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Keskusteluaiheita - Discussion papers

No. 317

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NEW TECHNOLOGIES AND STRUCTURAL CHANGES IN A SMALL COUNTRY

ISSN 0781-6847

17.04.1990

VARTIA, Pentti, NEW TECHNOLOGIES AND STRUCTURAL CHANGES IN A SMALL COUNTRY. Helsinki : ETLA, Elinkeinoelämän Tutkimuslaitos, The Research Institute of the Finnish Economy, 1990. 15 p. (Keskusteluaiheita, Discussion Papers, ISSN 0781-6847; no. 317).

ABSTRACT: This paper was a contribution to a conference on technological change as a social process - society enterprises and the individual organized jointly by the OECD and the government of Finland in Helsinki in December 1989. It deals with problems related to technological transformation in a small open economy. Particularly the problems related to diffusion of technology and the relative roles of public technology policy and private firms are discussed.

KEYWORODS: New technologies, structural change, diffusion of technology.

VARTIA, Pentti, NEW TECHNOLOGIES AND STRUCTURAL CHANGES IN A SMALL COUNTRY. Helsinki : ETLA, Elinkeinoelämän Tutkimuslaitos, The Research Institute of the Finnish Economy, 1990. 15 s. (Keskusteluaiheita, Discussion Papers, ISSN 0781-6847; no. 317).

TIIVISTELMÄ: Tämä esitelmä pidettiin seminaarissa, joka käsitteli teknologista muutosta yhteiskunnallisena prosessina. Seminaarin järjestivät yhdessä OECD ja Suomen hallitus Helsingissä joulukuussa 1989. Esitelmässä käsitellään pienen avotalouden teknologiseen kehitykseen liittyviä ongelmia, erityisesti julkisen teknologiapolitiikan ja yritysten rooleja.

AVAINSANAT: Uusi teknologia, rakennemuutos, teknologian diffuusio.

TECHNOLOGICAL CHANGE AS A SOCIAL PROCESS
- SOCIETY, ENTERPRISES AND THE INDIVIDUAL
International Conference jointly organised by
the OECD and the Government of Finland
Hotel Strand Intercontinental, Helsinki, December 11-13, 1989

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NEW TECHNOLOGIES AND STRUCTURAL CHANGES IN A SMALL COUNTRY*)

Dynamic gains from the international division of labour

Participation in the international division of labour is particularly important for small countries. Specialization and international trade have meant a great opportunity for these countries to benefit from the expanding world markets. As our topic today is new technologies, it is important to stress not only the static, but also dynamic aspects of participating in the international division of labour. Trade and international contacts not only make imports of foreign goods possible, but also allow citizens and firms to follow technological, scientific and cultural developments in other countries. Much of what nowadays is regarded as part of the Finnish identity has originally come from abroad: ability to read and write, religions, political ideas, the industrial revolution, most new ideas related to music and architecture, and so on.

Many small countries have had brilliant scientists, good composers and high R & D intensity and performance, but the fact remains: most of the new original ideas are born outside of the country frontiers. This is, of course, also true for all bigger countries, but in a small country this fact is so obvious that it cannot be forgotten.

Combining new and old ideas

How to combine new ideas with good old ideas? This problem goes to the

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*) This paper is partly based on a more extensive discussion of the same issues in Vartia, P. & Vuori, S.: Development and Technological Transformation - The Country Study for Finland, Discussion Paper 245, The Research Institute of the Finnish Economy.

core of the practical and theoretical problems of a modern firm. I don't have time to discuss this very interesting area here, but something can be said on a macro-level.

For understanding the present production structure and the present technology in any country a historical analysis of accumulation of technology is necessary. To give an example of relatively successful combination of new and old ideas on a national level I will shortly describe the role of spill-over effects from the raw-material based sectors in the structural change and technological transformation of the Finnish economy.

Finland has 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 on aggregate economic developments and on the standard of living. These are the forest and the mining sectors.

Forest products accounted for about 70 per cent of total Finnish exports at the beginning of this century. This trade was important in making possible increasing imports of e.g. machinery and equipment. A large part of forests were owned by farmers, who supplemented their income by selling timber, taking on logging and floating jobs, or by selling their products to workers.

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 persons abroad to complete their studies or to be 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 (see Raumolin, 1988).

Since that time, Finnish manufacturers have developed into leading suppliers 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 closely related areas. As all other sectors, also the forest complex makes extensive use of micro-electronics in its processes. For example, a modern paper machine has been much influenced by recent developments in information technology. (Since the forest sector has occupied a central position in the Finnish economy, there has been national unanimity of the importance of developing this sector, which no doubt has contributed to its favourable spill-over effects.)

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

New technologies and mature industries

Technological transformation and structural change in the Finnish economy confirm in my opinion the view that new ideas can often successfully be integrated with old skills. This is also the way by which technological change on a national level in practice proceeds.

Discussion of the adoption of new technologies and the related structural changes have strongly focussed on the fast-growing core sectors of the economy - mainly engineering and electronics. However, there are many mature industries with slowly growing or even decreasing production, for which new technologies are of vital importance.

In such industries the environment where decisions on new production methods are made is often crucially different from that of growing sectors. New technologies are not adopted in the context of capital expansion - often the whole operating system of the firm is being profoundly changed. Investments in new technologies contain significant risks, and at the same time the risk-taking ability of the firm may be low because of weak profitability and financial structure.

The main methods for revitalizing the mature industries seem to be social and organizational innovations. Production technologies are mainly developed outside these industries, but survival requires an ability to apply the techniques which are generally easily available.

The role of education

The simple idea that small countries are very dependent on the scientific and technological developments outside their borders has profound implications on the science and technology policies of these countries. It is clear that much stress has to be put on the international diffusion of knowledge. In the case of Finland and other Nordic countries the shrinking technology gap between our own economies and foreign competitors lays an extra burden on organizing the diffusion network in a proper manner. Following technological developments abroad and rapid adoption of imported techniques, of course, has to be supported by in-house research and development activities.

How can a small country try to arrange the rapid inward diffusion? 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 sectors, is the high level of education reached already at the turn of the century. In 1880 the share of illiterate persons in the popultaion was already below 3 per cent, and some 2 per cent had more than a primary level education.

In 1970 the enrollment ratio for second level education of the relevant age-group had reached 100 per cent. 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 the general educational system has not been flexible enough.

Of course, raising the general level of education does not happen quickly. The first university was established in Finland in 1640. The first government-funded research institutes as well as advanced high-level educational institutions were founded around the turn of the last century. 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.

The role of the public sector and technology policy

While there is wide agreement about the importance of promoting technology in Finland, the role of the public sector in this context has so far 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 telecommunication systems. Of the general circumstances necessary for a favourable economic performance, the advanced level of social policy and health services should also be mentioned.

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 been necessary to resort to extensive subsidizing of firms or industries. Thus the policies have also aimed at choosing the positive approach of supporting and stimulating new activities instead of the subsidy approach.

Public financing of research and development in Finland has primarily been directed towards universities and research institutes. In 1987 the public sector accounted for 42 per cent of R & D financing in Finland, but for only 7 per cent of the manufacturing industry's R & D costs.

The role of state-owned companies has historically 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. To a large extent the state-owned companies have been run in the same way as private ones and in recent years there has been a tendency to increase private ownership in the companies where state has a majority.

Technology policies have been more pronounced in public scientific and industrial policy since the late 1970's. This is evidenced by the establishment of the Technology Committee in 1979 and the Technology Development Centre (TEKES) in 1983.

Establishment of the Technology Development Centre 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. When comparing the projects supported by the Centre with similar projects in other countries one sometimes wonders why is it that we all have to do the same things. Of course, we all have to follow recent developments in information technology and bio-technology. However, if we go to projects where the idea is not to combine old with new, but rather to start something completely new with government support, then we should be careful. It is not enough that these projects are successful. If the best brains are gathered together, the result is likely to be successful. We have to ask ourselves how successful these brains would have been in other activities. The situation is similar to the one where the state supports sports activities: if the best individuals from each cohort are chosen to play tennis then we shall have good tennis players. If they are chosen to play football then we have a good football team. But how should we decide whether we should concentrate on tennis or football?

Role of the firms

Innovativeness and decisions related to acquisition of high technology to Finland have traditionally been primarily dependent on the initiative of individual firms and even individual persons.

The technological performance of different firms, of course, has varied substantially. However, there seems to be a tendency, not unknown in other countries, for certain activities to be concentrated in certain groups of firms, especially the largest companies. Thus e.g. in 1987 the ten biggest Finnish manufacturing companies, which produced 40 % of total manufacturing output, accounted for a clearly larger proportion of foreign trade and R & D activities, namely for 43 per cent of manufacturing exports and 55 % of the R & D expenditures of

the manufacturing sector (table 1). The main products of the largest firms are also given in table 1 to demonstrate the present structure of industrial firms. There are also a lot of small export-oriented and research-intensive firms, but their relative weight is of course much smaller. New small firms have an important role in the restructuring of the economy, since they often have the flexibility needed for responding quickly to changing conditions. (See ETLA-IFF-IUI-IØI 1987.)

Table 1. Share of ten largest manufacturing companies in total manufacturing output, exports, R & D expenditure and employment (companies ranked according to value added in 1987)

	Industry/main products	Value added	Exports	R & D	Employment
Nokia	Electronics	6.6	5.7	18.0	5.5
Neste	Petroleum refining, chemicals	4.6	3.7	11.3	2.3
Enso	Forest industries	4.5	6.8	1.5	3.1
Kemira	Chemicals	4.1	2.1	5.5	2.6
Outokumpu	Basic metals, engineering	4.0	5.0	3.6	2.9
Rauma-Repola	Engineering, forest industries	3.8	5.1	2.8	3.5
Kymmene	Forest industries	3.7	4.9	0.7	2.1
Valmet	Machinery, engineering	3.4	3.4	7.8	3.2
Metsä-Serla	Forest industries	3.2	4.8	1.1	2.4
Ahlström	Forest industries, machinery	2.8	1.9	2.3	2.2
TOTAL		40.3	43.4	54.6	29.8

Source: Ripatti - Vartia - Ylä-Anttila (1989)

Firm and plant size distribution

One interesting consequence of technical change is manifested in the changes in firm and plant size distributions. Except for Sweden, average plant size has declined in the engineering industries of the Nordic countries over the last ten years. The same phenomenon is visible in many other economies too (see Carlsson 1988). It has been argued that the main factor explaining the shift in the size distribution of plants is a new emerging technoeconomic system, the core of which is flexible

technology. There is a growing amount of evidence that the flexible technologies are more conducive for small than larger firms (see, e.g. Diwan 1989 and Carlsson 1988). The minimum efficient scale is decreasing especially in engineering where the flexible manufacturing systems are widely adopted and where diffusion of these systems has been fastest.

On the basis of recent studies (see, e.g. Ylä-Anttila & al., 1989) it is evident that Nordic company structures are in transition. Large companies are strengthening their positions in R & D activities and in foreign operations. The concentration tendencies will go on in those industries where economies of scale are important or where competition has been restricted (via technical barriers, public procurement etc.). At the same time there is a growing number of new small firms changing the other end of the size distribution.

There is some evidence that the diffusion of new flexible technology has been quite rapid in the Nordic countries (mainly in Sweden and Finland) and the efficiency of FM (flexible manufacturing) systems is high in international comparison (see Ranta 1989 and SITRA 1990). This fits quite well to Nordic industrial operating environment: a high level of social infrastructure, including education, is often argued to be a prerequisite for adoption and efficient running of FM systems.

The strategy of flexible specialization, associated with new information technology based production, calls for new, technology based linkages, leading to strategic networks. The future markets are affected by changes in both competitive and cooperative behaviour. It is often pointed out that those kind of cooperative cross-border linkages, driven by innovations and new technologies, are more likely to emerge in the economies with the same type of cultural and institutional setting.

Productivity problems

The report of the group of experts discusses the old employment-technology problem and correctly stresses the job-creating effects of

technological change, which over the longer run compensate for the job-destructing effects. I wouldn't go as far as the report does - that productivity growth actually would raise employment. I would rather say that in the long run technological transformation does not have large effects on the number of unemployed, even if it may effect employment and working time. During the last two hundred years there has been enormous productivity growth and most of the time most of the people have found something to do. Of course, it is important to remember that technological change does not lead to permanent and increasing unemployment, as has been sometimes suggested. And, of course, if we want to raise standards of living, and not only employment, then productivity increases are necessary.

Poor statistics and measurement problems may be, as correctly pointed out in the report, an important reason for productivity problems. Particularly the measurement of output in service production brings difficulties: How should we measure the output of this seminar? Measurement of production is an area where much theoretical and statistical work is needed. Progress in these fields would have far-reaching consequences for solving many problems of our profession. A related statistical problem is the categorization of various activities in our societies according to ideas which may have less relevance today than previously. It has even been suggested that the whole idea of de-industrialization and growth of the service sector may be misleading.

The report recommends dissemination of best practice production. Over the longer run this, of course, sounds good. However, in this connection it must be remembered that sectors consist of firms and workplaces which have their own history, skills, management and so usually differ very much from each other. We have at ETLA, the Research Institute of the Finnish Economy, studied some homogenous branches and their behaviour through technological changes.[1)] Structural change within a sector is a complicated problem where many decisions are of a putty-clay type and where competition between firms complicates matters. As

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1) Førsund-Hjalmarsson-Karko-Eitrheim-Summa (1985), Summa (1986), Karko (1988).

rapid change as possible is good neither for the firms, nor for the country. It is also clear that aggregation of firms to sectors does not reveal all the interesting problems.

Structural changes: causes and consequences

The title given for my presentation by the organizers of this seminar include the words "structural change". It is undoubtedly true that many changes occur in our economies today, some of which may be called structural.

What are the true causes of these changes? This is, of course, an extremely important question if we want to influence the developments. Technological change is usually considered to be a "cause" of many other changes; even though theoretical problems are created by the fact that technological change is also endogenous - and thus not the final course - in the process. I would be more generally ready to defend the view that some changes which are regarded as great exogenous shifts (or causes) actually are not.

For example, there has been much discussion of changes in values, which have lead to various consequences. One often proposed view is that the new generations somehow value leisure more than work. It is true that working time has been gradually reduced through reduction in daily and weekly working hours, increases in number of holidays, early retirement, etc. But is this a result of a change in values? I would rather say that it is a result of increased productivity and income and the fact that leisure is a luxury good. This means that if income levels were reduced, we would - on the basis of our income-leisure preferences - choose to work more and not less. This reduction in labour input measured in man-hours and the corresponding increase in leisure, due to technological change, constitutes a major rise in standards of living, often forgotten in standard statistics.

It is also important to remember that tax systems have an important effect on work-leisure choices, even if the basic consumption-leisure preferences may remain the same. Thus, for example, the popularity of early retirement is partly due to high marginal tax rates.

The need for flexibility

The need for increasing flexibility is seen also in the changing expectations of employees, which should be matched with the demands of new production systems and work organizations. For example, when discussing the future working time and work patterns, it is important to balance the future income leisure prospects so that they somehow correspond to the average preferences. Thus, if we believe that we are now in some kind of equilibrium, a rapid cut in working time would take us to a situation where leisure-consumption choices would be out of equilibrium. What has often been forgotten in the past, is that individual work-leisure preferences vary greatly between individuals and also over the life cycle of a given individual. This kind of changes may be due to, for example, the wish to take care of children at home. There are also many women who work full-time and would like to work less, not only women who work part-time and would like to work more.

The report has a section on flexibility in the workplace, and personally I find it very well written. For example, when discussing the working arrangements, the report correctly points out that it is in the mutual interest of managers and workers to reorganize working time. This need for flexibility has, of course, always been there. Some recent technological and also social changes - like reduction in the standard working time and the resulting less intensive use of capital equipment - emphazise the need for all organizations to monitor the traditional structures.

Technical change as a social process

I would like to finish my scattered observations on the report with the comment that the view that technological change is a social process, with corresponding social innovations in institutions, education, work patterns, infrastructure, etc., is well presented in the report. Of the many recommendations of the report, I like particularly the idea that various forms of technology assessment should be a continuing process which promotes constructive public debate of the process of change. It is a good suggestion particularly for us Finns,

since that kind of technology assessment certainly can be strengthened in our country. Small countries are very dependent on diffusion of knowledge and they certainly feel the impacts of new technologies. Thus they should also participate actively in international activities in this field. Also in this respect, this seminar is a step forward.

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