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Government policy and the demands for economic innovations: a historical example of a European periphery

Historical specifications of the concept of periphery

The concept of periphery in the European context is not easy to define in a simple and precise way. However, the relevance of a center-periphery distinction has been noted on a geographical, economic, political, cultural, and scientific-technological level in many empirical and historical analyses (Wallerstein, 1974; 1980; Katzenstein, 1985; Kiljunen, 1979; Pollard, 1981; Löppönen & Tamás, 1985; Alestalo, 1987; Stolte-Heiskanen, 1987a). Usually technological development has been regarded as a key factor in center-periphery relations in Europe. Accordingly, the history of industrialization has been emphasized (Pollard, 1981; Rosenberg, 1982: 8). Nevertheless, until the 17th century the expansion, specialization. and commercialization of agriculture were important elements of the formation of a capitalist "world-economy" and the power relations inside it (Wallerstein, 1974).

Obviously, the differences in industrial and commercial traditions in various countries were related to differences in the timing of economic and technological development. From the latter half of the 18th century industrialization and modernization of economic activities were linked with the capacity to generate technological innovations (Rosenberg, 1982; Wallerstein, 1980). As a result there was a transformation in the European cultural and economic order.

The new stage of development is described in Bairoch's studies of the economic situation in Europe during the first half of the 19th century. Pioneer countries can be distinguished on the basis of national income from the later comers, along a hierarchical scale wherein per capita GNP in 1860 is the highest in the early industrialized countries (England, France, Belgium, Switzerland) and the lowest in the Eastern European countries (Russia, Romania, Bulgaria) (Pollard, 1981: 185).

Technological progress and increased welfare cannot be regarded as the only denominators of the reorganization process of the center-periphery relations. In any case, industrialization raised rapidly the volume of world trade and helped the technologically most advanced countries to achieve a powerful position in the center. Thereby the core of the European periphery was formed by Scandinavia and Eastern Europe. The Scandinavian model of development was, however, different from the Eastern European one. In the Nordic countries there was a higher level of literacy, a more rapid industrial, commercial and social development, and an earlier structural transformation (Berend & Ránki, 1982; Soikkanen, 1985; Alestalo, 1987). While

among the Scandinavian countries Sweden was the first to became a semiperipheral country, Finland remained until the 1960's the most agrarian and economically the most slowly developed (Alestalo, 1986; Alestalo, 1987; Allardt, 1985).

Delayed and slow process of industrialization, limited human and material resources, a great dependency on technology transfer, strong impacts of foreign trade and international division of labor, as well as one-sided and specialized production structures constitute some of the important elements of economic innovation on the periphery (Katzenstein, 1985; Pollard, 1981). The rise and fall of economic hegemonies raises the question, how successor states were able to narrow the technological gap with the center. In this respect the periods of industrialism and reindustrialism are of interest.

As Rosenberg (1982:253—254, 270) points out, England's dominance of world trade was rooted in technologies that created the original industrial revolution. However, England was slow to exploit the new industries and its range of industries was narrow. Consequently, after World War I Germany and the United States emerged as industrial powers. Simultaneously, the old European economic and technological hegemony began to loose its importance.

In the modern world economy the aspects of the center and periphery that are of central concern are related to new demands for technology and the technology-intensiveness of industrial production. The extremely rapid post-war economic advancement in Japan has especially intensified the need to redefine the concept of center and economic hegemony (Lovio & Lemola, 1987). At the same time redefinitions of the process of the technology transfer are needed.

Some European countries earlier classified as the periphery also had spurts in their technological progress. The case of Finland provides an excellent example. During the past 20 years the rise of the technological level of Finnish industry has been one of the most rapid in Europe, raising the country from the economic periphery to the semiperiphery. Explanations of this process gave impulse to specific small-country analyses wherein the new adjustment policies, the content of economic "nationalism" and the increase in domestic scientific and technological potential have been described (Katzenstein, 1985; Mjøset, 1986; Alapuro et al, 1985; Stolte-Heiskanen, 1987b). As such, a distinction between large and small countries rather than between center and periphery may be worth of emphasizing. However, such small European states as the Scandinavian countries have a history in which center-periphery relations played a prominent role. This history still affects in one way or another their future development. For example, in Finland attempts to raise R & D expenditures have intensified the aspirations toward structural transformation of industrial production. Yet, traditions of low-technology-intensiveness are strong.

This paper explores the main economic activities that have been and still are characteristic of the peripheral countries as well as their impacts on science and technology.

The conditions for economic development on the periphery

In the center countries industrialization rapidly transformed the forms of production. In this process new technologies involving new modes of transportation, new sources of power, new metallurgical and machine making techniques as well as rich natural resources, capitalist relations, labor supply, markets, and the creation of infrastructure have been stressed (Pollard, 1981: 4—7, 113; Rosenberg, 1982:246).

National resources, labor force, capital accumulation, and technology were obviously important factors of economic change. In the core countries new technology implied increased industrial output, cost reduction and expansion of markets. These were linked with new principles of effectiveness and imperatives of economic progress (Lyotard, 1985:70—71). They were also related to social and institutional transformations in which economic and political mobilization was dominant.

A central question for the periphery is, why it was so long so slow in its economic progress and technological orientation. The answer can be found in several reasons. First, internal development was strongly externally determined. The Scandinavian countries industrialized late and were greatly dependent on export industries on the one hand and limited national resources on the other. The main export sectors emerged as a result of growing demands for agricultural products and raw materials from England. Consequently, the main industries in Finland, Norway and Sweden were based on forest products, which have always given impulse to low-technology intensive production structures (Jörnberg, 1979:375—485; Mjøset, 1984). Finland remained dependent on forest and paper industries until World War II. This overly specialized and low-technology-intensive structure of production increased external economic dependency and

strengthened the peripheral status of the country both on the industrial and the technological level.

Characteristically on the periphery foreign trade dependency is with the center, not with the periphery. These type of center-periphery relations may have promoted adjustment by opening up channels of technology transfer from the center to the periphery. At the same time they have also increased peripherialization by retarding the mechanisms of industrial diversification and creating one-sided economic dependencies. From this perspective Finland's geopolitical situation and its effects on her foreign trade are interesting[1]. Although the general center-periphery model holds for Finnish exports and imports, there was an emphasis in interperiphery trade with Russia until World War I (Kiljunen, 1979:282—285; Pihkala, 1985:25—42). Radical political changes at the end of the 1910's shook the balance of the Finnish economy and created specific needs of adaptation. They were, however, not yet strong enough to transform the structure of industry, which remained heavily concentrated until the 1950's.

In the explanations of technological development the periphery is usually given a borrower's role. Pollard's (1981) studies tend to stress the importance of timing of technology transfer and the complex influences of politico-economic traditions. Typical of the Eastern European periphery and in many respects also of the Scandinavian countries was that the economic spurts happened with the assistance of foreign capital. In Finland too, foreigners were mostly the initiators of industrialization and foreign capital and technological know-how came both from the center and the neighboring periphery (from England, Germany, Norway, Sweden and Russia) (Jörnberg, 1979:416).

Studies of the technological change in Finland in 1869—1920 imply that despite quite rapid transfer of specific machine and process technologies, the diffusion of technology inside the country was very slow (Myllyntaus et al, 1986:8; Pihkala, 1985). Weak expectations of the surplus value of innovations, difficulties in capital accumulation, and low level of technical and commercial education have been offered as an explanation. Finnish industry has also relied on standard solutions, which have retarded the promotion of national technological know-how.

The role of the state in peripheral economies

Several studies have confirmed the Gerschenkron hypothesis of relative backwardness, which correlates slow economic development with the expansion of economic functions of the state (Gerschenkron, 1962; Pollard, 1981:187; Katzenstein, 1985:174; Alestalo, 1985; Kuusterä, 1985). In the peripheral countries the primary economic sector, agriculture, was unable to create sufficient surplus to activate industrial production. Accordingly, the gap in technology and capital provision could not be narrowed without state intervention. Thus, the economic autonomy of the state and its capacity to pursue its industrial policy become important (Skopcpol, 1985).

Criticism of traditional theories of capitalism stress the interdependence of the capitalist system, technological control, and political power (Albury & Schwartz, 1982; Habermas, 1971). The theories of modern welfare states have also emphasized the conception of relative autonomy of the state (Flora, 1986). Recently it has been argued that effective state intervention is an integral part of succesful capitalist development (Rueschemeyer & Evans, 1985). In the peripheral countries the dependence on world markets implies a special role of the state.

In Finland the beginnings of industrialization, the growth of the infrastructural functions of the state, the reorganization of the state bureaucracy, and the creation of the educational and scientific system occured during the latter half of the 19th century. As a rule the economic functions of the state have in Finland been concentrated on the promotion of agriculture. During 1920—1970 the share of industry of the total government expenditures has been only a half of that concerning agriculture and forestry (Nikkilä, 1979, Appendices 2—6). The intensity of economic functions has increased during economic crises, especially after World War II and in the 1960's and 1970's. Diffuse aspirations can be noted in the goals presented in the Cabinet programs. This analysis implies that despite rapid structural transformations in the postwar period, the share of industrial issues has never been greater than that of agricultural issues (Table 1).

A content analysis of the Cabinet programs provides a good summary of the qualitative changes in governmental industrial and technology policy in the 20th century (Table 2).

At the end of the 19th century the key industry, the forest industry, did not need a complicated technology or great capital investments. In this sector the main applications of economic innovations were in the field of power (Rasila, 1982; Myllyntaus et al, 1986). Despite the rapid growth of foreign trade during 1860—1917 the export industry was totally dependent on fluctuations in the world market (Ahvenainen & Vartiainen, 1982).

Table 1: The proportional share of agricultural, industrial, and economic issues of all the issues in the Cabinet programs in Finland, 1917—1982.

	1917—20	1921—30	1931—40	1941—50	1951—60	1961—70	1971—80
	Percentages						
promotion of agriculture and forestry	5	26	13	14	13	5	9
promotion of trade and industry	5	6	13	5	10	7	8
promotion of economic and fiscal programs	29	18	9	9	43	29	19
other issues	61	50	66	72	34	59	64
total	100	100	100	100	100	100	100

Source: Cabinet programs in Finland, 1917—1982.

After World War I the structure of industrial production became more and more restricted. The Russian markets were closed and the opening of new markets in Central Europe was successful only for agriculture and forest industry.

In the 1910's the state began to take part in capital accumulation by starting to establish state owned companies. They were in forest, paper, and mining industries and in the production of electricity (Puumalainen, 1977). The instability of the political situation strengthened the economic intervention of the state: there was a permanent shortage of risk investments and foreign capital. However, the state only partially affected the structural expansion of industry: the state owned companies were concentrated in traditional basic industries.

The Great Depression of the 1930's was followed by protectionist policies which in Finland were compensated by looking for domestic markets rather than promoting new branches of industry. Yet, in the 1930's Finnish industry was able to adopt some technical improvements, which made possible to compensate for low prices on world markets. Also the metal industry began to develop, although it was based on few raw-materials until the 1960's.

After the war Finland has increasingly tried to participate in international economic integration. Thus, its dependence on the world economy has increased. In the 1950's there were government strivings to increase industrial production as such. Despite the growth of the metal industry the structure of industry remained the same until the 1960's (Pihkala, 1982). On the other hand, after 1951 trade with the Soviet Union promoted the modernization of industry; first basic metal industries, afterwards petroleum refining became new branches of production. Both industries have been subject to strong state intervention.

Obviously, the state by its interventionist aspirations strongly influenced the structure of industry. During the 20th century the share of the public industrial sector of the gross value of industrial production has been high. Recently the state owned companies have reoriented their activities toward rerefinement. At the same time Finnish industry became transformed into a more technology-intensive form, which is reflected in changes in foreign trade both with western and eastern markets (Hjerppe, 1982; Hirvonen & Hjerppe, 1984).

Government technology policy as a reflection of the state's interventionist aspirations

In many capitalist countries government R&D expenditures and direct public subsidies to industrial innovations have become important mechanisms of state intervention and offensive economic policy. At the end of the 1960's and especially in the 1970's the challenge of increased competition for world markets also raised a discussion in Finland about the state's means to promote economic innovations. The growth and structural transformation of industrial production, growth of export industries, as well as compensative technology were emphasized. At the same time there was a vivid debate about the problems of technology transfer as well as about the possibilities to increase domestic technological resources and to abolish restraints on technical and commercial education (Lovio, 1986; Kom.miet. 1969: A 15; Finland's Industrial Associa-

Table 2: The content of goverment industrial policy in Finland as reflected through the Cabinet programs, 1917–1982.

Period	Content of goals
In the 1910's and the 1920's	Global promotion of trade and industry Establishment of state owned companies
In the 1930's	Emphasis on the production of export goods and the extension of export markets
In the 1940's	Promotion of metal industry because of growing domestic military demands and war reparations to Soviet Union Promotion of industrial production, national welfare, and full employment Increase of state economic intervention in cases, when the private capital is unable to take risks
In the 1950's and the 1960's	Aspirations to diminish the discrepancies between the production costs of export industry and the prices Emphasis on export industries and the expansion of iron and steel industry Promotion of effective uses of raw materials Support of small and semi-small industries Aspirations to provide more effective tax credits to industry Promotion of regional industrialization in underdeveloped regions of the country
In the 1970's	Promotion of economic growth and global economic planning Expansion of industrial production Promotion of competitiveness in world market Expansion of state owned companies Promotion of import compensating industrial production, especially technology-intensive industry Promotion of scientific and technical research as well as science and technology policy programs
In the 1980's	Emphasis on new international division of labor Attempts to control inflation Promotion of economic conditions for private enterprises Emphasis on corporatist industrial policy

Source: Cabinet programs in Finland, 1917–1982.

tion, 1970; The Ministry of Trade and Industry, 1979; 1981a; Kom.miet. 1980:20; Kom.miet. 1980:55).

The typical strategy was to increase government R&D expenditures in general and direct support to economic innovations in particular. During 1970—1985 the average annual real growth of government R&D expenditures was 5.1 % while total government expenditures rose 4 % (Kunttu, 1985:25). As is typical of a "capitalist" mode of government R&D funding, more emphasis has been put on economically and technologically relevant research than on the traditional promotion of science. Thus, the share of the Ministry of Trade and Industry of the total government R&D expenditures increased between 1970—1986 from 19 % to 39 %. At the same time R&D expenditures of the Ministry of Education (supporting academic research) diminished from 57 % to 37 % (Kunttu, 1985; Alestalo, 1985; Kaukonen, 1987).

The Ministry of Trade and Industry was given the primary responsibility for government industrial and technology policy. Consequently, it began to support technological innovations since 1967. Subsidies to goal-oriented research appeared in the state budget in 1973 and those to the development of export goods in 1977. A specific Technology Development Center was established in 1983. In general the public support is given to technology-intensive industry and large enterprises. Between 1963—1980, 60—70 % of the total governmental technical expenditures were channeled to the metal and electrical industries, based on the argument for the need of structural transformation of export industries (The Ministry of Trade and Industry, 1981b).

There is some evidence of the flexibility and adaptability of the Finnish industrial and economic policy. Economic growth during 1979-81 was above the OECD average. The average growth of exports has been even higher than that of the "ideal" case (Mjøset, 1984; Lovio, 1986). From this point of view Finland has left her peripheral history behind her. The coming years will show the long-sightedness of the policy pursued.

Natural resources, the state, and economic-technological underdevelopment: the example of the beginnings of the mining and metal industry and the Geological Survey of Finland

Mining and the production of iron have a long history that began before industrialization. Both types of production are dependent on the availability of natural resources, on the existence of markets, capital, and the adaptation of technology. Similarly, they have been sensitive to political and military requirements: during international conflicts and economic depressions there have been pressures to intensify domestic production of metal goods. Nowadays, the exhaustion of natural resources has increased efforts towards domestic self-sufficiency in minerals and development of compensatory technologies.

Geological surveys can be considered as a reflection of economic innovations. Obviously, geological research can indirectly promote economic and technological development by mapping specific areas of a country, by prospecting and analyzing minerals for basic metal industries and for those specialized in refinement, as well as by developing appropriate technology. However, geology has been subject to strong politico-economic pressures. In Finland the Geological Survey of Finland, established in 1885, is one of the oldest state research institutes. Thus, its history covers the periods of industrialization and reindustrialization, and reflects transformations typical to these phases of development.

The following analysis is based on existing historical studies and documents, as well as on personal interviews with the representatives of the Ministry of Trade and Industry and of the mining and metal industry, and the researchers of the Geological Survey of Finland.[2]222

Although there was some mining and iron making in Finland already in the middle of the 16th century, they did not promote the rise of industrialization. As is typical of a peripheral country, there was a shortage of domestic high-quality minerals, lack of advanced technology, and conceptions of economic progress were vague and immature.

In the beginning of the 19th century mercantilist economic policy tended to stress the importance of industrialization Finland. As a result mining was chosen as a means of industrial progress, self-sufficiency of minerals as a focus of economic development and state support as a promoter of this process (Laine, 1955). State economic intervention was intended to guarantee the availability of capital. Although capital was also available from Russia, technologically underdeveloped Russia was not able to act as a channel in needed transfer of technology.

Until the middle of the 19th century iron making was totally dependent on the import of iron ore from Sweden. When these markets were closed the production of iron collapsed (Laine, 1937). Mercantilist policy and state support were intended to raise the level of iron production. Because of many kinds of backwardness this policy could not succeed. Prospecting methods and iron making technologies were primitive, there was a shortage of qualified personnel, the findings were small and poor in quality, and there was a lack of markets.

In a way the first attempts to institutionalize geological surveys were the outcome of the state' s subsidy of mining, although the proposal to start systematic research in the field came first from "science's" side. The approach was made in 1858 by the head of the Mining Board, who had scientific training and interests. Characteristically the model as such was adopted from Sweden.

Although there was an emphasis on the promotion of mining and mineral prospecting, the establishment of the Geological Commission took many years, because of diffuse and unrealistic industrial policy, underdeveloped structures of production, and immature scientific traditions. The first proposal of establishment of a geological survey was rejected by the government. However, in 1864 activities began under the supervision of the Mining Board. Next year the leader was ready to retire claiming to be overly suppressed by the Board. Some years later the activities were stopped and the personnel transferred to gold prospecting in Lappland. Activities were started once again in 1877. In this decision the economic relevance of geology to agriculture rather than to industry was stressed.

In 1885 the Geological Commission was established under the supervision of the Industrial Board. Its main duties were mapping and mineral prospecting. These could be only partially fulfilled because the expenditures were scanty, the personnel was small and unqualified, the scientific theories and methods were immature and primitive, and there was a lack of proper technology (Laine, 1937). Nevertheless, the Geological Commission did promote scientific aspirations by starting to explore the structure and development of the bedrock and the conditions of unconsolidated sediment depositions. Few theories were applicable to the specific geological situation in Finland. Thus, for a long time mineral prospecting faced theoretical difficulties and a lack of specialized technology (Eskola, 1919).

During its first years the Geological Commission

was more theoretically than practically oriented. Later on it was also realized that the scale of the maps the institute produced was too small for practical purposes and that the areas chosen as a focus of interest were those in which high-quality materials did not exist.

The development of expansive industry and the demands for economic innovations

At the end of the 19th century forest and paper industries emerged as the main branches of industrial production. The high hopes for the economic value of mining were not fulfilled because of the great capital investments needed and lack of mineral deposits. Overproduction of minerals caused a collapse in the world market and the Russian industry began to take away markets from Finnish metal products. After all these misfortunes the government was no longer willing to promote mining or support geological research.

In the 1910's and 1920's mining and metal industry took a step towards a new direction. From the point of view of the problem of periphery, this change shows that a new branch of industry cannot flourish without a balance between external and internal economic imperatives. The politico-economic interests in research were closely related to governmental industrial policy. The most important internal impulse to a new situation was the discovery of rich mineral deposits (copper, nickel, iron), as a consequence of prospecting activities of the Geological Commission (Hausen, 1968).

Following independence (1918), govermental emphasis was on national economic independence. Interventionist aspirations of the end of the 19th century became less prominent. The Civil War that errupted in 1918 severely burdened the state economy and led to reduction of expenditures for infrastructural functions. This weakened also the promotion of relevant technology for industrial development, especially for mining and metal industry.

Although World War I raised demands for minerals on the world market the private sector in Finland was not interested in investing in mining and metals industry. In order to prevent foreign invasion of the economy the state began to intervene by establishing a state owned mining company, Outokumpu, in 1924. Economic pressures were also exerted on the Geological Commission. By law its activities were to benefit the state, and the state's rights to the discovered deposits were guaranteed.

Despite state interventionist efforts no significant markets were found for the metal and mineral products. At the turn of the 1920 decade overproduction of minerals on the world market became an effective hindrance for further development. There were also difficulties with technology transfer. The methods of separation and ore prospecting that were rapidly developing in Europe were not easy to transfer to Finland. Outokumpu Company imported a copper separation method from Norway, which did not turn out to work. Because of foreign monopolies, the Geological Commission was unable to buy an electrical prospecting method and was forced to develop its own method through a slow process, which was finally ready only in the 1930's (Laitakari, 1959).

At the end of the 1930's mining and metals production began to expand. Outokumpu, which had a key role in the field, first increased rapidly its production and later on the grade of refinement.[3] Military interests also appeared on the scene. Preparations for national defence and the production of metals for political crises began to be emphasized.

World War II was a final turning point in the structural transformation of Finnish industry. External political and economic pressures on mining and metal industry became intense. Germany tried in vain to get raw-materials for its military industry from Finland. Finland's war reparations to the Soviet Union after the war consisted mainly of metal products. As a result metal industry achieved an important position among the other industries.[4]

The growing economic and military pressures were also felt by the Geological Survey of Finland (formerly the Geological Commission and the Geological Research Institute). Despite a primarily non-practical orientation of activities, the official letters, which were sent by the institute to the Industrial Board concerned many kinds of politico-economic questions. In the 1930's the institute was reorganized in order to make mineral prospecting more effective (The Geological Commission, 1934; Kom.miet.1934:3). Accordingly, the mining sector was broadened significantly. This development is also reflected in the growth of expenditures of the Geological Survey of Finland (Table 3)

After the war the government published programs for the reconstruction of industrial production. Ore prospecting and analyses of minerals, technological readiness, and economically oriented research were emphasized in the goals of the Geological Survey of Finland. As a rule national self-sufficiency has been realized by the industrial policy. Domestic minerals have been utilized in metal, paper, and construction industries and in agriculture. After the war the search for new minerals and

Table 3: Percentage growth in real expenditures in the Geological Survey of Finland and total expenditudes of state research institutes in Finland, 1910—1980.

Years	The Geological Survey of Finland	Total expenditures of state research institutes
	Percentages	
1910—20	—54.9	—45.0
1920—30	224.9	713.8
1930—40	164.4	6.3
1940—50	87.4	109.7
1950—60	151.2	126.1
1960—70	174.6	219.7
1970—80	72.7	103.9

Source: State budgets in Finland, 1910—1980.

ores gained importance (The Geological Commission, 1945).

At the end of the 1960's and especially in the 1970's mining and metal industry was confronted with the new realities of the potential exhaustion of minerals. Already in the 1950's it was realized that domestic minerals will suffice only until the 1970's. The growth of the metal industry specializing in refinement has also intensified the search for new deposits. Thus, the Ministry of Trade and Industry as well as the state owned and private mining companies began an intense program of ore prospecting. In these efforts the role of economic innovations became more important than earlier. Similarly, the importance of compensatory technologies was stressed. The energy crisis in the 1970's increased interests in the possibilities of turf as an alternative source of energy (The Geological Research Institute, 1950; The Ministry of Trade and Industry, 1975; Teollisuusneuvottelukunta, 1981). Recent geological discussions also tend to emphasize "strategic metals", which are related to the problem of international division of political power.

Emphasis on economic innovations placed the Geological Survey of Finland in a situation wherein research priorities are mostly defined outside the institute. Alongside traditional basic research areas, such as the exploration of the bedrock, research topics have been broadened according to economic goals.

The exhaustion of minerals led to a decline in mining production. While this had negative effects on employment it had positive impacts on the structural transformation of the field. By changing from production of raw-materials to refinement and export of high-technology, the mining and metal industries raised themselves from technology adopter's to technology producers.[5]

The recent development of the biggest mining company, Outokumpu, reflects how the structural transformation has been effectively linked with the expansion of trade[6]. These kinds of economic relationships tend to level the traditional hierarchies between the center and the periphery.

The historical example, which has been presented in this paper gives a good insight into the politico-economic elements of the periphery. They also show, how the rise from the periphery was possible. Industrial development in Finland was strongly related to export industries and the availability of domestic natural resources. Despite strong state interventionist aspirations transformation of Finnish industry happened only when the external demands changed. Obviously, no transformation was able to flourish without a balance between external and internal economic imperatives. As such, along with the availability of markets, clarification of the goals of industrial policy, new forms of international economic integration, economic expansion, as well as the role of high technology should be emphasized.

The analysis of the Geological Survey of Finland implies, how strong the economic pressures towards scientific activities can be even in an underdeveloped economy. However, their realization was keenly linked with the developmental level of internal economic preconditions. Surely, this paper shows that politico-economic pressures have become stronger also towards a scientific field in which the primary economic motive was only indirect.

NOTES

1. Finland was incorporated to Sweden until 1809 and to Russia in 1809—1917. Despite her geopolitical situation lying halfway between West and East, Finland's economic and social systems have always been more Western European than Eastern European.
2. The interviews were made in 1980—81. The sample consists of 111 representatives of various state research institutes and 68 representatives of the "practice".
3. Ore production increased from 0.1 in 1913—14 to 2.7 million tons by1930—39 (Kuisma, 1985: 257).
4. During 1950—81 GDP of mining and metal industry has been 30 % of the total GDP of industry and handicraft industry (Hirvonen & Hjerppe, 1984:154).
5. Analysis of the distribution of the trade of Outokumpu Company shows that the share of the export of high technology of all the products was 6 % in 1974, 17 % in 1978, and 12 % in 1982 (Kuisma, 1985:397).
6. In 1980 Outokumpu Company had 12 subsidiary companies of which three were situated in Scandinavia, three in the Western Europe, two in North America, and four in South America (Outokumpu Oy, 1981:34—36).

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