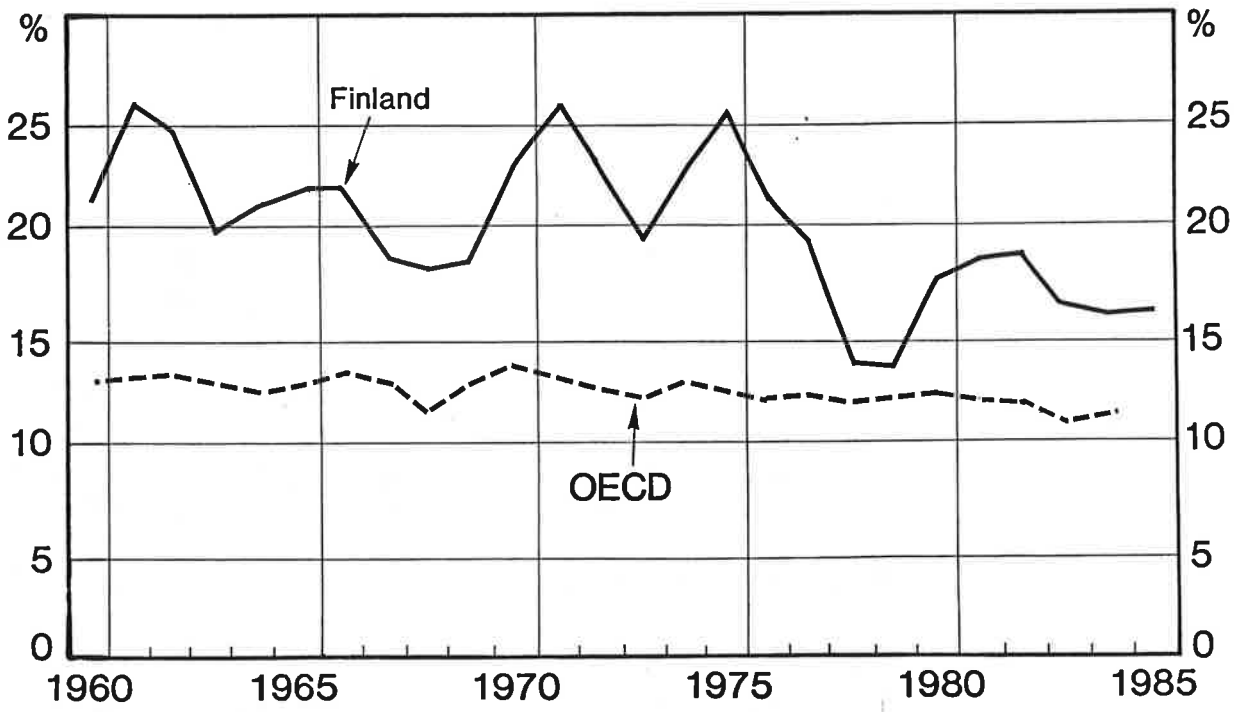
In the 1970's and 1980's a rapid internationalization of Finnish banks, insurance companies and other financial institutions took place. This has happened especially in recent years. The credit-rationing financial system, which together with bank dominance has characterized the Finnish economy is losing its importance, and the role of interest rates in clearing the financial market has become significant. In the last few years the main changes have occurred in the short-term money market, and activities in this area will be further extended and developed in the near future. Also the equity and bond markets are experiencing increasing pressures towards change, since i.a. the rise in real interest rates and changes in the structure of investments increase the demand for risk capital by firms. Because of stronger international integration capital movements and the level of domestic interest rates are more dependent on international developments than before.

IV DEVELOPMENT IN TECHNOLOGY-EMBODYING INPUTS

1. Input growth and productivity

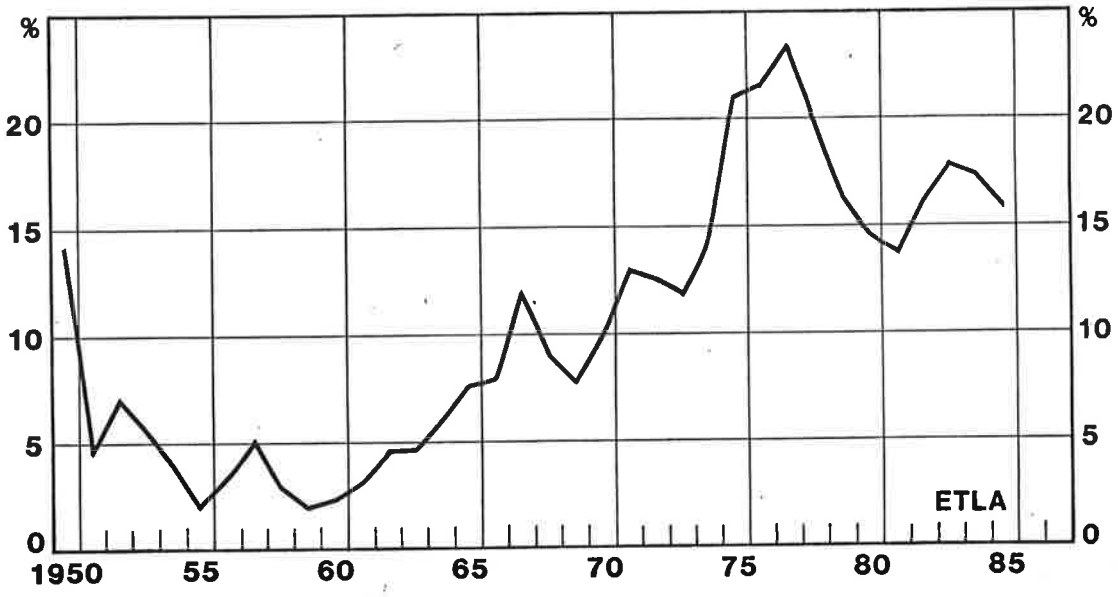
Part of the rapid growth during the post-war period can be explained by a high investment ratio and accumulation of the physical capital stock. Particularly industrial investments have been on a higher level than in the OECD-countries on average (see Fig. 13). Part of the investment has also been financed by borrowing from abroad. This happend particularly in the 1960's and the early 1970's (see Fig. 14 for the foreign debt of Finland). The growth strategy based partly on foreign borrowing was generally accepted in the 1950's and 1960's but when foreign debt in relation to GDP rose over 20 % in the 1970's, this policy line was changed.[1)]

Fig. 13. Investment ratio in manufacturing in Finland and in the OECD.



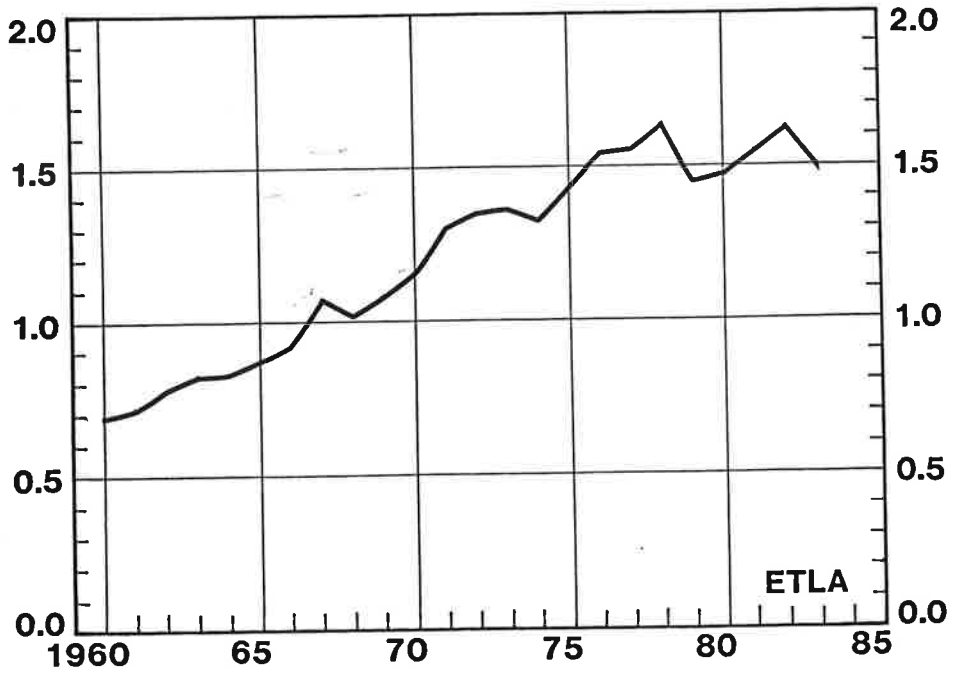
1) For an analysis of problems related to foreign borrowing see Tanskanen (1976).

Fig. 14. Net foreign debt in relation to GDP.



Owing to the lower real interest rates and thin stock markets, Finnish firms have traditionally financed a large proportion of their investments by bank loans (see Fig. 15).

Fig. 15. The ratio of debt to own capital in Finnish manufacturing.



In Table 1 an effort has been made to estimate the contribution of the increase in capital and labour inputs to growth. Labour input has been measured as hours worked and capital as the volume of net capital stock. It is seen that an increase in labour input contributes very little to growth, while capital input has been much more important. A large part of the increase in output is explained by the change in total factor productivity.[1] This residual reflects the effects of changing quality of inputs (e.g. education and motivation)[2], technical change, economies of scale, reallocation of resources, better organizational skills and social innovations, etc., which make it possible to produce more with the "same input basket". The apparent growth in the ratio of output to labour input, i.e. labour productivity, has been to a large extent due to both the increase in capital intensity and total factor productivity.[3]

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1) The usual definition of total factor productivity is $r = y - \Sigma w_i x_i$ where r = relative change in total factor productivity, y = relative change in output, x_i = relative change in input i and w_i = value share of input i ($\Sigma w_i = 1$). Regardless of their apparent simplicity, these formulas pose several problems, e.g. as to how aggregate labour and capital inputs should be measured during structural changes. It is particularly difficult to measure changes in the capital stock in the 1970's since part of the stock may have become obsolete due to considerable changes in relative prices. If this has happened to a larger extent than assumed, variations in capital stock might, after all, explain a larger than estimated part of the observed deceleration in recent productivity growth. Many index number problems, the questions of how the weights w_i should be determined, how intermediate inputs should be taken into account and what conditions the production functions have to satisfy in order to make the definition of total factor productivity sensible, are not satisfactorily solved either. See, e.g., Kendrick & Vaccara (1980), Karko (1986) and Wyatt (1983).

2) Questions related to the quality of labour input and education are presented in chapter V on managing the dynamics of technological transformation.

3) In the case of two inputs, labour L and capital K, we have $y = w_L \ell + w_K k + r$, where ℓ and k are relative changes in labour and capital inputs, respectively. The change in labour productivity $p = y - \ell$ can now be expressed as $p = y - \ell = w_K k + (w_L - 1)\ell + r = w_K(k - \ell) + r$.

Table 1. Growth of manufacturing output in Finland and contributions of labour and capital input and total factor productivity (TFP), average annual changes

Industry	Output growth	Contribution of labour	Contribution of capital	Contribution of TFP
Food manufacturing				
1961-74	4.7	0.5	2.2	2.1
1975-85	2.3	-0.7	0.9	2.0
Textile, wearing apparel and leather industries				
1961-74	3.9	-0.8	1.1	3.6
1975-85	0.9	-2.5	0.3	3.2
Wood industry				
1961-74	3.0	-0.7	1.7	2.1
1975-85	0.6	-2.4	0.3	2.7
Pulp and paper industry				
1961-74	6.5	0.7	2.0	3.8
1975-85	1.9	-1.8	0.8	2.8
Chemical industries				
1961-74	11.4	2.0	5.5	3.9
1975-85	3.1	-0.2	1.1	2.2
Basic metal industries				
1961-74	9.4	2.2	3.7	3.6
1975-85	6.0	-0.5	0.6	5.9
Machinery and engineering				
1961-74	6.9	1.6	1.6	3.8
1975-85	4.7	0.1	1.1	3.5
Total manufacturing				
1961-74	6.2	0.7	2.2	3.3
1975-85	3.0	-0.7	0.9	2.9

As a whole, in the late 1970's Finnish manufacturing industry reached a phase of more pronounced productivity-based intensive growth, where growth has been very little affected by an increasing labour and a fixed capital input. Instead, growth of industrial output has been almost exclusively based on growth in total factor productivity (TFP), which has been faster than in Finland's most important competitor countries. In 1961-74 the growth contribution of total factor productivity was about 50 per cent, whereas in 1975-85 it was about 97 per cent on average.

2. Rapid increase in R & D expenditure

With the accumulation of technological capacity and the shrinking "technology gap" between Finland and the countries of the "technological frontier", it has become evident that more resources to indigenous development of technology are needed. However, for a small industrialized country the diffusion of technology from abroad will always be extremely significant. Even if it were on the frontier with some products, developments in the related fields require constant follow-up.

R & D expenditures have increased rapidly in Finland since the beginning of the 1970s at the same time as traditional fixed investment has decreased or increased only slowly. A marked change in the investment structure has thus taken place during the past ten years in favour of R & D investment. Unfortunately there are no reliable figures for R & D investments in the 1950's and 1960's. Several studies of the Research Institute of the Finnish Economy have tried to investigate the relationship between productivity developments and R & D expenditure.[1] Tentative results suggest that the return on R & D investments has been high.

As can be seen from Figure 16, the volume of industrial R & D investment has undergone an about 2.5-fold increase since the mid-1970s whereas fixed investment has remained at more or less the 1975 level. The growth in R & D expenditure has been substantial in all the main manufacturing industries, except the forest industry (Table 2). It

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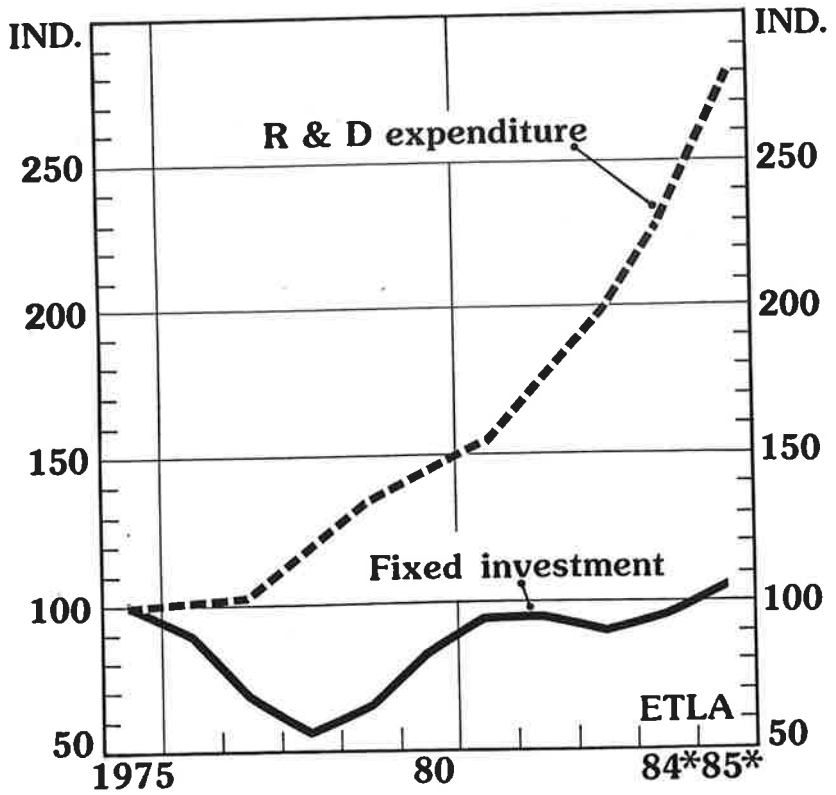
1) The effects of R & D on productivity are discussed e.g. in Wyatt (1983), Vuori (1986), and Ylä-Anttila (1986).

Fig. 16. Volume of R & D expenditure and fixed investment in manufacturing (1975=100).



should be noted that the metal and engineering industry accounts for almost two thirds of industrial R & D investment compared with about 30 per cent of total industrial fixed investment. The R & D expenditure of industrial companies in 1985 corresponded to around 20 per cent of fixed investment. Also other forms of intangible investments, i.e. education of employees and long-run marketing expenditures, are becoming increasingly important. E.g. for the ten largest manufacturing companies these investments amounted in 1984 to about one third of their research expenditures. Some large firms spend on intangible investments more than half of the amount that is spent on fixed investment and acquisitions of firms.

Table 2. Industrial fixed investment and R & D expenditure by industries

	Fixed investment		R & D expenditure	
	Share in total manu-facturing % 1985	Average annual change in volume, % 1975-85	Share in total manu-facturing % 1985	Average annual change in volume, % 1975-85
Food industry	9.2	0.3	5.0	10.7
Textile, clothing and leather industries	2.5	-3.8	0.7	6.8
Forest industry	32.8	1.1	8.5	2.6
Chemical industry	12.8	0.0	20.4	9.7
Metal and engineering industry	29.2	-2.3	61.7	9.5
Other industry	13.5	7.1	3.8	13.7
Total	100	0.1	100	9.8

Sources: National accounts and Research statistics.

3. Foreign trade of high-tech products

Although research expenditure increased more rapidly in Finland in the 1970's than in most other industrial countries, it is still low by international standards.[1)]

The extent and development of high-tech exports, and the foreign trade balance for these products are frequently considered indicators of a country's technological development. In Finland high-tech exports have over the past ten years grown distinctly more rapidly than in the OECD countries on average. However, high-tech exports still correspond to only

1) In 1983 research expenditure in relation to GDP was 1.3 % in Finland, 2.7 per cent in the United States, 2.6 per cent in the Federal Republic of Germany and Japan, and 2.5 per cent in Sweden.

Table 4. Production, foreign trade and markets of major high-tech product groups in Finland in 1982, million FIM (estimate).

	Production (1)	Exports (2)	Import (3)	Market (4)
Electronic telecommunication equipment	955	481	511	985
Industrial automation and metering equipment	790	313	431	908
Electronic medical instruments	277	252	72	97
Automatic data processing equipment	250	177	1092	1165
Electronic microcircuits	25	13	121	133
Industrial robots	50	30	50	70
Numerically controlled machine-tools	25	20	220	225
Space technology	1	0	1	2
Fiber optics and optoelectronics	4	-	4	8
Total	2377	1286	2502	3593

Source: Luukkanen (1984).

half of the corresponding imports, in other words foreign trade in high-tech products is clearly in deficit. In 1973 the export-import ratio was as low as 0.2.[1)]

The definition of high-tech products has always been somewhat arbitrary and various classifications may give very different pictures of these products' foreign trade. The figures given in this section are based on OECD's latest classification.[2)] The main classification criterion

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1) In 1983 the export/import ratios for selected other countries were the following: Sweden 1.0, FRG 1.4, U.S. 1.5, Japan 3.5.

2) Vuori and Ylä-Anttila (1985).

here is the research intensity of products: high-tech industries or products are considered to be those where the research input exceeds 4 per cent of turnover.

Finland's high-tech exports in 1983 amounted to 5.2 per cent of total exports on industrial goods as compared with half this figure ten years earlier. The corresponding average shares in the OECD countries were distinctly higher: in 1973 slightly below 14 per cent and in 1983 17.5 per cent.

The major Finnish high-tech product groups are telecommunication equipment, industrial automation and metering equipment and medical instruments, accounting for an 85 per cent of the total high-tech production. The same product groups also dominate Finnish high-tech exports. Because of the small local market, only a few foreign companies are involved in high-tech production or R&D activities in Finland. Thus also a minor share of local production is based on foreign direct participation or licences.[1)]

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1) Luukkanen (1984).

V MANAGING THE DYNAMICS OF TECHNOLOGICAL TRANSFORMATION

1. Role of the public sector and role of firms

While there is wide agreement about the importance of promoting technology, the role of the public sector in this context has mainly been of a general character, so as to create favourable conditions for the industrial firms, where most of the actual decisions related to choice of techniques are made. The public sector has done this e.g. by organizing general education and keeping it at a high level and by taking care of the transport and communication system. In 1807 the length of main roads was about 11 000 km, as compared with 26.000 km in 1900. In the independence period the road network has continued to grow steadily; in 1921 the length of public roads was 48.000 km and in 1985 about 76.000 km. Also the railway network has been extended until quite recently. From a modest start in 1862 (107 km), the length of railway lines developed to consist of 2900 km in 1900, 5000 km in 1950 and 6000 km in 1984. The telephone network had developed in 1935 to a level of 39 telephones per 1000 inhabitants, as compared with 572 telephones in 1983. The latter figure compares well with European standards: in 1983 the corresponding figure was 523 telephones for the United Kingdom, 572 for the Federal Republic of Germany, and 889 for Sweden.[1)]

The infrastructure for energy production has also developed rapidly in the last 50 years. The yearly production of electricity was only about 1 TWh in 1930 and reached about 38 TWh in 1980. Between 1940 and 1980 the share of rural dwellings equipped with electricity increased from

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1) Vattula (1983) and Statistical Yearbooks of Finland.

nearly 50 % to 100 %.[1] Of the general circumstances necessary for a favourable economic performance, the advanced level of social policy and health services should also be mentioned. The social security system includes extensive health and pension insurance schemes.[2] Expenditures for health services have in the post-war period risen faster than for any other major item in government final expenditures (see Table 5).

Table 5. Government final consumption expenditure by purpose, in per cent of GDP.

	1950	1960	1970	1980	1985
Public administration	3.4	3.0	3.8	3.0	3.0
Education	2.9	4.0	4.8	4.9	5.0
Health services	1.7	2.2	3.6	3.9	4.6
Social security and welfare	1.1	1.1	1.3	2.3	3.0
Other	2.5	2.3	2.4	4.1	4.6
Total	11.6	12.6	15.7	18.1	20.2

Sources: Economic surveys of the Ministry of Finance, Statistical Yearbooks of Finland.

In this respect public industrial policies in the 1950's, 1960's and 1970's followed a non-selective market-oriented approach instead of a planning approach. In contrast to e.g. Sweden and Norway it has not either been necessary to resort to extensive subsidizing of firms or industries.[3] Thus the policies have also aimed at choosing the positive approach of supporting and stimulating new activities instead of the subsidy approach.[4]

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1) Vuosisata sähköä Suomessa (1982).

2) An indicator of the high level of health care is the fact that Finland has, together with Iceland, Japan and Sweden the World's lowest infant mortality rate.

3) There are, of course, several systems of financial support for e.g. promoting exports, regional development and R&D, but they are much less significant than in the above-mentioned two countries. For detailed data see Carlsson, B., Industrial Subsidies in the Nordic Countries, in DØR-ETLA-IFF-IUI-IØI.

4) For discussion of various industrial policy options see Eliasson (1983).

The role of state-owned companies has been important in the development of the basic or heavy industries, where the private sector has not been sufficiently involved because of i.a. the magnitude of the required capital inputs and a high degree of risk. These industries include the basic metal industry, the chemical industries, and to some extent the forest industries. Almost all Finnish state-owned companies were originally founded by the state.[1] In 1984 the value added produced by 13 state-owned industrial companies represented some 18 per cent of value added in total industry (including mining and energy production), and their personnel somewhat less than 12 per cent of total industry personnel. These figures reflect the higher than average capital intensity of the state-owned companies.[2] To a large extent the state-owned companies have been run in the same ways as private ones. In some periods they have tried to promote the general goals of regional and employment policy, but less so in recent years.

Innovativeness and decisions related to acquisition of high technology have thus traditionally been primarily dependent on the initiative of individual firms and even individual persons. However, there are some cases, e.g. the adoption of nuclear energy in the middle of the 1970's, which have required political decision making. The rules and regulations set by the state, of course, also affect the choice of techniques by

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1) Enso-Gutzeit, however, at that time called Ab W. Gutzeit & Co., became state-owned in 1918, the state having bought several companies from Norwegian owners mainly because of their substantial land and forest property. Also Ajokki Oy, Oy Sisu-Auto Ab and Valvilla Oy were previously privately-owned. See Moilanen (1986), p. 44-45. Ajokki was sold back to the private sector in 1986.

2) Moilanen (1986) contains a survey of the institutional framework of control and the activities of state-owned companies. See also company histories for interesting details, e.g. Kuisma (1985).

the firms. Thus, e.g. antipollution laws have meant important restrictions on the choice set.

The technological performance of different firms, of course, has varied substantially. However, there seems to be a tendency, not unknown in other western countries, for certain activities to be concentrated in certain groups of firms, especially the largest companies. Thus e.g. in 1984 the ten biggest Finnish manufacturing companies, which produced 30 % of total manufacturing output, accounted for a clearly larger proportion of foreign trade and R & D activities, namely for 35 per cent of manufacturing exports and 49 % of the R & D expenditures of the manufacturing sector (Table 6). It may be noted that five out of these ten companies are state-owned. The main products of the largest firms are also given in Table 6 to demonstrate the present structure of industrial firms. There are also a lot of export-oriented and research-intensive mall firms, but their relative weight is of course much smaller. New small firms are considered to have an important role in the restructuring of the economy, since they often have the flexibility needed for responding quickly to changing conditions.

2. Role of education

One important factor which has significantly contributed to the accumulation of Finnish technological capacity, e.g., to the dynamic role of the raw-material based forest and mining sectors, is the high level of education reached at the turn of the century. In 1880 the share of illiterate persons in the population was already below 3 per

Table 6. TEN BIGGEST MANUFACTURING COMPANIES IN FINLAND: VALUE ADDED, EXPORTS AND R & D EXPENDITURE, 1984

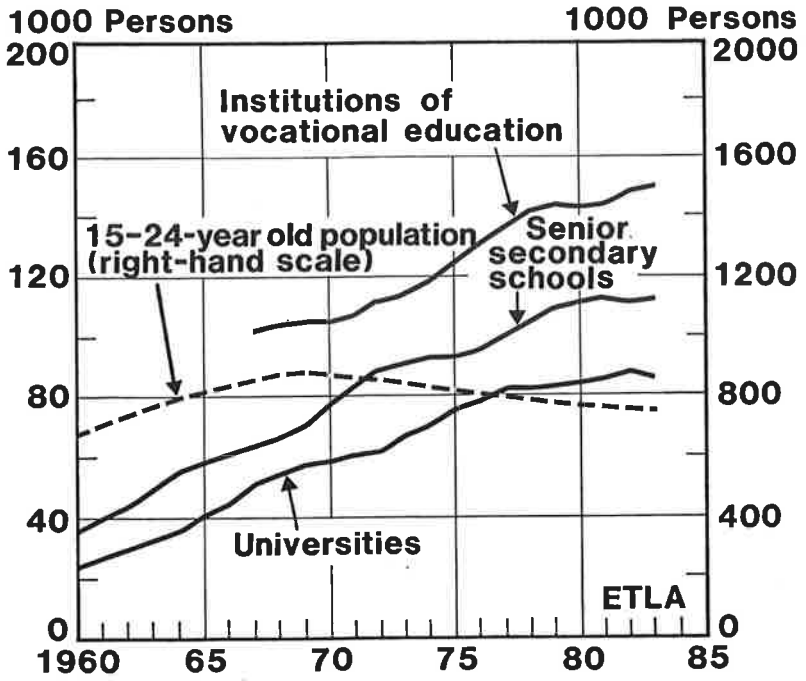
Company	Industry/ main products	Per cent of total manufacturing		
		Value added	Exports	R & D expenditure
Nokia	Electronics	4.7	3.3	15.6
Enso-Gutzeit	Forest industries	3.6	4.4	1.2
Wärtsilä	Machinery, ship-building	3.3	4.3	6.3
Rauma-Repola	Engineering, forest industries	3.1	4.7	2.8
Neste	Petroleum refining, chemicals	3.1	4.7	3.4
Valmet	Machinery, ship-building	2.8	2.4	5.6
Kymi-Strömberg	Electric machinery, forest industries	2.7	2.4	1.3
Outokumpu	Basic metals	2.5	4.0	5.6
Ahlström	Forest industries, machinery	2.3	2.3	2.2
Kemira	Chemicals	2.2	2.0	4.7
Total, %		30.3	34.5	48.7
Total, mill. FIM		24545	33095	1126

Source: ETLA-IFF-IUI-IøI (1987).

cent, and some 2 per cent had an above-primary level education.[1] In 1920 the share of illiterates was below one per cent, and that of persons with above-primary level education nearly 5 per cent.

1) A great majority of the population, some 87 per cent, however, was unable to write (Statistical Yearbook of Finland 1922). Cipolla (1969) places Finland in the nineteenth century in the high literacy group of European countries. Reliable figures for the literacy rates are available only from 1880 onwards. Primary education as such didn't become compulsory until 1921.

Fig. 17. Number of students in senior secondary schools, institutions for vocational education and universities (left-hand scale), and 15-24-year old population (right-hand scale), 1960-83.



Source: Ingberg and Lahdenperä (1985).

In 1970 the enrollment ratio for second level education of the relevant age-group had reached 100 per cent, in contrast to 75 per cent in 1960 (see Appendix Table 9). Many industrial firms have also provided large schemes for the training and education of their employees. This has been especially important in periods when the general educational system has not been flexible enough. E.g. since the late 1970's the economy has suffered from lack of high level ADP personnel.

The first university was established in Finland in 1640. It benefitted from close connections with scholars at the universities in Sweden, which had long traditions of teaching and scientific research, especially in the fields of botany and chemistry. In 1890 there were only about one thousand university students. In 1920, some 0.8 per cent of the 15-25 year old male population and 0.25 % of the female population

studied at the universities. In 1980, the share of female students in the age group concerned had already slightly exceeded that of male students: they were 11.1 per cent for the former and 10.9 % for the latter. The same trend of higher participation rates of women in education can already also be seen in senior secondary shools.

3. Development of technology policy

The first government-funded research institutes as well as advanced high-level educational institutions serving particularly the needs of manufacturing industry were founded around the turn of last century. The Geological research institute was already founded in 1885 and the Institute of Technology in 1908. Particularly the Institute of Technology with its good relations with industry has played an important part in the transfer of foreign technical sciences and technology to Finland. Nevertheless, more significant measures to establish an explicit framework for public technology policy were not taken until the mid-1960's.

The problems related to the one-sided structure of Finnish industry have been discussed since the first decades of this century. The Finnish economy was considered too vulnerable to changes in demand, because of its strong dependence on exports of forest industry products. The most important parts of manufacturing industry were also very capital and energy intensive but at the same time had a low technology content. Despite significant changes in the industrial structure in the 1970's, the problem still remains. The focus of discussion of industry policy has, however, shifted to the importance of advancing

high technology production and exports and to the problem of how to promote product and process innovations at the firm level.

After World War II and particularly in the 1960's several government activities for promoting research and development in industry were started and the activites of already existing organizations were intensified. E.g. the tax deductibility of firms' research expenditures was extended in 1966, a new item for R & D contracts to be made with industry was included in the state budget in 1967, and the Technical Research Centre, founded in 1942, was reorganized by establishing three research departments in 1972.

Public financing of research and development has primarily been directed towards universities and research institutes. In 1983 the public sector accounted for 37 per cent of R & D financing in Finland, but for only 6 per cent of the manufacturing industry's R & D costs. The share of public financing in corporate research activity in Finland is also low by international standards.[1)]

The government started to directly support R & D activities of firms by means of loans, grants and tax reliefs around 1970. The funds for universities and research institutes were increased and their activities reorganized to be better in harmony with the needs of industry.

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1) In 1983 this share was around 32 per cent in the United States, 16 per cent in the Federal Republic of Germany and 7 per cent in Finland; a notable exception is Japan where the share was only 2 per cent. In most of the OECD countries the public sector's share in all research and development expenditure varied during the 1970s between 40 and 60 per cent.

The significance of technology development has been more pronounced in public scientific and industrial policy since the late 1970's. This can be seen in the establishment of the Technology Committee (Committee report 1980) because of i.a. great concern about microelectronics, the technology policy programme of the government (Valtioneuvoston teknologiapoliittinen periaatepäätös) in 1982 and in the start of operation of the Technology Development Centre (TEKES) in 1983. Establishment of TEKES has meant a slight change in the traditional non-selective approach, since it has also tried to find particular areas where R&D activities in Finland could be concentrated. Several industry executives and industry organizations have also stressed the importance of the renewal of firms and of raising the level of technology.[1)]

4. Spill-over effects from the raw-material based sectors

For understanding the present production structure and the present technology a historical analysis of accumulation of technology is necessary. As described above, the public sector has provided much of the institutions and infrastructure (e.g. education) necessary for local technological developments. The actual "learning by doing" has, however, happened to a large extent in the Finnish firms.

There are particularly two raw-material based sectors which have experienced important technological development combined with large spill-over and multiplier effects on closely related sectors and also

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1) For a more detailed analysis of technology policy see Lovio-Lemola (1986) and Lemola-Lovio (1984).

on aggregate economic developments and on the standard of living. These are the forest and the mining sector.

Exports of forest-based products accounted for about 70 per cent of total exports at the beginning of this century. This trade was important in making possible increasing imports of e.g. machinery and equipment. The expansion of the forest industries, especially of the sawmill industry, offered a large number of new job opportunities. As a consequence the living conditions of the rural population were improved. Since a large part of forests were owned by small farmers, they benefitted from selling timber, as well as from incomes from logging and floating works, and from selling their products to workers. Landless people had also an opportunity to increase their incomes by working in logging, floating and in the sawmills.

The production of domestic machinery and supplies for the forest industry developed little by little, and technology was transferred to Finland not only in the form of imported machinery but also by means of sending several persons abroad to complete their studies and for being trained in factories. In general not many technological innovations were made in Finland, but because of a high level of education new methods could be quickly adopted and adapted to local needs. In the 1930's, most of the machinery and equipment for the new sawmills and papermills were produced at home and the mills were designed by Finnish engineers.[1)]

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1) Raumolin (1985).

Since that time, Finnish engineering industry has developed into one of the leading suppliers in the world of machinery and equipment for the forest industries. While the share of forest industry products in total exports has significantly declined, the forest sector has managed to create high-technology production and exports in this closely related area. Since the forest sector has occupied a central position in the Finnish economy and also in everyday life, there has been national unanimity of the importance of developing this sector, which no doubt has contributed to its favourable spillover effects.

Of course, there have been also many problems and difficulties in transferring originally foreign technology to the Finnish forest complex. One example, which has been studied by Raumolin[1)] under WIDER's work programme on "Development and Technological Transformation of Traditional Societies: Alternative Approaches", was the process of mechanization of forestry in the 1950's and 1960's, which in the beginning leant very heavily on foreign imported technology. Intensification of forestry (and agriculture) had great regional effects and led to an unexpectedly rapid depopulation of many rural regions in the late 1960's and early 1970's. In the pre-war period forestry technology had largely been produced domestically, and it is only in recent years that the domestic manufacturing industry has caught up with the production of machinery better suitable particularly to Finnish conditions.

Developments in the mining sector have largely been similar in character to those in the forest complex. While Finland is not very rich in

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1) Raumolin (1986).

mineral resources, a significant amount of know-how has been created and utilized in the industry producing machinery and equipment for the mining sector, and Finland is today also an important exporter of these products. This development can also be attributed to the significant participation of the state-owned company Outokumpu in creating a mining industry, which perhaps would not have developed with exclusively private entrepreneurship.

5. Some comments on economic policies in the post-war period

To give some idea of the macroeconomic environment, in which technological transformation has occurred, we will summarize some difficulties encountered by the small Finnish economy engaged intensively in the international division of labour, when trying to protect the economy by traditional macroeconomic demand management and exchange rate policies from international price and growth disturbances while at the same time trying to safeguard the competitive position of the country. The competitive position of the country has been directly linked to profitability and investments in the open sector and thus to the growth problems of the country.

5.1. Trade policies

After World War II there emerged strong endeavours towards free trade. Finland's trade policies were affected by the new economic situation as well as the foreign policy situation. Participation in international economic cooperation was considered important, and in 1948 Finland

joined the IBRD and the IMF, and in 1949 GATT. She did not, however, become a member of the OECD until 1968. In the 1950's import tariffs were reduced, and in 1957 import regulation and licencing were abolished, and the markka became a convertible currency.[1)]

At the same time as Finland was paying considerable war reparations to the Soviet Union, the bilateral trade relations between these two countries were again developed.[2)] In 1947 a trade agreement with the Soviet Union, including most-favoured-nation treatment, was reached. In 1950 the first five-year trade and payments agreement between the two nations was signed. From the mid-1950's onwards there have also been intergovernmental scientific, technical and economic agreements and commissions. As a consequence of these developments, Finland was in the period before 1968 the Soviet Union's main western trade partner. Since that year, Germany's (F.R.) and frequently also Japan's share in the Soviet Union's western imports have exceeded Finland's share.[3)]

Finland's participation in international organizations has aroused lively debates from time to time, and especially in the context of her free trade agreement with the EC, which was reached in 1973. Already in 1961 Finland became an associated member of EFTA. In the mid-1970's also trade agreements with the smaller socialist countries (KEVSOS agreements) were signed. According to the agreement with the EC, the last tariffs were abolished in the beginning of 1985, and with the two

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1) Kiljunen (1985), p. 95.

2) In the autonomy period, when Finland was a grand duchy of Russia (1809-1917), the latter was her most important trade partner. After Finland's becoming independent, here eastern trade practically stopped. See Tanskanen et al. (1984).

3) See Kiljunen (1985), p. 92-93 and Alho et al. (1986), p. 49-53.

countries joining the organisation in 1986, Spain and Portugal, they will be abolished by the end of 1992.[1)]

5.2. Experiences from demand management policies

Though there have been rapid changes in the structure of exports since the Second World War, the share of various forest products in exports is still large. World trade in these products has typically experienced larger volume and price changes than other industrial products and this has made the economy particularly sensitive to fluctuations in world trade.

In a small economy the external equilibrium constraint has essentially limited the possibilities of compensating for foreign disturbances by demand management policies.[2)] If domestic demand is increased, the attainment of a better employment situation will happen at the cost of the current account equilibrium. Figure 18 illustrates the present trade-off between external and internal equilibrium corresponding to the expansion of public demand.[3)] Point 89 A corresponds to a position where Finland would be in 1989 on certain assumptions concerning international developments and economic policies. With 1 % p.a. extra public demand growth the economy would be moved to point 89 B. Points

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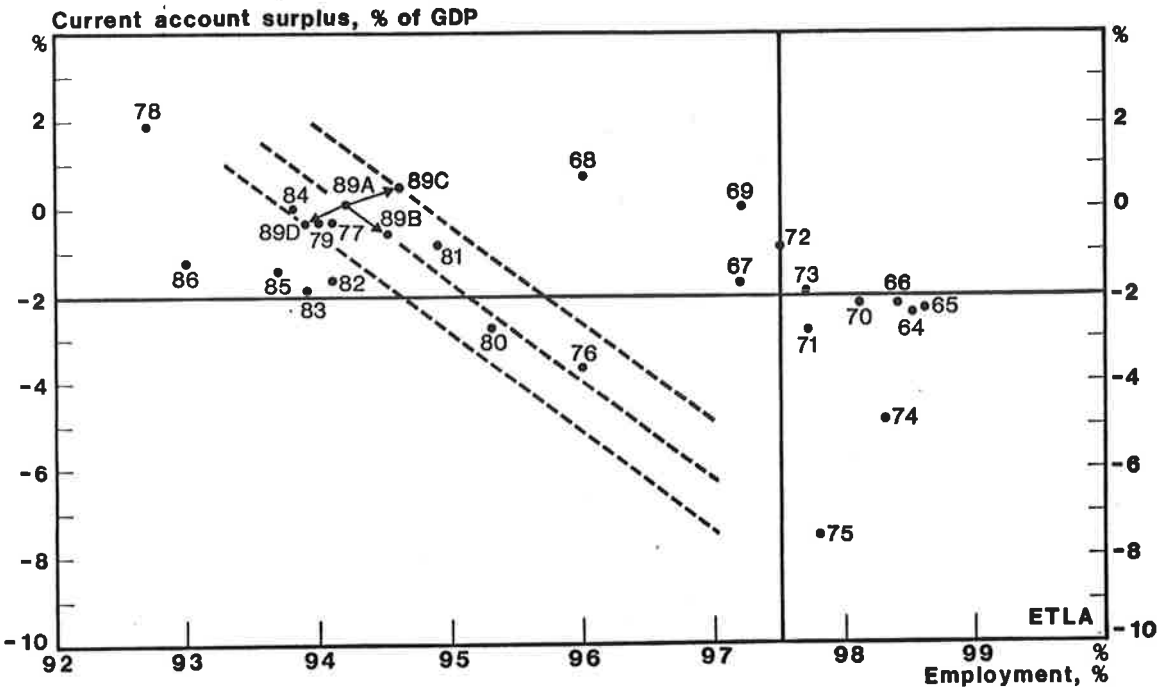
1) See Tanskanen et al. (1984) and Kauppapolitiikka 2-3/1986.

2) During a large part of the post-war period external equilibrium limited also longer-term growth possibilities because imports- particularly of investment goods - increased rapidly with growth acceleration.

3) The trade-off lines have been calculated with a revised version of an econometric model presented in Vartia (1974).

Fig. 18. The trade-off between external and internal equilibrium.



64-86 correspond to those actually observed in 1964-1986.[1] The possibilities of overcoming, e.g., the present unemployment problems by only stimulating domestic demand thus seem very small indeed.[2] As discussed in section III 3. in connection with the adjustment to oil crisis, this line of action was followed in 1974-75, when the recession

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1) Two important exogenous shifts are considered in the figure: if industrial production in the OECD area grew 1 % a year faster than in the basic alternative, the demand management line of 1986 would shift upwards to the righ to pass through point 89 C. If domestic wages and prices increased by 2 % a year more than in the basic alternative and the exchange rate were fixed, the demand management line would pass through point 89 D. The position of the demand management trade-off lines varies, in principle, with changes in all predetermined variables, and its slope depends on all the parameters of the simultaneous equation model. The steepness of the trade-off lines also depends on the time span during which the effects of the policy measures are observed. If, e.g., one believes in a vertical Phillips curve, then also the trade-off line will in the long run be vertical.

2) We do not discuss here the internal constraint of public deficit, which also has been an important reason for conservative fiscal policies, see Pekkarinen & al. (1984).

was also expected to be shorter. With persistently low external demand and growing current account deficits, the policy stance had to be changed.

The Finnish economic policies have often aimed at easing the external constraint by stimulating investments in the open sector of the economy rather than private consumption or public demand. The short-run macro-effects of increases in various demand components are similar. Stimulation of investment, however, not only raises the short-run demand (the Keynesian investment multiplier) but also increases productivity and the potential long-run output of the open sector and thus helps to solve some of the structural problems when investment projects mature.

5.3. Incomes policies

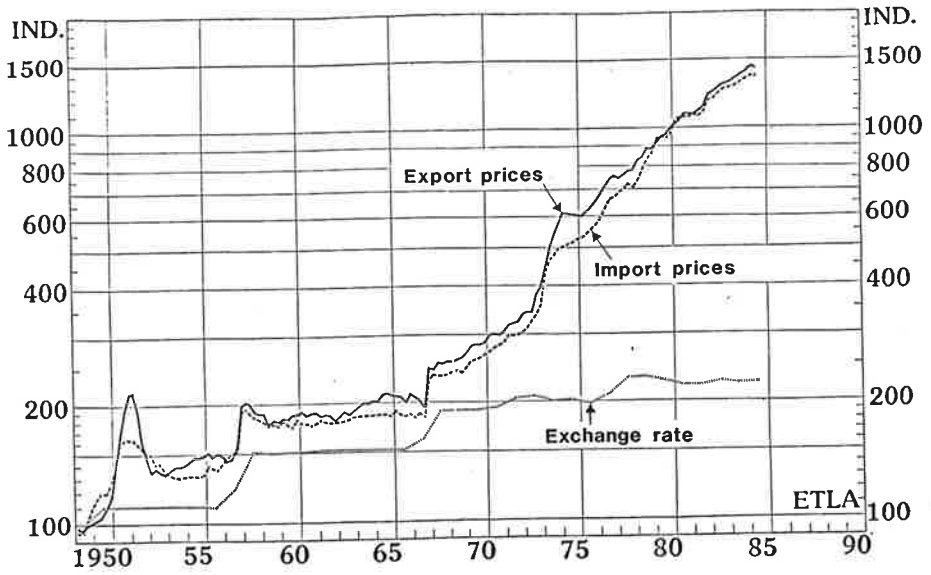
The Finnish labour market is characterized by a small number of unions, high particiaption rates in unions and centralized wage agreements typical also to other Nordic countries. It has been sometimes also possible to reduce the inflation rate rapidly by incomes policies. These successful experiences (moderate wage increases in centralized wage negotiations, or even postponement of already agreed wage increases) are from situations where the unemployment rate has been high. On the other hand, it has not been possible to manage the inflation rate by incomes policies alone. In "overheated" situations the negotiated wages and at least wage drift will increase rapidly. Incomes policies have thus to be supported by other economic policies, e.g. the demand management and exchange rate policies.

5.4. Exchange rate policies

Until 1973 Finland was part of the Bretton Woods system with a fixed exchange rate and since then, the Finnish markka has been fixed against a basket of currencies, except for short periods in the early 1970's. The average inflation rate of the country has clearly exceeded that in the competing countries and there were notable devaluations during the second half of the 1940's, in 1957, 1967, 1977-78 and 1982. Particularly the 1957 and 1967 devaluations were aimed at increasing the profitability and investments in the open sector and thus were also part of the policies for export led growth.

Figure 19 shows that, except during the Korean boom, export and import prices in foreign currencies (i.e., export and import prices deflated

Fig. 19. Quarterly development of Finnish export and import prices in domestic currency and annual average effective exchange rate (1949=100)

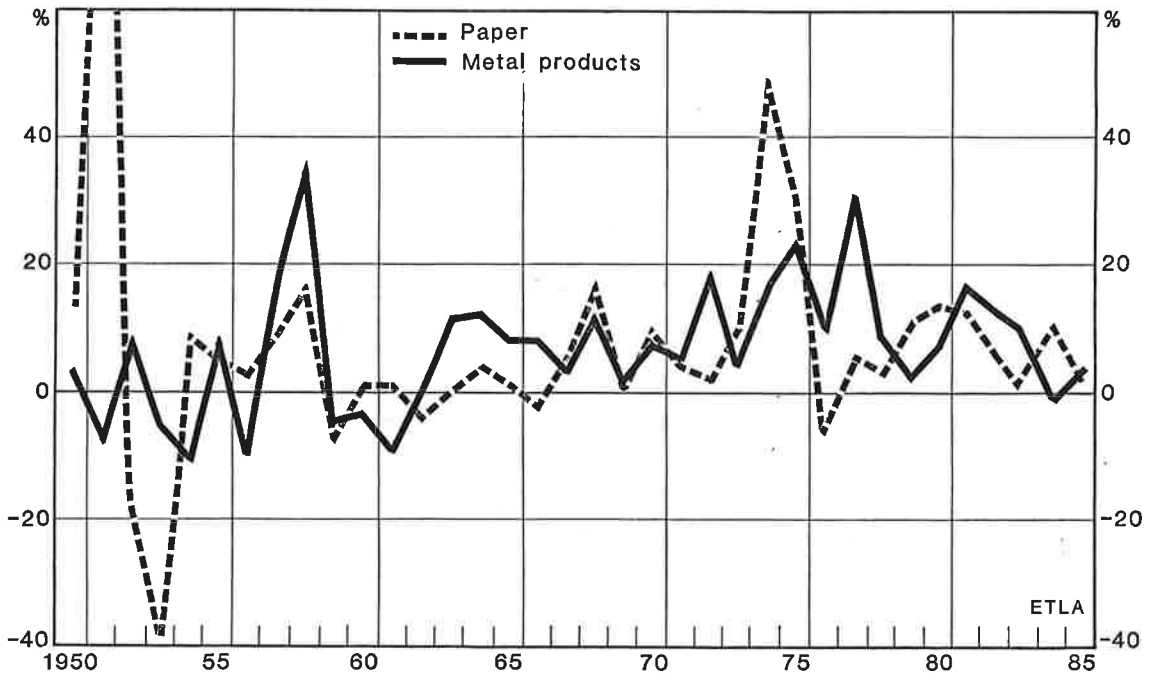


by the exchange rate index) stayed more or less constant during the 1950's and the 1960's. During the 1970's they almost tripled, but Finland was not able to use exchange rate policy to reduce imported inflation. One reason for this has been that the exchange rate has also been used to safe-guard the country's competitive position.

In situations where a revaluation is seen to lead to lower than normal levels of competitiveness and to a profit squeeze, the social costs of the revaluation in the short and medium run may be high.

A particular difficulty experienced with exchange rate policies in Finland has been the sometimes very divergent price movements in various sectors (see Pekkarinen (1981)). Fig. 20 demonstrates the course of export prices in the paper industry and in the metal product industry. Had exchange rate policy been used to deal with rapid increases in the volatile forest product prices, this would have meant serious problems in other sectors.

Fig. 20. Finnish export prices of paper and metal products in 1950-85.



Most of Finland's foreign trade is denominated in foreign currencies. That is why the export prices in agreements negotiated before exchange rate changes hold in foreign currencies during the so-called "currency contract period" immediately following the exchange rate change (see e.g. Magee (1973)). Thus in the very short run, domestic-currency export prices change almost by the full amount of the exchange rate change. According to Vartia & Salmi (1981) renegotiated export prices in Finnish currency have been adjusted upwards by about 75-80 % of the amount of the devaluation. In other words, there has been only little pass-through into lower foreign currency prices, and devaluations have been used as an opportunity to restore profit margins, which before the devaluations have usually reached lower than "normal" levels.

Large exchange rate changes have also meant large changes in the income shares between firms and households and between firms in the open sector and those in the sheltered sector. Between devaluations the inflation rate has most of the time been higher than in competing countries and income shares have slowly returned to the predevaluation levels. When seeking causes for the "devaluation cycles", even "fixed" exchange rates must be considered endogenous. An explanation must rather be sought in the difficulties encountered in the general demand management policies or in the institutional or structural features which have made the Finnish economy so inflation prone.

VI CONCLUDING ASSESSMENT

Finland's economic performance has been relatively good during the post-war period covered in this study. This has meant both large structural changes and rapid technological transformation.

Many of the prerequisites for faster growth than in other industrial countries on the average - such as the necessary institutions and high level of education - were already built into the socio-economic and technological conditions which prevailed at the beginning of the period of the study. The Finns had already before the war accumulated a considerable capacity for scientific and technological research and succesfully adopted and improved foreign technology. During the post-war period more and more emphasis has been laid also on indigenous generation of new technologies. This has lead, e.g., to a rapid increase in R&D investments in recent years.

Only part of the growth performance during the 1950-85 period can be explained by an increase in the amount of labour and capital inputs as measured in the National Accounts statistics. Particularly during the latter half of the period "extensive growth" turned to more "intensive growth", i.e. a larger share of growth can be attributed to an increase in total factor productivity, which reflects technical change, higher R & D investments, investments in human capital, better organizational skills, social innovations, etc.

The role of the public sector in the technological transformation has been to create general favourable conditions and institutions for the economy, e.g. by assuming responsibilities in the educational, health,

transportation and social security sectors and supporting R & D investments by general tax allowances. State-owned firms have also played an important role in some basic industries. Furthermore, macro-economic policies of the government and central bank have been growth-oriented, even though it is very difficult to assess their contribution to long-term growth rates.

Most decisions related directly to technological transformation have been made at the micro level in Finnish firms. This is also where the actual learning by doing has happened. Technology policies have thus followed, at least until recently, a market oriented (rather than selective) and positive (rather than subsidy) approach. Many of the Finnish firms have benefitted from the technology gap which existed between Finland and the most industrialized countries after the war. The multiplier and spill-over effects from the originally raw-material based forest and mining sectors have been considerable.

It is very difficult to assess the extent to which "intangible" factors have affected Finnish post-war developments. It is, however, the opinion of the authors that things like national cohesion, the will to do well after the lost war, flexibility of the small homogeneous nation and sometimes even pure luck e.g. in the form of terms of trade improvement during certain difficult periods have contributed to the succesful technological transformation of the country in the post-war period.

Present economic prospects

Past favourable performance of the economy is not a guarantee of similar developments in the future, especially as the good results of

the past cannot be attributed solely to conscious skilful management of the economy.

Despite an expected recovery in the principal markets, the growth rate of the Finnish economy over the next few years is expected to be slower than it has been in the recent past. The export potential of the country still consists largely of products for which, and is directed toward regions where, the markets are growing rather slowly in the long run.[1] For example, the share of high-technology products, the markets for which are growing very rapidly, is small in Finnish exports. In addition, the level of exports to the Soviet Union will in the next few years be lower than in the early 1980's because of lower oil prices and the bilateral nature of the trade.

According to a recently published medium-term survey by the Research Institute of the Finnish Economy, the growth rate of GDP is expected to average about 2.5 per cent per annum over the years 1986-1990. The growth in industry will still be somewhat faster than this average. The employment situation will also be fairly satisfactory compared to the average Western European levels.

It seems unlikely that expansionary macro-economic policies similar to those of the past years can be continued. So far it has been possible to postpone the problems related to general government finances, since economic developments have been comparatively favourable, and since public debt has still remained at a rather low level. In the future,

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1) For a more detailed analysis, see Horwitz, E.C., Export Performance of the Nordic Countries 1965-82, in DØR-ETLA-IFF-IUI-IØI (1984).

however, restraining the growth of public debt will also have an impact upon the degree of stringency of economic policies in Finland.

At present, the most important objective of economic policy is to bring inflation in Finland down to competitor countries' level. The competitive position of the economy is already at a level which is historically rather low and the cost of reducing inflationary and devaluationary expectations permanently may prove very high. The margin for stimulatory policies is small and it is used to keep up the high investment ratio, in line with the policy stance adopted in the late 1970's. Economic policies aimed at reviving investment may be seen as a combination of demand management policies and supply-side policies. They create employment opportunities in the short run and strengthen the productive capacity of the economy when the projects mature.

It has also been understood that it is important from the standpoint of the development of the productive structure of the economy, that investment be designed not only to modernize capital equipment but also to serve research and product development and the development of organizations. Strategies based on the shrinking technology gap and low labour costs cannot be followed by Finnish firms any more. Following technological developments abroad and rapid adoption of imported techniques of production will always be important particularly for a small country like Finland. However, they need to be supported by directing more resources to in-house research and development activities.

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APPENDIX

This appendix includes the following tables suggested in the WIDER outline for country studies:

Table 1. Changes in real GDP: 1950 to 1985

Table 2. Changes in sectoral shares of GDP: 1950 to 1984

Table 3. Changes in sectoral shares of employment 1950 to 1984

Table 4. Changes in GDP per head of economically active population in major sectors: 1950 to 1984

Table 5. Changes in branch shares of manufacturing value added: 1950 to 1984

Table 6. Changes in branch shares of employment in manufacturing industry: 1950 to 1984

Table 7. Changes in value added per employee in manufacturing industry: 1950 to 1984

Table 7.b Changes in value added per employee in manufacturing industry: 1950 to 1984 at constant prices, total manufacturing in 1950= 100

Table 8. Changes in trade and its strucuture: 1950 to 1985

Table 9. Changes in indicators relating to technological development: 1960 to 1984

Appendix Table 1. Changes in real GDP: 1950 to 1985

Year	Mill.mk at 1980 prices GDP	GDP per head of economically active population	Average annual growth rate (%) GDP	GDP per head of economically active population	
1950	52 068	24 877	..	..	
1960	84 338	38 093	4.9	4.4	1950-60
1970	134 814	59 573	4.8	4.6	1960-70
1980	192 556	78 852	3.6	2.8	1970-80
1985	220 058	84 605	2.7	1.4	1980-85

Appendix Table 2. Changes in sectoral shares of GDP: 1950 to 1984
(Percentage based on current prices)

Year	Agri-culture a)	Industry b) Total	Manu-facturing c)	Services d) Total	Industry-related services e)	
1950	25.9	40.3	27.8	33.8	..	10.4[1)]
1960	18.1	38.0	24.6	43.9	18.7	17.0[1)]
1970	12.1	39.2	26.0	48.7	20.0	
1980	9.4	38.3	27.3	52.3	21.2	
1984	8.1	37.1	25.8	54.8	22.7	

Notes: a) ISIC division 1.
b) ISIC divisions 2 - 5.
c) ISIC division 3.
d) ISIC divisions 6 - 9.
e) ISIC divisions 7 - 8.

1) excluding real estate and business services

Appendix Table 3. Changes in sectoral shares of employment 1950 to 1984
(Percentage) National Accounts figures

Year	Agri-culture a)	Industry b) Total	Manu-facturing c)	Services d) Total	Industry-related services e)	
1950	39.4	32.0	21.8	28.6	..	7.3[1]
1960	33.7	29.8	19.3	36.6	8.2	7.4[1]
1970	20.6	33.2	22.7	46.3	9.9	
1980	12.8	34.3	24.8	52.9	12.3	
1984	11.9	32.6	23.1	55.5	12.8	

Notes: a) ISIC division 1.
b) ISIC divisions 2 - 5.
c) ISIC division 3.
d) ISIC divisions 6 - 9.
e) ISIC divisions 7 - 8.

1) excluding real estate and business services

Appendix Table 4. Changes in GDP per head of economically active population in major sectors: 1950 to 1984
(Current price)

Year	Agri-culture a)	Industry b) Total	Manu-facturing c)	Services d) Total	Industry-related services e)	
1950	590	920	633	771	..	237[1]
1960	1209	2533	1643	2930	1247	1132[1]
1970	2236	7221	4803	8985	3690	
1980	6787	27811	19823	37962	18018	
1984	8885	40454	28200	59841	24752	

1) excluding real estate and business services

Appendix Table 5. Changes in branch shares of manufacturing value added: 1950 to 1984 (Percentage based on current prices)

	Branch	ISIC code	1950	1960	1970	1980	1984
(a)	Consumer goods	31-34,39	65.6	59.3	54.9	51.7	49.4
	Food, beverages & Tobacco	31	13.1	15.1	13.2	10.5	10.2
	Textiles, wearing apparel, leather	32	19.1	12.3	9.7	8.3	7.1
	Wood products and furniture	33	13.9	11.6	9.3	10.5	9.0
	Paper, printing and publishing	34	17.7	19.0	21.8	21.5	22.3
	Other	39	1.8	1.4	0.8	0.8	1.0
(b)	Intermediate goods	35-36	10.6	11.2	14.5	16.0	15.4
	Chemicals, petrochemical	35	5.9	7.2	10.3	11.8	11.4
	Non-metallic mineral products	36	4.7	4.0	4.2	4.2	4.0
(c)	Capital goods	37-38	23.6	29.5	30.6	32.3	35.0
	Basic metals	37	1.7	2.6	4.4	4.8	4.9
	Metal products	38	21.9	26.9	26.2	27.5	30.1
(d)	Total manufacturing	3	100	100	100	100	100

Appendix Table 6. Changes in branch shares of employment in manufacturing industry: 1950 to 1984 (Percentage)

	Branch	ISIC code	1950	1960	1970	1980	1984
(a)	Consumer goods	31-34,39	65.2	63.2	57.9	53.0	51.0
	Food, beverages & Tobacco	31	9.9	11.6	12.4	11.3	11.5
	Textiles, wearing apparel, leather	32	24.5	20.1	16.1	13.0	11.7
	Wood products and furniture	33	17.0	14.4	12.6	11.8	10.5
	Paper, printing and publishing	34	11.9	15.2	15.7	15.8	16.2
	Other	39	1.9	1.9	1.1	1.1	1.1
(b)	Intermediate goods	35-36	9.6	8.4	11.0	11.1	11.9
	Chemicals, petrochemical	35	4.4	4.5	6.7	7.2	7.6
	Non-metallic mineral products	36	5.2	3.9	4.3	3.9	4.2
(c)	Capital goods	37-38	25.3	28.4	31.1	36.0	37.1
	Basic metals	37	1.7	2.3	2.9	3.6	3.4
	Metal products	38	23.5	26.1	28.2	32.4	33.7
(d)	Total manufacturing	3	100	100	100	100	100

Appendix Table 7. Changes in value added per employee in manufacturing industry: 1950 to 1984 (in current price) 1000 mk/person

	Branch	ISIC code	1950	1960	1970	1980	1984
(a)	Consumer goods	31-34,39	3.8	8.3	20.6	84.0	131.7
	Food, beverages & Tobacco	31	5.0	11.5	23.1	79.7	135.8
	Textiles, wearing apparel, leather	32	2.7	5.4	13.1	55.2	75.8
	Wood products and furniture	33	3.1	7.2	16.1	76.4	101.6
	Paper, printing and publishing	34	5.5	11.1	30.2	117.3	189.9
	Other	39	3.6	6.3	16.8	68.7	110.5
(b)	Intermediate goods	35-36	3.5	11.8	28.6	124.3	182.1
	Chemicals, petrochemical	35	4.9	14.1	33.3	142.2	206.5
	Non-metallic mineral products	36	3.4	9.1	21.3	91.6	138.2
(c)	Capital goods	37-38	3.5	9.2	21.3	77.4	126.8
	Basic metals	37	3.6	9.7	32.9	117.1	173.3
	Metal products	38	3.5	9.2	20.1	73.1	122.1
(d)	Total manufacturing	3	3.7	8.9	21.7	86.1	135.8

Appendix Table 7.b Changes in value added per employee in manufacturing industry: 1950 to 1984 at constant prices, total manufacturing in 1950=100

	Branch	ISIC code	1950	1960	1970	1980	1984
(a)	Consumer goods	31-34,39	113.6	160.4	240.0	317.0	373.6
	Food, beverages & Tobacco	31	167.2	179.6	238.5	300.8	341.1
	Textiles, wearing apparel, leather	32	70.2	92.8	143.4	208.3	233.2
	Wood products and furniture	33	102.6	164.2	223.4	288.3	329.4
	Paper, printing and publishing	34	184.9	243.8	355.5	442.6	530.2
	Other	39	41.5	70.2	216.6	259.2	327.5
(b)	Intermediate goods	35-36	58.9	152.5	338.9	469.1	500.0
	Chemicals, petrochemical	35	46.4	188.7	402.3	536.6	573.6
	Non-metallic mineral products	36	69.8	109.8	239.6	345.7	367.5
(c)	Capital goods	37-38	90.2	141.1	203.0	292.1	362.6
	Basic metals	37	90.2	151.7	279.2	441.9	553.2
	Metal products	38	90.2	140.0	195.5	275.8	343.0
(d)	Total manufacturing	3	100	154.3	239.2	324.9	384.5

Appendix Table 8. Changes in trade and its structure: 1950 to 1985

	1950	1960	1970	1980	1985
I. Exports					
(1) Total value of exports (1,000 US$)	352.7	985.9	2306.4	14154.0	13538.8
(2) As per cent of GNP	15.1	19.6	21.4	27.9	25.4
(3) Composition of exports (Percentage)					
Primary goods[1)]	11.4	8.7	3.0	2.7	3.2
Manufactured goods[2)]	88.6	91.2	96.5	97.1	96.7
Machinery & equipment[3)]	4.1	13.6	18.8	21.9	29.0
II. Imports					
(1) Total value of imports (1,000 US$)	385.9	1060.1	2636.1	15616.7	13117.3
(2) As per cent of GNP	16.5	21.0	24.4	30.8	24.6
(3) Composition of imports					
Primary goods[4)]	78.2	67.8	66.1	73.3	69.2
Manufactured goods[5)]	21.8	31.7	33.4	26.5	30.3
Machinery and equipment[6)]	9.5	19.6	17.6	13.7	14.3

1) agriculture, forestry and mining (ISIC 11, 12, 13, 2)
2) ISIC 3
3) ISIC 38

4) raw materials and auxiliary commodities + fuels and lubricants
5) investment goods + consumer goods
6) investment goods

Appendix Table 9. Changes in indicators relating to technological development: 1960 to 1984

Indicators	Unit	1950	1960	1970	1980	1985
I. Capital formation						
(1) Index of gross domestic fixed capital formation	1960=100	48.2	100	153.8	184.0	208.7
(2) Gross domestic fixed capital formation as % of GNP	%	22.6	28.4	26.5	25.7	23.9
(3) Domestic procurement ratio of capital goods[1)]	%	..	59.8	57.6	59.2	57.7
(4) Index of capital goods production	1960=100	51.3	100	184.1	334.9	442.0
II. Technology imports						
(1) Number of operating direct foreign investment projects[a)]	Number	..	67 (1965)	106	196	213
(2) Cumulative value of direct foreign investment	mill.US$	..	4.3 (1965)	66	467	411
(3) Cumulative number of technology transfer agreements	Number	..	..	..	..	..
(4) Technology payments (e.g., royalties, fees,...)	mill.US$	..	3.4	12.6	81.2	107
III. Education						
(1) Literacy rate	%	100	100	100	100	100
(2) Enrollment ratio for second level education Per 10,000	%	..	75	102	97	101[e)]
(3) Number of graduates from third level education[b)]	of total population	5.8	8.3	19.7	23.0	19.9[e)]
(4) Number of scientists and engineers	Number	..	..	.. ..	160895	..
IV. Research and Development and extension activities						
(1) Number of scientists and engineers engaged in R & D	Number	..	..	4885 (1971)	9454 (1981)	..
(2) Expenditures on R & D per capita	US$	..	..	22.6 (1971)	119.9 (1981)	149.3 (1984)
(3) Number of patents and utility models held by nationals[c)]	Number	3542	4220	6420	8386	11275
[d)]	Number	(64.2)	(33.1)	(24.4)	(33.2)	(34.2)
(4) Number of agricultural and industrial extension workers		..	..	..	..	..

Notes: 1) As a proxy for capital goods, ISIC 38 (metal products) was used for production statistics and SITC 7 (machinery and equipment) for trade statistics. Domestic procurement ratio was calculated as: (Gross domestic output - exports) divided by (Gross domestic output - exports plus imports).

a) number of foreign firms
b) degrees obtained and dissertations accepted at universities
c) all valid patents
d) share in patent applications of nationals, %
e) 1984

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