

**From The Space Of Flows To A New Business Geography:
The Internet, Firm Location, And Clustering**

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Paper prepared for the 39th Meetings of the European Regional Science Association,
Dublin, Ireland, August 23-27, 1999

Abstract:

The use of advanced information and communications technologies has a tremendous impact on the internal organization of companies. More efficient communications, a closer integration of output and factor markets, a faster rate of introduction and adoption of new technology, and thus increased productivity are some of the expected but not yet empirically verified consequences.

This paper discusses the changing role of information in the production process and some of the economic consequences. The use of advanced information and telecommunications technologies makes internal and external communications more efficient. It allows faster and more flexible interaction among different agents. This causes changes in the internal organization of the company and in the strategic behavior. Specifically, depending on the cost savings that can be achieved with the use of information technologies, companies will either integrate more activities within their organization or outsourcing will become more important. The related consequences are in the first case larger firm sizes and more concentration, in the second case a trend toward smaller companies and more decentralization. The strategies depend on the characteristics of the specific goods and services

The paper reviews several relevant theoretical concepts, including information theory, growth theory, and transaction cost theory. Based on that discussion it develops a conceptual framework for the analysis of the impacts of information technologies on the internal organization of firms and on their strategic decisions.

1. Introduction

The use of advanced information and communications technologies has a tremendous impact on the internal organization of companies. More efficient communications, a closer integration of output and factor markets, a faster rate of introduction and adoption of new technology, and thus increased productivity are some of the expected but not yet empirically verified consequences (Globerman 1996). Those changes affect the strategic business decisions, which in turn have potentially tremendous impacts on regional economic development. It is yet unclear whether the use of information technologies will increase decentralization or concentration of economic activities and businesses. Both scenarios are possible and would have different consequences for regions and cities. On one hand, the availability of information technologies could stimulate economic development in currently lagging regions if they are able to attract footloose, information-dependent businesses. On the other hand, information technologies could reinforce and strengthen agglomerations and downtown business areas and increase the gap between urban and rural areas. A slightly different scenario sees an increased trend toward the concentration of business activities in edge cities and satellite cities.

The ongoing changes affect all parts of the economy and all industries. Producer services, however, are probably more affected than most other sectors because of the nature of their products and activities. This sector has been growing dramatically over the past years and decades, underlining the trend toward a service economy. Producer service firms have always been considered more footloose than other sectors. However, over the past decades agglomerations have developed that show a high concentration of specialized producer services (Stanback and Noyelle 1982, Noyelle and Stanback 1984, Cuadrado-Roura 1997). The globalization of the economy has supported this trend, especially for the banking and finance sector (Hepworth 1989, 1991, Daniels 1991).

The underlying thesis for this paper is: *The use of advanced information and telecommunications technologies makes internal and external communications more efficient. It allows faster and more flexible interaction among different agents. This causes changes in the internal organization of the company and in the strategic behavior.* Information technology can be used as a complement or as a substitute for transportation, but also for labor or capital expenses. Depending on the specific cost savings that can be achieved with the use of information

technologies, companies will either concentrate more activities within their organization or outsourcing will become more important. The related consequences are in the first case larger firm sizes and more concentration, in the second case a trend toward smaller companies and more decentralization. The strategies depend on the characteristics of the specific goods and services and on the need for information.

The main focus of this paper is on the role of information in the production process. The paper summarizes the main theoretical concepts that provide the background for my planned dissertation research. In the next section, information theory, growth theories and transaction costs literature are reviewed. Section 3 presents some empirical evidence from earlier studies. Section 4 draws implications for future research and proposes a conceptual framework. The paper ends with a concluding section.

2. The Role of Information in the Global Service Economy

Information and knowledge have always been of key importance for companies. The modern economy is built around these two elements. Not all theories reflect this important role of information very well, the neoclassical theory for example simply assumes perfect information. This section briefly reviews the theory of information and new growth theory, which considers knowledge as a production input allows for increasing returns to scale. A brief discussion of transaction cost economics concludes this section.

The Theory of Information

The theory of information provides a valuable framework for the proposed research. A first crucial distinction is between codified information and tacit knowledge (Malecki 1997a, Burmeister 1998). Codified information is standardized and tangible, usually in the form of printed manuals, documentation or papers. This kind of information can easily be exchanged over long distances through telecommunication devices. It can travel independently from the person who “codified” it. Tacit knowledge, on the other hand, cannot travel in space independently, it “remains in the heads of the technical and research personnel of the manufacturer” (Boisot 1995, in Malecki 1997a). This knowledge is embedded in the specialist and its exchange thus requires transportation and face-to-face contacts (Burmeister 1998). According to the theory of

information, interactions involving a lot of tacit knowledge imply spatial proximity between the partners. This is also an important aspect in the industrial districts literature.

The distinction between information and knowledge and between tacit and codified knowledge is important as conceptual background for the choice between face-to-face contacts and communication through media. The question remains whether transportation and communication are substitutes or complements. Whereas the first thesis argues that telecommunications and virtual interactions will eventually replace face-to-face interaction, the second thesis opposes that view. The need for proximity will never disappear completely, because certain types of interactions (whenever tacit knowledge is involved) cannot take place without spatial proximity (Burmeister 1998). The concepts of firms as learning organizations and the existence of learning regions are also based on the assumption that communications technologies cannot substitute spatial proximity completely (Malecki 1997a).

Romanoff and Levine (1993) also make the distinction between stocks of knowledge and flows of information. Harrington (1997) suggests that knowledge should be depreciated as a capital stock, because “it is not depleted by its use (by information flows), but rather by obsolescence” (Harrington 1997, p.3). Information flows make this knowledge available to others. Companies need to know about new technologies, market needs, new products, about activities of their competitors, about the preferences of their customers, and about new innovations in order to remain competitive. Information is crucial for the economic success of a firm, maybe even for its future survival. Being cut off from information sources means speculation, “guessing,” instead of “knowing.” Whereas the neoclassical growth theory does not account for the crucial role of information, the new growth theories stress the importance of knowledge as a production input (Romer 1986, 1990, Krugman 1991a, b).

Traditional and New Growth Theory

The traditional neoclassical paradigm assumes that an uninhibited working of the market mechanisms will be equilibrating and any disparities in regional wages will disappear over time (McCombie 1988a). Any disparities in productivity growth will eventually vanish as the misallocation of resources is progressively corrected and regional growth rates approach the steady state. The growth of wages is determined by the rate of exogenous technical progress. If

factors of production are, for whatever reason, initially being used sub-optimally between regions, any improvements in the efficiency with which these resources are used will register as an increase in productivity. This temporary acceleration in productivity growth is the result of non-optimal growth in the past. An implication of the neoclassical model is that the low-wage regions should experience the fastest growth rates of both capital and the capital-labor ratio. If at any moment there are regional differences in the level of technology, part of technical progress may be the result of the diffusion of new techniques from the relatively advanced to the more backward areas. The differences are seen similar to market failure. The failure is due to the fact that information is not instantaneously available everywhere but takes time to diffuse. As this is corrected over time to the extent that the rate of diffusion increases, there will be equilibrating effects similar to those generated by the improved allocation of tangible inputs. Following these arguments, information technologies would enable lagging regions to catch up.

The Post-Keynesian theory argues that economic growth is the result of forces that are likely to prevent all regions from growing at their maximum potential although these forces may be partially or totally offset by the development of other factors (McCombie 1988b). The theory of cumulative causation (Myrdal 1957) puts even more emphasis on growing disparities between rich and poor regions.

In some way, the new growth theories try to bridge the gap between neoclassical equilibrium theory and cumulative causation theory. The concepts developed by Krugman (1991a, b), Romer (1986, 1990), or Grossman and Helpman (1992) also assume a general equilibrium, but also consider external effects and monopolistic markets that can cause long-term polarizing developments. Increasing returns, imperfect competition, multiple equilibria, an often decisive role of history and accident are some of the ideas that have become popular since the 1980s (Krugman 1991a).

The main achievements of the new growth theories are the explicit consideration of knowledge and technological change as production input factors (Romer 1986, 1990). Romer (1986) develops a competitive equilibrium model with endogenous technological change. In contrast to models based on diminishing returns, growth rates can be increasing over time, the effects of small disturbances can be amplified by the actions of private agents, and large countries

can grow faster than small ones. One of the main conclusions is that the stock of human capital determines the rate of growth (Romer 1990).

Krugman (1991a, b) emphasizes the importance of circular causation (Myrdal 1957) and positive feedback (Arthur 1990). Manufacturers will concentrate their production where there is a large market, but demand in turn will increase where the production is concentrated. Other things equal, it will be more desirable to live and produce at a location where production is already concentrated because it will be less expensive to buy the goods provided at this central location.

According to the new growth theories, information technologies should not be expected to have equilibrating effects in the neoclassical sense. On the contrary, the gap between “global village,” between the “connected” regions and those that are cut off from the global network will increase (Castells 1993).

Transaction Cost Economics

The transaction costs literature – mainly associated with Williamson (1975, 1985) – tries to explain why some transactions are done in markets whereas others are done within firms. This is done by analyzing the relative costs of the two ways of executing transactions. The main distinction is the one between market transactions and hierarchical transactions. In market exchanges, the partners agree on everything that is relevant for the transaction before the actual exchange takes place. Every detail is spelled out in the contract, there is no uncertainty and no room for renegotiations. In hierarchical exchanges, on the other hand, not everything is spelled out in advance. There is scope for unforeseen events to occur, for renegotiations, and for bargaining. Typically, there are also authority systems where somebody has the right to make decisions and impose them on others as events unfold. The concept of transaction costs refers to costs associated with executing market or contractual exchanges (Peterson 1995).

There are a number of underlying assumptions in Williamson’s work. *Bounded rationality* refers to the inability of human actors to compute correctly, to gather the correct information, and to make “optimal” or perfectly rational decisions. Human actors intend to be rational, but they have only limited ability to behave rationally. *Opportunism* is another assumption in transaction cost economics. Williamson claims that humans act upon self interest and also strategically

misrepresent information in order to attempt securing a better outcome for themselves. Regarding the characteristics of the transaction, Williamson stresses that *uncertainty* is important. We are uncertain the preferences, information, and goals of other actors; and partially ignorant about our own needs and about costs of doing something. Another characteristic of transactions is the *frequency* with which they recur. This can range from one-shot deals to frequent and regular daily or weekly transactions. The last characteristic is *asset specificity*. It refers to the degree to which durable, transaction-specific investments are required to realize least cost supply.

Uncertainty, bounded rationality, opportunism, and asset specificity lead to high costs of market transactions. The question arises whether one should rely on a contractual exchange or rather seek some other governance structures for the transaction. One of the applications of transaction cost theory uses the concept to explain vertical integration or disintegration of companies. The use of information technologies could reduce uncertainty by providing better and easier access to information. While not even the most advanced information and telecommunications technologies will give us complete information and allow us to make perfectly rational decisions, they have the potential to reduce transaction costs. If that can be verified, we could expect to see less vertical integration in the future.

3. Empirical Evidence

Empirical data show that overall the number of jobs that are related to the provision or the processing of information has increased steadily (Hepworth 1989, Kellerman 1993, Li 1995). The general trend towards a service economy as well as the increasing globalization of the economy are closely related with the increase of the number of information workers. The growing importance of information goes hand in hand with the advances in telecommunications technologies and the increasing importance of the service economy. According to data adapted from Porat (1977) and Bell (1979) and summarized by Hepworth (1989), a majority of people in the workforce are not involved in the production (assembling) of goods, but in the acquisition, transformation, and dissemination of information.

Information enters the production process at all different levels. At the “creative” stage, when new product ideas are considered, the company needs information about market preferences, potential market niches, activities of the main competitors, room for improvement of

existing products, and other factors that are crucial for decisions about future strategic behavior. Product development and design are the next steps that require information. At this stage, partner firms, subcontractors and clients might be the most important information sources (Gertler 1995, Lundvall 1988, von Hippel 1988, 1994). Information technologies play an important role in the actual production of goods too. Concepts such as Just-in-Time require real-time communication and the immediate transfer of information. The information component in marketing and customer service is self-evident. The faster a company is able to respond to its clients' needs, the better.

Much has been written about the importance of information networks (e.g. Camagni 1991, Capello 1994, Castells 1985, 1993, 1996, Gordon 1991, Malecki 1997b). Traditionally, access to information is not always open to everybody in the same way, most of the information is distributed through channels or networks. These networks can be formal or informal. While certain conditions and requirements regulate access to and membership in the formal networks (cooperations among firms in the same sector, organized by their association, formal private-public research networks etc.), the informal networks are often characterized by "knowing the right people." Personal contacts play an important role, and the flow of information is not transparent at all for outsiders. Internal corporate networks are another different category. Although very formal and usually strongly hierarchical, the information flow is again not accessible to anybody from outside. This distinction between "private" and "public" information is essential. Whereas private information is bought and sold, public information is explicitly considered a public good. Producer service firms make their internal specialized stock of knowledge available to others for a charge. This is only one example of private information that can be modeled via a market mechanism. Public information, on the other hand, flows through direct information and social networks and is modeled using network theory and stochastic models. The transmission is not free, but there is no direct charge on the networks for this kind of information (Harrington 1997).

An important global trend in this context is the internationalization of research and development (Howells 1990a, b, 1995, Morris 1992). Small and large, public and private, profit and nonprofit institutions benefit from international science and technology linkages. Not only manufacturing, distribution and marketing, but also R&D networks gain importance.

Information has always been a part of the production process, the availability and quality of information creates a number of different sets of outcomes. Companies that have more and faster access to more information than others can be more productive, they can penetrate more markets faster than their competitors, and they can operate at a larger geographical scale. The recent advances in information and telecommunications technologies thus affect firms in different ways: from a pure economic perspective, they help to increase productivity and reduce costs, particularly the often quite substantial costs of information acquisition.

Companies get their information from various sources, including customers, partners, subcontractors, competitors, universities, and other public and private sources. Traditional ways to distribute and to access information are publications, conferences and fairs, as well as through personal contacts, by mail, phone, and fax. Traditionally, the acquisition of this information involves costs that can sometimes be substantial. Direct costs of information as well as transportation costs and opportunity costs occur. Companies sometimes need personnel whose only task is to find and to access information sources. The use of advanced information and telecommunications technologies can help to reduce these costs. This cost reduction is, however, not achieved through labor substitution. Previous studies (Solow 1990, Brynjolfsson 1993) have not found any evidence that information technology substitutes for labor. There is even some evidence that the use of IT may actually increase employment (Osterman 1986, Morrison and Berndt 1990, Berndt and Morrison 1991). It is more likely that the use of IT reduces both internal and external coordination costs.

One can expect that the increased use of advanced technologies will increase the relative demand for skilled labor. At the same time, information technology can be a substitute for low-skilled labor in routine jobs. Using aggregate data, Brynjolfsson et al. (1993) show that the use of IT leads to smaller average firm sizes within the same sector or industry. They also find a time lag of two to three years until the effects become visible. The authors hypothesize that this might be the result of an increasing externalization of services, which in turn would lead to a shift in employment from manufacturing to the service sector.

The spatial impacts might be even more dramatic and more important. The increasing globalization of the economy requires more and better information. Faster and better access to information, on the other hand, enables companies to participate on global markets who would

otherwise not be able to do so – companies located outside the major metropolitan agglomerations, and smaller companies that are not part of the internalized information networks of large multinational companies. Thus, advanced information and telecommunications technologies can help existing companies to expand their operating scale and new firms to enter markets that have previously been closed or where the entry barriers had been too high. As a consequence, firms become more flexible in their location decisions. This might allow them to relocate to places where they can reduce costs (e.g. for office space) or to avoid a costly relocation to higher-ranking urban center in order to reach new markets or to be closer to information sources, partners and competitors. Now they can access the same information that had been available only in selected places before from their current location. This has potentially important consequences for economic development. The concentration and decentralization of individual services and activities can change the existing economic landscape of cities and regions and either reduce or increase gaps between agglomerations and peripheral regions.

4. Implications for the future research

Based on the review of the theoretical and empirical literature, we can draw the following conclusions and summarize the main problems:

- *There is no direct link between information technology and spatial structure.* Several studies over the past decades have shown that there is no direct connection between the use of information and communications technologies and regional economic development. In fact, efforts to use technology to stimulate development in lagging regions have failed. Technology is only a necessary, never a sufficient condition. Therefore it is necessary to approach this question from a different perspective, from the point of view of the firm as decision-maker. Future research will have to build a bridge between the micro-level of the firm and the macro-level of regional economic development.
- *There is no single accepted theoretical concept to explain the spatial impacts of information technologies.* This point is related to the first statement. The existing theories do either not handle the role of technology very well, or they do not have a spatial component. Neoclassical economic theory treats technological progress as exogenous and assumes perfect information. New economic growth theory considers knowledge not as a public good and

allows for endogenous technological change and is therefore better suited to explain potential impacts of information technologies. Traditional location theories focus heavily on transportation and thus allow to analyze only the potential substitution of information for transportation, which is a too narrow focus and only one aspect. The industrial districts and innovative milieu literature emphasizes the importance of proximity and information exchange, but does not handle the role of technology in this context very well. It is possible to argue that connectivity becomes more important than proximity, but this covers again only one aspect.

- *There is no reliable data on the specific use of advanced information technologies and particularly the Internet.* While we know that at this point there are 36.7 million registered hosts worldwide, and that 10.3 million of those hosts are registered with the domain .COM and are therefore commercial sites (Center for Next Generation Internet, Aug. 28 1998), we still do not know much about what businesses actually use the technology for and how they use it. Prior studies rather have the character of pilot or case studies and do not answer the question whether the companies use the technologies efficiently. We have only limited ideas whether information technology is used a substitute or a complement, and whether it helps to reduce costs (for labor or capital). The first goal of future research needs to be to provide some information about the actual and specific use of advanced information and communications technology.
- *The consequences for the companies and for regional economic development are unclear.* The discussion of the literature has made clear that there is a wide disagreement about the most likely consequences that the use of information technologies might have for the businesses that use (or not use) those technologies and subsequently for the regions in which those firms are located. It is necessary to develop a theoretical framework in which the potential consequences are can be analyzed and to determine the conditions under which specific consequences are most likely.

As mentioned in the introduction, the literature review provides the theoretical background for my dissertation research. In the last part of this section I will outline the conceptual framework for the proposed research.

We start at the firm level. Businesses have a specific knowledge that they use to provide services for others. They access and provide information through networks with partners, suppliers and customers. Some of the information is codified, for some activities tacit knowledge plays an important role. This part of the framework builds on the theory of information. Depending on the kind of information and knowledge that is being used and exchanged, businesses can potentially use information technologies to make the internal and external communication more efficient. They make the decision whether, to what extent, and for which purpose they use the technologies. The advanced information and communications technologies that will be considered in this research include the Internet with all its potential uses (from email to file transfer, remote computing and information provision on the web), but also other computer networks and all the more established communications technologies

Strategic business decisions are the next issue of interest. Businesses make their decisions based on information that they have available. The strategic decisions include potential changes in products, services, internal organization, or location, among others. This approach follows the recent work by Beyers and Lindahl (1997a, b). We can expect developments in two opposite directions: vertical integration or disintegration of activities within businesses (micro level) or changes in the spatial concentration of businesses themselves (macro level). The theoretical basis for this part comes from the strategic directions literature and from transaction cost theory. Firms that use information technologies could make (or intend to make) different decisions than other companies within the same sector that do not use those technologies.

The last aspects of interest are the consequences for regional economic development. What do the strategic business decisions, the concentration and decentralization mean for cities and regions? What are the spatial impacts? We cannot expect to find a lot of empirical evidence to answer those questions; the technologies and the developments are still too recent. Recent studies show the presence of lone eagles and high fliers (Beyers and Lindahl 1996, 1997a, b) as well as concentration tendencies (Holly and Clark 1998) in producer services. However, none of the studies has linked spatial changes to the use of information technologies by the companies. It is, however, possible to use existing theories to formulate expectations about changes in location behavior and clustering tendencies of producer service firms.

Information theory makes the important distinction between tacit knowledge and codified information. While the exchange of knowledge requires face-to-face contacts, codified information can be easily exchanged via communications media (Burmeister 1998). Face-to-face contacts require fast and easy access to all the partners who are involved in the exchange of knowledge. This can be most easily achieved through spatial proximity or – involving possibly substantial costs – through access to high-speed transportation, usually (international) airports. The industrial districts and local milieu literature also emphasizes the importance of spatial proximity for the exchange of knowledge. A possible result are knowledge spillovers and the development of “learning regions” (Malecki 1997a, Camagni 1991, Steiner, Gruber, and Hartmann, 1997, Tödtling and Kaufmann, 1997). The frequency and intensity of interactions results in a clustering of firms, often both in economic and spatial terms. Therefore we can expect that businesses that need access to and exchange large amounts of knowledge seek proximity to each other. Empirical evidence shows that this is particularly the case for high-tech firms (Burmeister 1998, Sweeney and Feser 1998).

The exchange of codified information, on the other hand, does not require face-to-face interaction. Therefore spatial proximity is not such a necessity and other factors (e.g. labor, capital, and infrastructure) become more important for the location decision. In that case, telecommunications technology increases the flexibility in business location decisions.

Industrial districts, flexible production, and local milieus are usually seen in context with vertical disintegration, frequent interactions with suppliers, customers, and other cooperation partners. The flexible networks enable those companies to be competitive and adjust quickly to changing market demands and technologies. The internal basis is a team-based, molecular organization, as opposed to the traditional “fordist” command-and-control hierarchy with a strong vertical integration (Malecki 1997a, Harvey 1987, Tapscott 1996). For vertically integrated companies (and particularly for multinational firms), information technologies make it possible to organize production and activities worldwide (Feldman and Kutay 1997, Castells 1996). It is possible to locate individual plants in different markets, using the existing competitive advantages of the individual locations, and still control the entire company from the top down. The use of information technology allows the fast exchange of codified information between the headquarter

and the individual plants. Geographic clustering is therefore not important for the individual plants, while headquarters tend to locate in major agglomerations.

A different aspect of location behavior relates to the preferences of highly qualified technical, managerial, or scientific personnel. Those groups show a greater mobility and require more amenities and services than unskilled labor. A clean and safe environment, good school systems, and a certain social and cultural environment are particularly important for them. Businesses – especially high tech firms – that have a high demand for skilled personnel tend to locate in such attractive areas, among them many edge cities (Garreau 1991, Castells 1996). If the use of telecommunications technologies changes the demand for highly skilled labor, then we might expect some spatial consequences related to their preferences.

It might be interesting to measure a more tangible effect, such as changes in the firm size, but these changes manifest themselves with a time lag of at least two years (Brynjolfsson et al 1993). Since so many new technologies have become available only very recently, we can again not expect to find this kind of hard empirical evidence. Changes in the strategic behavior (actual or intended for the near future), however, can provide a good indicator for other changes – for example in firm size or location behavior – that we can expect to see in the future.

The central research question for the proposed study is: *Do intense users of advanced information and telecommunications technologies show a different strategic behavior than others who use those technologies infrequently or not at all? In particular, can we predict any changes in the location of activities or businesses?* As discussed in the previous sections, telecommunications technologies are enabling technologies and have an indirect effect on strategic decisions. The primary effects are changes in the internal organization of the companies, which then can lead to changes in the strategic behavior.

Based on the theoretical literature, the following hypotheses can be formulated:

1. *Companies that exchange mostly codified information use advanced telecommunications technologies more regularly than companies that depend more on the exchange of tacit knowledge.* Tacit knowledge requires more face-to-face meetings and collective learning processes (Burmeister 1998). Thus, the use of information and communications technologies will be restricted to routine activities only. For producer service firms, we would rather expect that the findings confirm the thesis of complementarity of face-to-face contacts and

telecommunication. The related spatial consequences have been discussed above. Businesses that rely heavily on exchange of knowledge and ideas (such as R&D labs and most computer services) can be expected to locate in close proximity to each other, whereas other firms that exchange primarily codified information (e.g. banking, insurance, and legal services) will rather seek proximity to their clients and try to find the most cost efficient location in an individual market.

For firms that rely heavily on codified information, information technology provides easier access to more and better information from their current location. Therefore the use of the technologies enables some companies to stay at their present location, but improve the quality of the service that they provide. For example, access to electronic databases and legal resources makes it possible for a local law firm to draw from other experiences and provide better service to their clients. Investment specialists and brokers can follow stock market developments in real time and provide better information to their customers (Cronin 1997).

2. *Companies that use advanced telecommunications technologies regularly are smaller than the average firms in the sector.* This hypothesis can be derived from a revised theory of the firm that includes information technologies. Information technologies reduce the transaction costs that occur when companies access external information sources. In particular, costs of overhead functions such as administration and marketing become more divisible through the use of the new technology (Globerman 1996). This reduces the optimal size of firms. However, there is one exception:

For specific services and sectors, the use of information technology will increase concentration. This is particularly true for the banking and finance sector. The recent merger of NationsBank with BankAmerica (The Raleigh News and Observer, April 14, 1998) provides a good example. The use of electronic communication networks allows these large companies to extend their services geographically at relatively low cost (Globerman 1996). We would expect to find this kind of concentration in sectors that provide mostly standardized routine services.

Changes in firm size do not have direct spatial consequences, but there might be some indirect effects. Other things equal, smaller businesses need less office space, therefore they can afford to remain for example in the CBD or in other attractive and more expensive locations and pay

higher rents there. Of course business size cannot be seen isolated from other factors and characteristics. The size of the firm is often linked to the main activity and the skills level of the personnel, both of which are more important for location decisions than the number of employees alone.

The size of a company also has an impact on the internal organizational structure. Whereas larger companies tend to be more vertically integrated, smaller companies are vertically disintegrated. The different structures have an impact on the communication patterns and the information exchange within and between companies. This creates different locational preferences and needs, as discussed above.

3. *Companies that use advanced telecommunications technologies regularly are more likely to develop new products or services.* This hypothesis is based on the findings and arguments by Beyers and Lindahl (1997b) and Quinn (1988), discussed in the appendix. Beginning with Schumpeter, economic theory has always emphasized the role of technology in (product) innovation. Advances in technology will lead to new innovations and services.

Following the industrial districts and innovative milieu literature as well as Schumpeter, agglomerations and geographic clusters are the centers of innovation. Innovation is also closely linked to knowledge spillovers and exchange of tacit knowledge. Therefore it seems more likely that innovative firms remain in close proximity to each other.

On the other hand, access to information about innovations allows companies in more remote locations to copy those innovations and to offer products or services that are new to them and to the area where they are located. As soon as information about a new development is codified and can be transmitted via information and communication networks, it becomes accessible to everybody who is linked to the network (Burmeister 1998). Information technology enables a faster diffusion of innovations.

4. *Companies that use advanced telecommunications technologies regularly are more likely to attract new clients.* The use of new information technologies goes along with changes in communication. Some potential client industries might require specific forms of electronic communication; thus the adoption of new technologies opens the door to new markets.

The spatial implications are linked to some of the other hypotheses. New clients might be located in different geographic areas or they might require more or less face-to-face interaction, depending on the kind of information exchanged.

5. *Companies that use advanced telecommunications technologies regularly are more likely to expand their geographic market orientation.* The use of new information technologies allows companies to penetrate former inaccessible markets or even to operate on a global scale.

The spatial implications in this case include the possibility that businesses remain at their present location and expand their markets from there. For a business that does not require a lot of face-to-face interaction, information technologies provide access to remote markets without the necessity to be physically present there. Examples include small independent software developers (Cronin 1994, 1996).

6. *Companies that use advanced telecommunications technologies regularly are more likely to undergo internal organizational changes.* The introduction of new communications technologies has the potential to break up existing hierarchies and to change the internal communication. This might also lead to changes in the demand for skilled labor and subsequently to changes in firm size (hypothesis 2) and location of activities (hypothesis 7). The related spatial implications have been discussed above.

7. *Companies that use advanced telecommunications technologies regularly show a greater flexibility with respect to their location or the location of specific activities within the company.* Users of new technologies are more flexible in their internal organization and can be expected to respond faster to external influences. They might also show a higher willingness to relocate.

The “regular use” of the technologies is an essential part of the hypotheses. As Malecki (1997b) shows, the access to new technologies alone is not necessarily related to the intensity of use. Thus it is not enough to take into account whether firms have access to information technologies or not, it is necessary to include an indicator of the frequency of use.

5. Conclusion

This paper has summarized different theoretical concepts that can be used to analyze the impacts of information technologies on the internal organization of firms and on their strategic decisions. The theoretical discussion shows that there is a wide disagreement and a common uncertainty about the spatial effects of information and telecommunication technologies. It is unclear if the recent developments will favor a vertical disintegration of industry and a spatial agglomeration of small firms, or if greater internationalization will make small firms obsolete and leads to the global dispersal of industrial activity (Gordon 1991).

The existing empirical evidence also shows contradicting trends and results. The use of advanced information technologies might lead to greater decentralization or it might strengthen existing agglomerations (Gillespie 1991). Companies see a potential for more flexibility in their location decisions, but they do not necessarily express the intention to relocate.

To analyze the effects of information technologies on businesses and to make predictions about possible impacts on location and regional economic development, it will be necessary to develop a framework that connects the internal firm organization and strategy with spatial agglomeration and dispersal. Such a framework needs to integrate several existing theoretical concepts, such as information theory, transaction costs economics, and growth theory. The result that we are most likely going to see is that both vertical integration and disintegration, agglomeration and dispersal will occur as a result of the use of information technologies.

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