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THE ABSORPTIVE CAPACITIES OF ESTONIAN FIRMS

- Can a Technology-based Industrial Strategy Succeed?

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ABSTRACT: This paper examines the inherited and emerging absorptive capacities in Estonia, which determine the prospects for a technology induced growth. The analysis is based on the concept of absorptive capacities by Cohen/Levinthal 1989, which shows the strategic role of firms´ absorptive capabilities for technological progress in market economies.

The study indicates the minor role of firms´ internal R&D activities and of the poor interactions between production and research in the Soviet type innovation system, to which Estonia belonged for about 50 years. This finding questions the advantages of the inherited absorptive capacities in Estonia today. On the other hand, the current absorptive capacities in Estonia emerge along with the research and production activities of market-oriented enterprises. The ability to establish competitive and technologically sophisticated production depends, however, both on ownership arrangements and on the branch of activity. The analysis of production and research activities in Estonian enterprises shows the presently slow emergence of absorptive capacities. The pattern of foreign direct investment in Estonia does not either indicate strong technological spillovers. A positive (though very small in quantity) exception are the newly founded entreprises by former research staff which deliver scientific and technological services for the Estonian electronic industry. These preliminary findings indicate the difficulties in utilizing inherited absorptive capacities and the slow emergence of new absorptive capacities in Estonia. For more precise results, an analysis of Estonian enterprises is required.

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TIIVISTELMÄ: Paperissa tarkastellaan Viron talouden perittyjä ja kehittyviä absorptiivisia kykyjä, jotka jatkossa määräävät teknologiavetoisen kasvun. Analyysi nojautuu Cohenin ja Levinthalin (1989) käyttämään absorptiivisten kykyjen käsitteeseen, joka osoittaa yritysten tällaisten ominaisuuksien keskeisen strategisen roolin markkinatalouksien teknologisessa edistymisessä.

Selvityksen mukaan yritysten sisäisen T&K toiminnan merkitys sekä tuotanto- ja tutkimustoiminnan välinen vuorovaikutus jäivät hyvin vähäisiksi neuvostotyyppisessä innovaatiojärjestelmässä, johon Viro kuului noin 50 vuoden ajan. Tulos täten kyseenalaistaa Viron perittyjen absorptiivisten kykyjen hyödyntämiskelpoisuutta. Toisaalta Viron nykyiset absorptiiviset kyvyt syntyvät markkinatalouden mukaisesti toimivien yritysten tutkimus- ja tuotantotoiminnan myötä. Kilpailukykyisen ja teknologisesti sofistikoidun tuotannon käynnistäminen riippuu kuitenkin sekä omistusjärjestelyistä että toimialasta. Analyysi virolaisten yritysten tuotanto- ja tutkimustoiminnasta osoittaa, että nykyinen absorptiivisten kykyjen syntymisvauhti on hidas. Ulkomaiset suorat sijoituksetkaan eivät näytä vaikuttaneen merkittävästi teknologiaosaamisen leviämiseen. Aiemman tutkijakunnan perustamat elektroniikkateollisuuden tieteellisiä ja teknologiaintensiivisiä palveluja tarjoavat yritykset muodostavat positiivisen poikkeuksen. Nämä alustavat tulokset viittaavat perittyjen absorptiivisten kykyjen hyödyntämisen vaikeuksiin ja hitaaseen uusien absorptiivisten kykyjen uusiutumiseen. Tarkempien tulosten saamiseksi olisi tutkittava virolaisia yrityksiä.

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1. Introduction

According to a dual industrial strategy, Estonia should not only exploit the present comparative advantages, but should simultaneously build up new innovative capacities for future growth. The relatively high level of human capital in Estonia and the large direct investment of foreign firms, which induces technological spill-overs, are expected to provide the adequate innovative and imitative capabilities (Hyvärinen & Borsos 1994).

Indeed, the transition countries inherited a high level of human capital measured by R&D input indicators such as the R&D personnel, but in a market economy a technology-based industrial strategy should rely mainly on the innovative and imitative capabilities of *firms*. A transition country should not either produce, or rely only on indigenous technology, but should rather exploit all sources of Western technology. This study focuses therefore on the role of the absorptive capacities of firms in a technology-based industrial strategy, which determine the capability for exploiting external sources of technology. The absorptive capabilities of firms for exploiting external sources of technology is built up by (cumulative) in-house research of firms (Cohen & Levinthal 1989 and 1990). In-house research has a dual role to play as its purpose is not only to innovate, but also to imitate and to exploit external sources of information.

This paper first investigates the inherited absorptive capacities in Estonia. This analysis also reveals the relatively minor role of enterprise R&D activities which was characteristic for a sosialistic innovation system. Secondly, the present development of the enterprise sector, the structure of production, and foreign investment are studied to discover, whether and where absorptive capacities are emerging today. Both the inherited and the emerging absorptive capacities of firms determine the success of the industrial strategy and future growth prospects in Estonia.

2. Diffusion of Technology and the Absorptive Capacities of Firms

In a market economy it is the role of profit-oriented firms to produce new technologies, to exploit external sources of knowledge and to convert that knowledge into profitable innovations.[1] The production and diffusion of new technologies by firms is a result of entrepreneurial R&D investment, which is induced by expected profits and competition (Nelson & Winter 1982). The technological capabilities and market behaviour of firms also play an important role (Mowery 1994, p.8-11).

The own innovations of firms are not, however, the only source of new technologies, but the technological spill-overs of competitors and the knowledge outside an industry are additional sources. These potential sources can also be exploited by the R&D investment, or in-house research of firms. Therefore, the in-house research of firms is not only aimed at the production of innovations but also at the imitation of competitors and the exploitation of external sources such as basic research or foreign technology. The cumulative in-house research of a firm simultaneously builds up its ability to identify, assimilate and exploit new technologies (Cohen & Levinthal 1989, p. 569-571).

The by in-house research accumulated absorptive capacity of a firm reduces the transfer costs of an external technology which may be quite high in the long run. These costs mainly arise because technology is not a public good. The higher the accumulated absorptive capacity in the relevant field of technology, the lower the respective transfer costs and the faster the exploitation of external sources of technology (Cohen & Levinthal 1989, p.570).

The absorptive capacity of a firm does not only result from past in-house research (cumulative R&D investment in a particular technology), but also from the cumulative production process and from the investment in the education of the staff (Cohen & Levinthal 1990, p.135-36). The absorptive capacity of a firm arise therefore partly as a by-product of the firm´s activities. However, especially important are the incentives to invest in absorptive capacities. The incentives for in-house R&D investment in a particular technology depend on the expected demand, appropriability and technological opportunities (Cohen & Levinthal 1990, p.138ff.).

Such concept of the absorptive capacities of a firm means that the assimilation of a new technology does not take place passively, but as a result of entrepreneurial investment. If a firm plans to exploit a new technology, which is not similar to its present technology, it must invest

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[1] The national innovation system includes various types of research and interactions between public and private research (universities, institutes, firms). All these factors are necessary in the production, diffusion and exploitation of new knowledge (Nelson & Rosenberg, p.4-5 in Nelson 1993 and Lundvall (Ed.) 1992, p.2.)

in the corresponding absorptive capacity. The level of such investment is, however, often too low (Cohen & Levinthal 1990, p.150).

3. The Inherited Absorptive Capacities of Firms in the Transition Countries[2]

The level of R&D inputs was very high in the transition countries which should have accumulated a large stock of own scientific and technological knowledge. However, the technological output indicators show that the science and technology sector was very inefficient. A restructuring of the science and technology sector would therefore induce large productivity effects (Schneider 1995). The solution of the problem requires, however, more than restructuring of the inefficient science and technology sector and reduction of R&D inputs. Besides of these efforts, the emergence of market-oriented firms with in-house research is necessary, since it is the firms which react to market incentives, invest in uncertain R&D and produce a diversity of technologies. Finally, the market forces select the most profitable innovations.[3]

Quite the reverse in the former socialist countries, in which in-house research of firms was determined and financed by the central planning authority without much reference to market incentives such as expected demand or returns to investment. In-house research took place in the research departments of the large state-owned firms, which cooperated mainly with the research institutes of industries (sub-ordinated to ministries and therefore, to the central plan). The research results both of the research departments and the research institutes were not expoited in production, because research and production were largely isolated from one another (Schneider 1994). As a result, the large state-owned firms therefore did not inherit absorptive capacities, which are efficient in the new market-oriented innovation system.

An additional problem is that the present external sources of information for the transititon countries exist mainly in the advanced capitalist countries. The inherited absorptive capacities of firms in the transition countries may be inadequate to exploit modern Western technologies, if the inherited technological capabilities and information differ largely from those in the West. Large R&D investment may be necessary to enable firms to exploit new kinds of technologies such as input-saving technologies or communication technology.

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[2] The analysis refers to the S&T system of the former Soviet Union, because Estonia was part of the SU from 1940 to 1991. In other transition countries the S&T sector was similarily organisied, but there are some important differences.

[3] In a market economy too, the public research and the interactions between public and private research play a very important role, but it not the focus of this paper.

4. Prospects for a Technology-based Industrial Strategy in Estonia[4]

4.1. Inherited Absorptive Capacities in Estonia

Structure of research activities in Estonia

In a market economy the cumulative in-house R&D expenditure and the cumulative production can be used as indicators for the accumulated absorptive capacities of firms. In the former Soviet system of innovation - and therefore also in Estonia until 1991 - the research activities of firms played rather a secondary role. The bulk of research took place in various types of research institutes - despite the fact that the *number* of research departments in the enterprises was much higher than that of the R&D institutes (see table 1). This is why the analysis of the inherited absorptive capacities in the Estonian firms requires also the consideration of the R&D activities in the research insitutes and their interaction with the R&D activities in the large enterprises.

Table 1 Type of R&D Instititutes in Estonia, 1990

Type of R&D Institutes	Number
Estonian Academy of Sciences	15
Higher education/Universities	6
R&D Institutes: industrial and others branches	23
Autonomous research institutes	44
Construction	4
Laboratories, construction and development offices and experimental departments in enterprises	634
Technical institutes and departments in the all-union enterprises	60

Source: Laas, J. 1990, Eestin tieteellinen tutkimus ja tiedeorganisaatio käännekohdassa. In: Kyläheiko,K./Pitkänen,S. 1990, Tuotantotalouden tutkimusella tuottavuuteen, Lappeenranta, p. 8, a reduced presentation of the original

The institutes of the Estonian Academy of Sciences (15) were involved in basic research, and beyond the control of the Soviet central planning authority. The research activities at the universities or at research institutes of higher education (6) concentrated mainly on pedagogical research topics. The autonomous research institutes (44) were, on the other hand, responsible for delivering scientific services to the research sector, in opposition to the industrial and other branches R&D institutes (23). They were sub-ordinated to their corresponding ministeries and fulfilled the central plan of the Soviet Union. These institutes

[4] This part of the analysis delivers the first preliminary results. The necessary data on the research activities of the firms during the socialistic period and on the research activities in the firms today is presently collected by Marianne Paasi, at the Institute for Economic Research Halle, and Julianna Borsos-Torstila (at ETLA) within a project at the Research Institute of the Finnish Economy, (ETLA), Helsinki.

were involved with applied research, which purpose was to serve the large enterprises. The large enterprises themselves also possessed their own laboratories, construction and development offices, and experimental departments (634), which focused on applied research and development. The all-union enterprises had their own technical institutes and research units as well (60). However, these departments and institutes played a minor role in a sosialistic innovation system, which was characterised by top-to-bottom-planning.

Such division of labour in research activities and the poor interaction between institutes and enterprises prevented the application of the research results; if applied, the utilization took place only after the permission of ministeries, which also took a very long time. Often the scientific potential in the research departments of the all-union enterprises was not even exploited (Venesaar & Vitsur 1985, page 188). The enterprises were also not free to make changes in the production process, but rather fulfilled the plan; they had neither economic incentives for innovation (because they had a monopolitic position) nor the ability to react to demand signals. After the reform (1985) in the Soviet Union, the enterprises received more autonomy and responsibility in their research activities, but unfortunately no real improvements resulted (Schneider 1995, page 73-75).

As a consequence, products were of low quality, in spite of high R&D expenditure and personnel in the Estonian and Soviet economy. The products were even material- and labour-intensive, even though raw materials and labour were scarce factors of production (Venesaar & Vitsur 1995, page 188).

Intramural R&D expenditure by economic branches

The intramural R&D expenditure by economic branches in 1991 is used here as an indicator in order to discover in which technological areas the inherited absorptive capacities in Estonia can today be found. In a Soviet-type innovation system the intramural R&D expenditure by branches provides information on the accumulation of inherited technological capabilites and absorptive capacities in Estonia. The lack of entrepreunerial data is not too serious at the present stage of this study because of firms´ minor role in research activities.

Table 2 **Intramural R&D Expenditure by Industry and Type of Activity, 1991, in thousands of rubles**

Industries	R&D total	R&D in %	Basic Research	Applied Research	Develop-ment
Agriculture, Forestry and Fishing	8059,0	27,1	320,0	2624,0	5115,0
Mining	2919,0	9,8	-	2019,0	-
Manufacturing	7274,9	24,5	-	5842,3	1432,6
Communal Services	-		-	-	
Construction	1894,7	6,4	-	1253,9	640,8
Transport, Storage and Communication	-		-	-	-
Other	10461,0	35,2	-	8612,0	1849,0
Total	29708,6	103	320,0	20351,2	9037,4

Source: Centre of Science, Research and Statistics. Science and Technology Indicators in the C.I.S. Moscow 1993, p.343; Data on economic branches, not industries; first column adds to 103%

Table 2 shows the total intramural R&D expenditure by economic branches in Estonia, divided in different types of R&D activities. The applied research (68,5 %) appears as the dominant type of research, whereas the minor role of basic research (1,1 %) is obvious. These intramural R&D expenditure by all branches made 29,6 % of the total R&D expenditure in Estonia[5] (Centre of Science, Research and Statistics 1993, page 333). This figure is comparable with a low income country like Portugal, where the share of GERD (Gross Domestic Expenditure on R&D) financed by industry amounted to 27 % in 1990 (OECD. Main Science and Technology Indicators 1/1995, page 20). The comparison of these data is of course very problematic.[6]

The allocation of R&D expenditure by economic branch in Table 2 indicates the important role played by the agriculture, forestry and fishing sector. The share is even higher than that of manufacturing. This reflects the high share of agriculture sector in Estonia (22 % of GDP in 1990, World Bank 1991, Estonia. The Transition to a Market Economy, page 97). The relative importance of agricultural research can also be explained by the role of agricultural products as input factors for the Estonian food industry (see table 3 below). On the other side, the neglect of R&D activities is obvious in the service and transport, storage and communication sectors. The information in table 2 is limited because of the sector „others" which shows the bulk of intramural R&D expenditure. This category includes sectors such as energy and water, and even military.

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[5] Total R&D expenditure amounted 100,3 Mio rubles in 1990. Total R&D expenditure contains R&D costs or money spent for performing R&D without profit.

[6] For Portugal, the data concerns only industry without agriculture and other branches. This is why the share in Estonia is systematically higher. The most difficult problem is however involved with the differences in the statistical recording of R&D activities.

Distribution of Production by industries in Estonia

The relative share of production by economic branch and industy is another useful indicator of the inherited absorptive capacities in Estonia. In the former Soviet Union, production was regionally highly concentrated and specialized, each republic producing a surplus which was exported to other republics. At the end of the Eighties there was an economic reform in Estonia which gave more autonomy to Estonian firms and allowed more private entrepreuneurship (Venesaar & Visur 1995, pp. 189-190). However, the bulk of the production was still produced by the large union enterprises; in 1990 industrial production in Estonia was produced in 256 state-owned enterprises (table 3).

Table 3: Distribution of the number of firms across industries, 1990

Industry	share in %	Number of firms	Number of employees
Food Industry	26	52	28.200
Light Industry	24	45	43.300
Engineering industry	18	46	58.200
Forest Industry	10	48	28.000
Chemicals	8	17	16.200
Building mat	5	21	14.300
Other	9	28	14.600
Total	100	256	202.800

Source: World Bank 1991, Estonia. The Transition to a Market Economy, p. 86

The most important industry in Estonia was the food industry which does not, by the way, belong to the R&D intensive industries.[7] This industry was nevertheless able to gain from the research activities in agriculture (see above) which delivered the inputs to production. The clothing and textile industry was also important but also this industry belongs to the low R&D industries.

The Estonian electronic and electromechanical industry played a very important role in the Soviet industrial system. This potentially R&D-intensive industry produced mainly for the other republics, whose demand was, however, not technologically sophisticated. Most of the raw materials were imported from the other republics and the distribution and marketing of the products were organised by the all-union authorities (Estonian Investment Agency 1.1.1995, Industry review „Engeneering industry"). Nevertheless, one of the large electronic enterprises in Estonia had its own research institute. Also the high share of the engineering (37 %) in the

[7] According to the concept of product life cycle.

researcher in Estonia in 1990 shows the importance of the research activities in this industry (Centre of Science, Research and Statistics 1993, p. 335).

Conclusions

The above analysis indicates that the absorptive capacities in Estonia have mainly been accumulated in engineering and agriculture. However, the separation of research activites from production, the missing incentives for innovation and consequently the low level of international competitiveness leads one to expect a low quality of the accumulated absorptive capacities in Estonian firms. Therefore, it is an open question whether the Estonian research system did accumulate absorptive capacity in the sense of Cohen/Levinthal and whether it can be used in the present new circumstances in order to exploit the sources of Western technologies. The inherited absorptive capacities which are suitable in exploiting the external sources of technology are rather embodied in the educated labour force than in firms. The strong fall of production and the closing of many research institutes and departments in Estonia however may risk the utilization of these capabilities, unless the educated labour force is employed in the new production.

4.2. The Emerging Absorptive Capacities in Estonia

4.2.1. The Emerging R&D Activities and Enterprises in Estonia

Today Estonia is a market economy in which the absorptive capacities accumulate due to in-house research and competitive production by firms. However, at present the research activities of firms are almost neglible, and there are few statistics available (Statistical Office of Estonia 1995, *Science 1994*, p. 6). The firms seem to buy R&D services from outside rather than to establish their own research departments: in 1993 productive enterprises spent 14,2 % of the total R&D funds in Estonia as repayments for orders and contracts[8], reflecting the demand for R&D services outside of the enterprises. The bulk of the demand for R&D services (63 %) came from the engineering sector. Also the correspondig share by agriculture is with 11,9 % quite high (Statistical Office of Estonia 1994, *Science 1993*, page 34). These figures reflect the slow technological dynamism which presently prevails in Estonia.

One should, however, analyse the single firm´s activities in order to get proper information about the present accumulation of absorptive capacity in the business sector. Such an analysis is complicated not only by missing data, but also by the very heterogeneous entrepreuneurship

[8] This share declined to 9,6 % in 1994.

during the transition period. The enterprises differ from one another according to their history and ownership conditions, differences which cause different types of entrepreunerial behaviours. These differences in turn affect the utilization of the inherited absorptive capacities and the present in-house R&D activities. Therefore, in order to distinguish among the various entrepreunerial dynamism, four analytical categories will be used:

- the state-owned, not privatised enterprises: in-house R&D activites (accumulation of new absorptive capacities) depend on the branch of the firm. However, without necessary reorganisations and new management behaviour in the enterprises, competitive production will not be induced. The usefulness of the inherited absorptive capacities is, however, a priori not clear.

- the privatised enterprises usually have a new management and have been reorganised.[9] The new behaviour and market competition induce new product quality and new production methods, which, depending on the branch, require in-house R&D investment (accumulates new absorptive capacities). The usefulness of inherited capacities is not a priori clear.

- the newly-founded enterprises have new management, but no inherited absorptive or entrepreuneurial capabilities. The emergence of absorptive capacitities depends on their in-house research which depends on the branch.

- foreign companies and joint-ventures import new management and technologies, which builds up the absorptive capacities in Estonia. However, an investigation about the actual extent of the technological spill-overs is necessary, because they do not arise automatically.

Presently there is no data according to these enterpreneurial categories. Therefore, the following analysis will focus on the emergence of the business sector in Estonia and the present distribution of production by branches. This will allow temporary results about the dynamics of absorptive capacities in Estonia.[10]

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[9] It is also possible that the old management or labour force has taken over the enterprise. In this case, new entrepreunerial behaviour and the economic success of these enterprises is not always certain.

[10] The necessary data is presently collected within a common project with the Finnish Institute of Economic Research, Helsinki. The research results will be published as soon as possible.

4.2.2. The Structure and Dynamism of Production in Estonia

According to the above classification, the ownership of firms along with their branches of production are important determinants for emerging absorptive capacities. The business sector is developing quickly in Estonia when measured by the number of private enterprises (see table 4). In 1995, 96,4% of all enterprises were privately-owned, that is, privatised, new or foreign firms. The private firms are expected to have the right behavioural pattern given the new market conditions. The number of newly-founded domestic firms has been growing very fast since Estonian independence 1991. Annually 12.000 - 14.000 new enterprises were registered (Estonian Economy 94/95, p. 16; Venesaar & Vitsur 1995, p. 196).

Table 4 Enterprises by Ownership, June 1995

Public Property		Private Property			Total
State Property	Municipal	Estonian Private	Foreign	Other	
1432	677	51744	5338	291	59482
2,4%	1,2%	87%	8,9%	0,5%	100

Source: Statistical Office of Estonia 1995, Estonian Statistics Monthly, 5/1995

Small-scale privatization contributed to this positive development, and the service sector has been about 80-90 % privatised. This large number of private firms in Estonia indicates positive prospects for the entrepreneurial competence and future absorptive capacities. The privatization of the large state-owned firms has, however, been much slower and has not yet been completed (Lainela 1994, pp. 176-177). As a consequence, the share of private firms in industrial *production* is not very high. Large state-owned firms still produce more than a third of industrial output, i.e. 38,3 % in 1995 (Ministry of Economic Affairs of the Republic of Estonia) which is problematic from the point of view of obsolete absorptive capacitites (see above) and slowing down the new absorptive capacities.

The analysis of the production by branches indicates the present technological dynamism in Estonia, since branches and industries can be identified according to their R&D intensity. During the transition period the share of the service sector rose up to 55,6 % on the BIP in Estonia and the level of production also rose. Newly-founded enterprises dominate in the service sector, especially in retail trade. They are usually small firms with very few financial resources. Also, entrepreunial knowledge is lacking, but will be increasing due to learning processes. Some of the new firms in the service sector are very R&D intensive. The researchers from the engingeering industry have founded consulting firms (Estonian Economy 94/95, page 55) which combine inherited absorptive capacities (embodied in the researcher)

with emerging new capabilities. The number of such consulting firms is, however, very small. This finding modifies the third classification of enterprises, because in this case inherited absorptive capacities are embodied in human capital and utilized in the newly-founded firms (see page 11 above).

The level of industrial production has declined and the structure of production has changed in Estonia since the independence (see table 5). Still today the food industry remains important in Estonia. The R&D intensity of food industry is low, however, technical progress takes place due to minor quality improvements and due to investment. The high degree of privatization in this industry (see table 6) is likely to support modernisation and quality improvements. Light industry on the other hand is labour-intensive with low R&D, but its present importance lies in its role in earning foreign exchange and in utilizing the educated labour force.

Table 5 The structure of industrial production 1994

	1991	1994
Energy Production	10,0	12,9
Mining	2,9	5,7
Foodstuff´s production	27,0	35,7
Light industries	18,9	10,4
Forestry	9,7	7,4
Chemical Industry	11,8	10,1
Construction materials´ industry	4,6	4,3
Machine building and engineering	11,5	11,0
Other	3,6	2,5

Source: Ministry of Economic Affairs 1995, Estonian Economy 1994/1995, Tallinn

Table 6 The share of the state-ownded enterprises in various industries, 1995

Industry	Share in industry´s output, %
Energy sector	100
Mining	91,1
Food industry	33,8
Textile, clothing and wearing apparel, footwear industry	21,0
Wood processing, furniture and paper	6,9
Chemical industry	52,3
Non-metallic mineral products, building materials	12,8
Metal products, engineering, electro-technical apparatus and electronical equipment	27,0
Furniture industry	100

Source: Ministry of Economic Affairs of the Republic of Estonia

The engineering and metal industry, in contrast to the above industries, includes R&D-intensive actitivies. This industry could play an important role for the technological dynamics in Estonia because it also incorporates the inherited accumulation of absorptive capacity. The emerging absorptive capacities in the Estonian engingeering industry requires the privatization

of the remaining state-owned enterprises or other concepts for restructuring and modernization of the firms.

Both chemical and energy industries may include R&D-intensive branches of production, but these industries are still mostly or totally state-owned. These branches require, if not privatised, modernisation and restructuring measures in order to replace the old production methods and to guarantee future competitiveness.

4.2.3. Foreign Firms in Estonia

A key factor in Estonia´s industrial strategy is the dependence on foreign direct investment to support privatization and restructuring of the economy (Estonian Economy 1994/95, p. 30). Over the period 1988 to January 1994, total foreign investment amounted to 468 mio. US$. As a result, Estonia today belongs, with Hungary and the Czech Republic, to transition countries with the highest per capita foreign investment (Agarwal 1995, p. 3).

Foreign companies are expected to transfer advanced technology and Western management skills to Estonia, which will have a positive effect on the absorptive capacities of the Estonian economy. However, foreign companies are only a potential source of modern technology, or technological spillovers from abroad. The strength of such spillovers depends on in-house research in the foreign companies. No interfirm data is currently available, but the analysis of the foreign direct investment in various economic branches[11] provides preliminary information about the expected R&D activities of foreign companies.

[11] According to the concept of product life cycle

Table 7: Sectoral distribution of FDI (Stock) in Estonia, January 1994

Economic Sector	in %
Primary Sector	2,0
Manufacturing Sector	35,6
Food	13,9 (1)
Textiles, leather & wearing apparel	2,6
Wood, paper, printing	3,6
Chemicals	0,8
Non-Metallic production	8,2
Basic metals	0,8
Maschinery and.equipment, n.e.c..	1,1
Electrical equipment	2,0
Transport equipment	0,1
Services Sector	62,4
Construction	0,8
Trade	31,7
Hotels and restaurants	2,6
Transport	15,1
Financial intermediation	5,6

Source: Agarwal, J.P. 1995, p. 6; (1) includes tobacco

Table 7 shows that the FDI stock is concentrated in industries where R&D activities do not normally occur (for example the food industry and the production of non-metallics). The share of the service sector is remarkably high (62,4 %) with retail trade and transport being the most important sub-sectors. Investment in the service sector requires usually not only a relatively cheap and educated labour force, but also a functioning infrastructure in communication technology.

The analysis seems to point to rather low R&D activities of foreign companies in Estonia. However, for technological spill-over another type of channel is possible, since foreign companies do not always establish their own R&D departments: they can buy R&D services outside of the company, or they can utilize the R&D results of their mother company. The breakdown of FDI stock according to branches suggests, however, that these channels are of minor importance. Nevertheless, these preliminary findings about the low R&D intensity of foreign invesment do not lessen the other, positive effects on Estonia´s economy.

Not only the in-house R&D activites and R&D demand by the foreign companies are of importance for the technological and managerial spill-overs, but also the contact with domestic firms and the demand for domestic human capital. In order to strengthen the learning spill-overs by foreign companies in Estonia, contacts to domestic firms (for example due to contracting and demand for domestic input factors instead of imported goods) are necessary. In the same way, joint ventures and other forms of cooperation with Estonian firms are to be

prefered because such cooperations may have a positive influence on the learning of the domestic firms. This would raise the future absorptive capacities of Estonian firms.

5. Can a Technology-based Industrial Strategy Succeed in Estonia?

The results of the above analysis are not very encouraging for a technology-based industrial strategy in Estonia. Firstly, the emerging absorptive capacities have a very weak basis, because the enterprises in Estonia do not produced technologically sophisticated products and invest in R&D. The new or re-structured firms operating in the new market environment however induce such enterpreneurial competence which is equally important in a technology-based industrial strategy. Secondly, the usefulness of the inherited absorptive capacities for exploiting external sources of technology is not clear. The high share of the not-yet-privatised firms may prevent the use of the inherited absorptive capacities, if they have not been reorganized. Thirdly, the role of foreign companies is very important in the technology-based industrial strategy for Estonia. The sectoral allocation of the foreign companies indicates, however, that technological spill-overs into the Estonian economy do not exist, or are presently very low. These results are however preliminary, because firm- level information about the state and emergence of absorptive capacities in Estonia is not yet available.

Finally, there is a small number of new firms which were been founded by the former research staff. They produce competitive technologically sophisticated services and may continue to invest in in-house research. Such firms - even if small in number - utilize the inherited absorptive capacity and therefore support the future growth prospects in Estonia.

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