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The Uneven Landscape of Innovation Poles

Local Embeddedness and Global Networks

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1) Introduction

Recent changes in industrialised economies and their spatial transformation seem to be of a fundamental and a long term nature. Some scholars argue that Fordism is transformed into Postfordism, others observe the emergence of a new long wave of development. As a consequence the spatial system is seen to change dramatically as has been indicated in a "break down or reversal of longstanding core periphery structures" (Aydalot 1984), the "emergence of new sunbelt regions" and of "Silicon Landscapes" (Hall and Markusen 1985) as well as of "new industrial districts and spaces " (Piore and Sabel 1984, Scott 1988). These changes are said to affect not just production but also higher level functions such as R&D, innovation and decision making. In the following it will be investigated to which extent a move from Fordism towards Postfordism is changing particularly the landscape of innovation poles in Europe.

The production- and innovation-process under Fordism was conceived to take place along a strict division of labor - to a large extent inside large firms. This was also reflected in space: The largest agglomerations tended to function as centers of decision-making, R&D and product innovation, the peripheral regions were locations of standardised production under external control. The fortune of localities and regions, thus, depended strongly on their respective role within this division of labor.

The "crisis" of Fordism and emerging Postfordism seem to change this structure of production, decision-making and innovation considerably (Piore and Sabel 1984, Kern and Schuman 1985, Scott 1988, Storper and Walker 1989, Harvey 1990). There is a shift expected from large scale standardised towards small scale customised production, and from the large hierarchically structured firm towards more decentralised firms as well as to networks of firms. In the innovation process there is a much larger role for incremental change, small firms as well as networks of firms.

Together these developments seem to lead to a stronger role of "place" in economic development and in the innovation process. The strongest expression of this is the debate about the role of the "local milieu" in innovation (Aydalot 1986, Aydalot and Keeble 1988, Maillat 1991). It is also argued that the traditional spa-

tial hierarchy of the innovation process might be replaced by a more dispersed pattern or even reversed.

In the following I want to analyse the changing landscape of innovation poles in the european context. I will start with the changing nature of the innovation process going along with a move from Fordism towards Postfordism (section 2). Then the embedding into the local "milieu" (role of local institutions and relations) and of global networks in the innovation process will be duscussed (3). In the fourth section I will present evidence concerning the existing and emerging landscape of innovation poles in Europe.

It will be shown that emerging Postfordism is bringing about substantial changes in this respect. However, the nature of this change is rather a coexistence of traditional and new organisational models in space, instead of a basic reversal of past structures. In fact it seems that despite some development in new areas, Postfordism tends to stregthen existing innovation poles, namely the large metropolitan areas as locations of technological innovation.

2) Changing nature of the innovation process moving from Fordism towards Postfordism

The **innovation process characteristic for Fordism** has been shaped by its basic principles such as

* a high share of standardised products for large markets (mass production);
* a dominant role of the large corporation organising production and innovation;
* a highly developed division of labour and a clearcut separation of conception and execution inside firms, whereby this "technical" division of labor is also reflected in space (Westway 1974, Watts 1980, Massey 1984).

The introduction of new products, their ageing towards mass products and the related firm behaviour has been described by product-cycle theory (Norton and Rees 1979, Utterback 1979). Firms are developing new products via their R&D departments, launching them on the market and subsequently reaping the benefits of growing demand and sales. In the course of maturation the product gets more standardised, competition increases and it becomes necessary to cut costs. New,

more standardised production processes are introduced and scale economies realised. The division of labor particularly within firms is increasing, external delivery links become more stable and they are extending over large spatial scales.

This process has a distinctive spatial pattern, particularly since the large firm, which is the motor of this process, is able to specialise locationally and is drawing benefits from a spatial division of labor (Bade 1984, Massey 1984): R&D-facilities are optimally located in large agglomerations near universities and highly trained labor, also the new products are best produced here since the markets as well as a variety of suppliers are close. In the course of maturation when cost considerations get more important and standardisation occurs, production is moving towards cheap labor in rural areas, very often supported by regional policy (Erickson and Leinbach 1979). In the late stage of the cycle it may become necessary to move to still cheaper locations such as the southern periphery of Europe or to newly industrialising countries (Fröbel et al. 1977). There is a spatial hierarchy of innovation implied: R&D and product innovation are concentrated in the largest agglomerations of the highly developed countries, while process change or a lack of innovation are to be observed in locations of the late stage such as old industrialised areas and the rural periphery (Tödtling 1990).

The emerging **postfordist accumulation and regulation regime,**[1)] in contrast, is characterised by

* a diversification of consumer demand and consequently a lower standardisation of products (customisation);

* use of flexible technologies, organisations and labor practices;

* a certain decentralisation of functions within large firms (bringing some of the higher level functions back to the production level) and a bias towards horizontal instead of vertical information flows; and

* a more prominent role of small firms partly through vertical disintegration of large firms, spin offs and subcontracting relations to large firms.

* Finally there is an increasing importance of institutions at the local/regional level but also at newly emerging international levels (such as the EC) as actors in economic development.

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1) See Moulaert et al. 1988, Harvey 1990, Benko and Dunford 1991, Cooke and Morgan 1991.

There are considerable implications for the innovation process. Due to the frequent changes of products and the shortening of product life cycles, technological change becomes more continuous (Nelson and Winter 1982, Dosi 1988). Furthermore, it is increasingly a nonlinear process which need not necessarily start with technical inventions but may also begin at the production level or may be initated by suppliers or customers (Hakanson 1987, von Hippel 1988). Technological change is furthermore seen as proceeding evolutionary along trajectories and is strongly shaped by existing routines. Such routines are partly rooted in the local/regional institutions and the milieu so that specific regional trajectories may emerge (Aydalot 1988, Malecki 1991).

The speed and cost of technological change are increasing and they lead to a reinforced division of labor in the innovation process. This is occuring between large and small firms, universities and public research institutions as well as other public institutions (transfer agencies, regional and local development institutions). Thus, there is an increasing variety of actors and institutions involved. Some of the firms engage in global networks, others establish links at the local and regional level (Cooke and Morgan 1991, DeBresson and Walker 1991, Freeman 1991).

Both, Fordism and Postfordism, describe rather extreme ideal-types of production and regulation which in reality cannot be found in pure form. Strongly disputed is particularly the stated transition to Postfordism. While some of the changes such as the increasing diversification and customisation of products as well as the trend towards more flexible technology, organisation and labor relations have been broadly accepted, it has been questioned whether this already constitutes a new production and regulation regime leading to a general return to "place" (Amin and Robins 1990, Sayer 1989). In the light of a recent wave of mergers and acqusitions and an increasing rather than decreasing dominance of large firms (Martinelli and Schoenberger 1991), the picture of an economy based on small and flexible firms, concentrated in certain districts, has been put into question.

3) Local embeddednes and global networks in the innovation process

The evolutionary character of technological change and the increasing social division of labor emphasize the relevance of both the local environment of firms (embeddedness into local networks and institutions) as well as of large scale and global networks. Both, however, fulfill different functions and they have different importance for small as against large firms.

Local embeddedess has been stressed particularly by the "milieu-approach" (Aydalot 1986, Aydalot and Keeble 1988, Maillat 1991). The "milieu" can be defined as the socio-economic environment of an area resulting from the interaction of firms, institutions and labor. It is expected to lead to a common way of perceiving economic and technical problems and finding respective solutions (Maillat 1991). The milieu fulfills mainly the task of informal knowledge transfer through mobile labor, information links, supplier and customer links as well as through cooperations at the local and regional level. Although there is evidence for the engagement of both large and small firms, the local milieu is said to be most important for the small firms, since these are less able to maintain costly boundary spanning functions (such as R&D) or to engage in large scale networking (see Maillat 1991, Camagni 1991). The milieu is considered to favour particularly learning processes in the innovation process such as learning by doing, learning by using and by interacting. An important element in the local mileu are education and training institutions as well as institutions engaged in firm formation and technology transfer such as incubation and innovation centers (Herrigel 1989, Tödtling-Schönhofer 1990, Cooke and Morgan 1991).

However, not just the embedding of firms into the local milieu can be observed, but also an **increasing integration into international and global R&D networks** (Castells 1989). This occurs both internally of firms through the location or acquisition of R&D units in several countries and in the form of interfirm arrangements (through various forms of R&D cooperations). Major forces of this globalization of R&D are to be found in a changing macro research environment (Howells 1990) such as the emergence of pervasive new technologies (information technologies, new materials and bio-technologies) breaking down traditional barriers between technological disciplines. Then there is an increasing complexity of new technology to be observed leading to increasing cost and time spans to develop new products while the life span of new products on the other hand has been reduced. Firms are thus seeking to extend the market for new products as fast as possible, to build up a stronger research base through mergers and acquisitions and/or to externalise certain steps of the R&D process.

The location of R&D activities of (multinational) firms in more than one country is, as Howells (1990) observes, not a totally recent phenomenon.[2] However, the occurance as well as the nature of such international R&D activities has been

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2) Until the 60'ies the number of multinationals undertaking R&D abroad, according to Howells (1990), were rather few. By 1965 it was estimated for US multinationals that only 6,5% of their total R&D expenditure was undertaken abroad.

changing since the mid seventies. Large firms are increasingly locating R&D units in more than one country, some of them moving towards global R&D networks. Along with this, the nature of R&D activities is changing from mere transfer units adjusting products only to local markets towards more autonomous R&D units which are involved in the own development of products and processes.

The second type of international and global R&D networks is of an interorganisational nature: Firms, particularly the large ones, are engaging into distant or global networks through carefully selected formal cooperations and strategic alliances (see Camagni 1991, Freeman 1991).[3] These allow them to organise complementary resources in the innovation process, reducing the development time of the new product, and/or to open up new markets more rapidly. Empirical work to this aspect has been undertaken more systematically by Hagedoorn and Schankenraad (1990) for selected technology areas (information technology, biotechnology, new materials). They show that these formal interfirm networks have increased particularly in the 80'ies (90% of about 4600 investigated cases) and that the vast majority of them (again 90%) occurs between the most highly developed countries of the "Triad" (Europe, USA, Japan). The major motives were the opening up of new markets, the time-reduction of the development process, the specific technological competence of the partner as well as the screening of technological opportunities. The long-run strategic positioning of the firm was in general a more important goal of the cooperations than the reduction of transaction costs (Hagedoorn and Schankenraad, 1990).

International R&D networks are also increasingly supported by supranational institutions and programs (Malecki 1991, Charles and Howells 1992). Within Europe there exist already a number of research and technology programs aiming at the international cooperation of firms and research institutions.[4] It appears that from these programs mainly large firms have been benefitting. For SME's it is rather difficult to be fast enough in getting the necessary infomation, organising the partner(s) and to go through the application procedure.

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3) Freeman (1991) defines the formal interfirm networks as joint ventures, research corporations, technology exchange agreements, minority holdings for technological reasons, licensing and second sourcing agreements, subcontracting, research associations, government sponsered joint R&D programs and computer networks for technical interchange (p. 502).

4) At the European level such programs are COST (since 1971), EUREKA (1985) and ESA (1987). Within the European Community particularly the second (1987-91) and third (1990-94) Framework Program for Research and Technology are supporting international R&D projects (Commission of the EC 1991).

The analysis up to now has shown that there is an increasing relevance not just of local embeddedness (particularly for small firms) but also of international and global networks. From a few studies it appears that there are also relations between these different types of networks. International and global network-links are sometimes established in order to tap into the knowledge base of a specific local or regional milieu. In the case of the Silicon Valley e.g., Gordon and Dilts (1988) have shown that a number of inward investments and cooperations from foreign firms to Silicon Valley firms had just this intention. On the other hand, Camagni (1991) has pointed to the fact that the local milieu also needs the linking up to international and global networks in order to stay innovative and avoid decline (an "entropic death") in the long run. Linkages between the local milieu and global networks may exist in various ways, e.g. through large firm - small firm cooperations and subcontracting, through spin offs from large firms or through mobile labor.

4) The uneven landscape of innovation poles - Empirical evidence

The changes in the organisation of production and innovation described above and the increasing variety of actors and institutions involved at the local/regional as well as on the supranational levels lead to a more complex landscape of "innovation poles" than has existed in the past. On the one hand, most of the large metropolitan regions remain important centers of innovation. On the other hand, new patterns of innovation are emerging. These are partly adjacent or near to the large metropolitan areas but partly also in newly industrialising intermediate or even in peripheral locations.

4.1 Large metropolitan regions as major innovation poles

Large metropolitan regions were the major innovation poles already in the fordist era, concentrating headquarters as well as R&D functions of large firms. They still have superior locational conditions such as high level eduction and research institutions and a highly qualified labor. They are also major nodes in the international communication and transport networks, so they tend to remain important poles of innovation. In fact, some of the postfordist conditions such as the increasing social division of labor or the high relevance of networks reinforce their position in that respect (Camagni 1988, Malecki 1991). Empirical evidence from quite a number of

countries (Austria, FGR, France, Italy, Switzerland, UK, US)[5] is showing the continuing dominance of large metropolitan regions in the innovation process. This evidence partly also reflects features of the traditional product cycle model:

* R&D activities are strongly concentrated in the largest agglomerations whereby few large firms of certain sectors are usually holding high shares of R&D employment and expenses there.

* Product innovations are relatively more frequent in agglomerations or in highly developed regions than e.g. in old industrial or peripheral areas.

* On the other hand, there is clearly more emphasis on process innovation or a lack of innovation in old industrial areas and peripheral regions.

This pattern of innovation is additionally shaped by contingent factors of respective countries, such as the historical spatial and urban structure or public policy. A more clearcut spatial hierarchy of innovation seems to exist in countries with a concentrated spatial structure such as Austria, France, Italy or UK, countries with one or few dominating agglomerations. In countries with a more balanced spatial structure such as the FGR, the Netherlands or Switzerland the pattern is less clearcut.

A very strong concentration of R&D activities has also been observed at the European level (both for countries and for level-II regions) showing the situation of a "two-speed" community.[6] In addition, there is a differentiation occuring between European cities (Drewett et al. 1992): Some of them are better able than others to further improve their knowledge base or to attract high level enterprise functions and activities (examples are London, Paris, Munich or Milan). Other cities, for a variety of reasons, are losing their entrepreneurial and technological dynamics. To the latter group belong agglomerations dominated by old industries (e.g. older conurbations in the UK or the Ruhrgebiet in Germany) or agglomerations where bureaucraticly organised firms and institutions have become dominant (Vienna).

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5) Empirical studies by Tödtling 1990, 1992 (*Austria*), Planque 1983 (*France*), Meyer-Krahmer et al. 1984, Meyer-Krahmer 1985, Ewers and Fritsch 1987, Pfirrmann 1991 (*FGR*), Cappellin 1983 (*Italy*), Brugger 1985, Brugger and Stuckey 1987 (*Switzerland*), Thwaites 1982, Buswell 1983, Gillespie 1983, Howells 1984, 1988, Thwaites and Oakey 1985, Goddard, Thwaites and Gibbs 1986, Thwaites and Alderman 1988 (*UK*), Malecki 1980, 1983, 1991 Castells 1989 (*US*).

6) In the mid 80'ies more than 75% of R&D-employment of the EC has been in the three countries FGR, France and UK. On the other hand, the less favoured member states (Italy, Ireland, Spain, Portugal and Greece) representing 40% of the population had only 10% of the R&D employment in the community. The R&D-gap of course is much larger at the regional level showing a very concentrated pattern or R&D in Europe (Commission of the EC 1987, 1988).

Around or adjacent to the most dynamic high ranking agglomerations there are "spill-overs" to be observed. These cover not just population, manufacuring industries and consumer services, but also advanced producer services and as well as innovative firms. Examples of such innovation poles close to major agglomerations are the Science city South of Paris (Aydalot 1986, Scott 1988), or the high-tech areas in the North and West of London (M4 Corridor, Cambridge: Segal 1985, Keeble 1988). These new growth areas have received a lot of attention in the literature as areas representing the "geography of the 5th Kontratieff" (Hall and Markusen 1985). Their success was very often ascribed to the special role of universities and research parks functioning as nuclei of development. However, the development of these areas seems to be more related to the nearby agglomerations and their locational advantages than to indigenous factors.

4.2 New spatial patterns of innovation ?

Along with an emerging Postfordism there are new organisational forms of innovation coming up which partly also modify the traditional spatial hierarchy. The major actors in these new models are public policy (case of science parks and technology centers), large firms which are deconcentrating some of their R&D activities to subsidiaries and branches as well as networks of firms. To which extent is there a change in the geography of innovation involved and what is the role of place in these developments?

a) Science parks and technology centers as policy approaches

Science parks have been emerging since the late 50'ies in the U.S. but growing rapidly and in large numbers particularly in the 80'ies in the U.S., Japan as well as in Europe. They can be found in quite different locations, both in dynamic and stagnating regions, in large metropolitan areas as well as in medium sized cities[7]. However, there are considerable qualitative differences concerning R&D-intensity and high-tech-orientation, skills of employment, university links as well as growth performance of science and technology parks between these locations.

For the U.K., Massey et al. (1992) find a significant North-South divide with regard to many features of the 83 science-parks existing in 1988. In the North they turned

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7) See Tödtling-Schönhofer (1990) for an overview, Sternberg (1988, 1990) and Dose and Trexler (1988) for the FGR, Luger and Goldstein (1991) for the US, Massey et al. (1992) for the U.K., Stöhr and Pönighaus (1992) for Japan.

out to be younger, smaller, more based on small indigenous firms and less "scientific" than those in the dynamic South-East. Similarly, Sternberg (1988, 1990), investigating 70 technology and incubation centers which were founded in the FGR since 1983, has observed a higher "technology-orientation" of centers in the more prosporous South of Germany as well as in the larger agglomerations as against those in the North or those in the assisted areas. Finally Luger and Goldstein (1991) in a comprehensive analysis of 116 US research parks have found that the more successful research parks, measured by employment growth, were more likely to be situated in sizable and dynamic regions and they were usually of an older vintage and had good links to a first class research university.[8] On the other hand, park failures, as indicated by closure or slow employment growth, were more often in smaller regions and in slower growing counties and not related to a nearby research university.[9]

The role of links to local universities and to the local economy are evaluated differently. While both the US study (Luger and Goldstein 1991) and the German study (Sternberg 1988) consider the links to a local university as rather important for the success of the relevant park or center, Massey et al. (1992) for the U.K. have been doubting their general importance. They found for the U.K. science parks that ... "formal research links between academic institutions and establishments on science parks were no more evident than similar links with firms located off-park" (Massey et al., 1992, p. 38).

What have been the effects of these research and technology parks on regional development and on interregional disparities? The available evidence suggests that in many cases there are positive (direct and indirect) employment effects (Luger and Goldstein 1991), positive effects on firm formation[10] as well as on the structure of firms and on skills of employment in the respective location. However, with

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8) More specifically Luger and Goldstein (1991, p. 175) state that regions are more likely to host successful research parks if they have (1) an existing base of R&D and high-tech activity, (2) one or several research activities, medical schools and/or engeneering institutes, (3) good air services, (4) a well developed network of infrastructure and business services, and (5) foresightful and effective business leaders. However, these locational characteristics are regarded neither as necessary nor sufficient to ensure park success.

9) Other examples of research parks and technology centers, which partly are also in nonmetropolitan locations, can be found in France (technopoles such as Sophia Antipolis near Nice, or ZIRST in Grenoble), Spain (9 technology parks existing), Sweden (innovation center in Chalmers in Göteborg, research park IDEON in Lund) as well as in Finland (7 technology parks).

10) A closer look, however, reveals that it is rather the persistence of newly created firms which is enhanced than the formation rate (Sternberg 1988, Tödtling-Schönhofer 1990).

a few exceptions, the overall impact on the respective regional economies remains limited, since the number of firms and jobs involved are usually not dramatically high.[11] Furthermore, it can be seen that these parks and centers are not bringing about substantial changes of the spatial pattern of innovation since the more sophisticated and more successful parks tend to be located either in large metropolitan or in more dynamic regions. Since they are more often supported by institutions at the local or regional level than by those on the federal level they just tend to reflect and even reinforce differences of economic strength between the regions rather than to reduce them.

b) R&D in the decentralised large firm

Peripheral regions very often have a high share of branch plants with standardised production and low levels of R&D and management functions. However, since markets are becoming increasingly volatile the requirement of flexibility exerts a certain pressure to reintegrate production with higher level functions such as R&D and marketing at the plant level. Does this bring about an upgrading of branch plants through the location of certain R&D- and decisionmaking-functions also in peripheral regions?

A well known example of semi-autonmous branches in high-tech industries is the UK Silicon Glen in Scotland, a peripheral economy which, due to the working of the Scottish Development Agency, was able to attract branch plants from a number of multinational companies (IBM, NCR, Honeywell, DEC, Hewlett-Packard, Motorolla, NEC, Sun Microsystems, Compaq). These partly had also more qualified high-tech-production and some R&D (Haug 1986). However, the overall effects on employment and skills have remained rather limited. Moreover, there were few links created to firms in the region and to universities and there were also few spin-offs. Being not strongly integrated into the regional economy, quite a number of plants have closed down or reduced employment in the early 1990's during a recession (Sutherland 1992).

Charles (1987), investigating the UK electronic industry, identifies the following mechanisms for the creation of more semi-autonomous units within large firms: the spin-off process (development of new entrepreneurial units in order to exploit

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11) In the 116 US research parks there were in total about 150 000 employees (1989), in the 83 parks of the U.K. there were about 15 000 people employed (1990), in the 60 technology centers of the FGR there were somewhat more than 10 000 employees (1988). Although these numbers are not negligable, they are just a very small percentage of total emloyment in the respective countries and regions.

new ideas and technologies), the acquisition of and equity investments into small firms to gain access to their technology as well as joint ventures. These new units remain semi-autonomous within the larger company and they have better employment characteristics and greater linkages to the local economy than the traditional branch-plant. However, due to higher locational and skill requirements, they are in general primarily a core region phenomena and less frequent in peripheral regions.

Other examples of semi-automnomous or upgraded peripheral branch plants can be found in various countries. A recent study on Austria has identified a number of subsidiaries and branch plants in "modern" industries with certain R&D functions also in peripheral regions (Tödtling 1990). Although these upgraded plants have better skill-effects and income-effects in the region than "pure" production branch-plants, the reduction of interregional disparities (income or qualifications) stays limited since the basic division of labor inside the large firms is not eliminated (Castells 1989, Martinelli and Schoenberger 1991).

c) Firm networks and small firm dynamics

Regions characterised by small firm dynamics and networks have received a lot of attention in the literature.[12)] Although particularly the model of the Third Italy (small firm networks) has attracted most interest, the networks where at least one or few large firms are involved, seem to be more frequent (Storper and Harrison 1991). Networks are in fact complex phenomena and they may contrast strongly in their industrial and spatial organisation.[13)] In addition to various actors involved (small and large firms, public institutions), they may have different governance structures: from a relatively egalitarian structure to a lose hierarchy (coordinating firm) and to a more rigid hierarchy (leading firm). From the spatial point of view, the main actors may be agglomerated or dispersed, maintaining local as well as long distance links. Many of these firm networks - like the research parks - cluster again around agglomerations or in industrialised areas, but many include also smaller cities in nonmetropolitan locations (this is particularly in Italian districts the case). Storper and Harrison (1991) in addition show that regional economies may consist not just of one but of several types of firm-networks.

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12) See e.g. Garofoli 1991, Cooke and Morgan 1991, Pyke and Sengenberger 1992.

13) See Bergman et al. 1991, DeBresson and Walker 1991, Storper and Harrison 1991.

Large firm - small firm networks

This type of network is coordinated or dominated by large firms which are externalising certain functions or production steps to small or intermediate sized firms. Partly, there are linkages involved at the regional level and the network takes an agglomerated form. Storper and Harrison (1991) give examples of agglomerated large firm networks from such different areas as Silicon Valley (systems integrators and "merchant" semiconductors in electronic industry), Toulouse (aircraft industry) as well as from Third Italy (Emilia Romagna: machinery industry). Perrin (1988) as well as Cooke and Morgan (1991) in addition bring examples and evidence from Baden Würtemberg (car industry: Daimler-Benz, Porsche, Bosch, Audi; electronic industry: IBM, Hewlett Packard, SEL, Sony), Hannover (Volkswagen), Milano (FIAT, Olivetti), the South of Netherlands (Philips) and the South of France (Sophia Antipolis). Hansen (1990) identifies large firm - small firm networks also in the Marseille region (including the hinterland) as well as in the area of Montpellier (region of Languedoc-Roussilion).[14)]

In many of these examples and cases, the strength of the network relations at the regional level is assumed and not made explicit. In the case of Baden Württemberg Cooke and Morgan (1991, p. 26 f.) find that a large proportion of the suppliers can be found within the region of Baden Württemberg although ... "these large firms are by no means averse to sourcing from outside the region or Germany itself". Schmitz (1992, p. 100) in addition states that the purchases from outside Germany have been increasing at a faster rate.[15)] Closer examination of other cases might well reveal that the spatial reach of these large firm - small firm networks is much larger than the respective region. This is certainly the case e.g. for many Austrian subcontractors which are delivering mainly to the german car firms.[16)]

The traditional subcontracting networks between large and small firms have implied a rather clear division of labor in the production and innovation process. The large firms had the function of "core-production", technology development (product and process innovation) as well as marketing and distribution, the small firms contributed certain steps and components in the production process. Tech-

14) Compared to the artificially created and rather exclusive technopolis of Sophia Antipolis, Hansen (1990) finds a stronger impact of the networks on regional development in these latter cases, since small firms were more spontaneoully involved.

15) We also have to keep in mind that the "region" of Baden Württemberg is fairly large (having a population of 9,5 Mio.); it is e.g. a clearly larger economy than Austria.

16) There are in Austria about 230 firms with an employment of 135000 engaged in subcontracting to the international car industry.

nological relations occured only in the form of a faster diffusion of process technology towards the subcontractors and a certain pressure for the subcontractors to introduce new machinery to keep the required quality standard or to save costs. The question arises whether the more recent kinds of networks go beyond these traditional relations and include also R&D, product- and process development in their division of labour. Up to now the answer to this question is not very well documented. Cooke and Morgan (1991), studying the regions of Baden-Württemberg, Emilia Romagna, the Basque Country and Wales, observe a move towards "collaborative manufacturing" for reasons of enhancing and maintaining the quality of supplies and materials and of shortening the innovation process.[17] Grabher (1991) gives some evidence of such emerging "innovation networks" for the German Ruhr area: large firms are restructuring from their traditional products (e.g. steel) towards more know-how and technology intensive activities (e.g. engeneering) and are utilising the flexibility and innovative capacity of small firms by building up network-relations to them. Large firms and small firms fulfill different tasks and functions: the large firm as a general contractor is organising the whole project, providing finance and market access, small firms are developing, designing and producing special contributions within this network. This implies that, despite a stronger role of the small firms, the nature of the collaboration stays basically a hierarchical one (Storper and Harrison, 1991).

Small firm networks

Based on the experiences of few "success stories" such as high-tech-regions (Silicon valley, Route 128, M4 Corridor) as well as some other dynamic regions (Third Italy, Baden Württemberg) localised small firm networks have been viewed as the clearest indication of a possible "end of Fordism" (Piore and Sabel 1984). Instead of the large firms involved in mass production, localised networks of a number of small firms are producing a variety of customised products in small scales, cooperating not just in production but also in distribution and in technological development (Garofoli 1991). This development was also seen as evidence for a new importance of agglomeration economies and a concentration of such industries in "new spaces" (Scott 1988).

Competitive strategies of firms in such districts are clearly different from fordist strategies since advantages are achieved by high quality, know-how or design inten-

17) They state that in Baden Württemberg for firms such as Bosch ... "design of components is now commonly a joint process in which an intrafirm network of the Purchasing, Engeneering and Design departments works with two Preferred Supplier Status firms, only one of which will be awarded the production contract. ..." (Cooke and Morgan 1991, p. 27).

sity as well as by flexibility instead of scale economies and low cost. Due to the customisation of products there is frequent change of both products and processes (modifications, design changes, etc.), whereby the innovation process is also supported by the network (see above 3). It helps to spread risks, combine ressources and assets and share know how and experience.

These networks where innovative small firms are strongly involved, are again to be found in various locations.[18] Some of them, particularly the high tech industries, cluster around large metropolitan areas (such as London, Milan, Paris, Madrid and Barcelona: see above 4.1), others are in intermediate regions with more diffused industry (Third Italy: clothing, textiles, leather goods, ceramics, furniture; Baden Württemberg: machine-tool industry; West Jutland in Denmark: garment/knitting, furniture). Finally there are also examples in "old industrialised" regions on their way to restructure (Swiss Jura: watch industry).

The constitution of firm-networks at the local and regional level is attributed not just to economic but also to socio-cultural factors resulting from the history of the region (Garofoli 1991). Together these factors are said to constitute a specific local milieu conducive for firm formation and innovation (see above section 3)[19]. Aydalot and Keeble (1988) regard innovations even as product of the local milieu by stating that " .. it is often the local environment which is, in effect, the entrepreneur and innovator, rather than the firm ... ". Spatial proximity and territorial agglomeration are considered as important preconditions for the creation and the functioning of such an innovative milieu (Stöhr 1987, Camagni 1991). This is due to the fact that highly skilled personnel is not very mobile interregionally, that direct personal and informal contacts are highly relevant and that synergy-effects are expected from a common cultural, psychological and political background.

An important element, which is part of the network and the milieu, are the public and semi-public institutions supporting the SME's in such regions. These may be trade or business associations, chambers of industry and commerce, technology transfer centers as well as public programs for innovation and firm formation. These institutions provide, amongst others, research capacity, contract research, training, technology transfer, business information as well as finance for the small

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18) See Aydalot 1986, Aydalot and Keeble 1988, Cooke and Morgan 1991, Pyke and Sengenberger 1992.

19) The "milieu" was, according to Maillat (1991), defined above (section 3) as "socio-economic environment of an area resulting from the interaction of firms, institutions and labor. It is expected to lead to a common way of perceiving economic and technical problems and finding respective solutions."

firms. Cooke and Morgan (1991, p. 43) consequently summarise the key elements of the "networked region" as "a thick layering of public and private industrial support institutions, high grade labor market intelligence and associated vocational training, rapid diffusion of technology transfer, a high degree of interfirm networking and, above all, receptive firms welldisposed towards innovation".

A particular "thick" tissue of such support institutions can be found in Baden Württemberg (Herrigel 1989, Schmitz 1992) as well as in the industrial districts of Third Italy (Cooke and Morgan, 1991, Brusco 1992). In both regions these institutions have a quite long history, casting doubt on the ready transferability of such institutions to other regions. It is furthermore difficult to evaluate the role and effectiveness of these institutions on the performance of firms in the regions and to draw direct causal links from one to the other. As Schmitz states ... "there is a great deal of description of the policy but - with a few exceptions - there is little analysis of its effectiveness" (p. 104).[20)]

It has been suggested that localised small firm networks might become a general model of innovation and regional development. However, there are both conceptual and empirical problems with this proposition. At the conceptual level, a clear-cut transition from Fordism towards Postfordism and to a small-firm economy has been questioned on various grounds (Sayer 1989, Amin and Robins 1990). Although it is true that small firms have experienced a certain renaissance since the mid seventies, the large firms are far from leaving the stage, as has been shown above (Martinelli and Schoenberger 1991). There is also no general return to "place" and local embeddedness since - as we have shown above - large scale and global networks as well as supranational institutions have at the same time increased their importance. Empirically, the evidence for localised small firm networks becoming a general model for innovation and regional development is up to now also not convincing:

* There are rather few regions in Europe and the US which have been serving as standard examples of localised and dynamic small firm networks

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20) In fact for Baden Württemberg Schmitz (1992) finds that ... "It would be misleading to attribute the success of Baden Württemberg in the 1970's and 1980's solely to the neoconservative modernisation policy of Lothar Späth. The success preceded or coincided with his technology policy. At the same time it would be unreasonable to entirely discard claims that regional government helped industry to cope with challenges of the 1990's" (p. 108).

We also have to keep in mind that "institutional thickness" is not just typical for dynamic districts, but can also be found in old industrial areas on their way to restructure such as the Ruhr area in Germany, the Swiss Jura or the Obersteiermark in Austria (Tödtling-Schönhofer 1990).

("success stories"). Other regions have also been cited (Zeitlin 1992) but the differences seem to be larger than the similarities.

* A closer look in fact reveals that these regions are very heterogenous: they range from regions with family- and craft based industries having sometimes very low levels of technology (many districts of "Third Italy")[21] to sophisticated high-tech regions at the "frontier" of technological development.[22]

* Both the high-tech regions and the districts do very often not stay as "small and beautiful" as they were at their early stage but are subject to rapid organisational change. On the one hand, in some districts small firms under competitive pressure are forming large groups in order to stay competitive. Some small firms are also growing and internationalising their markets and networks. On the other hand, these regions get also penetrated and dominated by external large firms.[23]

* As was shown above, there are many more regions which are linked in one way or the other to large coordinating or leading firms, inside or outside the region (see above; as well as Storper and Harrison 1991) or which have no significant network links at all.

* The empirical evidence for the strength of linkages at the local/regional level and of local embeddedness is very often rather anectodal than systematically derived. There exist only case studies in which usually rather few firms and institutions have been intervieved. More systematic and representative studies in a broader comparative setting are lacking. Furthermore, in the existing studies there has often been an implicit bias in favour of the

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21) From about 60 industrial districts in "Third Italy" over 50 were specialised in fashionware (textiles, clothing, shoes and other leather goods) or wooden furniture (Amin and Robins 1990, p. 17).

22) Zeitlin (1992, p. 185) consequently states that ... "In the face of these difficulties, it seems necessary to move away from a 'thick', 'closed' model of the industrial district based on a stylised account of a particular national experience towards a 'thin', 'open' model capable of generating a variety of empirically observable forms."

23) In the case of Silicon Valley this has been shown e.g. by Gordon an Dilts (1988). For the Italian industrial districts Brusco (1992) has shown that there is a considerable change towards the formation of groups of firms as well as towards the internationalisation of markets. The increasing role and dominance of large firms in such regions is by some defenders of the district model seen as a process of a "double convergence" of large- and small-firm structures (Sabel, Zeitlin) ... "as small firms in the districts build wider forms of common services often inspired by large-firm models, while large firms seek to recreate among their subsidiaries and subcontractors the collaborative relationships characteristic for small-firm districts" (Zeitlin, 1992, p. 184).

identification such localised networks. All this makes broader generalisation and evaluation of this phenomenon rather difficult.

5) Conclusions

From the paper the following conclusions may be derived: First, the move towards Postfordism is indeed bringing about substantial changes in the production and innovation process, its organisation as well as its manifestation in space. The changes imply a more continuous and evolutionary character of innovation and a stronger need to integrate R&D, marketing and production at the plant level. The linear innovation process, organised in a hierarchical way within firms, which has been typical for Fordism, is losing relevance. There is also more need to rely on external partners, both firms and public institutions. Consequently there are new organisational forms coming up such as research parks and innovation centers, a decentralisation of R&D and innovation activities in large firms and, last but not least, networks of innovators.

Second, along with these changes there are new patterns of innovation in space emerging both in and around metropolitan areas and also in nonmetropolitan regions. These changes, however, do not imply a basic reversal of past structures and trends. Instead, they constitute a more complex structure since past and new patterns are coexisting (Amin and Robins 1990). In fact, it seems that despite some development in new areas, the move towards Postfordism tends to stregthen major metropolitan areas as innovation poles. Since these are still important nodes in national and international transport and communication networks as well as locations for high level educational and research institutions they also stay major locations for research parks and technology centers, for R&D functions of large firms as well as for firm networks.

Third, local and regional institutions and the "embeddedness" of firms seem to have more relevance in the evolutionary innovation process. However, this cannot be interpreted as a general return to "place" as an exclusive driving force for economic and technological development because of several reasons:

* Firms are not just getting locally embedded but at the same time increasingly integrated into the global economy. Particularly in the 80'ies international and global networks (both within and between large firms) as well as supranational institutions have increased their importance.

* Local embedding ("place") and international and global links have different relevance for different actors: SME's rely clearly more on local networks and local institutions (with regard to information gathering, markets, finance) than large firms and their branches. Large firms and their plants, in contrast, are very often quite independent from the local environment. However, this pattern does not always hold true since a considerable part of the SME's is also engaged in international and global markets and networks and a part of the large firms is also linked to the local environment.

* Local embedding and networks are furthermore dynamic and subject to change, since many firms are extending their markets and networks in the course of their maturation. On the other hand, external large firms are very often penetrating regional economies and tapping into local networks by takeovers or interfirm alliances.

* Finally we must point to the fact, that the empirical evidence concerning the local embedding of firms and its role for the innovation process is still very limited. In contrast to some of the "euphoric" literature, there seem to be relatively few cases of "milieu driven" innovative regions. Also the particular role and functioning of local networks and the local "milieu" vis à vis global forces up to now has not been demonstrated convincingly.

Thus, from the analysis it appears that local firms and networks get increasingly interlinked with global markets, corporate hierarchies as well as networks. It is actually this interaction of global forces with specific local conditions and histories, which is shaping more and more the innovation process and consequently local and regional development.

REFERENCES

AMIN, A. and K. ROBINS, 1990, The reemergence of regional economies? The mythical geography of flexible accumulation. *Environment and Planning D, Society and Space,* Vol 8. pp. 7-34.

AMIN A., A. MALMERG and P. MASKELL, 1991, Structural change and the geography of production in Europe. RURE working paper, WG1.

AYDALOT, Ph., 1984, A la recherche des nouveaux dynamismes spatiaux. In: Aydalot, Ph., ed., *Crise & Espace*, Paris, Economica.

AYDALOT, Ph., ed., 1986, *Milieux Innovateurs en Europe*. GREMI, Paris.

AYDALOT, Ph., 1988, Technological trajectories and regional development in Europe. In: Aydalot Ph. and D. Keeble, eds., *High Technology Industry and Innovative Environments: The European Experience*. London, Routledge.

AYDALOT, Ph. and D. KEEBLE, eds., 1988, *High Technology Industry and Innovative Environments: The European Experience*. London, Routledge.

BADE, F.J., 1984, *Die funktionale Struktur der Wirtschaft und ihre räumliche Arbeitsteilung.* Deutsches Instititut für Wirtschaftsforschnung (DIW), Berlin.

BENKO, G. and M. DUNFORD, 1991, Structural change and the spatial organisation of the productive system: an introduction. In: Benko G. and M. Dunford, eds., *Industrial Change and Regional Development: The Transformation of New Industrial Spaces*. London, Bellhaven Press.

BERGMAN, E., G. MAIER and F. TÖDTLING, eds., 1991, *Regions Reconsidered: Economic Networks, Innovation and Local Development in Industrialised Countries*. London, Cassel.

BREHENY, M.J. and R.W. McQUAID, 1987, *The Development of High Technology Industries - An International Survey*. London, Croom Helm.

BRUGGER, E.A., 1985, *Regionalwirtschaftliche Entwicklung - Strukturen, Akteure und Prozesse*. Bern, Hauptverlag.

BRUGGER, E.A. and B. STUCKEY, 1987, Regional economic structure and innovative behaviour in Switzerland. *Regional Studies*, Vol 21/3, pp.241-254.

BRUSCO, S., 1992, Small firms and the provision of real services. In: Pyke, F. and W. Sengenberger, eds., *Industrial Districts and Local Economic Regeneration*. International Institute for Labor Studies, Geneva.

BUSWELL, R.J., 1983, Research and development and regional development: A Review. In: Gillespie, A., ed., *Technological Change and Regional Development*. London Papers of Regional Science, London, Pion Ltd..

CAMAGNI, R., 1988, Functional integration and locational shifts in new technology industry. In: Aydalot and Keeble, eds., *High Technology Industry and Innovative Environments: The European Experience*. London, Routledge.

CAMAGNI, R., 1991, Space, networks and technical change: An evolutionary approach. In: Camagni, R., (ed.), *Innovation Networks*, London, Belhaven Press.

CAPPELLIN, R., 1983, Productivity growth and technological change in a regional perspective. *Giornale degli Economisti ed Annali di Economia*, 42, 459-482.

CASTELLS, M., 1989, *The Informational City - Information Technology, Economic Restructuring and the Urban-Regional Process*. Cambridge/Mass., Basil Blackwell.

CHARLES, D.R., 1987, Technical Change and the Decentralized Corporation in the Electronics Industry: Regional Policy Implications. In: Chapman, K. and G. Humphrys, eds., *Technical Change and Industrial Policy*. Oxford, Basil Blackwell.

CHARLES, D. and J. HOWELLS, 1992, *Technology Transfer in Europe - Public and Private Networks*. London, Bellhaven Press.

COMMISSION of the EUROPEAN COMMUNITIES, 1987, Research and Technological Development in the Less Favoured Regions of the Community (STRIDE), Final report by Goddard, J., D. Charles, J. Howells and A. Thwaites, Brüssel.

COMMISSION of the EUROPEAN COMMUNITIES, 1988, Science and Technology for Regional Innovation and Development in Europe (STRIDE), Final Report by the National Board for Science and Technology, Brüssel.

COMMISSION of the EUROPEAN COMMUNITIES, 1991, Forschungs- und Technologieförderung der EG. Ein Leitfaden für Antragsteller. Amt für amtliche Veröffentlichungen der EG, Brüssel.

COOKE, PH. and K. MORGAN, 1991, The network paradigm - New departures in corporate & regional development. Regional Industrial Research Report No. 8. Cardiff.

DeBRESSON C. and R. WALKER, eds., 1991, Network of Innovators, Special Edition of *Research Policy*, Vol. 20, No. 5, North Holland.

DOSE, N. and A. DREXLER, eds., 1988, *Technologieparks - Voraussetzungen, Bestandsaufnahme und Kritik*. Opladen, Westdeutscher Verlag.

DOSI, G., 1988, The nature of the innovative process. In: Dosi, G., CH. Freeman, R.Nelson, G. Silverberg and L. Soeste, eds., *Technical Change and Economic Theory*. London, New York, Pinter.

DREWETT, R., R. KNIGHT and U. SCHUBERT, 1992, The Future of European Cities: The Role of Science and Technology. Prospective Dossier No. 4., FAST-MONITOR Programme, Commission of the European Communities.

ERICKSON, R.A. and TH.R. LEINBACH, 1979, Characteristics of Branch Plants Attracted to Nonmetropolitan Areas. In: Lonsdale, R.E. and H.L. Seyler, eds., *Nonmetropolitan Industrialization*. London/New York, John Wiley.

EWERS, H.J. and M. FRITSCH, 1987, Die räumliche Verbreitung von computergestützten Techniken in der Bundesrepublik Deutschland. Diskussionspapier 120, Wirtschaftwissenschaftliche Dokumentation, TU Berlin.

FREEMAN, C., 1990, Networks of innovators: A synthesis of research issues. *Research Policy*, Vol. 20, No. 5, North Holland.

FRÖBEL, F., J. HEINRICHS and O. KREYE, 1977, *Die neue internationale Arbeitsteilung*. Reinbek bei Hamburg, Rororo.

GAROFOLI, G., 1991, Local Networks, Innovation and Policy in Italian Industrial Districts. In: Bergman, E., G. Maier and F. Tödtling, Eds., *Regions Reconsidered: Economic Networks, Innovation and Local Development in Industrialised Countries*. London, Cassel.

GILLESPIE, A., ed., 1983, *Technological Change and Regional Development*. London Papers of Regional Science, London, Pion Ltd.

GODDARD, J., A. THWAITES and D. GIBBS, 1986, The regional dimension to technological change in Great Britain. In: Amin and Goddard, Eds., *Technological Change, Industrial Restructuring and Regional Development*. London, Allen&Unwin.

GORDON, R. and A. DILTS, 1988, High technology innovation and the global milieu: Small & medium sized enterprises in Silicon Valley. Paper prepared for Colloque GREMI II, Ascona, April 1988.

GRABHER, G., 1991, Rebuilding Cathedrals in the Desert: new Patterns of Cooperation between Large and Small Firms in the Coal, Iron, and Steel Complex in the German Ruhr Area. In: Bergman, E., G. Maier and F. Tödtling, eds., *Regions Reconsidered: Economic Networks, Innovation and Local Development in Industrialised Countries*. London, Cassel.

HAGEDOORN, J. and J. SCHANKENRAAD, 1990, "Strategic partnering and technological cooperation." In: Dankbaar, B., J. Groenewegen and H. Schenk, eds., *Perspectives in Industrial Organization*. Dordrecht/Boston/-London, Kluwer.

HAKANSSON, H., ed., 1987, *Industrial Technological Development: A Network Approach*. London, Croom Helm.

HALL, P., and A. MARKUSEN, eds., 1985, *Silicon Landscapes*. London, Allen and Unwin.

HARVEY, D., 1990, *The Condition of Postmodernity. An Enquiry into the Origins of Cultural Change*. London, Basil Blackwell (first edition 1989).

HAUG, P., 1986, US high technology multinationals and Silicon Glen. *Regional Studies*, Vol. 20.2, pp. 103-116.

HERRIGEL, G. B., 1989, The Politics of large firm relations with industrial districts: A Collision of organisational fields in Baden Württemberg. University of Chicago, Mimeo.

HOWELLS, J., 1984, The location of Research and Development: Some observations and evidence from Britain. *Regional Studies*, Vol. 18, S. 13-29.

HOWELLS, J., 1988, The Location and Organisation of Research and Development, Paper presented to the European Summer Institute of the RSA, Arco, Juli 1988.

HOWELLS, J., 1990, The internationalization of R&D and the development of global research networks. Regional Studies, vol 24., pp. 495-512.

KEEBLE, D., 1988, High-Technology Industry and Local Environments in the United Kingdom. In: Aydalot Ph. and D. Keeble, eds., *High Technology Industry and Innovative Environments: The European Experience*. London, Routledge.

KERN H. and M. SCHUMANN, 1985, *Das Ende der Arbeitsteilung? Rationalisierung in der industriellen Produktion*. München, Beck Verlag. (first edition 1984).

LUGER, M. and H. GOLDSTEIN, 1991, *Technology in the Garden - Research Parks & Regional Economic Development.* Chapel Hill & London, The University of North Carolina Press.

MAILLAT, D., 1991, The innovation process and the role of the milieu. In: Bergman, E., G. Maier and F. Tödtling, eds., *Regions Reconsidered: Economic Networks, Innovation and Local Development in Industrialised Countries*. London, Cassel.

MALECKI, E.J., 1980, Corporate organization of R&D and the location of technological activities. *Regional Studies*, Vol. 14, S. 219-234.

MALECKI, E.J., 1983, Technology and regional development: a survey. *APA Journal*, 50/3, 1984, pp. 262-26

MALECKI, E.J., 1988, Research and development and technology transfer in economic development: the role of regional technological capability. In: Capellin, R. and P. Nijkamp, eds., *The Spatial Context of Technological Development*. Aldershot, Avebury.

MALECKI, E.J., 1991, *Technology and Economic Development. The Dynamics of Local, Regional and National Change*. Essex, Longman Scientific & Technical.

MARKUSEN, A., 1987, *Profit Cycle, Oligopoly and Regional Development. Cambridge, Mass.*, MIT Press. (First edition: 1985).

MARTINELLI, F. and E. SCHOENBERGER, 1991, Oligopoly is alive and well: Notes for a broader discussion of flexible accumulation. In: Benko, G. and M.

Dunford, eds., *Industrial Change and Regional Development: The Transformation of New Industrial Spaces*. London, New York, Bellhaven Press.

MASSEY, D., 1984, *Spatial Divisions of Labor: Social Structures and the Geography of Production*. London, McMillan.

MASSEY, D., P. QUINTAS and D. WIELD, 1992, *High Tech Fantasies - Science Parks in Society, Science and Space*. London, New York, Routledge.

MEYER-KRAHMER, F., R. DITTSCHAR-BISCHOFF, U. GUDRUM and U. KUNTZE, 1984, Erfassung regionaler Innovationsdefizite. Schriftenreihe des BM für Raumordnung, Bauwesen und Städtebau, 06.054, Bonn-Bad Godesberg.

MEYER-KRAHMER, F., 1985, Innovation behaviour and regional indigenous potential. *Regional Studies*, Vol. 19, S. 523-534.

MOULAERT, F., E. SWYNGEDOUW and P. WILSON, 1988, Spatial responses to fordist and postfordist accumulation and regulation. *Papers of the regional Science Association*, Vol. 64, pp. 11-23.

MÜDESPACHER, A., 1987, Adoptionsverhalten der Schweizer Wirtschaft und regionale Aspekte der Diffusion der Neuerungen der Telematik. *Jahrbuch der Regionalwissenschaft* 8/1987, pp. 106-134.

NELSON, R.R. and S.G. WINTER, 1982, *An evolutionary theory of economic change*. Cambridge/Mass, Harvard University Press.

NORTON, R.D. and J. REES, 1979, The product cycle and the spatial decentralisation of American Manufacturing. *Regional Studies*, Vol. 13, S. 141-151.

PERRIN, J.C., 1988, New technologies, local synergies and regional policies in Europe. In: Aydalot and Keeble, eds., 1988.

PFIRRMAN, O., 1991, *Innovation und regionale Entwicklung - Eine empirische Analyse der Forschungs- Entwicklungs und Innovationstätigkeit kleiner und mittlerer Unternehmen in der Bundesrepublik Deutschland 1978-1984*. München, Verlag Florentz.

PIORE, M. and J. SABEL, 1984, *The Second Industrial Divide: Possibility and Prosperity*. New York, Basic Books.

PLANQUE, B., 1983, *Innovation et Developpement Regional*. Paris, Economica.

PYKE, F. and W. SENGENBERGER, eds., 1992, *Industrial Districts and Local Economic Regeneration*. International Institute for Labor Studies, Geneva.

SAYER, A., 1989, Postfordism in Question. *International Journal of Urban and Regional Research*, 13/4, pp. 666-695.

SCHMITZ, H., 1992, Industrial districts: Model and reality in Baden-Württemberg, Germany. In: Pyke, F. and W. Sengenberger, eds., *Industrial Districts*

and Local Economic Regeneration. International Institute for Labor Studies, Geneva.

SCOTT, A.J., 1987, Flexible production systems and regional development: The rise of new industrial spaces in North America and Western Europe. *International Journal of Urban and Regional Research,* Vol. 12/2, S. 171-185.

SCOTT, A.J., 1988, *New Industrial Spaces: Flexible Production Organization and Regional Development*. London, Pion.

SEGAL, N., 1985, The Cambridge Phenomenon, *Regional Studies*, 19/6, 563-70.

STERNBERG, R., 1988, Technologie- und Gründerzentren als Instrument kommunaler Wirtschaftförderung. Dortmund.

STERNBERG, R., 1990, Regionaler Informatinstransfer - Die Rolle von Technologie und Gründerzentren in der Bundesrepublik Deutschland. In: ÖROK-Schriftenreihe 81, Innovations- und Technologiezentren - Ein taugliches instrument der Regionalpolitik? Wien.

STÖHR, W., 1987, Territorial Innovation Complexes. *Papers of the Regional Science Association*, Vol. 59, S. 29-44.

STÖHR, W. and R. PÖNIGHAUS, 1992, The Effect of new technological and organizational infrastructure on urban and regional development - the case of the Japanese technopolis policy. *Regional Studies*, forthcoming

STORPER, M., 1986, Technology and new regional growth complexes, the economics of discontinous spatial development. In: Nijkamp, P., Ed., *Technological Change, Employment and Spatial Dynamics*. Heidelberg, Springer-Verlag.

STORPER, M. and R. WALKER, 1989, *The Capitalist Imperative - Territory, Technology and Industrial Growth*. Oxford, Basil Blackwell.

STORPER, M. and B. HARRISON, 1991, Flexibility, hierarchy and regional development: The changing structure of industrial production systems and their forms of governance in the 1990's. *Research Policy*, Vol. 20, No. 5, pp. 407-422. North Holland.

SUTHERLAND, E., 1992, Silicon Glen - a technological Brigadoon? Unpublished Paper (Draft), University of Stirling, Scotland.

THWAITES, A., 1982, Some evidence of regional variations in the introduction and diffusion of industrial products and processes within British manufacturing industry. *Regional Studies*, Vol 16/5 pp. 371-382.

THWAITES, A. and R.OAKEY, eds., 1985, *The Regional Economic Impact of Technological Change*. London, Francis Pinter

THWAITES, A. and N. ALDERMAN, 1988, The location of R&D: Retrospect and Prospect. In: Capellin, R. and P. Nijkamp, eds., The Spatial Context of Technological Development. Aldershot, Avebury.

TÖDTLING, F., 1990, *Räumliche Differenzierung betrieblicher Innovation - Erklärungsansätze und empirische Befunde für österreichische Regionen*. Berlin, Edition Sigma.

TÖDTLING, F., 1992, Technological Change at the Regional Level - The Role of Location, Firm Structure and Strategy. Environment & Planning A. Forthcoming.

TÖDTLING, F. and H. TÖDTLING-SCHÖNHOFER, 1990, Innovations- und Technologietransferzentren als Instrumente einer regionalen Industriepolitik in Österreich. ÖROK-Schriftenreihe Nr. 81, Wien.

UTTERBACK, J.M., 1979, The dynamics of product and process innovation in industry. In: Hill Ch.t. and J.M. Utterback, Eds., *Technological Innovation for a Dynamic Economy*. New York, Pergamon Press

VON HIPPEL, E., 1988, *The Sources of Innovation*. Oxford University Press.

WATTS, H.D., 1981, *The Branch Plant Economy - A Study of External Control*. London/New York, Longman.

WESTAWAY, J., 1974, The Spatial Hierarchy of Business Organisations and its Implications for the British Urban System. *Regional Studies*, Vol. 8/1, S.145-155.

ZEITLIN, J., 1992, Industrial districts and local economic regeneratin: Overview and comment. In: Pyke, F. and W. Sengenberger, eds., *Industrial Districts and Local Economic Regeneration*. International Institute for Labor Studies, Geneva.

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