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Factors and Mechanisms Causing the Emergence of Local Industrial Clusters - A Meta-Study of 159 Cases

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ABSTRACT. Local industrial clusters have attracted much attention in the recent economic and geographical literature. A huge number of case studies have been conducted. This paper presents a meta-analysis of the case studies of 159 local industrial clusters in various countries and industries. Based on an overview of the various theories and arguments about the emergence of such clusters in the literature, it analyses the involvement of 35 different local conditions and processes, providing a summary on the knowledge that is gathered in these case studies with a comparison between continents, new and old clusters, and high- and low-tech industries.
KEYWORDS: local industrial clusters, case studies, meta-study, local conditions.
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1. Introduction

In the recent economic and geographical literature, the phenomenon of local industrial clusters has attracted much attention. Under the headings of 'industrial districts', 'industrial local clusters', 'innovative milieu' and 'regional innovative systems', the reasons why certain regions are successful while others are not have been extensively studied. Three kinds of approaches dominate this literature: case studies of regions identified as being economically successful (around 200 such studies are included in this meta-study), approaches generalising the findings in case studies in order to identify some of the causes why regions are successful (such approaches can, e.g., be found in Becattini 1990, Porter 1990, Scott 1992, Camagni 1995 and Markusen 1996), and approaches explaining the existence of local industrial clusters by mathematically modelling or simulating economies of location (Krugman 1991, Fujita & Thisse 2002, Maggioni 2002 and Brenner 2004).

The above literature addresses the questions of why local industrial clusters exist, how they emerge and why they are successful in comparison to other locations. In this paper we focus on the question of how local industrial clusters emerge and how the causes or prerequisites for the emergence of industrial clusters differ in time, space and industry. Although many of the case studies under review have addressed the question of why and how local clusters emerge, they have come to different conclusions. Studies that combine more than a few case studies or compare their findings are rare. The literature provides a huge number of single studies and a few studies in which two, three or four clusters are compared (an exception comparing nine cases can be found in van den Berg 2001a). In addition, the case studies are conducted on the basis of different concepts and assumptions. Thus, it is difficult to grasp a clear picture of what really causes the emergence of local industrial clusters.

Only one large meta-study can be found in the literature (van der Linde 2003), based on the theory of Porter (see Porter 1990). Van der Linde focuses his meta-study on mainly four factors that Porter claimed were important: Firm strategy and interaction, endowment of the region with relevant factors, local demand conditions, and related and service industries. He examines whether these factors play a role in 833 local clusters. Data is gathered by asking experts in the regions to answer a questionnaire. Van der Linde finds evidence for three of the four factors. Furthermore, he provides additional statistics on various characteristics, such as age and size, of the analysed clusters.

In order to obtain a more detailed picture, we scan the literature for potentially relevant factors and include all of them in our study. To this end, we provide an overview on the discussion in the literature about a total of 35 factors. Furthermore, we use the theoretical framework developed by Brenner (2004) to distinguish between three types of factors: local factors that

are present before the localised industrial cluster emerges and function as prerequisites, factors that are involved in a self-augmenting process during emergence, and specific events that trigger the emergence. Furthermore, we analyse the differences in the importance of these factors between industries, countries and points in time. To obtain usable knowledge about all these factors from a case study, this has to contain a detailed description of the emergence of the local cluster. Overall 159 local industrial clusters that are described in the literature in detail are included in our meta-study. In total 183 publications are used to conduct the study, some of them containing several case studies.

The paper proceeds as follows: in Section 2, the theoretical background is outlined and all factors included in the analysis are discussed. In Section 3, the methodology is described and some descriptive statistics on the 159 cases that are analysed are given. In Section 4, the findings of the comparison between countries, industries and points in time are presented. Section 5 concludes.

2. Theoretical background

The literature provides various concepts and theories of, and reflections on the mechanisms that lead to local industrial clusters and the factors that constitute necessary or supportive prerequisites. As Benneworth and Henry (2004) state, cluster research should be "recognised as an emergent set of multiple perspectives in dialogue" (p. 1011). We agree with Benneworth and Henry that this does not have to be a disadvantage. As we intend to be as general as possible, not excluding potential factors from the beginning, we use the theoretical framework developed by Brenner (2004, ch. 2) which allows to include all the different factors. Brenner (2001 and 2004, ch. 2) developed a mathematical model that describes the evolution of local industrial clusters, based on the assumption that local self-augmenting processes exist.

It is commonly argued in the literature on local clusters that the success of such clusters is self-reinforcing caused by positive local externalities (see, e.g., Krugman 1991). This notion goes back to Marshall and his discussion of industrial districts (Marshall 1920). He argued that small firms can benefit from their co-location because they develop a common labour pool, profit from knowledge exchanges and cooperation and can rely on an emergence of a large population of service and supplier firms in the region. Since Marshall's work many further mechanisms with similar self-augmenting dynamics have been proposed to be involved in local clustering. Fujita and Thisse (2002) have shown mathematically that such mechanisms lead to the stability of local clusters.

The analysis of the model by Brenner leads to the identification of three, fundamentally different kinds of conditions for the emergence of a local industrial cluster (Brenner 2004,

ch. 2). First, before such a cluster emerges, the regions can be characterised by the factor endowment and other features relevant for the industry. The emergence of a local cluster is only possible if the relevant factors and features, called *prerequisites* here, are sufficiently given in the region. In each industry there might be different prerequisites that are of crucial importance. However, in each region in which a local cluster has developed, some crucial prerequisites must have been given to a significant extent before the cluster emerged, thus making its emergence possible.

Second, a sufficient endowment with prerequisites does not automatically cause the emergence of a local industrial cluster. It only provides the potential for such a development. According to Brenner (2004), some actors have to be present and make use of this potential. This can be done in many ways, such as founding a firm, using favourable circumstances to generate a ground-breaking innovation, or mobilising the actors in a region. In other words, some action has to be taken to trigger a development in the region, making use of the favourable conditions. We call these actions *triggering events*.

Third, given the necessary prerequisites and a triggering event, a self-augmenting process occurs. This process is the basis for all theories and explanations of local clusters found in the literature. It implies that the activity in an industry and a region increases further once it has exceeded a certain critical mass. The literature describes many different mechanisms that cause such a self-augmenting process. Examples are spillovers that cause local firms to grow faster, the attraction of specialised service or supply firms to the region, making it more attractive and beneficial for the industry, and the generation of human capital and knowledge in the region that are beneficial for additional firms. We call these dynamics *self-augmenting processes* in the following.

The case study literature on local clusters shows that the latter differ considerably. Repeatedly, local clusters have been classified into types (the most prominent classification was proposed by Markusen 1996). It implies that each local cluster is characterised by different prerequisites, different triggering events and different self-augmenting processes. The theoretical framework described above merely suggests there must have been some favourable prerequisites, some triggering events and some self-augmenting processes during the emergence of a local cluster. Which prerequisites, triggering events and self-augmenting processes play a role in a specific situation might well depend on the industry, the kind of region and time. This will be studied below. But first, we will discuss the potential candidates for each kind of condition in detail.

2.1. Prerequisites

Prerequisites are all local factors and resources given in a region when a local cluster emerges, making its emergence in this region more likely. Brenner (2004, ch. 2) argues that local clusters in a certain industry emerge at a certain time. Usually there are many regions in which they can emerge. The characteristics of these regions do not determine where the cluster emerges, but they influence the likelihood of an emergence in each region. Although some factors and resources might be more crucial than others, many of them can be expected to influence the likelihood of the emergence of a local cluster in a specific region. Many such factors and resources have been put forward in the literature, which we discuss and use in the analysis below. Notice that we refer to factors and resources here that are already present before the emergence of the local cluster. This should not be confused with the local factors that develop during the emergence because of the self-augmenting processes (they will be discussed in Section 2.3). In Porter's concept of clusters both, factors and resources that are already given and factors and resources that develop during cluster formation, are found in the same boxes of the diamant model. However, Porter (1998) also stresses the fact that the quality, quantity and the development of factor conditions matter for the emergence of clusters and that there are interdependencies between different conditions. Here only the quality and quantity of factor conditions from Porter's concept are included.

Qualified labour (LABOUR): The relevance of the presence of sufficiently qualified labour is frequently discussed and reported for the location decisions of firms. It is an important part of Porter's factor conditions (Porter 1998). Furthermore, many case studies mention qualified labour as a crucial factor for the development of the industry in a specific region. This should not be confused with the argument that firms benefit from a common labour market in local clusters, which will be discussed under the heading of self-augmenting processes below and is a prominent issue in the literature on local clusters.

Networks (NET): Normally networks are assumed to evolve during the emergence of local clusters. Often they are even seen as part of a local cluster, although the structure and organisation of interactions differs between clusters and networks (Maskell & Lorenzen 2004). However, in some cases a number of actors are seen as crucial for the emergence of a local cluster (see, e.g., the case of Jena as described in Hagen 1996). These well-connected actors can be seen as an existing network that is important for the emergence of a local cluster.

Universities and public research (UNI/RES): The famous cases of Silicon Valley and the Cambridge Boston area are said to rely strongly on the existence of a renowned

university (Rosegrant & Lampe 1992 and Saxenian 1994). There is general agreement in the literature that universities and public research facilities often function as a crucial prerequisite for the development of local clusters. They work as creators of new knowledge, a source of entrepreneurs, founding high-tech firms and becoming cooperation partners for firms. They are often seen as the starting point of a local cluster (e.g., Garnsey 1998).

Tradition and historical preconditions (TRAD): In case studies it is repeatedly argued that regional traditions matter for the development of local clusters (e.g. van den Berg 2001 finds this for a number of cases). It is difficult, however, to distinguish tradition from the factors CULT (culture) and IND (industrial structure). Under the label of tradition and historical preconditions, we capture characteristics and past regional developments, while CULT and IND capture the norms and social institutions and the industrial structure, respectively, at the time of the emergence of the local cluster. For example, Storper (1993) highlights the impact of the history of a region on its developments.

Industrial structure (IND): Although this effect is little discussed in the conceptual and theoretical literature, the existing industrial structure in a region has a strong impact on the future technological developments in this region. Often technologies and industries develop in a region because there are already similar activities present (Brenner & Fornahl 2007). This is called a regional technological trajectory in the literature, a topic that has recently gained increasing scientific interest.

Local policies (LOC-POL): Local policies is a topic with many facets. Nowadays policy makers on the one hand try to trigger the emergence of a local cluster (this will be discussed in Section 2.2). On the other hand, they react to developments in the region, such as the emergence of a local cluster, and attempt to support them (this will be discussed in the section on self-augmenting processes). Here we are interested in a third kind of policy: policies that were in place before the emergence of a local cluster and influenced this emergence. Specific measures put forward in order to trigger the emergence of local clusters are excluded here. The conceptual and theoretical literature does usually not distinguish between these different kinds of policies. Policy is assigned a specific relevance in the emergence of local clusters without being treated in detail. For example, Porter (1990, p.127) assigned an important role to policy, including all the different facets of policy-making. Garnsey (1998) considers public support to be a precondition.

Culture (CULT): The literature on the industrial districts in the north of Italy has started to address the importance of local culture and attitudes for the emergence of local clusters (see, e.g., Becattini 1990 and Dei Ottati 1994b). Porter (1990) argues in a similar way that the attitudes towards self-employment, cooperation or innovation are relevant for

local clusters. A comprehensive discussion on this topic is given by Pilon and DeBresson (2003).

Geographical location (GEOGR): Under the heading of geographical location we subsume all factors that are given in a region because of its geographical location. This includes the presence of natural resources, the access to a natural transport infrastructure, geographical specificities, and the location in relation to other regions. Natural resources are seen as important initial conditions for some local clusters, such as the metal industry in the Ruhr area in Germany (Orsagh 1974). In other case studies it is argued that, although the regions had no specific resources endowment, a local cluster developed, such as Silicon Valley (Saxenian 1994). It seems that natural resources played an important role for the location of industries in the past, but that they have lost most of their importance in recent years.

Local demand (DEMAND): Local demand is a factor that has been made prominent by Porter (1990). The argument is that proximity to customers who demand technologically advanced or very fashionable products has positive effects on firms. Such customers exert pressure on firms to develop advanced products but also provide them with detailed information about what kind of developments will be successful on the market.

National policies (NAT-POL): Similar to local policies, there might also be national policies in place at the time of the emergence of a local cluster, making its emergence in the respective country more likely. The literature on national innovation systems has taken up the topic of how national institutions and settings influence the economic develop (Lundvall 1992 and Nelson 1993). As mentioned above, in the conceptual and theoretical literature on clusters policy is seen as a general factor having an influence. In case studies the distinction between local and national policies can be easily made so that we obtain knowledge about the frequency of the importance of each of them.

Suppliers (SUPP): This factor is discussed in more detail in the context of self-augmenting processes (see 2.3 below). There are also no prominent case studies arguing that the presence of suppliers was a prerequisite for the emergence of local clusters. Nevertheless, some case studies exist that support such an argument so that we include this factor as a potential prerequisite in our study.

Transportation infrastructure (INFRA): The attractiveness of a region is partly determined by its transportation infrastructure. Especially firms that require transportation of a large amount of goods to and from the firm benefit from a well-developed transportation infrastructure. This is therefore an important prerequisite for some industries. Usually, the literature regards a bad transport system as a factor that hampers the emergence of a

cluster (see, e.g., van den Berg 2001a). In general the local transportation infrastructure is still seen as an important factor for economic development, although transport costs have lost a lot of relevance while the economy became more globalised.

Quality of life (LIFE): The quality of life is an important factor for the attraction of people to a region (Garnsey 1998). This might support the emergence of a local cluster in certain regions. A well-known example is Munich, which is considered in Germany as the best location for people to live in. This fact supported the emergence of a number of industrial clusters there (Sternberg & Tamásy 1999). Van den Berg et. al. (2001, p. 189) argue that 'firms increasingly seem to move to areas where they can find the appropriately skilled people'. Highly skilled people, in turn, prefer to live in regions with a high quality of life.

Local capital market (CAPITAL): A high rate of start-ups is often seen as an important starting point for the emergence of a local cluster (Audretsch 2001 and Feldman et al. 2005). These start-ups require financial resources that are not equally provided in all regions. For example, Garnsey (1998) argues that the provision of venture capital is an important precondition. Again, we have to distinguish between the effect that the already existing capital market in a region has on the emergence of a local cluster and the interaction between the firm dynamics and the dynamics in the local capital market, which is discussed in the context of the self-augmenting processes.

Wages (WAGE): Wages as a prerequisite for the emergence of local clusters are not discussed in the conceptual and theoretical literature. However, the number of local clusters in developing countries that have been studied has increased in recent years. A number of these local clusters developed because of the comparatively low wages there. Therefore, we include this factor in our analysis.

Type of region (TYPE): It is repeatedly argued in the literature that (big) cities are the breeding ground for new ideas and thus new technological developments (Duranton & Puga 2001). Jacobs (1969) argues that big cities provide a mixture of many different industrial activities that lead to higher innovativeness. Local clusters often develop out of such new technologies and local clusters are claimed to emerge in relation to the industrial life cycle (Brenner 2004).

Technology parks (TECH-PARK): Technology and science parks are a recent development. They are seen as one of the preconditions for the emergence of a high technology milieu by Garnsey (1998). The aim is to establish networks and local benefits of co-location by the provision of land and infrastructure to high-tech firms. Often the policy intention is to create a local cluster by setting up a technology park. The results of such policy initiatives in the past have been mixed.

2.2. Triggering events

It is repeatedly argued in the literature that the local conditions do not determine the emergence of a local cluster and that it can also emerge in regions with less favourable conditions (see, e.g., Storper & Walker 1989). There have to be actors in the region who seize opportunities as they arise.

The literature puts such triggering events forward in various forms. For example, Porter (1990, p. 124) recognises that random events, such as wars, crucial innovations, and political and economic shocks, play an important role for the shifts in competitive positions and thus the emergence of local clusters. Rauch (1993) states that historical events, and thus chance, are important for the location of industries. St. John and Pouder (2006, p. 145) take up these arguments and state: 'There is generally an element of chance in the origin of a particular geographical cluster of firms'.

Although the importance of chance in the form of random events is widely acknowledged, little is said about the potential events that may trigger the emergence of local clusters. We include six such events in our meta-study:

Promoting activities (PROM): In some local clusters individuals or small groups of individuals played a crucial role in the emergence of local clusters. They developed a vision for the region, or only for their own businesses, and put this into practice. The resultant dynamics finally led to the emergence of a local cluster. Nowadays such actors are called promotors. We found several examples in the case studies that we examined. The theoretical discussion on this issue is, however, restricted on the issue of entrepreneurs shaping their local environment (e.g. Boschma & Lambooy 1999, Malmberg & Maskell 2002 and Feldman et al. 2005). This is part of the effect that we have in mind here.

Specific policy measures (SPEC-POL): In recent years it has become very popular among policy makers to actively create or support the emergence of local clusters. In the scientific literature, the possibility to create local clusters driven by political initiative is seen as being very limited (Boschma & Lambooy 1999 and Brenner 2004). However, there are also a number of case studies in which it is claimed that specific policy measures have at least contributed to the emergence of the local cluster.

Historical events (HIST): Historical events, such as wars, are repeatedly cited in case studies as triggering events for the emergence of local clusters. Porter (1990, p. 124) includes them in his list of random events. They are able to change global or local conditions and force firms to move to other locations where they might function as initiators of further developments.

Specific innovations (INNO): Important innovations are also on Porter's list of random events (Porter 1990, p. 124). Initial innovations often trigger a huge number of successive innovations. If knowledge related to the initial innovation is spatially sticky, successive innovations are more likely to occur in the same region. This gives the firms there a competitive advantage and might cause the emergence of a local cluster.

Founding of leading firms (LEAD-FIRM): One successful firm might also be the starting point for the emergence of a local cluster (van den Berg et al. 2001b, p. 9). Many spin-offs from this firm might occur that will later constitute the local cluster. For example, Wolfe and Gertler (2004) state 'of particular importance is the emergence of a lead or anchor firm for the cluster. Whole clusters can develop out of the formation of one or two critical firms that feed the growth of numerous smaller ones' (p. 1074). Many case studies support this statement. Klepper has made this line of argument very prominent by showing that the location pattern of some industries can be explained by such a process (Klepper 2006).

Chance (CHANCE): As mentioned above, many scientists who do case studies do not explicitly search for triggering events. The description of such events is often not very detailed. Sometimes it is only mentioned that chance played a role. To capture these cases in our study, we define CHANCE as another triggering event.

2.3. Self-augmenting processes

Self-augmenting processes are the underlying mechanisms responsible for the existence of local clusters. In the literature they are also called Marshallian externalities or localisation economies (see, e.g., Fujita & Thisse 2002, p.267). It can be proved that if such Marshallian externalities exist and if they are sufficiently strong, industrial activities might agglomerate in one or a few regions (Fujita & Thisse 2002, ch. 8, and Brenner 2004, Section 2.2). Their existence is necessary for the occurrence of local clusters.

We use the term self-augmenting processes here for two reasons. First, we want to highlight the fact that we discuss a dynamic process. Second, we also want to highlight the fact that we make a distinction between the processes that cause the emergence of a local cluster and the features that cause firms to benefit from being located in a local cluster. Usually such a distinction is not made because it is implicitly assumed that if firms benefit from co-location, this makes them grow faster and attracts more firms to the region. Hence, it is assumed that what causes the benefits of co-location also causes the emergence of local clusters.

Two aspects are ignored by such an argument. First, both processes do not occur at the same time. Local clusters emerge because there are some forces that cause more firms to be

established in certain regions and/or cause them to grow faster there. Once a local cluster has emerged, we can study whether and why the firms in the local cluster benefit from the co-location. The same mechanisms might but need not be responsible for both processes. Mechanisms might be different during the time of cluster emergence, which takes place usually during the expansion phase of a technology/industry/product, and during the time of cluster existence, which tends to coincide with the mature phase of an industry (Brenner 2004, Section 2.3).

Second, the theoretical examination even tells us that firms will ultimately not benefit from locating within a local cluster. Fujita and Thisse (2002, p. 291) state 'The distribution $M_A \in [0, 1]$ is a spatial equilibrium when no firm may earn a higher profit by changing location'. If not all firms locate in one region, which we do not observe in reality, this implies that ultimately the benefits of co-location are outweighted by some disutilities. Benefits from being located in a local cluster should not be expected once a local cluster has stabilised in size, except if the spatial distribution of firms is not in equilibrium for other reasons. This is supported by Hakanson's (2005) conclusion that there is no empirical evidence for the statement that firms benefit from being located in a cluster. Some empirical studies find advantages for firm in clusters, such as Porter (2003) who finds higher wages in clusters and Bönte (2004) who finds that 'linkages to geographic proximate firms and institutions do have an impact on product innovations' However, all this positive impacts refer to parts of what causes firms' profits. This can be well explained for Porter's findings. One might argue that firms in clusters show a higher productivity and are, thus, able to pay higher wages (as found in Porter 2003). However, in these locations they also have to pay higher wages so that the final profits might be the same, at least for the average firm, as in other locations.

Hence, we distinguish between the mechanisms that cause the emergence of local clusters and the features that may make being located in a local cluster profitable. The former are called self-augmenting processes here, while the latter are not further discussed here. All potential self-augmenting processes are discussed in the following.

Buyer-supplier relations (BUYSUP): The importance of the local interaction between buyer and supplier firms is recognised in many different works on, and definitions of, local clusters (see Porter 1990, Camagni 1993, Braunerhjelm & Carlsson 1999, and Hill & Brennan 2000). Marshall (1920) argued already in his work on industrial districts that the presence of many similar firms in an area also attracts suppliers to this area, making it again more interesting for further firms. Nevertheless, there is a lively discussion about the importance of proximity in buyer-supplier interactions. In the past decade

empirical studies have shown that the proximity of suppliers and customers has become less important (cf., e.g., Hahn & Gaiser 1994, Grotz & Braun 1997), mainly due to the strong decrease in the relative costs of transportation. Despite this, a slightly higher intensity of contacts was found when supplier and customer were located near to each other (cf. Fritsch 1999).

Choice of co-location with other firms (COLOC): The conceptual literature on local clusters rarely discusses start-up processes. More attention is paid to the process of spin-offs, which we define here as a separate mechanism. The label COLOC stands for the conscious decision of a firm to open a firm site in a region where already many competitors are located or of a founder to start a firm in a region with many competitors (see Maskell 2001 for a discussion of these processes). For start-up firms it has repeatedly been found that the location decision is made mainly based on personal factors, especially the previous location of the founders. This also holds for start-ups in local clusters (Keeble et al. 1999). If other factors are considered, the location of competitors does not show up in the list of relevant factors (Keeble et al. 1999).

Cooperation among firms (COOP): Cooperation is one of the factors that are most frequently put forward in the literature on local clusters, industrial districts and innovative milieux. It was already argued to play a role by Marshall (1920). Later, mainly in the literature on industrial districts and on innovative milieux, it was argued that cooperation was central for the working and success of these systems (see, e.g., Dei Ottati 1994a and Camagni 1995). This argument is based on the assumption that local cooperation makes firms more successful, a claim that is controversial (see, e.g., Staber 1996). Nevertheless, cooperation is often even seen as part of the definition of local clusters, especially by policy makers. It needs to be pointed out here that the mechanism COOP partly overlaps with the mechanism BUYSUP, because many cooperations between firms take place between buyers and suppliers, and the mechanisms INTRA-SPILL and INTER-SPILL because cooperation often involves a transfer of knowledge. The same overlap holds for the discussion in the literature. Especially outside the scientific domain, local cooperation, networks, synergies and spillovers are equated with the existence of a local cluster. This might be misleading.

Interaction with public education and research (F-EDU/RES): Another cooperation that firms frequently conduct is that with public education or public research institutions. This interaction is often also argued to be important for the emergence of local clusters. However, we have to be clear here about an important distinction: on the one hand, existing public education and research facilities can be important cooperation partners

for firms – this is covered by the prerequisite EDU/RES above. On the other hand, the interaction between public education and research facilities and local firms might cause an increase in public spending or a stronger focus on education and research relevant for the firms. The latter implies a self-augmenting process because these changes make the region more attractive for further firms with the same needs. This latter process is denoted by F-EDU/RES here and not discussed in the literature.

Accumulation of local human capital (F-HC): The accumulation of human capital has also been already identified as an important driving force of the clustering process by Marshall (1920). He argued that all local firms contribute to the education of the common local labour force, which in turn makes the region attractive for further firms with similar demands for labour qualities. In more recent works on local clusters and industrial districts, this process is still often seen as crucial (see, e.g., Hill & Brennan 2000 and Hanson 2001). Power and Lundmark (2004) show empirically that indeed the mobility of workers is higher within industrial cluster than in other urban areas and argue that this is the major process of knowledge exchange within clusters.

Interaction with local public opinion (F-OPIN): Local public opinion and attitudes are often seen as supportive of the development of local clusters. However, this does not define a self-augmenting process but is included in the prerequisite CULT. A self-augmenting process results if the increase in the number or size of firms in the region causes a change in the public opinion towards these firms. For example, once an industry becomes visible in a region (because of high employment numbers), people might identify the region with this industry, be more willing to work in this industry, or support policy measures in favour of this industry. The existing firms might also be role models for further entrepreneurs in the region (Fornahl 2007). These processes are little discussed in the literature, but are mentioned in some case studies.

Interaction with local policy makers (F-POL): Usually it is assumed that local policy makers influence the emergence of local clusters mainly by taking specific actions (see SPEC-POL). However, local policy makers are influenced by the industrial situation in their region. If there are more or larger firms of a specific industry in their region, these might lobby their interest more successfully. Thus, these firms become more visible for policy makers, or the latter's actions regarding these firms might become more prominent. This might also cause a self-augmenting process that is not discussed in the theoretical literature but observed in some case studies.

Interaction with local venture capitalists (F-VC): Venture capital firms usual locate near their market. The literature shows that most contracts between firms and VC firms

take place within a region (Rickne 2000). Hence, if there are many start-ups in a certain region, this will attract VC firms to it. This is part of Porter's argument that agglomerations attract service firms to the region (Porter 1990). Once there are more VC firms in a region, it is easier for further entrepreneurs to obtain money to start their own firm. Often we also note that VC firms focus on a certain industry that fits the industrial structure in a region.

Inter-industrial spillovers (INTER-SPILL): Spillovers are treated as a central element in the literature on innovative milieux (Camagni 1995). They are also mentioned by Marshall (1920) as taking the form of an exchange of knowledge between the actors. The literature furnishes strong evidence for the fact that spillovers mainly occur locally (Jaffe et al. 1993, Anselin et al. 1997 and Maurseth & Verspagen 1998). This provides a strong basis for the argument that spillovers generate an advantage for a firm being located within a local cluster. There is an increasing strand of cluster literature which takes a more broad view and puts knowledge and its exchange centre stage for the functioning of clusters. Good overviews on the arguments are given by Maskell (2001) and Wolfe and Gertler (2004) and a discussion of the empirical evidence for the different mechanisms is provided by Malmberg and Power (2005). The personal interaction between workers and their movement between local firms seems to be of strong importance, at least, in some industries (Malmberg & Power 2005). Here we distinguish two kinds of spillovers: those among firms belonging to the same industry and those among firms belonging to different industries. The importance of spillovers between industries might primarily result from the fact that innovations are often generated by the combination of different pieces of existing knowledge. Nevertheless, the literature on local clusters focuses more strongly on intra-industrial spillovers.

Intra-industrial spillovers (INTRA-SPILL): Intra-industrial spillovers are the second type of spillovers that we consider here. As discussed above, they are frequently referred to in the literature on local clusters (see the discussion of INTER-SPILL).

Spin-offs (SPIN): The importance of the spin-off mechanism has been stated in a number of conceptual works on cluster formation (see, e.g., Maskell 2001). In addition, Klepper (2006) argues that spin-offs are the crucial and sole reason for the existence of cluster, at least, in some industries. It has been shown for a number of industries that the existing local clusters can be explained by one or a few early successful firms and the spin-offs that they generated (see, e.g., Hakanson 2005 and Klepper 2006). Such a process also constitutes a self-augmenting process because the more firms already exist, the more likely further spin-offs will occur. Most of the conceptual and theoretical literature ignores this

process. Part of the reason might be that spin-offs do not represent benefits of co-location for the existing firms. Hence, they do not fit the standard framework that equates the factors that produce benefits through being located in a local cluster with the processes that cause the existence of local clusters. Spin-offs are definitely involved in the emergence of local clusters, at least in some cases. Practitioners usually confirm this statement. But firm owners or managers would never see the start of new competitors in the region as something beneficial to them.

Support of start-ups by firms (SUP-START): In some cases existing firms actively support start-ups, for example by acting as venture capitalists. This is not discussed in the theoretical literature but might also generate a self-augmenting process and is included in our analysis.

3. Meta-study

3.1. Methodology

Which of the above prerequisites, triggering events and self-augmenting processes are relevant in the emergence of a particular local industrial cluster is an empirical question. It has to be studied for each cluster separately. However, only if we combine the knowledge obtained in such studies of specific clusters, are we able to develop a comprehensive picture of the emergence of local industrial clusters.

Therefore, this paper combines the findings of many case studies, 159 to be exact. The common framework necessary for such a study is provided by the above theory. Thirty-five different prerequisites, triggering events and self-augmenting processes are listed above. We checked these potential influences for each case study. Since the authors of the case studies may not have been aware of all possible causes and influences studied here for each case study and each prerequisite, triggering event and self-augmenting process, the results of our study can be organized as follows:

Class I (important): The author of the case study explicitly states that the prerequisite, triggering event or self-augmenting process is present and important.

Class U (unimportant): The author of the case study explicitly rejects the importance of the prerequisite, triggering event or self-augmenting process.

Class N (no information): The case study does not address the presence/importance of the prerequisite, triggering event or self-augmenting process.

By analysing a case study, we were able to classify it with respect to each prerequisite, triggering event and self-augmenting process into one of the three classes above. As a result, we obtained a matrix in which each row presents a local industrial cluster and each column presents a prerequisite, triggering event or self-augmenting process. Each cell of this matrix contains either an 'I', a 'U', or an 'N'.

For some local industrial cluster more than one case study was available. In these cases all available case studies were used. When the results for the case studies varied for a factor or process, the following rules were applied:

- If only classes I and N appeared, the cluster was classified as I.
- If only classes U and N appeared, the cluster was classified as U.
- If classes I and U appeared, we looked for further evidence in other sources. If further evidence was found, this was used for a classification into I or U (including a mark of uncertainty). If no further evidence could be found, it was classified as N.

These rules imply that if a prerequisite, triggering event or self-augmenting process was examined only in some of the case studies for one local industrial cluster, only those case studies were considered here. This implies that not mentioning an explanation results mostly from not considering this explanation at all.

In this way, 159 local industrial clusters were classified using 183 publications (see the appendix for a list of these publications). We studied a total of 35 potential explanations for the emergence of local industrial clusters. According to the above theory, these explanations are distinguished into prerequisites, triggering events and self-augmenting processes. We tried to define the different prerequisites, triggering events and self-augmenting processes such that they would not overlap and the classification of statements in the case studies could be easily done.

More problematic was the fact that many of these potential explanations were not mentioned by the authors of the case studies. As a consequence, we obtain a matrix that contains many N-entries (no information). The aim should have been to have only I- (factor is important) and U-entries (factor is unimportant) in the matrix. However, without repeating all case studies this was not possible. For the analysis we had to decide how to deal with the N-entries. It can be assumed that the authors of the case studies focused their attention on the factors, events and processes that were important for the emergence of the local industrial cluster they studied. Hence, they presumably pointed out most of the important variables, while those on which the case studies give no information were most likely thought unimportant. It can, however, also be assumed that the authors ignored some potential explanations when conducting their

case study and searching for explanations of the emergence of the local cluster. This problem could only be solved by doing further case studies in which all possible explanations defined above are considered.

As a consequence, we kept in mind that the variables varied in terms of their prominence. Some of them might show up less often in the case studies simply because the authors did not think about them in their analysis. Thus, the comparison between the frequency of the different variables should be interpreted with caution.

3.2. Data sources

All case studies of local industrial clusters that describe the emergence of a local industrial cluster and that we became aware of were included in the analysis. We used the very broad definition of a local industrial cluster by Brenner (2004, ch. 2) which covers industrial districts, innovative milieus and local clusters. Thus, the analysis is not restricted to any of the concepts available in the literature. However, we only considered those case studies that contained a detailed description and/or analysis of the emergence of the local industrial cluster.

In total 183 publications are considered in this analysis. Some of them concern the same local industrial cluster so that a total of 159 local industrial clusters are represented (some publications also mention several cases). Besides checking each prerequisite, triggering event and self-augmenting process for each local industrial cluster, the approximate date or period of emergence, the country in which it is located, and the main industry in the cluster are recorded. A list of the geographical distribution of the local clusters considered is given in Table 1. Obviously, some countries have been studied more frequently than others.

In the last twenty years, analysing local industrial clusters has become increasingly popular. Nonetheless, this period of time is not overrepresented in our sample as Table 2 shows. However, local industrial clusters that have emerged recently are somewhat more frequent in the sample. We distinguished time periods of twenty years and, if possible, assigned each local industrial cluster to one of these periods.[1] The frequency of each time period is given in Table 2.

The sample of local industrial clusters included in this analysis represent a very heterogeneous sample of industries. It is neither dominated by high-tech or low-tech industries. A classification of the analysed local industrial clusters into one of the standard industry classifications has often not been possible because many clusters span these classes, and we had

[1] In 14 cases the time of the emergence of the local cluster was not stated in detail so that we could not assign the cluster to one of the time periods.

Europe		North America		South America	
Austria	3	Canada	5	Brazil	2
Belgium	1	Mexico	2	Colombia	2
Denmark	3	USA	25		
Denmark/Sweden	1				
Finland	2				
France	4				
Germany	18				
Ireland	1	Asia		Africa	
Italy	15	China	1	Ghana	2
Norway	4	India	4	Kenya	6
Portugal	1	Japan	16	South Africa	2
Russia	1	Pakistan	1		
Spain	3	South Korea	2		
Sweden	6	Taiwan	1		
Switzerland	4			Australia	
The Netherlands	3			Australia	2
UK	16				

Table 1: Number of local industrial clusters from each country included in the analysis

Time of emergence	Number of cases
Before 1909	28
1910-1929	11
1930-1949	18
1950-1969	31
1970-1989	41
After 1990	16
Not classified	14

Table 2: Number of local industrial clusters from each time period included in the analysis

to rely on the description of the authors of the case studies. We thus used the categories frequently used by the authors of the case studies themselves, defining some prominent classes. The frequencies are given in Table 3.

The distribution of the local industrial clusters included in this study in time, space and

Industry	Number of cases
Textile & leather	25
ICT	23
Life sciences	15
Media	13
Electronics, instruments & optics	12
Furniture, jewellery & musical instruments	10
Automotive	9
Metals	9
Agriculture, fisheries & food	8
Machines	8
High-technology (general)	5
Tourism & culture	5
Glass & ceramics	4
Banking & business services	4
Aerospace	2
Shipbuilding	2
Others	5

Table 3: Number of local industrial clusters from each industrial class included in the analysis

industry shows that local clustering is not a specific phenomenon. It is very general, and the cases that are included here seem to be adequate to capture the wide range of this phenomenon.

3.3. Some descriptive statistics

With respect to the prerequisites, we found that for each of the 159 local clusters the literature identifies at least two prerequisites that are said to have been important. This shows that prerequisites are well documented in the literature on local clusters. Nevertheless, there are some prerequisites, such as WAGE, TYPE and TECH-PARK, for which no information is provided in many case studies. The results for the prerequisites are given in Table 4.

As stated above, the triggering events are much less discussed in the literature than the prerequisites and the self-augmenting processes. Thus, the list of triggering events is much shorter and for 36 local clusters we did not find any triggering event being mentioned as important. The findings for the triggering events are listed in Table 5.

The self-augmenting processes are again much more widely discussed and studied in the literature. There were only four local clusters where we did not find any of the self-augmenting

Prerequisites	Important (I)	Unimportant (U)	No information (N)
LABOUR	105	10	44
NET	78	37	44
UNI/RES	70	22	67
TRAD	66	10	83
IND	61	2	96
LOC-POL	56	18	85
INFRA	52	10	97
CULT	52	14	93
GEOGR	51	2	106
DEMAND	49	20	90
NAT-POL	47	8	104
SUPP	43	13	103
LIFE	31	18	110
CAPITAL	30	16	113
WAGE	23	10	126
TYPE	21	0	138
TECH-PARK	21	9	129

Table 4: Frequency of each prerequisite mentioned as an important or unimportant factor for the emergence of the local industrial cluster in the respective case studies

Triggering events	Important (I)	Unimportant (U)	No information (N)
LEAD-FIRM	62	4	93
SPEC-POL	53	10	96
HIST	52	0	107
PROM	22	7	130
INNO	15	4	140
CHANCE	14	1	144

Table 5: Frequency of each triggering event mentioned as an important or unimportant factor for the emergence of the local industrial cluster in the respective case studies

processes being mentioned as an important cause for the emergence of the cluster. Often various of these processes are argued to be simultaneously relevant. The findings are listed in Table 6.

The above analysis shows that many variables are involved and that each local cluster is specific in that a mix of variables is involved. The theoretical prediction that there are three

Self-augmenting processes	Important (I)	Unimportant (U)	No information (N)
F-HC	116	10	33
COOP	87	22	50
COLOC	83	3	73
INTRA-SPILL	81	14	64
F-EDU/RES	66	19	74
SPIN	60	4	95
F-POL	49	10	100
INTER-SPILL	46	1	112
F-OPIN	44	9	106
F-VC	35	6	118
SUP-START	31	6	122
BUYSUP	30	8	121

Table 6: Frequency of each self-augmenting process mentioned as an important or unimportant factor for the emergence of the local industrial cluster in the respective case studies

groups of variables and that each group has to be represented in each emergence of a local industrial cluster has been mainly confirmed. We also established a ranking for the average importance of each variable. However, this has to be used with caution. First, some variables might be underrepresented because the authors of the case studies tended to ignore them. Second, some case studies contain no information in this respect because they were conducted for a different purpose. Third, we have seen that each local industrial cluster is an individual case, so that it is unclear what such a ranking tells us.

4. Differences in time, industry and space

The literature agrees on the fact that local clusters are different. Many authors have developed various typologies of local clusters (e.g., Markusen 1996, Iammarino & McCann 2006 and St. John & Pouder 2006). The same holds for the reasons for their emergence. Case studies of local clusters come to different results, as shown in Section 3.3 above.

Given these differences, it is interesting from a scientific and policy perspective to understand the causes for these differences. Three potential causes are examined here. First, it is studied whether the relevant prerequisites, triggering events and self-augmenting processes change in time. Second, we compare high-tech and low-tech industries as well as knowledge-intensive and non-knowledge-intensive industries. Third, we make comparisons between countries.

All the comparisons are conducted using Fisher's exact test. For each observation we set up two categories: 1) observations classified as I (important) and 2) observations classified either as U (unimportant) or N (no information). The number of entries in both categories is compared for the different periods of time, industry classes and spatial units. Below, all results that reject the hypothesis that time, industry or space do not matter, at least on a 5% significance level, are recorded.

4.1. Differences in time

Initially, we set up a sequence of periods of time into which we sorted the analysed case studies (see Table 2). However, the number of cases for each period of time was too small to conduct a fruitful comparison. Therefore, we divided the total time into two parts and compared the two groups of local clusters. We make a division at 1950, comparing the clusters that emerged before 1950 with those that emerged after 1950. In addition, we compared the local clusters that emerged before 1970 with those that emerged after 1970 in order to study the more recent developments. All 35 variables were examined. However, only the significant changes are presented in Table 7.

This comparison delivers some interesting results. Most variables that are listed in Table 7 are more frequently mentioned in the studies of newer local industrial clusters. There are only four variables that seem to have decreased in importance. These are the geographical location (GEOGR) of the region, the industrial structure in the region (IND), historical events (HIST) and chance (CHANCE). The first is well in line with the argument of globalisation. The geographical location of a region is becoming less and less relevant for its economic development. According to the above analysis it decreased especially from before 1970 to after 1970, which reflects the recent trend to globalisation. Besides this, historical events and pure chance have been mentioned to play a more important role before rather than after 1950. The significance of chance seems to have further decreased after 1970. Furthermore, the local industrial structure has lost importance after 1970.

Nowadays specific policy measures (SPEC-POL) seem to have become more important. Among the prerequisites, university and public research (UNI/RES), policy (LOC-POL and NAT-POL), the quality of life (LIFE), the availability of venture capital (CAPITAL), and technology parks (TECH-PARK) have increased in importance, with the prerequisites UNI/RES, NAT-POL and TECH-PARK becoming especially significant after 1970. Most of these prerequisites depend on policy. Hence, much more importance is attached to policy in the case studies of newer local industrial clusters than in those of older clusters. Policy seems increasingly to be involved in the development of local clusters.

	Variable	P-value for the difference with a division at 1950	1970
Variables with an increasing importance	UNI/RES	0.039	0.010
	LOC-POL	**0.007**	
	NAT-POL	0.040	0.027
	LIFE	0.013	
	CAPITAL	0.032	
	TECH-PARK	**0.003**	**0.001**
	SPEC-POL	**0.001**	**0.000**
	F-EDU/RES	**0.006**	0.041
	F-POL	0.011	0.044
	F-VC	**0.009**	0.047
	SUP-START	0.020	0.012
Variables with a decreasing importance	IND		**0.003**
	GEOGR	0.011	**0.001**
	HIST	0.032	
	CHANCE	0.018	**0.001**

Table 7: Significant differences in the importance of the prerequisites, triggering events and self-augmenting processes for the emergence of local industrial clusters during different periods of time. The cells show the p-values (significance levels below 1% are highlighted in bold).

There are also some self-augmenting processes that have gained in importance over time. Existing firms play a more important role in supporting new start-ups (SUP-START). Furthermore, the interaction between firms and universities, public research (F-UNI/RES), local policy (F-POL) and local venture capital (F-VC) has increased in importance. This indicates that the local interaction between different local actors has now become more important, as is, e.g., argued in the concept of the triple helix (see Leydesdorff 2000).

4.2. Differences between industries

Again, as there were not sufficiently many cases available to compare single industries, we had to set up groups of industries. We used two sources for a distinction: the definition of high- and low-tech industries according to Hatzichronoglou (1997) and the definition of knowledge-intensive and non-knowledge-intensive industries by Grupp et al. (2000). We find that the results for the two distinctions of industries are very similar. Again, we listed only

the variables for which the importance differs significantly between the industries (see Table 8).

	Variable	P-value for the difference between high-tech and low-tech	P-value for the difference between knowledge-intensive and non-knowledge-intensive
Higher importance for high-tech / knowledge-intensive industries	LABOUR	**0.001**	**0.003**
	UNI/RES	**0.000***	**0.000***
	LOC-POL	0.010*	**0.006***
	INFRA		0.015
	NAT-POL	**0.000***	**0.000***
	LIFE	**0.000***	**0.000***
	CAPITAL	**0.001***	**0.006***
	TYPE		**0.003**
	TECH-PARK	**0.000***	**0.000***
	LEAD-FIRM	**0.000**	**0.000**
	SPEC-POL	**0.003***	**0.003***
	PROM	0.017	0.015
	F-HC	**0.009**	
	F-EDU/RES	**0.000***	**0.000***
	SPIN	**0.000**	**0.001**
	F-VC	**0.004***	0.010*
	SUP-START	**0.001***	**0.001***
Higher importance for low-tech / non-knowledge-intensive industries	GEOGR	**0.000***	**0.002***
	WAGE	**0.001**	**0.000**
	HIST	**0.009)***	0.023*
	COOP	**0.001**	**0.001**

Table 8: Significant differences in the importance of prerequisites, triggering events and self-augmenting processes for the emergence of local industrial clusters between different kinds of industries. The cells show the p-values (significance levels below 1% are highlighted in bold; entries that are also shown in Table 7 are highlighted with a star).

In comparing Tables 7 and 8 it becomes evident that there are more differences between industries than over time. However, many of the differences found between local industrial clusters that developed before 1950 and after 1950 are also found between high- and low-tech industries, or between knowledge-intensive and other industries (highlighted by stars in Table 8). The reason for this is that local clusters in high-tech industries are, on average, younger

than those in low-tech industries. Since the industries which are now low-tech would probably have been classified as high-tech in the past, these differences should rather be attributed to changes in time. Nevertheless, a number of additional differences are found between high- and low-tech industries.

There are two prerequisites that play a stronger role in the emergence of local industrial clusters in low-tech industries than in high-tech industries. These are the geographical location (GEOGR) and low labour costs (WAGE). The significance of the former might be explained by the correlation between older clusters and the involvement of low-tech industries, which are more dependent on natural resources. The latter's significance is related to the fact that in low-tech industries location decisions are primarily based on labour costs. In high-tech industries a number of prerequisites are found to be more important. However, most of these factors are also more important for newer local clusters than they are for older ones. This holds especially for the policy-related factors (LOC-POL, NAT-POL, LIFE and TECH-PARK). The same holds for the quality of life in the region (LIFE) and the availability of capital (CAPITAL). In addition, the availability of qualified labour also plays a more important role (LABOUR). This is in line with arguments in the literature that qualified labour is especially important for high-tech and knowledge-intensive industries (see, e.g., Beise et al. 1999). Furthermore, the local infrastructure (INFRA) and the type of the region (TYPE) play a more important role for knowledge-intensive industries as compared to other industries. This might result from the importance of knowledge spillovers that are more likely to occur in cities, which contain more different kinds of activities (Jacobs externalities, Jacobs 1969).

As regards the importance of triggering events, specific policy measures (SPEC-POL) are found to be more relevant in high-tech industries, while historical events (HIST) matter more for low-tech industries. Again, the same differences in importance are found between old and new local industrial clusters. In addition, two new differences have turned up: first, the emergence of local clusters in high-tech and knowledge-intensive industries is more often triggered by local promoters (PROM) and the existence of leading firms (LEAD-FIRM). Second, it seems that specific persons and individual outstanding firms are of greater importance in high-tech and knowledge-intensive industries. This might be caused by the importance of innovations and technological leadership in these industries.

For the self-augmenting processes cooperation between firms (COOP) plays a more important role in the low-tech and non-knowledge-intensive industries. However, that might be caused by the strong focus on cooperation in the Italian studies, where such industries dominate. In high-tech and knowledge-intensive industries the self-augmenting processes are comparatively more often provided by spin-offs (SPIN), the support of start-ups by established

firms (SUP-START), and the interaction of the existing firm population with the local human capital (F-HC), universities and public research (F-UNI/RES) and local venture capitalists (F-VC). Especially the last three variables are clearly related to the needs of firms in high-tech industries. The interaction with local human capital (F-HC) does not show up in the comparison between the different periods of time. This is in line with the above finding that human capital matters more for high-tech and knowledge-intensive industries.

4.3. Differences in space

For individual countries we find even fewer cases than for individual industries or periods of time. Again, we set up groups to make comparisons possible. We have studied two kinds of differences: those between developed and developing countries and those between some continents. Since continental Europe differs from the UK more than the USA differs from the UK, we distinguish between the Anglo-Saxon sphere (Australia, Canada, UK and USA), continental Europe, and Asia. The other continents are not reflected by a sufficient number of case studies in this analysis. The results of these comparisons are given in Tables 9 and 10.

	Variables	P-value for the difference between country groups
Higher importance in developed countries	UNI/RES	0.029*
	LOC-POL	0.024*
	LIFE	**0.003***
	LEAD-FIRM	**0.008***
	SPIN	**0.000***
	F-EDU/RES	**0.001***
Higher importance for developing countries	SUPP	0.028
	WAGE	**0.000***
	HIST	0.021*
	COLOC	0.030
	BUYSUP	0.011

Table 9: Significant differences in the importance of prerequisites, triggering events and self-augmenting processes for the emergence of local industrial clusters between developing and developed countries. The cells show the p-values (significance levels below 1% are highlighted in bold; entries that are also shown in Table 8 are highlighted with a star).

Again, some of the findings can be explained by the correlation with other characteristics

of the local industrial clusters. High-tech clusters are more frequent in the developed countries. Thus, it is not surprising that some variables, such as UNI/RES, LOC-POL, LIFE, LEAD-FIRM, SPIN, F-EDU/RES, WAGE and HIST are similarly assessed when we compare developing and developed countries with high- and low-tech industries. More interesting are the facts that the availability of suppliers in a region (SUPP), the decision to locate near to other firms of the same industry (COLOC), and the relationships between buyers and suppliers (BUYSUP) play a more important role for the emergence of local clusters in developing countries. This leads to the conclusion that the interaction between firms plays a more important role in less developed countries, while the interaction between firms and universities and public research plays a more important role in more developed countries.

The comparison between the three groups of countries also shows some similarities with the other comparison. For example, Asia has some developing countries which is not the case in the other two groups. Therefore, some differences can be expected between developing countries and developed countries when comparing Asia and the other two groups. However, these differences should be much weaker because 19 of the 25 local clusters in Asia studied are located in developed countries. Therefore, we discuss the differences between the three groups of countries independently of the analysis comparing developing and developed countries.

Let us first look at the prerequisites that are important in the different groups of countries. The Anglo-Saxon sphere is an outstanding example for the strong relevance of infrastructure (INFRA) and the type of region (TYPE). This might be due to the fact that the industrial activity in such large countries as the USA, Canada and Australia is very much concentrated in big cities. Continental Europe shows a comparatively strong influence of the tradition of regions (TRAD). Obviously, Europe has the longest history of industrial activity. Asia deviates by showing a weaker dependence on universities and public research (UNI/RES), public opinion and cultural aspects (CULT) and the quality of life in the region (LIFE). Interpretations are less clear in this case. The quality of life seems to play a stronger role in the so-called Western countries. The fact that universities and public research show up more frequently in Western countries can be explained by the huge number of case studies done there that put universities centre stage regarding the development of the respective local cluster. Finally, there are two prerequisites that are inportant significantly more often in the Anglo-Saxon sphere than in Asia: national policy (NAT-POL) and the availability of capital (CAPITAL). No significant differences are found for the comparison with continental Europe, allowing us to conclude that the importance in continental Europe of these prerequisites lays between their importance in Asia and the Anglo-Saxon sphere. The strong importance and availability of venture capital

	Variables	P-value for the difference to Asia	Anglo-Saxon	Europe
Higher importance in Asia	COOP		**0.006**	
Higher importance in Anglo-saxion	UNI/RES	**0.000**		
	INFRA	**0.003**		0.012
	CULT	**0.000**		
	NAT-POL	0.017		
	LIFE	**0.001**		
	CAPITAL	0.014		
	TYPE	**0.003**		0.023
	INNO	0.012		0.010
	F-EDU/RES	**0.000**		
	SPIN	0.036		
	F-POL	**0.001**		
	F-OPIN	**0.000**		
	F-VC	0.011		
Higher importance in continental Europe	UNI/RES	**0.000**		
	TRAD	0.038	0.040	
	CULT	**0.000**		
	LIFE	**0.009**		
	LEAD-FIRM	**0.005**	**0.001**	
	F-EDU/RES	**0.000**		
	SPIN	**0.002**		
	F-POL	**0.001**		
	F-OPIN	0.011		

Table 10: Significant differences in the importance of prerequisites, triggering events and self-augmenting processes for the emergence of local industrial clusters between developing and developed countries. The cells show the p-values (significance levels below 1% are highlighted in bold).

in the Anglo-Saxon sphere is well known, while there is no similar knowledge that helps to interpret the differences in the importance of national policy.

With respect to the relevance of triggering events in the countries, only two differences are found between the three groups of countries. First, the Anglo-Saxon sphere shows a strong importance of major innovations (INNO). This is in line with the argument that especially the US economy is strong in transforming major inventions into market products. Second, the

founding of lead firms (LEAD-FIRM) plays a significantly stronger role in continental Europe than in the other two groups of countries. This might again be the result of a longer history of industrial activity and the crucial role that firms played for a region in the past.

An interesting finding is that the Anglo-Saxon sphere does not differ from continental Europe with respect to the relevant local self-augmenting processes, while Asia differs strongly in the relevant processes from the other two groups of countries. In Asia, spin-offs (SPIN) and the interaction of the existing firm population with universities and public research (F-UNI/RES), local policy makers (F-POL), local public opinion (F-OPIN) and local venture capitalists (F-VC) play a less important role. As concerns the level of interaction with local venture capitalists, continental Europe seems to be somewhere between Asia and the Anglo-Saxon sphere. In contrast, cooperation between firms (COOP) plays a more important role in Asia, while continental Europe is not significantly different from both other groups of countries. Especially the findings for the variables F-VC and COOP are well in line with the general finding that venture capitalists play a stronger role in the Anglo-Saxon sphere, while Asia takes a more cooperative attitude. Similar to the findings above, Asia again shows a much weaker connection of the firms to their environment.

All the above findings are subject to the problem that they are based on subjective evaluations by researchers. Hence, the differences found between times, industries and countries might be the result of differences between the respective researchers. However, in the case of times and industries this seems to be less of a problem. All case studies have been done within the last twenty years, and there is no reason why researchers who study local clusters that emerged a hundred years ago should look at different factors and developments than researchers who study local clusters that emerged twenty years ago. The same holds for industries. In contrast, most local clusters have been studied by researchers from the same country. If there are differences in the way researchers from different countries conduct case studies, this will result in differences in the findings for different countries. This somewhat weakens the findings concerning the comparison of countries.

5. Conclusions

The aim of this paper has been twofold: first, to discuss the factors and processes put forward in the literature as causing the emergence of local clusters. We distinguish three types of factors and processes: prerequisites, triggering events and self-augmenting processes. In total 35 different factors and processes are discussed. This provides a theoretical framework that can be used to compare different local clusters. The second aim has been to present a meta-study of a large number of case studies of local clusters. In this meta-study it is examined whether

the prerequisites, triggering events and self-augmenting processes described in the literature are found consistently to be important for the emergence of local clusters.

The results are used to detect differences between various kinds of clusters, such as clusters in developed countries compared to clusters in developing countries or clusters in high-tech industries compared to clusters in low-tech industries. This has produced many instructive findings, for example, that over time (comparing clusters before and after 1950 and 1970) the geographical location and the particular industrial environment have become less important, while policy intervention and location interactions of various kinds have gained importance. The latter point is in striking contrast to globalisation tendencies otherwise prevailing. Furthermore, high-tech local clusters are based more on variables related to human capital, public research and policy intervention than low-tech local clusters.

In comparing different groups of countries with each other, we find that in Asia cooperation plays a more important role, while the local interaction between firms and public research, policy makers, venture capitalists and public opinion play a less important role there. In continental Europe, the emergence of local clusters is characterised by a relatively stronger influence of the founding of leading firms and the tradition of regions. The Anglo-Saxon sphere is characterised by a higher importance of major innovations, national policies and venture capital.

We provide here a first approach to use the existing literature for a more detailed understanding of the emergence of local clusters, especially of how the relevant factors and processes differ between periods of time, industries and countries. The progress that we have made is limited by the fact that the existing case studies use different concepts and consider different factors and processes. This paper provides a comprehensive list of factors and processes which we defined and discussed. It is to be hoped that future case studies will take this list as a basis. This would make future meta-studies such as this more fruitful and might eventually finally lead to a complete understanding of the circumstances that influence the way in which local clusters emerge.

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A. Appendix: Sources

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