ETLA
ELINKEINOELÄMÄN TUTKIMUSLAITOS
THE RESEARCH INSTITUTE OF THE FINNISH ECONOMY
Lönnrotinkatu 4 B 00120 Helsinki Finland Tel. 358-9-609 900
Telefax 358-9-601 753 World Wide Web: http://www.etla.fi/

Keskusteluaiheita - Discussion papers

No. 700

Jari Hyvärinen

GLOBAL AND REGIONAL ASPECTS OF EU FOREST CLUSTER

ISSN 0781-6847

10.01.2000

Hyvärinen, Jari, **Global and Regional Aspects of EU Forest Cluster**, Helsinki: ETLA, Elinkeinoelämän Tutkimuslaitos, The Research Institute of the Finnish Economy, 2000, 28 p. (Keskusteluaiheita, Discussion Papers, ISSN; No. 700).

ABSTRACT: The local, regional, national and global production structure can be assorted in the EU forest cluster. International breakthrough is discovered in the pulp, paper and board industry as well as in the supporting and related industries such as in the pulp and paper machinery, consulting, forest chemicals, automation and information technology. National, regional and local sector are mainly such as construction, furniture, energy, forestry, packaging industry, printing industry and wood processing. Economic growth and the mobile factors of production have reached a new interest in the spread of information and technology, economic integration, clustering and mergers. The broad roles of EU forest cluster have been found in this paper. All countries are the paper and board producers. Technology developers are industries such as industrial chemicals, pulp and paper machinery, automation and information technology. These are located in countries such as Germany, UK, France, Italy, Netherlands, Belgium, Finland and Sweden.

KEY WORDS: globalisation, regionalisation, EU, forest cluster

---

Hyvärinen, Jari, **EU metsäklusterin globaalit ja alueelliset piirteet**, Helsinki: ETLA, Elinkeinoelämän Tutkimuslaitos, The Research Institute of the Finnish Economy, 2000, 28 s. (Keskusteluaiheita, Discussion Papers, ISSN; No. 700).

TIIVISTELMÄ: Paikalliset, alueelliset, kansalliset ja globaalit tuotantorakenteet voidaan erotella EU:n metsäklusterissa. Kansainvälinen läpimurto on tehty sellu- ja paperi-, ja kartonkiteollisuudessa sekä tuki- ja lähialoilla kuten sellu- ja paperikoneissa, konsultoinnissa, kemikaaleissa ja automaatio- ja informaatioteknologiassa. Kansalliset, alueelliset ja paikalliset alat ovat enemmänkin rakentamisessa, huonekaluissa, energiassa, metsänhoidossa, pakkausteollisuudessa, painoalalla ja puunjalostuksessa. Talouskasvu ja mobiilit tuotannontekijät ovat saavuttaneet entistä suuremman merkityksen informaation ja teknologian leviämisessä, talouksien integroitumisessa, klusteroitumisessa ja fuusioitumisessa. EU metsäklusterin väljät roolit on selvitetty paperissa. Kaikki maat ovat paperin ja kartongin valmistajia. Teknologian kehittäjiä ovat alat kuten teollisuuskemikaalit, sellu- ja paperikoneet ja muu alaan liittyvä konepajateollisuus, automaatio- ja informaatioteknologia, jotka sijaitsevat maissa kuten Saksa, Iso-Britannia, Ranska, Italia, Hollanti, Belgia, Suomi ja Ruotsi

AVAINSANAT: Globalisaatio, alueellistuminen, EU, metsäklusteri

Contents

EXECUTIVE SUMMARY

EU forest cluster sales are on average EUR 400 billion and the cluster employs around 4 million people. The behaviour of regional clusters can be noticed. The cluster branches have created the demand to the input of the other branches, which has encouraged the cluster companies to invest in, factories or distribution centres in the regions, thus being able to develop a stronger cluster, by supporting each other.

The EU forest cluster utilises both absolute and comparative advantages in international trade, in which case each region has concentrated on products in which it has either an absolute or at least a comparative advantage compared to other regions.

The concepts of local, regional, national and global production are determined in this report. The international breakthrough can be found in the pulp, paper and paperboard industry as well in supporting and related industries as machinery and equipment, consulting, chemicals, automation and information technology. The national, regional and local dimensions are clearer in sectors such as construction, furniture, energy, forestry, printing and packaging, and wood processing.

Marginal return and costs play the central role in the EU forest cluster in finding an optimal level of production. The positive effects of the emerging global economy are seen in the areas with strong competitive advantages, which are also highly developed technologically.

World output of paper and paperboard totalled 301 million tonnes in 1998. The European and especially the Scandinavian paper industry has concentrated more on high-quality printing and writing grades.

Economic growth and the mobile factors of production have aroused new interest through the spread of information and the technology, economic integration, and the cluster and merger activity of corporations. In 1998, comparing the 10 largest forest industry companies in the world, the European biggest companies had a 25% share of turnover

The broad roles of EU forest cluster countries are discovered in report. All the EU cluster countries are paper and board makers. The technology developers, in areas such as industrial chemicals, machinery, automation and information technology and energy, are located in countries such as in Germany, United Kingdom, France, Italy, Netherlands, Belgium, Finland and Sweden.

Almost all European countries have research institutes concentrating on pulp and paper research. The largest organisations measured in man-years are KCL in Finland, PIRA in the UK, STFI in Sweden and CTP in France.

The European printing industry covers thousands of small printing and publishing houses located around Europe. The main cluster players as printers and publishers are in Germany, UK, France, Italy, Spain, Netherlands and Greece.

Wood and furniture workers form a large SME sector and the biggest sawmill and furniture factories are mainly located in Germany, Italy, Austria, Denmark and Portugal.

The packaging industry is also a significant client for the European paper and board industry, since it purchases on average 35-40 per cent of total European paper and board production. The companies are located all around Europe, but the main user country is Germany, which consumes approximately one third of all European paper and board packaging by value.

YHTEENVETO

EU metsäklusterin liikevaihto on noin 400 miljardia euroa ja se työllistää noin 4 miljoonaa ihmistä. Klusterissa on myös alueellisia pienempiä klustereita. Klusteriin kuuluvat toimialat ovat luoneet kysyntää keskenään, joka on lisännyt alueiden investointeja vahvistaen klusterin dynamiikkaa ja keskinäistä tukemista.

EU metsäklusteri hyödyntää sekä absoluuttisia ja suhteellisia etuja kansainvälisessä kaupassa. Täten alueet ovat keskittyneet tuotteisiin, joilla on joko absoluuttinen tai vähintään suhteellinen etu verrattaen muihin alueisiin.

Paikalliset, alueelliset, kansalliset ja globaalit tuotantorakenteet voidaan erotella EU:n metsäklusterissa. Kansainvälinen läpimurto on tehty sellu- ja paperi-, ja kartonkiteollisuudessa sekä tuki- ja lähialoilla kuten sellu- ja paperikoneissa, konsultoinnissa, kemikaaleissa ja automaatio- ja informaatioteknologiassa. Kansalliset, alueelliset ja paikalliset alat ovat enemmänkin rakentamisessa, huonekaluissa, energiassa, metsänhoidossa, pakkausteollisuudessa, painoalalla ja puunjalostuksessa.

Marginaalituotoilla ja kustannuksilla on keskeinen asema EU metsäklusterissa, jolla optimaalinen tuotannontaso saavutetaan. Myönteiset vaikutukset on havaittavissa aloilla, joilla on vahva tekninen osaaminen globaalissa kilpailussa

Maailman paperin ja kartongin tuotanto saavutti 301 miljoonan tonnin rajan vuonna 1998. Sanomalehtipaperin tuotantoa on siirretty entistä enemmän lähelle kuluttajia. Osaltaan siksi Pohjoismaissa paperin tuotanto keskittyy entistä enemmän korkealaatuisiin paino- ja kirjoituspapereishin.

Talouskasvu ja mobiilit tuotannontekijät ovat saavuttaneet entistä suuremman merkityksen informaation ja teknologian leviämisessä, talouksien integroitumisessa, klusteroitumisessa ja fuusioitumisessa. Vuonna 1998 Euroopan metsäyhtiöillä oli 25 % osuus liikevaihdosta maailman 10 suurimman metsäyrityksen vertailussa.

EU metsäklusterin roolit on selvitetty paperissa. Kaikki maat ovat paperin ja kartongin valmistajia. Teknologian kehittäjiä ovat alat kuten teollisuuskemikaalit, sellu- ja paperikoneet ja muu alaan liittyvä konepajateollisuus, automaatio- ja informaatioteknologia, jotka sijaitsevat maissa kuten Saksa, UK, Ranska, Italia, Hollanti, Belgia, Suomi ja Ruotsi.

Lähes kaikissa EU-maissa on T&K-keskuksia. Miestyövuosilla mitattuna suurimmat ovat KCL Suomessa, PIRA UK:ssa, STFI Ruotsissa ja CTP Ranskassa.

Euroopan painoala sisältää tuhansia painotaloja ja merkittävimmät maissa kuten Saksa, Iso-Britannia, Ranska, Italia, Espanja, Alankomaat ja Kreikka. Puunjalostus ja huonekalut ovat myös suuri P&K-sektori. Tehtaat sijaitsevat pääosin Saksassa, Italiassa, Itävallassa, Tanskassa ja Portugalissa. Pakkausteollisuus on tärkeä asiakas kartonkiteollisuudelle käyttäen 35-40 % Euroopan paperi- ja kartonkiteollisuuden tuotannosta. Suurin asiakas pakkausteollisuudessa on Saksa, joka käyttää kolmanneksen Euroopan paperin ja kartongin tuotannosta.

Global and Regional Aspects of EU Forest Cluster

Jari Hyvärinen[1]

1. Introduction

In general, Europe, the United States, Japan or the OECD countries are regions which are "main players" when we consider the role of the regional versus the global economy. Trade in goods and services between these trade blocks has been liberated during various rounds of international trade has dramatically increased during the past few decades. Moreover, the most important trading partners are either neighbouring countries or those belonging to the core group of the industrial countries where international trade has played a significant historical role. Consequently, the EU forest cluster has a significant role in this development. The globalisation process has made possible the present-day wealth of these industrial countries and in consequence increased the GNP while at the same time regional inequality of income levels have diminished.

The conversion of regional income also has its roots in what are called "external effects." In a certain region, one large international forest cluster corporation may begin to develop subcontracting co-operation with machinery and equipment, packaging, chemical or automation and information technology companies in the region or with the small and medium-sized companies such as printing houses or sawmills in neighbouring regions. In the course of the co-operation the companies learn the pressure of international competition, while at the same time the viability of the region rises in terms of salaries and other factor compensations. The growth of workers' consumption spreads prosperity to other fields of industry and especially to service branches, which are usually local or regional companies. The external effects also create new potential for smaller regional cluster companies to enter the international market and at the same time open the region to international competition. Thus the external effects are created at the regional level, in the so-called "regional clusters" which Porter (1991) emphasises. This implies that in the regional politics the evolution of regional clusters should be supported, among other things. According to Porter, regional policy will be more effective if it follows the principle of developing of the cluster, in which the different relating and supporting industries are in a central position.

[1] This paper is a part of EU Forest Cluster Project. I am thankful for comments from Colin Hazley and Pertti Laine. I also appreciate comments received from Forest Cluster Project supervisor group. Comments: jari.hyvarinen@forestindustries.fi

This view of regional clusters also emphasises the significance of education and skilled employees with advanced competencies in technology. The availability, price and quality of productive factors are of crucial significance for competitive advantage at both the cluster and the company level. Some of the factors are inherited as in the form of local resources, climate and infrastructure. Some can be created by investing in human and physical capital: in digital data communications network, to efficient energy management, to high-quality universities and research laboratories, in specialised training for the sector, in production plants and so on. The more specialised and more developed the factors of production, the more difficult it is for the competing countries or regions to imitate them. These factors in particular which are "difficult to copy" are the source of long-term competitive advantage.

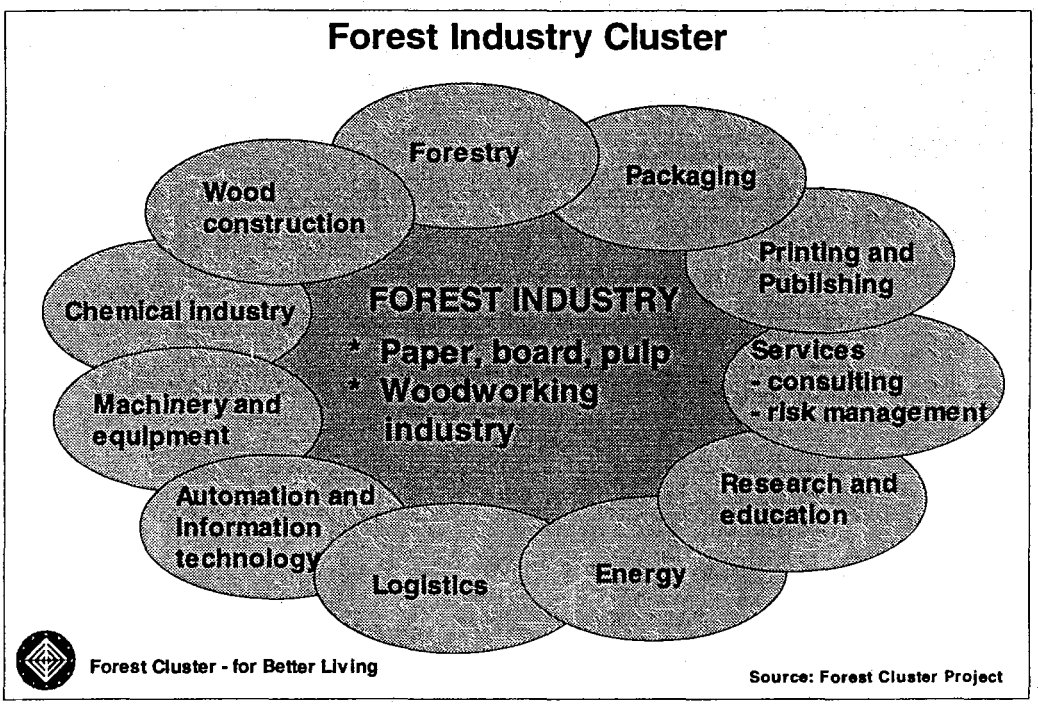
According to the regional cluster view, one branch has created demand for the input of the other branches, which in turn has encouraged these companies to invest in factories or distribution centres in the region, thus being able to develop into a stronger cluster and support each other. Geographically located clusters are built on a strong basic industry or industries. However, there must be a "certain critical mass of companies" so that the cluster can gain ground in the international competition. Porter (1991) classifies the effects which result from the following innovations and may lead to competitive advantage: *i)* new technology in use can lead to cost advantages or increase the surplus value accruing to the customer from the product ii) the buyers' needs can change; iii) the "first in the market place" breaking into a new market gain clear advantages compared to the companies which enter it later; iv) changes in the chosen market segments or choice of new segments. Dunning (1993) agrees that certain regions have a driving force increasing the activities first in the neighbourhood regions and on a global scale. By this, Dunning is referring to wider regions, and the way in which the growth of industrial countries spreads into developing countries. Similarities to the localisation studies of Krugman can be found in this view.

2. What is the EU Forest Cluster?

The industry's competitive advantages can be analysed by clustering sectors which are in co-operation with the forest industry. The vast bulk of capital goods are purchased when the industry launches investment programmes - such as paper machines, recovery boilers, grinders, refiners, forest machines and many other kinds of machinery and equipment. These items play a significant role in the mechanical engineering industry's output. The inputs of com-

panies in other sectors, such as chemicals manufacturers, service producers and the contributions of research institutes and universities have likewise helped to make the European forest cluster the integrated and competitive entity what it is today. Furthermore, consulting firms have increasingly enhanced the cluster's competitive advantage. The effectiveness of this entity is further strengthened by such features as its advanced technology in the field of energy in general, and more specifically in electricity generation, automation and information technology as well as logistics.

Figure 1.



According to estimates, the EU forest cluster sales are on average EUR 400 billion and the cluster employs around 4,2 million people (table 1). The EU forest cluster is both research and technology intensive and environmentally sound, based as it is on sustainable forestry, recycling, and the function of forests as carbon sinks. Advanced technology is therefore used throughout the chain. Employees in EU forest cluster can reach the highest level of expertise and enjoy challenging job opportunities.

Table 1

Comparison of EU Industries

bill. EUR in current prices 1995

	Production	Employment (thousands)	Extra-EU exports	Production av. growth 1985-1994
Chemicals	357,7	1599	66,6	2,8
Pulp, paper and paperboard	49,4	183	8,2	2,7
Wood processing	54,2	482	3,5	3,7
Printing and publishing	89,6	818	4,7	1,3
Mineral oil refining	137	101	7,6	3,6
Metal products	216,1	2133	17,8	2,2
Machinery and equipment	329,7	2394	91,5	0,7
Electronic engineering	211,7	1377	51,5	4,9
Electrical machinery	117	1128	26,6	3,5
EU forest cluster	399	4200	20,5	-

Sources: Panorama of EU Industry 1997, EU Forest Cluster Project database, OECD, ETLA

Table 2

World population and paper consumption

	Population mill.	% of population	% of paper production	% of paper consumption	Consumption / capita kg	Production/ capita kg
W. Europe	386	6,6	26,5	24	184	205
- Nordic Countries	21	0,4	8,2	1,6	222	1166
- Other W. Europe	365	6,2	18,3	24,4	181	150
E. Europe	417	7,1	2,8	2,7	19	20
N. America	299	5,1	35,3	32,5	323	352
Latin America	489	8,4	4,5	5,7	34	27
Asia	3483	59,7	28,9	32	27	24
Other	764	13,1	2,0	2,7	11	8
WHOLE WORLD	5838	100,0	100,0	100,0	51	50

Source: PPI

3. Dimensions of Growth, Trade and Competitive Advantage in the EU Forest Cluster

3.1 Some Aspects of Economic Growth and Competitive Advantage

There is greater economic growth in regions which possess special competitive advantages. Economic growth does not necessarily continue ad infinitum while in the examination of scale effects and of diminishing returns, the conclusion has been reached that, in the long run, returns on capital dwindle and the nation's growth begins to slow down after a certain stage of prosperity.

Growth of population and the education level, and in particular, changes in technological development, have affected economic growth through the specialisation of the labour, the re-organisation of production and the innovation of new products. Therefore, marginal return and costs are the central factors in the effort of the EU forest cluster to find an optimal level of production.

Each of these factors has had its own effect during different periods of time leading to the strengthening or weakening of economic growth. Economic integration has led to a situation in which the division of labour between specific organisations deepens and the significance of internationalisation is emphasised.

Economic growth and the mobile production factors have groused new interest through the spread of information and technology, through economic integration, and the cluster and merger activity of corporations. The accumulation of capital in the forest cluster is worth studying. It is hardly explained by raw materials or the amount of the population of the country because, those countries, in particular, in which the supply of raw materials is scarce and the number of population is limited, have been successful in economic growth (Hernesniemi - Lammi - Ylä-Anttila 1995). It is better explained by the ability of the EU forest cluster to create new innovations and build well-functioning organisations. It is also attributed to the economic institutions which support affirmative social development.

In Solow's (1956) neo-classical growth theory, the growth of production was based on basic factors such as labour and capital. The regional growth described by the neo-classical theory has not been sufficient. In theory there are numerous restrictions, so the reasons for growth can not be explained. The

most central criticism has been directed against the significance of technology and of human capital as interpreters of growth. A new growth theory corrects these shortcomings by modelling the effects of human capital and technology, in particular. With Romer (1986), "the technology leaders" varied in every time period measured: during the last 200 years strong growth varied across countries, but the leading position measured by economic growth was dependent on technical progressiveness. Furthermore, in many studies it has been shown that productivity and production have a positive correlation. According Romer (1989) there is also a greater growth rate on the countries which have concentrated on research and development.

The convergence between economic growth and the development of technological intelligence is not independent by coincidence but the effect of competitive ability and market forces play the key role (Grossman and Helpman 1992), and this point is also worthy of further notice in the EU forest cluster. Those countries or regions in which favourable competition conditions exist are also the most progressive technologically. International trade and the economic integration add to the pressure which has been directed towards the development of technology and at the same time the exploitation of innovations. The technology is not national property "as a matter of course" and it spreads into other integrating countries (Romer 1991). Competition for the utilisation of technology increases through innovations, and imitation crosses the borders of national economies. These arguments are essential in the EU forest cluster and must be presented in the present globalisation. The positive effects of the emerging global economy are seen in the areas with strong competitive advantages and they are developed technologically. The technology becomes global and the pressure to create new innovations in conditions of market competition causes it to spread into other countries.

A new growth theory offers more realistic arguments, also for the EU forest cluster, in explaining regional development in the global economy. Knowledge can increase without limits and thus knowledge is one of the essential factors contributing to increased productivity in economy. Furthermore, education is not the only variable, but the organisations are needed which exploit the education and in which the education can be further refined in the form of R&D. Education is implemented both through public or private education and through learning at work (Lucas 1988). The quality of human capital (the participation in education, the ratio of pupils related to teachers) correlates positively with the growth of the income level. Low-income countries or regions reach higher-income countries or regions through education. However, the yield of education is not sufficient in those regions where there is already a

high level of education. Therefore, education above all benefits low-income regions. Furthermore, a high degree of investment is related to the gross national product on the countries which have a good education level (Barro 1991).

The exploitation of knowledge in the EU forest cluster cannot be seen only as factors in technological and economic development but also in the understanding of human values also, one's own society and other societies and cultures. The accumulating of human capital is interpreted as the people's "private human capital" and as human capital which has accumulated to the society (Stokey 1991). The choice of to train himself to a longer period the individual is an alternative cost of that lost salary which he or she would have got by the working life earlier. On the other hand, his or her knowledge reserve has increased after studying for a longer time in which case the student has exchanged his or her salary for a gaining a larger "store of knowledge". The choice of the individual to acquire special knowledge will thus create external effects: it expands the knowledge reserve of the society in question and increases the effectiveness of education

Productivity is increased by education and the marginal revenue of labour does not necessarily decrease. Likewise the addition of the new factor does not correlate directly with the growth of the production. The new machinery equipped with new technology can indeed increase production more than the earlier machinery, and scale effects and marginal revenues can grow likewise. The negative effect is that the regions which have a higher income level can continue their growth, while low-income regions become further impoverished.

It is reasonable to study these assumptions of the new growth theory in the regional development of the EU forest cluster. The significance of the trained population of a region is surely essential to regional development, and similarly, the concentration of certain technological know-how contributes its value added to this regional cluster. The migration of trained labour force adds to the know-how of the cluster and to productivity at the same time. The establishment of corporations in the region adds to clustering in the region and in particular external effects. These new standpoints serve to explain more comprehensively why the some regions manage better either on the regional or on the global market. To explain regional development in global process these created competitive advantages in particular, are needed to succeed in the wider market. From this broader point of view, the adequacy of regional resources must be examined, especially those in which the education and language skills, the versatility and readiness of the nation's education are primus motors for innovation and adoption new belief models in the EU forest cluster.

This examination includes the adequacy of R&D activities and the transfer, spread and adoption of the technology.

3.2 The EU Forest Cluster Regions in International Trade

The EU forest cluster has utilised both absolute and comparative advantages in international trade. Historically, the forest cluster regions have founded factories in places which were near large forest resources and where there was the possibility for transport via water routes. In each region there were certain resources with the help of which it breaks into the international market such as, for example, energy, raw materials, labour force, engineering and marketing skills. Later pulp and in particular paper mills have increasingly been located near the customers. The regions have traded forest-based goods and services among themselves, in which case each region has concentrated on production in which it has an absolute or at least comparative advantage compared to other regions.

According to the view of Hechsler-Ohlin, regions have concentrated on production for which they have the preconditions provided by already existing resources. If the region has been labour intensive, then it will concentrate on the branches of industry which require abundant labour in the area such as sawmills and furniture companies. Likewise the theorem has defined the areas which are capital intensive and in this case where pulp and paper mills as well as machinery and equipment works have been established.

The actual H-O theorem has explained that a nation has a certain comparative advantage and thus the export of products is based on the abundance of these factors of production. Therefore in the EU forest cluster, for example, countries such as Finland and Sweden export paperboard, pulp and paper products. This is not far from the concept of the competitive advantage where the region concentrates on products in which it has this kind of advantage. Hence, the differences between the old and new theories are crucial since the previous theories are based on immobile regional resources.

In the creation of the new competitive advantage the resources are mobile, which is both a challenge and a threat also in forest cluster. The employees move to find a job which matches their education, while other branches such as information technology compete for educated employees. Furthermore, capital moves in the international market to find the highest possible return on capital which causes pressure to raise cost and profit effectiveness within the cluster: technology attracts the best investment. These interpreters in the background of competitive advantage support the variables of the new growth the-

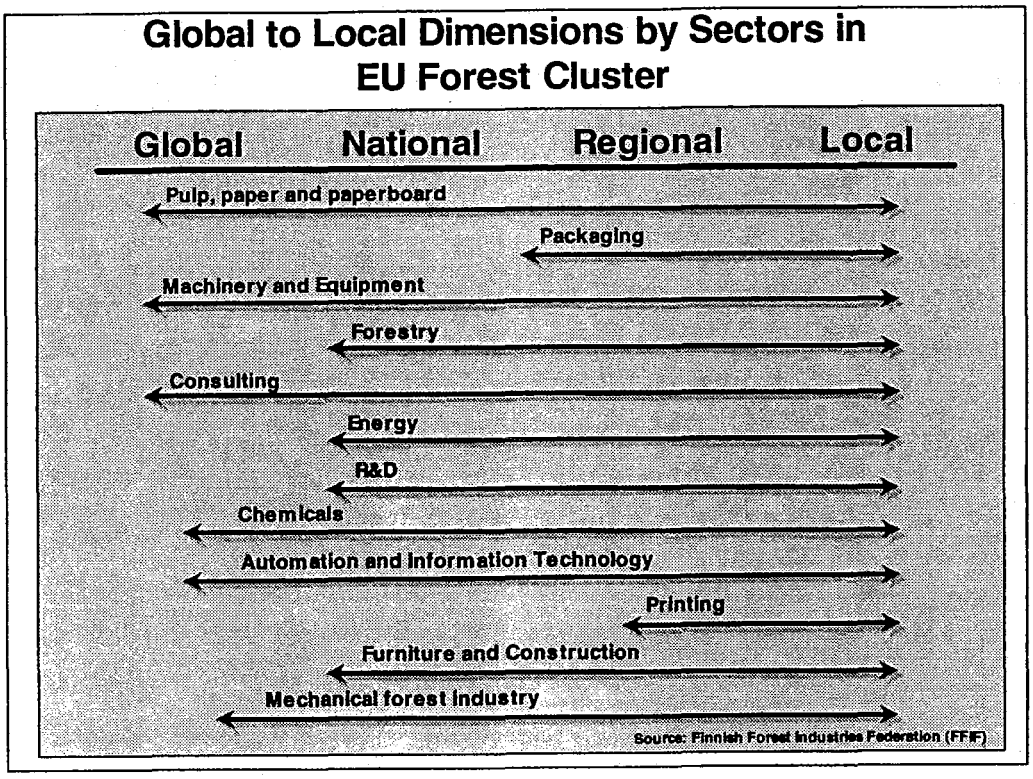
ory. In the areas of the strong economic growth, it is known that highly trained labour is found.

Dunning noticed that the global process also has connections with competitive advantage and the new trade theory. According to Dunning (1997 p 43), along with production resources - especially educated employees, capital, information and know-how - move more freely across national borders in the present global economy than earlier. These factors also have to be taken into account in the EU forest cluster. In political "national state" decision-making it cannot be assumed that the resources which create productivity and know-how are "tied to their regions."

According to Krugman (1991, 1996), international trade has been based on the external effects and on comparative advantage. These external effects have been more significant at a local and regional level than at the national level. The resources where competitive ability of an international level has been reached are found on a local and regional level. Krugman estimated that in connection with the expansion of international trade it is necessary to understand the concentrating effects in the local and regional production.

The connections between regional and the global economy in the EU forest cluster can be examined in relation to the forms of free trade (Timbergen 1965). Timbergen points out that demand remains local, regional and national even if the international trade increases. Figure 2 shows the broad definition of these levels within the cluster. This could be interpreted as meaning that before international breakthrough the entrepreneurs acted locally, as has happened in the pulp and paper industry, supporting and related industries such as machinery and equipment, consulting, chemicals, automation and information technology. When business activity and competition increased, the entrepreneurs moved to the wider market, however, in such a way that some of the entrepreneurs and products were supplied in local and national dimensions, such as construction, energy, forestry, printing and packaging.

Figure 2



3.3 Growth, International Trade and R&D in the EU Forest Cluster

The share accounted for by R&D of the turnover in the forest cluster industries is estimated so that R&D expenditures in wood and furniture are 0.7 and in pulp and paper around 1 per cent of the turnover. This result is satisfactory, although in the related and supporting industries the result is more encouraging. Pulp and paper machinery consumed approximately 4 per cent, forest electrical machinery 4-5 per cent and forest chemicals 5 per cent of turnover (Hyvärinen 1999).

Technology inputs are a central interpreter of regional wealth, and some main concerns can be taken account in the EU forest cluster. Firstly, for the conversion of the regional income levels, the diffusion of technology and information is a central interpreter. (Romer 1991, Barro and Sala-i-Martin 1995). Secondly, unemployment is not necessarily caused by technology. For example, unemployment is low in the United States and Japan, where R&D inputs are at the top level among the OECD countries (Pohjola 1996). However, a lower regional R&D input did not signify an improvement in the region but these re-

gions got help from more advanced regions. Thirdly, the driving force in core regions can influence that development in the declining regions, which will also become more affirmative. Employment and living conditions in the periphery can improve due to the effect of growth in the neighbouring region. Finally, the following factors (Okko 1996), among others, can affect the favourable development of the region: *i)* immobile resources such as an existing economic structure and location factors such as transport and other services, *ii)* The regional ability to keep and to attract mobile resources, including regional co-operation in relation to high productivity and to wage level, *iii)* regional preferences which affect the location decisions of consumers and entrepreneurs. However, environmental factors are not enough; the economy of the region must be able to create jobs, *iv*) technological development and growth of human capital. The industrial changes brought by the information society have affected the supply of labour decisively. These changes emphasises the significance of the human capital, especially.

Significant correlations have also been found between international trade and the R&D input. Fagerberg (1996) examines the relation of technology, competitive ability and foreign trade and finds that the higher the ratio of the R&D input is in relation to the GNP the stronger is the growth of market shares on the export market. The technology has its own share in the favourable development of exports in the long run. Three main foundations can be found: *i)* R&D and innovations have a distinct and important role in various industries, even if these are not the "technology leaders", *ii*) in the high technology fields, the size of the domestic market plays a significant role, and therefore R&D and innovations are important for retaining the competitive advantage both in large and in smaller countries; however, a small country can not lean only on one technology leader, *iii*) The diffusion of R&D to other companies and fields, as exploited in the EU forest cluster, is a significant factor for retaining new competitive advantages.

3.4 EMU and the EU Forest Cluster

The discussion about the European integration has divided the economists into two camps (Martin and Sunley, 1996). It is suggested primarily that free mobility of goods, services, capitals and citizens together with Economic and Monetary Union (EMU) would lead to a narrowing of regional differences. This must also be noted in the EU forest cluster. Regional integration would not only be seen as the approaching of the factor income and of economic effectiveness but the changes would take place also in the structure of the economy. The labour existed in the less productive level and in the regions of low

growth it is estimated that freeing of the mobility of trade in the internal market will increase the effects of the future comparative advantage. At the same time, it is believed that the decrease in deregulation will increase direct investments and capital movement. On the other hand, there have been proposed the sceptical estimates that because of the economic integration, the regional income indifferences will increase. Doubts have been expressed that companies and the direct foreign investments would seek their way to regions of cheap labour and weak growth in the internal market. According to this view, it is estimated that the breaking down the trade barriers will expand economic activity in those regions in which the productivity is high and growth is already strong, since these regions already enjoy a higher comparative advantage. They have already broken down the barriers to entry and they have a strong ownership of the factors, the special know-how and an infrastructure that supports companies' needs.

The effects of EMU on the production structure have also been assessed. According to Krugman (1991), monetary union will increase the need for specialisation. Also, the industrial structure in the various member countries could change decisively. Comparing the structure of production in regions of the EU and the United States, it can be found that in the US states there are considerably more specialised production structures than in EU member states (Krugman 1991). "The EMU effect" could increase the need for more specialisation, also inside the EU forest cluster. In European economic integration, regional concentration would be more distinctly emphasised and high-level production mergers would be possible. It is credible that every EU member country will certainly want to retain a versatile production level in order to hedge against possible crises.

The connection between the stages of international trade and the EU forest cluster activities can also be analysed from the growth point of view by Schumpeter (1934). A basic message of Schumpeter was that when business activity increases, the entrepreneur will not survive alone but by creating new contacts with new interest groups. When a business expands, the resources of the company must increase in harmony with international competition. Therefore, the company must optimise the transaction costs by expanding the income gained from the growth of firm. When a business increases from the local and regional to the international or global scale, the cluster may need new competitive advantages to compete in the international market. The new competitive advantages must be created by education and co-operation in forms which expand value added and guarantee a competitive future.

4. Global and Regional Roles of the EU Forest Cluster

4.1 The Regional Role of the Cluster in the Pulp and Paper Industry

The World output of paper and paperboard totalled 301 million tonnes in 1998. North America's share of this was over a third and the EU produced at least a quarter. Asia's share of global production accounted for 30 %. The EU forest cluster is a particularly important player as a producer of paper and paperboard and its share is 25 % of world's total paper and paperboard production (table 3).

The World's printing and writing grades together account for a 30% share of the world output of paper and paperboard. The share of newsprint is 12%. The European and especially the Scandinavian paper industry have concentrated more and more on high-quality printing and writing grades. The European share of world production of these papers is 33% and therefore almost the same as that of North America.

Table 3.

World Paper and Board production by Region

1998 (1000 tons)

Region	Newsprint	%	Printing & Writing	%	Packaging and other P&B	Total %	P&B	%
EU	8792	24,2	29837	33,1	38919	22,3	77548	25,8
Other W. Europe	1221	3,4	1296	1,4	1334	0,8	3850	1,3
Total W. Europe	10014	27,6	31132	34,6	40253	23.0	81399	27
East Europe	1742	4,8	1813	2.0	5291	3.0	8846	2,9
Total Europe	11756	32,4	32946	36,6	45544	26,1	90245	30
N. America	15084	41,6	29334	32,6	60160	34,4	104578	34,7
Asia	7159	19,7	23302	25,9	55499	31,8	85948	28,6
Australasia	834	2,3	436	0,5	2107	1,2	3377	1,1
Latin America	1069	2,9	3366	3,7	9432	5,4	13867	4,6
Africa	358	1.0	654	0,7	1983	1,1	2996	1
Total	36260	100	90039	100	174713	100	301011	100

Source: PPI

In the mechanical wood industry, more than 400 million cubic metres of sawn timber are used world wide annually 75% of this being softwood species. North America and Russia are the biggest producers of softwood lumber and also its biggest consumers. Their combined share of consumption is around 70%. Japan also uses large quantities of sawn timber. North America produces nearly a half of the world's softwood lumber (145 million cubic metres) and Asia 50 million cubic metres. The EU is second biggest producer of this wood by 70 million cubic metres production. In plywood, the biggest producer is Asia with 29 million cubic metre, and second North America with 17 million cubic metres. The EU is a third biggest plywood producer and far behind Asia and North America with 3 million cubic metres.

The biggest paper and paperboard user is North America, which consumes over a third or 98 million tonnes of the 301 million tonnes produced world wide each year. In 1998, the European Union consumed 70 million tonnes and Asia around 92 million tonnes respectively. These three regions thus account for around 90 % of world consumption. Western Europe consumed 10 million tonnes of newsprint the same year and about 31 million tonnes of printing and writing grades. Thus the total demand for graphic papers came to nearly 41 million tonnes. When the 10 biggest producers and consumers are compared in printing and writing papers, then on the production side there are five EU forest cluster countries - Germany, Finland, Sweden, France and Italy. On the consumer side the main EU countries are Germany, the United Kingdom, France, Italy and Spain (table 4).

Table 4.

The World's Top 10 Producers and Consumers

1998 (1000 tons)

Printing & Writing Production

Country	1998	% change 98/97
1. USA	85855	-0,4
2. Japan	29888	-3,7
3. China	27800	1,3
4. Canada	18723	-1,3
5. Germany	16310	2,4
6. Finland	12703	4,6
7. Sweden	9880	1,3
8. France	9161	0,2
9. Italy	8245	2,7
10. Korea	7750	-7,3

Printing & Writing Consumption

Country	1998	% change 98/97
1. USA	90953	1,5
2. China	32892	0,6
3. Japan	29989	-4,5
4. Germany	16855	4,5
5. UK	12477	2,1
6. France	10681	3,4
7. Italy	9919	3,1
8. Canada	7306	9,7
9. Brazil	6211	0,7
10. Spain	6072	8,4

Source: PPI

4.2 Regional Behaviour of Pulp and Paper Companies in the Global Production Environment

The corporate composition of the sector has changed in general, but especially in the European forest cluster paper industry, where the ten biggest companies' aggregate share of capacity has increased from 20 to 50% in the past two decades. In Japan and North America, a similar development already took place in the 1970s.

With the aims of maintaining competitiveness, gaining economies of scale and lowering unit costs, companies have increased in size and merged their operations. A further factor behind increasing company size is the sheer scale of investment projects; for example, a paper mill costs about 420 million EUR ($450 million). In the European forest cluster, company size grew substantially in the 1980s and 1990s. In 1998, the biggest European forest industry companies had 25 % share of turnover compared with the 10 largest forest industry companies in the world (table 5). As a result of the merger trend, European forest producers are nowadays among the biggest in the world.

Table 5.

Main forest industry companies
Forest industry turnover 1998, mill.USD

Europe	mill.USD	World	mill.USD
1. Stora Enso	9732	1. International Paper	24044
2. UPM-Kymmene	8203	2. Kimberly-Clark	12298
3. SCA	7500	3. Weyerhauser + MacMillan	11411
4. Jefferson Smurfit Group	4126	4. Stora Enso	9732
5. Metsäliitto	3406	5. Georgia-Pacific	8890
6. AssiDomän	3018	6. Nippon Paper	8579
7. Arjo Wiggins Appleton	3000	7. UPM-Kymmene	8203
8. MoDo	2390	8. Oji Paper	7870
9. Norske Skog	1975	9. Smurfit-Stone Container	7731
10. Ahlstrom	1628	10. SCA	7500

SOURCE: Paperinfo, July 1999

The effects of the dynamics of cluster company strategies and regional production are the background of the regional industrial and economic structure (Asheim and Dunford 1997). Regional growth is the background in local or global production. International and global production are then seen from a different point of view. International production includes all operation which takes place outside the limits of the national economy, whereas globalisation takes a deeper dimension in which the integration has a more evident geographical role.

In the EU forest cluster, globalisation has been influenced by the big multinational companies and as the result of international competition. The structure of global production creates a significant change in the integration of the production in the world economy. In the earlier stages of globalisation, it was the national states that increased the integration of the world economy (for example commercial and competition policy) whereas in the latest stage of globalisation the changes has been transferred through multinational companies. The localisation of companies can change regional vitality rapidly through mergers and acquisitions. Also, the role of SME's as, for example, in sawmills or printing houses has changed so much that the technologically more advanced companies face financing problems through the growth of their R&D inputs, and financial safety is sought through acquisitions of pulp and paper corporations.

According to Morgan and Cooke (1994), the strategies of small and medium-sized companies have become more aggressive than before and also more flexible, when they serve as subcontractors of the large-scale enterprises. The flexibility of these SME's changes the behaviour of large-scale enterprise making them also more flexible. This behaviour can be found also from the EU forest cluster. According to Lundvall and Johnson (1994), this kind of a "learning organisation" is significant in R&D companies, in which the competitive advantages can be better exploited. The innovation process itself is tied up with the institutional background and the environment of the economic culture of the region. The human capital is therefore an important location factor and it also restricts the transfer of the company, for example, to the cheap labour countries.

There has been a significant change in the relative significance of the different costs which affect the localisation of investment in companies. Particularly the cost advantages which are related to the poorly educated labour and to the raw materials have lost their significance. Meanwhile, the availability of trained la-

bour, R&D, transport and a communication infrastructure have correspondingly become more significant factors in the EU forest cluster.

4.3 Regional Roles in EU Forest Cluster

The EU forest cluster is the world's third biggest paper and paperboard producer. The largest producers in the EU are Germany, Finland and Sweden, whose output exceeded 38 million tonnes in 1998 and 50% of total EU paper and board production (table 6). France, Italy and United Kingdom are likewise major producers, but export only a small percentage of their output. The main pulp producers are Finland and Sweden, which produce 66% of total EU pulp production.

Table 6.

Paper and Pulp Production in EU Forest Cluster
(1998)

(1000 tons)	Newsprint	Printing & Writing	Paper and Board	Pulp
Finland	1483	7700	12703	11355
France	923	3101	9161	2677
Germany	1630	6452	16310	1950
Sweden	2478	2545	9880	10541
Italy	190	2780	8245	585
Austria	376	2003	4009	1650
UK	1043	1767	6476	584
Portugal	0	551	1136	1708
Belgium	117	986	1545	381
Netherlands	349	875	3180	127
Spain	192	884	4196	1620
Denmark	0	105	344	68

Source: PPI

In the EU forest cluster, the biggest paper and pulp exporters are Finland and Sweden (table 7). Finland is export-oriented especially in printing and writing papers, with nearly 90% of output going abroad to customers. As a newsprint and pulp exporter Sweden has the leading role compared to other EU countries.

Table 7.

Paper and Pulp Exports in EU Forest Cluster
(1998)

(1000 tons)	Newsprint	Printing & Writing	Paper and Board	Pulp
Finland	1199	7360	11343	1642
France	578	1858	4288	416
Germany	561	4131	7448	342
Sweden	2071	2081	8034	2787
Italy	5	950	2242	17
Austria	265	1862	3286	286
UK	192	510	1410	18
Portugal	0	449	693	1037
Belgium	45	795	1053	132
Netherlands	240	866	2406	150
Spain	38	518	1221	744
Denmark	0	90	223	60

Source: PPI

While EU forest cluster includes both forest-based industries and also significant related and supporting industries, such as energy, chemicals, machinery, construction, printing and publishing and logistics, then it is obvious that these industries have some specific regional or country roles.[2] The forest industry roles are grouped as *i)* paper and board maker and *ii)* wood and furniture worker. The second group includes the function of developing technology in related and supporting industries, such as machinery, chemicals energy and research and development companies. Therefore, the roles are *iii)* technology developer and *iv)* printer and publisher.

Using this classification, all the EU cluster countries are paper and board makers. The biggest companies are UPM-Kymmene, Stora-Enso, Metsä-Serla and Ahlström of Finland, SCA, AssiDomän, and MoDo of Sweden, Jefferson Smurfit Group of Ireland and Arjo Wiggins Appleton of United Kingdom, whose production capacity is spread over Europe.

[2] This description of country roles is based on the mimeo "Roles in the European Forest Cluster" composed by Jaakko Pöyry Group (November 23, 1998).

The technology developers, in this case, called related and supporting industries, give a strong R&D input to the cluster. These are areas as industrial chemicals, machinery, automation and information technology and energy. These sectors are located in countries such as Germany, the United Kingdom, France, Italy, the Netherlands, Belgium, Finland and Sweden. The main machinery producers are, for example, Ahlström Machinery and Metso from Finland, Beloit from the U.S. and the Swiss-German Voith Sulzer group. In harvesting and forwarding the principal manufacturers are Timberjack and Ponsse from Finland and Partek in Sweden. Other machinery companies in the EU forest cluster include, for example, Celli A. in Belgium, Bon Engineering AB and Tremcel AB and Malux Electro AB in Sweden, McLean & Gibson Ltd. and Parsons & Whittemore Lyddon Ltd in the UK, ABB Industry Oy and Larox in Finland[3]. The principal chemicals producers include, for example, Raisio Chemicals and Metsä Specialty Chemicals of Finland, EKA Chemicals of Sweden and BASF of Germany. Other forest chemical companies are such as Barentz BV and MAF Magnesite BV in Netherlands, Blagden Chemicals and Clariant UK Business Unit Paper Ltd in UK, Produtec Foughton SA and Seppic in France, BK Ladenburg GmbH and Degussa AG in Germany and B&C Electronics Srl in Italy [4]. The most significant group of paper chemicals is fillers and coating pigments, such as clay, calcium carbonate and talc.

Almost all European countries have research institutes concentrating on pulp and paper research. The largest organisations measured in man-years are KCL in Finland, PIRA in the UK, STFI in Sweden and CTP in France.[5]

The European printing industry covers thousands of small printing and publishing houses, which are located around Europe. The main cluster roles as a printer and publisher are in countries such as Germany, the UK, France, Italy, Spain, the Netherlands and Greece.

Wood and furniture workers form a large SME sector and the biggest sawmill and furniture factories are mainly located in Germany, Italy, Austria, Denmark and Portugal.

The packaging industry is also a significant client for the European paper and board industry, since it purchases on average 35-40 per cent of total European paper and board production. The companies are located all around in Europe,

[3] A reference to Phillips International Paper Directory, see more information for publication
[4] A reference to Phillips International Paper Directory, see more information for publication
[5] Eriksson (1997)

but the main user country is Germany, which consumes approximately one third of all European paper and board packaging by value. In Europe, the main packaging sectors by end-use are food (46%), beverages (24%), household products (18%), and personal care (12%) (Hyvärinen 1999).

Consulting services have played an increasingly crucial role in the EU forest cluster. The knowledge of consultant enterprises co-operating with universities and research institutes, engineering and information technology companies and pulp and paper enterprises constitutes a globally competitive advantage for the European forest cluster (Hyvärinen 1999).

5. Conclusions

EU forest cluster sales are on average EUR 390 billion and the cluster employs around 4 million people. It includes industrial products such as paper machines, recovery boilers, grinders, refiners, forest machines and many other kinds of machinery and equipment. The inputs of sectors such as chemicals manufacturers, service producers and the contributions of research institutes and universities have likewise helped to make the European forest cluster the integrated and competitive entity it is today. Furthermore, consulting firms have increasingly enhanced the cluster's competitive advantage. According to the regional cluster view, one branch of industry has created the demand for the input of the other branches, which has encouraged these companies to invest in factories or distribution centres in the region, thus enabling them to develop into a stronger cluster through reciprocal support.

The EU forest cluster utilises both absolute and comparative advantages in international trade. Historically the forest cluster regions founded factories in places which were near large forest resources and where there was the possibility of transport via water routes. Later, pulp and paper mills have increasingly located close the customers. The regions traded in forest-based goods and services among themselves, with each region concentrating on products in which it has either an absolute or at least a comparative advantage compared to other regions.

The export of products by comparative or competitive advantage is based on the abundance of factors of production. Therefore, the EU forest cluster countries, such as Finland and Sweden, export paperboard, pulp and paper products.

The concept of local, regional, national and global production is considered in the EU forest cluster. The international breakthrough can be found in the pulp, paper and paperboard industry as well as in supporting and related industries such as machinery and equipment, consulting, chemicals and automation and information technology. The national and local dimensions are more clearly seen in industries such as construction, energy, forestry, printing and packaging.

Marginal return and costs play a central role in the EU forest cluster in finding an optimal level of production when the growth of population and the education level, and in particular, changes in technological development have affected economic growth through the specialisation of labour, the new organisation of production and the innovation of new products. The convergence between economic growth and the development of technological intelligence is not independent and also worth of further noticing in the EU forest cluster. The competition for the utilisation of technology increases through the innovations, and imitation crosses the boundaries of national economies. These arguments are essential in the EU forest cluster and should be presented in the present globalisation. The positive effects of the emerging global economy are seen in the areas with strong competitive advantages and they are developed technologically.

The world output of paper and paperboard totalled 301 million tonnes in 1998. EU forest cluster is a particularly important player as a producer of paper and paperboard and its share is 25% of the world's total paper and paperboard production. The European and especially the Scandinavian paper industry has concentrated increasingly on high-quality printing and writing grades. The European share of world production of these papers is 33% and thus almost the same as that of North America. The EU is second biggest producer in the world of the softwood lumber with 70 million cubic metres production and the third largest plywood producer totalling 3 million cubic metres, but far behind Asia and North America.

The biggest paper and paperboard user is the North America, which consumes over a third or 98 million tonnes of the 301 million tonnes produced world wide each year. In 1998, the European Union consumed 70 million tonnes and Asia around 92 million tonnes respectively. Thus these three regions account for around 90% of world consumption.

The economic growth and mobile factors of production have aroused new interest through the spread of information and the technology, economic integration, and the cluster and merger activity of corporations. The accumulation

of capital in the forest cluster is worth studying. With the aims of maintaining competitiveness, increasing economies of scale and lowering unit costs, companies have increased in size and merged their operations. In the EU forest cluster, globalisation has been influenced by the large multinational companies and as the result of international competition. The structure of global production creates a significant more towards integration of production in the world economy. Furthermore, the flexibility of SMEs change the behaviour of large-scale enterprises, making them also more flexible. This behaviour can also be found from the EU forest cluster. This kind of "learning organisation" is extremely important in R&D companies, in which competitive advantages can be better utilised.

As the EU forest cluster includes both forest-based industries and also significant related and supporting industries such as energy, chemicals, machinery, construction, printing and publishing and logistics, it is obvious that these industries have some specific regional or country roles. Using this classification of roles the all EU cluster countries are paper and board makers. The technology developers give a strong R&D input to the cluster. These are areas such as industrial chemicals, machinery, as well as automation and information technology and energy. These sectors are located in countries such as Germany, the United Kingdom, France, Italy, the Netherlands, Belgium, Finland and Sweden. Almost all European countries have research institutes concentrating on pulp and paper research. The largest organisations measured in man-years are KCL in Finland, PIRA in the UK, STFI in Sweden and CTP in France. The European printing industry covers thousands of small printing and publishing houses, which are located around Europe. The main cluster roles as printer and publisher are in countries such as Germany, UK, France, Italy, Spain, the Netherlands and Greece. Wood and furniture workers form a large SME sector and the biggest sawmill and furniture factories are mainly located in Germany, Italy, Austria, Denmark and Portugal. The packaging industry is also a significant client for the European paper and board industry, since it purchases on average 35-40 per cent of total European paper and board production. The companies are located all around in Europe, but the main user country is Germany, which consumes approximately one third of all European paper and board packaging by value.

SOURCES

Asheim, B. ja M. Dunford (1997): Regional Futures, Regional Studies, Vol. 31.

Barro, R. (1991): Economic Growth in a Cross Section of Countries, Quarterly Journal of Economics.

Barro, R. - X. Sala-i-Martin (1995): Economic Growth, New York, McGraw-Hill.

Coase, R. (1937): The Nature of the Firm, Economica 4.

Cooke, P. - K. Morgan (1994): Growth Regions under Duress: Renewal Strategies in Baden-Wurttemberg and Emilia-Romagna, Kirjassa Amin, A. - N. Thrift: Globalization, Institutions and Regional Development in Europe, Oxford.

Dunning, J. (1993): Internationalizing Porter's Diamond, Management International Review, vol. 33, 1993/2.

Dunning, J. (1997): Talouden globaalistuminen, talouspolitiikan muutoshaasteet ja yli-kansallinen hallinto, kirjassa Murroksen aika, toim. T. Hämäläinen, WSOY.

Emmerij, L. (1992): Globalization, Regionalization and World Trade, The Columbia Journal of world Business, Summer 1992.

Eriksson, L. (1997): European R&D Resources in Pulp and Paper, Proceedings of the European Conference on Pulp and Paper Research, October 9-11, 1996 Sweden.

Fagerberg, J. (1996): Technology and Competitiveness, Oxford Review of Economic Policy, Vol. 12, No. 3.

Grossman, G. - E. Helpman (1992). Innovation and Growth in the Global Economy, Cambridge MA, MIT Press.

Hernesniemi, H. - Lammi, M. - P. Ylä-Anttila (1995): Kansallinen kilpailukyky ja teollinen tulevaisuus, Elinkeinoelämän tutkimuslaitos, B 105, Taloustieto Oy, Helsinki.

Hyvärinen, J. (1999): R&D in EU Forest Cluster, report, Finnish Forest Industries Federation, FFIF.

Hyvärinen, J. (1997): EU:n alueelliset erot ja julkisen talouden asema Emussa, Eurooppa-Instituutin keskusteluaiheita 3/97, Turku.

Hyvärinen, J. (1993): Alueellinen kilpailukyky Suomen itäisellä rannikkoseudulla, Pietarissa ja Virossa, ETLA, keskusteluaiheita, No. 455.

Kenen, P. (1995): Economic and Monetary Union in Europe - Moving beyond Maastricht, Cambridge, University Press.

Krugman, P. (1991): Geography and Trade, Cambridge: MIT Press.

Krugman, P. (1996): Making Sense of the Competitiveness Debate, Oxford Review of Economic Policy, Vol. 12, No. 3.

Lucas, R. (1988): On the Mechanics of Economic Development, Journal of Monetary Economics, 22.

Lundvall, B. - B. Johnson (1994): The Learning Economy, Journal on Industrial Studies 1(2).

Mankiw, G. (1995): The Growth of Nations, Brooking Papers on Economic Activity, 1:1995.

Okko, P. (1996): Integraatio ja aluekehitys - Turun seudun mahdollisuudet, esitelmä.

Okko, P. - J. Hyvärinen (toim.) (1997): Rahaliittoon siirtyminen ja sopeutuminen, Eurooppa-Instituutin julkaisuja 2/97.

Okko, P. - A. Miettilä - J. Hyvärinen (1998) Globalisaatio ja aluerakenteen muutos, SITRA:n julkaisuja 177.

Pohjola, M. (1996): Tehoton pääoma - Uusi näkökulma taloutemme ongelmiin, WSOY, Porvoo 1996.

Porter, M. (1991): Kansakuntien kilpailuetu, Otava, Helsinki.

Romer, P. (1986): Increasing Returns and Long-run Growth, Journal of Political Economy, 94.

Romer, P. (1989): What Determines the Rate of Growth and Technical Change?, The World Bank Policy, Planning and Research Working Paper, No 279, Washington, DC.

Romer, P. (1991): Increasing Returns and New Developments in the Theory of Growth, Teoksessa Equilibrium Theory and Applications, toim. Barnet - Cornet - d'Aspremont - Gabszewicz - Mas - Colell, Cambridge University Press.

Schumpeter, J. (1934): The Theory of Economic Development. Cambridge Mass:Harvard University Press.

Solow, R. (1956): A Contribution to the Theory of Economic Growth, Quarterly Journal of Economics, 70.

Stokey, N. (1991): Human Capital, Product Quality, and Growth, Quarterly Journal of Economics.

Timbergen, J. (1965): International, National, Regional, and Local Industries, teoksessa Trade, Growth, and the Balance of Payments, Essays in Honor of Gottfried Haberler, Amsterdam.

ELINKEINOELÄMÄN TUTKIMUSLAITOS (ETLA)
THE RESEARCH INSTITUTE OF THE FINNISH ECONOMY
LÖNNROTINKATU 4 B, FIN-00120 HELSINKI

Puh./Tel. (09) 609 900
Int. 358-9-609 900
http://www.etla.fi

Telefax (09) 601753
Int. 358-9-601 753

KESKUSTELUAIHEITA - DISCUSSION PAPERS ISSN 0781-6847

No 673 ANTTON LOUNASHEIMO, The Impact of Human Capital on Economic Growth. 30.03.1999. 35 p.

No 674 PASI SORJONEN, Ex-Dividend Day Behaviour of Stock Prices in Finland in 1989-90 and 1993-97. 30.03.1999. 29 p.

No 675 PASI SORJONEN, Ex-Dividend Day Stock Returns and Tick Rules. 30.03.1999. 21 p.

No 676 PASI SORJONEN, Ex-Dividend Day Stock Price Behaviour, Taxes and Discrere Prices; A Simulation Experiment. 30.03.1999. 28 p.

No 677 JUHA HONKATUKIA, Kioton mekanismien käytön rajoittamisen vaikutukset Suomeen. 08.04.1999. 41 s.

No 678 ANSSI PARTANEN - INKERI HIRVENSALO, North and Westbound Foreign Trade Potential of the Baltic Rim. 28.04.1999. 17 p.

No 679 GRIGORI DUDAREV, The Role of Technology in Shaping the Energy Future in Russia. 06.05.1999. 48 p.

No 680 REIJA LILJA - EIJA SAVAJA, En översikt av systemet för arbetslöshetsskydd i Finland. 06.05.1999. 21 s.

No 681 REIJA LILJA - EIJA SAVAJA, Olika sätt att söka arbete, attityder och motivation hos arbetssökande i Finland. 06.05.1999. 73 s.

No 682 JARMO ERONEN, Cluster Analysis and Russian Forest Industry Complex. 24.06.1999. 16 p.

No 683 SEPPO HONKAPOHJA - ERKKI KOSKELA, The Economic Crisis of the 1990s in Finland. 09.08.1999. 53 p.

No 684 STEPHEN KING - ROHAN PITCHFORD, Private or Public? A Taxonomy of Optimal Ownership and Management Regimes. 12.08.1999. 33 p.

No 685 HANNU HERNESNIEMI - MIKKO HONGISTO - LASSI LINNANEN - TORSTI LOIKKANEN - PÄIVI LUOMA, Kioto-sopimus ja yritykset. Esitutkimus strategioista. 07.09.1999. 68 s.

No 686 PETRI ROUVINEN, R&D Spillovers among Finnish Manufacturing Firms: A Cost Function Estimation with Random Coefficients. 08.09.1999. 51 p.

No 687 ANNE ERONEN, Classification of Intangibles - Some Comments. 04.10.1999. 13 p.

No 688 HANNU PIEKKOLA, Rent Sharing and Efficiency Wages. 06.10.1999. 25 p.

No 689 MIKA PAJARINEN, Foreign Firms and Their R&D in Finland. 11.10.1999. 33 p.

No 690 PETRI ROUVINEN, Characteristics of Product and Process Innovators among Finnish Manufacturing Firms. 11.10.1999. 29 p.

No 691 HANS GERHARD HEIDLE, Market Microstructure and Asset Pricing: A Survey. 25.10.1999. 57 pages.

No 692 JUHA HONKATUKIA - PEKKA SULAMAA, Tekninen tehokkuus ja kokonaistuottavuus Suomen sähköjakeluverkkotoiminnassa 1996-1998. 03.11.1999. 69 s.

No 693 JUHA HONKATUKIA, The Effects of Energy Saving on the Costs of Abatement Policies in Finland. 09.11.1999. 44 p.

No 694 PETRI ROUVINEN, Issues in R&D-Productivity Dynamics: Causality, Lags, and 'Dry Holes'. 09.11.1999. 29 p.

No 695 HANNU PIEKKOLA - PERTTI HAAPARANTA, Liquidity Constraints Faced by Firms and Employment. 15.11.1999. 42 p.

No 696 HEIKKI HELLA - REIJO MANKINEN, Alcoholic Beverage Taxation: Alternatives and Impacts. 30.11.1999. 14 p.

No 697 VILLE KAITILA - MIKA WIDGRÉN, Revealed Comparative Advantage in Trade between the European Union and the Baltic Countries. 02.12.1999. 32 p.

No 698 ALBÆK, Karsten - ASPLUND, Rita - BLOMSKOG, Stig - BARTH, Erling - GUÐMUNDSSON, Björn Rúnar - KARLSSON, Vifill - MADSEN, Erik Strøjer, Dimensions of the Wage-unemployment Relationship in the Nordic Countries: Wage Flexibility without Wage Curves. 15.12.1999. 40 p.

No 699 JARI HYVÄRINEN, Research and Development in EU Forest Cluster. 10.01.2000. 37 p.

No 700 JARI HYVÄRINEN, Global and Regional Aspects of EU Forest Cluster. 10.01.2000. 28 p.

Elinkeinoelämän Tutkimuslaitoksen julkaisemat "Keskusteluaiheet" ovat raportteja alustavista tutkimustuloksista ja väliraportteja tekeillä olevista tutkimuksista. Tässä sarjassa julkaistuja monisteita on mahdollista ostaa Taloustieto Oy:stä kopiointi- ja toimituskuluja vastaavaan hintaan.
Papers in this series are reports on preliminary research results and on studies in progress. They are sold by Taloustieto Oy for a nominal fee covering copying and postage costs.

d:\ratapalo\DP-julk.sam/10.01.2000