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Oliver Falck
Stephan Heblich

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Oliver Falck[+], Stephan Heblich[++]

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[+] ifo Institute for Economic Research, Poschingerstraße 5, D-81679 Munich (Germany), Phone: **49-9224-1370, Fax: **49-9224-1460, Email: falck@ifo.de.

[++] University of Passau, Faculty of Economics and Business Administration, Innstr. 27, D-94032 Passau (Germany), Phone: **49-851-5092546, Fax: **49-851-5092542, Email: stephan.heblich@uni-passau.de.

Dynamic Clusters

Abstract

Globalization has had an enormous impact on traditional industrial structures. It seems almost the case that everything is everywhere the same. And yet, in reality, some regions in a single industrialized country enjoy rapid economic growth while others are downsizing or stagnating. Thus there must be some remaining regional competitive advantages—even in the "Age of Globalization." This paper engages in a quest to discover what these new "locational" factors might be and how and why they are necessary in creating a dynamic cluster of regional growth. In doing so, we try to link agglomeration advantages of the new economic geography with competitive advantages of Porter's cluster theory. But we also go beyond these approaches and add further regional growth factors such as creativity or diversity. Using data that paint a comprehensive picture of industry and regional development in Germany we try to find empirical evidence for our approach. A case study from the automobile industry – one of the leading industries in Germany – completes our picture of dynamic clusters.

Keywords
Cluster, Regional Growth, Innovation, Creativity

JEL Classification
R11, R12, O18, O33

1. Introduction

Globalization has had an enormous impact on traditional industrial structures—one could even go so far as to say a “shattering” impact. Increasing competition has led to a greater variety of products at low price-cost margins and sellers’ markets are rapidly evolving into buyers’ markets. Today, consumers expect increasingly customized products so that mass production capability is not necessarily the advantage it once was (Piore & Sable, 1984). This is especially true for the automotive industry (Womack *et al.*, 1990), where statistics show that producing two cars that are exactly the same color and have exactly the same equipment options happens about as often as a blue moon.

Customer demands for customized products and quick delivery necessitate a highly flexible, fast-reacting production system. Increasing complexity in production has led manufacturers to disaggregate the production process by out-sourcing much of it, a strategy that originated in Japan and is known as *lean production*.[1] In reducing vertical integration, manufacturers create an external supply chain, a process that has been made considerably easier by low transportation costs and an almost global communication infrastructure. Globalization has made it possible for manufacturers to not only find, but to use, the cheapest inputs for their businesses. However, it turns out that only the production of standardized and labor-intensive inputs has been shifted to countries with competitive labor costs; R&D and capital-intensive production tends to stay close to home. In the automobile industry, for example, it is generally true that first- and second-tier suppliers are located in direct proximity to the original equipment manufacturer (OEM). The low vertical integration in this industry necessitates close R&D coordination between OEM and important suppliers. This network is often complemented by universities and other research establishments, as well as by corresponding service providers. Taken together, this cooperative interlocking creates the sort of regional structure that Michael Porter (1990, 1998) calls a “cluster.”[2]

In reality, some regions in a single industrialized country enjoy rapid economic growth while others are downsizing or stagnating. This leads to the conclusion that there must be some

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[1] “Lean production is ‘lean’ because it uses less of everything compared to mass production—half the human effort in the factory, half the manufacturing space, half the investment in tools, half the engineering hours to develop a new product in half of the time. Also, it requires keeping far less than half the needed inventory on side, results in many fewer defects, and produces a greater and ever growing variety of products” (Womack *et al.*, 1990, p. 13).

[2] “Clusters are geographic concentrations of interconnected companies; specialized suppliers; service providers; firms in related industries, and associated institutions (for example, universities, standard agencies, and trade associations) in particular fields that compete but also cooperate” (Porter, 1998, p. 197f).

remaining regional competitive advantages—even in the "Age of Globalization." During the Industrial Revolution, the availability and accessibility of natural resources was critical to success and the basis for traditional agglomeration theories. For example, regional coal deposits attracted steel production, which led to surrounding and large industrial districts. However, today transportation costs have become less important and hence "traditional arguments for the existence of clusters have been undercut by the globalization of supply sources and markets" (Porter, 1998, p. 208). So, if some areas have a competitive advantage and it is not based on natural resource endowment, but still appears to be regional, what exactly is it? What are the "new" location factors conducive to innovation and growth?

The quest for postindustrial location factors is reflected in new economic theories that have as their goal understanding the comparative advantages of regions in an increasingly globalized environment. Seminal approaches include Porter's (1990, 1998) "theory of clusters," Krugman's (1991) "new economic geography," and Piore and Sable's (1984) "theory of collaborative economies." In general, all three approaches state that regions can compensate for potential disadvantages due to higher wages by setting up stable regional networks that literally bind companies to a certain region. This is good news, especially for those who see globalization as a job-destroying monster. However, when it comes to *how* this regional advantage can be achieved, the three approaches diverge. Porter highlights the importance of inter-industry clusters that will provide a competitive and supportive environment; Krugman focuses on the existence of large-scale firms with increasing returns to scale, leading to industry agglomeration (cluster); Piore and Sable trust in the flexibility and social ties within clusters of small specialized firms. All three approaches are looking at the same thing—regional clusters—but from very different points of view, leading each of them to develop some similar, but many different, factors that might have an impact on regional development (Doeringer & Terkla, 1995).

The quest for clusters is our focus in Section 2 of this paper. We first look at how industrial agglomeration evolved over time, ending with the present day and the tentative conclusion that clusters are a type of modern industrial agglomeration. Capturing a "cluster," though, that is, defining exactly what it is and tracing its development, is not an easy business as there is no consensus in the literature on how to trace (or trap) the elusive cluster. However, in Section 3, by combining different approaches, we derive a workable way to trace clusters. Instead of strictly following just one approach, we apply an explorative strategy in order to locate clusters in Germany. Starting from the seminal approaches outlined above and taking into consideration recent developments, we deduce crucial factors that are hypothesized to have a positive impact on regional economic development and thus lead us to the discovery of dynamic clusters. Section 4 introduces our data set and characterizes defined regions in Germany as being dynamic or not. In this section we begin to explore whether and to what extent the factors deduced previously are relevant to regional growth. The goal is to discover regional factors that are common to the dynamic regions. Section 5 further describes our findings and in doing so, changes the discussion from an aggregate macro-perspective to the micro-perspective of one single region. Our conclusions and some political implications are found in Section 6.

2. The (Elusive?) Quest for Clusters

Traditional economic theory provides several location factors that support regional industrial agglomeration. Alfred Marshall (1890) introduced the concept of industrial districts to economic theory. He found that industries clustered around specific locations were taking advantage of external economies of scale. Marshall separated these economies of scale into three types: (1) economies resulting from access to a common labor market and shared public goods, such as infrastructure or educational institutions; (2) economies from saved transportation and transaction costs due to the regional proximity of firms along the supply chain; and (3) economies resulting from knowledge spillovers that result from “working on similar things and hence benefiting from each other’s research” (Griliches, 1992).

The existence of such location factors can attract more and more firms that are in the same industry as those already present, thus leading to an industrial agglomeration within a region. Some of the best-know examples of regional industrial agglomeration include the automobile manufacturing industry in southern Germany, the manufacturing belt in the northeastern United States, the footwear and fashion industry in northern Italy, or the former concentration of textile industry in Lancashire and Yorkshire in England, which was the subject of Alfred Marshall’s analyses. Economies resulting from industry agglomeration within a region are also known as *localization economies* or *Marshall-Arrow-Romer externalities*. The Marshall-Arrow-Romer model predicts that local monopoly is more favorable to regional growth than local competition because intensive competition will reduce the appropriability of postinnovative rents and, therefore, also reduce incentive to innovate (Feldman & Audretsch, 1999). This argument reflects Marshall’s influence and the circumstances of industrial production proceeded in his time. At the turn of the 20th century, industry structure was marked by mass production and economies of scale resulting from vertical integration and cost-saving process innovation. As transportation costs were high in those days, industrial agglomeration primarily occurred in areas endowed with mineral resources and in proximity to important suppliers, buyers, or consumers. Thus, industrial agglomeration was the result of *comparative cost advantages*.[3]

However, things have changed since Marshall's day, and so has the relative importance of his location factors. As economic wealth rose and markets became increasingly saturated with consumer goods, customers started demanding more individualized products, a process nicely illustrated by an example from the U.S. shirt production industry. Until the 1960s, men's shirts were a basic commodity and 70 percent of all shirts produced were white and of the same cut. By 1986, the market share of standardized white shirts decreased to 20 percent (Abernathy *et al.*, 1999). Within a span of 20 years, uniformity was out; individuality in. This led to a change in production processes as individualized customer requirements could not be met with standardized mass production. Smaller batch numbers were produced and former economies of scale vanished. Manufacturers vertically disaggregated their production and started relying more on suppliers instead of producing everything themselves. Furthermore, economies from saved transportation costs are less important in today's world. Hence, Marshall's location factors need to be reexamined. The proximity of input-output relations pales in comparison with the rapidly rising importance of knowledge spillovers. What Acemoglu (2002) and Siegel (1999) describe as "skill biased technological change" has created an immense demand for skilled workers and hence knowledge in general. However, in contrast to other production factors, knowledge, in the form of human capital, sometimes also referred to as *tacit knowledge*, is comparatively immobile—even on the "information highway."[4] Tacit knowledge is a certain know-how learned by doing. It cannot be formalized or codified; rather, it is embodied in a person. Thus, von Hippel (1994) terms knowledge that is possessed by a person and, by extension, to a certain region, as *sticky knowledge*. It constantly circulates within a community's social network in the form of regular face-to-face communication and informal meetings. The close interconnection between the social and the economic network within a community (e.g., friends who work for different firms) makes knowledge spill over (Saxenian, 1994)—it jumps, or runs, or "spills" from firm to firm via the

[3] Krugman (1991, p. 14ff) provides a simple model of geographic concentration based on the interaction of increasing returns, transportation costs, and demand that leads to comparative cost advantages.

[4] In contrast, information such as an exchange rate or a mathematical formula is codified and thus can be transferred.

social network. Thus, a community’s social life acts as a knowledge multiplier, increasing the pool of geographically bound knowledge. This, in turn, fosters innovation and dynamics in the product lifecycle (Feldman, 1994a, 1994b). In contrast to former comparative advantages deduced from a static cost-comparing point of view, competition and innovation now lead to dynamics and hence a *competitive advantage*.

Porter calls location factors such as raw material and unskilled labor “nonkey” factors or general use factors. Due to low-cost transportation and globalization, this type of factor is available everywhere today and thus can be obtained by every company. One might think of this factors as “inherited.” In contrast, key factors, or specialized factors, in production are created. They include skilled labor, infrastructure, and capital. These man-made factors are can lead to competitive advantage. Porter (1998, p. 208) combines the traditional theory of comparative advantages and dynamic theory of competition when he states: “To understand this role [of clusters in competition] requires embedding clusters in a broader and dynamic theory of competition that encompasses both cost and differentiation and both static efficiency and continuous improvement and innovation, and that recognizes a world of global factor and product markets.” Thus, a cluster can influence competition in three ways: (1) it can improve the productivity of the firms within the cluster, thereby leading to process innovation; (2) it can drive innovation within the cluster, thus fostering the product lifecycle; and (3) it can stimulate new businesses, which, again, foster the product lifecycle and might further promote new industry lifecycles. Competition results from an ongoing quest for future rents, to be derived from successful innovation-stimulating dynamics, and thus either invites the entry or forces the exit of firms. By introducing competition as a regional location factor, Porter is in accord with Jacobs’s (1969) concept of *urbanization externalities* or *Jacobs externalities*. In contrast to the Marshall-Arrow-Romer model, this approach considers local competition, rather than local monopoly, to be a key regional growth factor.

Both approaches, the one by Marshall-Arrow-Romer as well as the one by Jacobs and Porter, are valuable in that they illuminate the concept of competition from different directions, namely, a static perspective and a dynamic perspective. The advantages of a local monopoly (static perspective; Marshall-Arrow-Romer) are covered in the literature on industrial organization. Competition is analyzed within the product market and hence at a certain stage of the product lifecycle. The focus of interest is the value chain. This perspective assumes that only intra-industry spillovers matter. In contrast, the local competition, or dynamic, perspective (Jacobs and Porter) attempts to explain the product lifecycle as being driven by competition for new ideas.[5] In this view, there is an emphasis on the importance of fresh ideas that result from inter-industry spillovers.[6] According to Gort and Klepper (1982), such inter-industry spillovers are most likely to occur in an early phase of the product lifecycle, they also find that most innovations originate outside the set of current producers, e.g., from entry of firms in technologically related markets or by way of independent inventors.

In line with Jacobs and Porter, Aghion and Howitt (2006) state that entry, exit, and firm turnover have an even greater effect than competition among incumbents on innovation and productivity growth, not only in the economy or region as a whole, but also within incumbent firms. There are two prominent explanations for the positive effect of entry on innovation and growth. One explanation concerns contesting established market positions. In the contestable markets approach, the threat posed by the possibility of new firms entering the market is taken to be a key determinant of existing firms' behavior (Baumol *et al.*, 1982). Incumbent firms have an incentive to innovate so as to make entry into their market more difficult. Aghion *et al.* (2004, 2005) present a model of technologically advanced entry. Each potential entrant arrives with leading-edge technology. If the incumbent is less technologically advanced, the entrant will replace the incumbent. If the incumbent is also employing leading-edge technology, it can use its reputation advantage and block entry. In short, an incumbent that is getting close to developing leading-edge technology has a strong incentive to continue its innovation and to keep pace with technological progress as doing so can prevent entry of competitors. However, an incumbent whose technology is out of date—regardless of whether it innovates—will find it difficult to keep pace with technological progress and, presumably, will not be able to prevent entry of leading-edge competitors. Consequently, an incumbent who is very behind the times technology-wise is discouraged from innovation.

The other explanation for the positive effect of entry on growth is amplified innovation by new firms. For example, research and development can generate new knowledge, which may then be exploited either by its developer or by another firm. When the actual developer of the new knowledge does not exploit it, and there are many reasons why he or she might not wish to do so, the knowledge can still 'spill over' and lead to economic growth. This is especially the case when the developer of new knowledge does not want to take the risk involved in with new products or processes. One of the most obvious ways knowledge spill-over can happen is when a person who previously worked for the incumbent firm becomes the founder of a new firm that commercializes the unexploited knowledge. Acs *et al.* (2004) present a growth

[5] Porter's (1990) diamond model for the competitive advantage of nations maps the relationships.
[6] For a more detailed discussion, see e.g., Audretsch and Feldman (2004) or Glaeser *et al.* (1992).

model considering new firm formation that diminishes the knowledge filter between the creation and exploitation of knowledge.

According to Florida (2002b), it is not just the developer's pure knowledge that leads to innovation and it is not just competition that determines a region's potential for innovation and growth, it is the combination of these two factors with *creativity*. Thus creativity has a twofold impact on regional development. First, Florida defines human creativity as the ultimate economic resource. In doing so, he eventually presents a more precise categorization of the important input factor knowledge. While knowledge in general allows for production at a technologically high standard, successful R&D leading to ground-breaking inventions and thus future rents requires an exceptional kind of knowledge, namely, creativity. For example, if Thomas Edison had confined himself to simply making a more efficient candle, he would never have discovered the electric light bulb. Creativity is the ability to think "out of the box" and thus arrive at new ideas and better ways of doing things.

Second, Florida (2002a) and Glaeser *et al.* (2001) believe that a creative environment, including a rich cultural life and an overall bohemian lifestyle, is essential for attracting human capital and high-technology industries. They assume that bohemians contribute to a city's amenity and thus establish an environment that attracts talented and highly qualified individuals. This theory complements traditional agglomeration arguments: the prospect of a pool of high skilled workers favors the agglomeration of R&D-intensive companies, which, in turn, contributes to regional innovation and growth. Thus the presence of bohemians as a sort of magnet for creativity might also be a location factor contributing to regional growth.

3. Tracing the Cluster

Clusters are more difficult to trace than are industrial agglomerations as they encompass more than just the intra-industry relations that are well documented in statistics. According to Porter (1998, p. 197f), "clusters are geographic concentrations of interconnected companies; specialized suppliers; service providers; firms in related industries, and associated institutions (for example, universities, standard agencies, and trade associations) in particular fields that compete but also cooperate." Thus, the major question is how to identify these hidden inter-industry relations and connections to associated institutions.

One way of tracing clusters is the case-study-based approach. Porter (1998, p. 200f) uses this procedure to describe the "California Vine Cluster" and the "Italian Footwear and Fashion Cluster." Starting from an industry agglomeration, he analyzes the surrounding infrastructure. This involves identifying the firms along the value chain; taking a look at firms providing complementary products and services or making use of similar supply or sales channels; tracing institutions that foster the exchange of specific knowledge and support R&D; and searching out the unions, associations, and political institutions that support the cluster. However, this procedure suffers from the major disadvantage that it is not explorative. It only works in the case of a known agglomeration and thus is not useful in discovering as-yet unknown or less-obvious clusters.

A second approach to tracing a cluster starts from a macro perspective. It is based on data from input-output tables. Input-output tables map all inter-industry supply and demand relationships within a national economy for a certain period of time. This approach can bring to light intense input-output relations between industries that might indicate a cluster. While this procedure uncovers hard facts based on formal relations it does not account for the possible informal relations that are only found by "reading between the lines" of the macro-economic data, e.g., knowledge spillovers. And yet, it is these very factors that are crucial for the existence of a cluster.

An approach based on case studies lacks transferability and is not conducive to the formulation of a general procedure for cluster discovery. In contrast, an approach based on macroeconomic data concentrates on intra-industry relations and does not account for regional factors because "knowledge flows are invisible, they leave no paper trail and by which they may be measured and tracked" (Krugman, 1991, p 53). So although both approaches have their strengths, both have obvious weaknesses, too, and neither is comprehensive. Thus the cluster remains elusive.

However, Jaffe *et al.* (1993) are more optimistic. They predict that there are traces of knowledge flows to be found in patent citations and they found evidence that these knowledge flows are geographically localized.[7] This finding inspired us to attempt to trace clusters in Germany. Starting from a meso-level, we classify 97 regions in Germany based on their dynamics and several cluster factors that we believe might indicate the existence of dynamic

[7] "[I]n principle, a citation of Patent X by Patent Y means that X represents a piece of previously existing knowledge upon which Y builds" (Jaffe *et al.*, 1993).

clusters. Our goal is to identify regions that are dynamic in terms of growth and net new firm entry and that also possess our cluster factors. Finding evidence of both—dynamic growth and particular cluster factors—in one place could produce a general theory about regional cluster factors. Then, regional case studies can be examined in the light of this theory to see if their results support it and to glean additional insight. Thus, we begin by tracing potential cluster-supportive regions within our macro-economic data and use a regional case study to test and categorize the discovered regional factors.

The cluster factors we are looking for include those mentioned by Marshall and Porter, namely, *labor market, infrastructure, services, inventions,* and *dominant industries.* Our uniquely rich data set enables us to check for these factors. In addition, we include *creativity* as a cluster factor.

4. Data

Our data are generated from the German Social Insurance Statistics (see Fritsch and Brixy, 2004, for a description of this data source). The Social Insurance Statistics requires every employer to report information about every employee, e.g., qualifications, whether he or she is subject to obligatory social insurance, and so forth. The information collected can be transformed into an establishment file that provides longitudinal information about the establishments and their employees. As each establishment with at least one employee subject to social security has a permanent individual code number, start-ups and closures can be identified: the inclusion of a new code number can be interpreted as a start-up, the disappearance of a code number can be interpreted as closure. Because the data are collected for the population of establishments that have at least one employee other than the founder, businesses having no employees are not included. The unit of measurement is the "establishment," not the company. The empirical data thus derived include two categories of entities: firm headquarters and subsidiaries. For the purposes of this analysis, the term "business" will be used to describe both types of entity.

Our information is available for Western Germany from 1987 to 2000 and for Eastern Germany from 1991 to 2000. This timespan is broken down into two periods. *Period I* starts in 1987 for West Germany and in 1991 for East Germany and ends in 1994. *Period II* starts in 1995 and ends in 2000. We have information differentiated by 52 private-sector industries (manufacturing, services, agriculture, and construction) and 97 planning regions. Planning regions are functional spatial units consisting of at least one city and the surrounding area (BBR, 2003).

To measure the dynamics of the planning regions, we use the definition of regional growth regimes introduced by Audretsch and Fritsch (2002) and revisited by Fritsch and Mueller (2006). Under this system, regions with above-average growth rates and above-average start-up rates are called "entrepreneurial." Regions with above-average growth rates but below-average start-up rates are "routinized." Regions with below-average growth rates and above-average start-up rates are "revolving-doors," while regions with below-average growth rates and below-average start-up rates are "downsizing." These regimes can also be linked to the "old lifecycle story" (see the seminal paper of Gort and Klepper, 1982, for a knowledge based interpretation of the lifecycle). Gort and Klepper's believe that systematic changes occur in the sources of innovations over the product lifecycle. They argue that in the early and adolescent phase of a product lifecycle, most innovations originate outside the set of current producers (e.g., from firms in technologically related markets, by way of independent inventors, etc.). Innovative entries should play a crucial role in this phase (*entrepreneurial regimes*). In later and more mature phases of the product lifecycle, however, innovations are more likely to originate from a process of learning-by-doing. The cumulative stock of such innovations operates as an entry barrier and hinders entry (*routinized regimes*). Among other things, ongoing process innovations lead to outsourcing activities, resulting in new business opportunities. These new suppliers are non-innovative, using nearly the same technology as the incumbents (*revolving-door regimes*). Incumbents that are not able to imitate permanent process innovations are forced to exit the market, resulting in a concentration process (*downsizing regimes*).

<< Insert Table 1, Table 2 and Table 3 about here >>

Employment and growth rates are closely related. Start-up rates are measured as net entry over the number of existing businesses. To account for business cycles and for structural differences between West and East Germany, averages are calculated separately for *Periods I* and *II* and for West and East Germany. Table 1 illustrates that the means of employment growth and net entry between East and West Germany differ. In particular, the extraordinary high net entry rate in East Germany is the result that area's move toward a market economy. *Period I* is characterized by a growing economy; however, in *Period II* the economy declines. This results in positive employment growth rates and high net entry rates in *Period I* and negative employment growth and low but positive net entry rates in *Period II* in West and East Germany, respectively (see Table 1). Figure 1 shows the spatial distribution of the four types of region for *Period I*; Figure 2 does the same for *Period II*. Table 3 reports the number of planning regions categorized as entrepreneurial, routinized, revolving-door, or downsizing in *Periods I* and *II*. Proceeding from *Period I* to *Period II*, 15 planning regions are *unchanged entrepreneurial*, six are *unchanged routinized*, eight are *unchanged revolving-door*, and 10 are *unchanged downsizing*. 34 planning regions succeed to initiate new lifecycles and become more adolescent, while 24 planning regions mature along the lifecycle. For a spatial distribution of the dynamics of growth regimes see Figure 3.

<< Insert Figure 1, Figure 2 and Figure 3 about here >>

To further characterize the planning regions, we define six groups of variables that, according to dynamic cluster theory, have been found (cf. Sections 2 and 3) to be important for regional development. Table 1 summarizes the mean values and Table 2 the deviations from the mean values by growth regimes of all variables described below.

The availability of a differentiated *labor market* in a region is measured by the number of highly qualified employees, engineers, and natural scientists and by the amount of small business (< 20 employees) employment in a region. Working in a small business may stimulate an entrepreneurial attitude and, therefore, increase the likelihood that the business's employees will consider starting their own businesses.

Whether or not the region is home to a *creative class* is measured as the share of bohemians subject to social security within the universe of all employees in the region and by the number of patents applied for by natural persons, under the assumption that these independent inventors can be considered as highly creative. Our information on the regional distribution of patents is from the German Patent Atlas (Greif & Schmiedl, 2002) and is available only for *Period II* (1995 to 2000).

The quality and availability of *infrastructure* is based on the type of region. The variable can take the values 1, 2 ..., 7, whereby agglomerations are coded 1 and rural areas with less than 2,000 inhabitants are coded 7. Furthermore, the stance local universities and other research institutions take toward the transfer of knowledge to the private sector is measured by the number of patents applied for by the universities and other research institutions.

The availability of differentiated *business services* in a region is measured by the share of employment in business services in the region. A high number of highly qualified employees working in business services indicates the knowledge intensity of those services.

Patent density, measured as the number of patents in a region over the number of engineers and natural scientists in the region, is used as a proxy for the efficiency of regional R&D activities (*inventions*).

Finally, planning regions are characterized by their three largest manufacturing industries, measured by share of employment. The share of employment in large businesses (> 500 employees), the share of engineers and natural scientist in large businesses (> 500 employees), the share of small business (< 20 employees) employment, and the net entry rate within the three *dominant manufacturing industries* characterize the size distribution and dynamics within these industries. Table 4 gives an overview of the distribution of the largest manufacturing industries in German planning regions by growth regimes.

<< Insert Table 4 about here >>

5. Findings

We report our findings along the lifecycle, that is, we start with *entrepreneurial growth regimes*, then move to *routinized growth regimes*, followed by *revolving-door growth regimes*, and end with *downsizing growth regimes*.

Surprisingly, the share of highly qualified employees, as well as the number of engineers, is below average in *entrepreneurial growth regimes*. However, the share of small business employment and the share of bohemians are above average. Creativity and entrepreneurial spirit seem to play a crucial role in entrepreneurial regimes. The number of inventions (patent density) is above average. Knowledge creation takes place in close cooperation between small businesses, independent inventors (patents applied for by natural persons), and business services (share of employment in business services). University knowledge production appears to be of less importance (patents applied for by universities). Dominant manufacturing industries in entrepreneurial growth regimes include motor vehicles, electronics, and food. Industry concentration (employment share of the three largest manufacturing industries) is more or less average, but the share of small business employment in the dominant manufacturing industries is comparatively high. These dominant industries are also characterized by a high net entry rate and are thus dynamic.

Routinized growth regimes differ from entrepreneurial regimes in at least three respects. The share of bohemians is below average, which might stem from the fact that routinized growth regimes are more rural (type of region). The number of inventions (patent density) is well above average; however, universities (share of patents applied for by universities) play a more important role in the knowledge production process. Business services (share of employment in business services) have only a subordinated role. Dominant manufacturing industries include motor vehicles, electronics, and a very strong emphasis on food. However, net entry rates in these industries are well below average, which makes them less dynamic than the entrepreneurial growth regimes.

Revolving-door growth regimes have a high share of highly qualified employees and engineers, but low levels of small business employment. As revolving-door growth regimes occur in more congested areas (type of region), the number of bohemians and the availability of business services (share of employment in business services) are well above average. However, knowledge production (patent density) is less efficient and most patents are applied for by (large) businesses. Dominant manufacturing industries are mainly focused on electronics, but also include machinery, motor vehicles, and food. These industries are dominated by large businesses and the share of engineers in these large businesses is the highest compared to all other types of growth regime. As these engineers are potential founders of spin-offs, there are high net entry rates in these industries and they are thus dynamic.

In *downsizing growth regimes*, knowledge production is again inefficient and, surprisingly, universities are the most prominent applicants for the few patents that there are. Neither highly qualified employees and engineers nor differentiated business services are available. Dominant manufacturing industries include electronics, machinery, and food. The net entry rate in the dominant manufacturing industries is well below average, making these industries the least dynamic of those investigated.

The above findings lead us to conclude that the outstanding characteristics of dynamic regions in the sense of employment growth and net entry are the simultaneous existence of entrepreneurial spirit, creativity, and dominant manufacturing industries that are small businesses and dynamic. In such regions, the business services available probably concentrate on providing those services most necessary for young and/or small businesses, for example, financial services. What must be emphasized is that it is not the *independent* existence of these factors that makes a dynamic region, but that they all occur *simultaneously*. This finding is strongly supported by the fact that in all the other types of regimes studied, one of the above cluster factors is missing. *Routinized growth regimes* lack the ability to commercialize their existing creativity, resulting in below-average net entry, and the employment growth in these regions is predominantly found in incumbent firms that have a still expanding market. *Revolving-door growth regimes*, which are dominated by large business structures, have not much growth in employment, but above-average net entry, possibly due to new business entrants substituting business activities of the incumbents as a result of disaggregation. In *downsizing growth regimes*, there is neither growth nor creativity; in these shrinking markets, incumbents appear to spend all their energy just holding on to their existent market shares, with none left over for the innovation that might lead to growth.

6. Case Study: The Regensburg Automotive Cluster

The Regensburg region, with its predominant automobile industry (BMW’s production facility is located here), fell into the entrepreneurial growth regime in both periods we studied, indicating that it contains dynamic cluster structures. Furthermore, the automobile industry is a leading industry in Germany and a promising prospect for tracking down the elusive cluster as production is for the most part vertically disaggregated (Womack *et al.*, 1990). We thus chose the Regensburg region for case-study-based analyses on a micro-level.

Today, Regensburg is a city of about 144,000 inhabitants and the entire observed region is home to at about 700,000 people. The region is located in Bavaria, in the southeastern part of Germany. During the Cold War, Regensburg—similar to all regions bordering the Iron Curtain—suffered from its proximity to the Czech Republic, i.e., the Eastern Bloc. Due to its borderland location, the region long remained an underdeveloped peripheral area marked by dense forests, sparse infrastructure, and rare investment. At the beginning of the 1980s, the region had a high unemployment rate and a low population density. However, in 1984, BMW decided to set up a production plant in Regensburg and production began at the end of 1986. Although governmental subsidies granted for investment in underdeveloped regions might have contributed to BMW’s initial choice of Regensburg, the production facility became a real success as time progressed. When the plant first started up, it was responsible for producing part of the BMW 3 series; since 2002, the entire BMW 1 series has been produced at the Regensburg facility. Production and employment have risen consistently. In 1987, BMW employed 2,418 workers who produced 35,622 cars. In 2005, there were 10,499 workers producing 301,200 cars. In total, about 3.5 million cars have come off the plant’s production line. BMW’s investment amounts to a total of 2.5 billion Euros and today the production facility includes a press shop, a car-body shop, a paint shop, and an assembly shop.

BMW convinced many suppliers to follow it, the original equipment manufacturer (OEM), to the Regensburg region, as its modern just-in-sequence production process often demands this sort of proximity. The innovation park Wackersdorf, located about 50 kilometers north of Regensburg, is an outstanding example of a cluster structure. Here, the facilities of nine core suppliers and BMW are located back-to-back or even in the same workshop and production proceeds in close cooperation. Benefits arise from close input-output relations, and hence spillovers, and also from shared secondary services, such as a collective ambulance service, joint conference rooms, and a common bistro. BMW’s cockpit production is a good example of how this cluster structure works to everyone’s benefit. Lear produces seats; Recticel produces the interior trim components used by Intier Automotive Eybl for the door and side coverings, and ContiTech supplies tubes. These components add up to a complete cockpit that is preassembled by BMW. About 85 trucks a day deliver the preassembled cockpits and seats to the just-in-sequence production line in Regensburg. This close proximity and cooperation necessarily leads to innovation, especially at the beginning of a new product series, in the sense of economies from a commonly improved production process and commonly enhanced equipment.

The importance of the automobile industry to the region is unquestioned and is strikingly reflected in employment figures. An extremely large number of jobs is connected to the automobile industry and inter-industry connections are apparent as well. Siemens VDO, a major international supplier of car electronics and mechatronics settled in Regensburg, which very well may have influenced Toshiba’s decision to set up a facility in Regensburg. Today, Regensburg offers an attractive business environment to many companies and the region has frequently been described as among the most prosperous in Germany with excellent prospects for the future. Because most of the companies now present in Regensburg moved there after BMW did, it is reasonable to believe that their decisions were at least partially based on the cluster factors we have identified as being present in the region.

Regensburg and the surrounding area provide a large pool of qualified workers, which is actively maintained by the companies in the region. These companies hire apprentices, offer practical training, and work in close partnership with the local university and university of applied science. The pool of workers is enhanced by a bus system that shuttles workers from surrounding regions to the center thus decreasing traffic jams and excessive migration into the city. Again taking BMW as an example, there is a real partnership between the community and the firm, leading to advantages for both. BMW has the benefit of a motivated and loyal workforce and the community benefits from BMW's broad social commitment, which includes not only donations and sponsoring activities, but also other social activities, such as traffic planning to support the community's future development.

A large part of BMW's sponsoring and donation budget is targeted at cultural institutions. The company supports festivals, concerts, exhibitions, and other bohemian projects in the region. Of course, this sponsoring is not completely altruistic as it enhances BMW's local reputation and may even have a positive impact on sales, benefits that are much discussed in marketing and PR literature. However, as these sponsored events do not always result in a huge amount of publicity, we are led to believe that BMW may have another motive behind its generosity. Could it be that the firm supports culture in order to create an environment attractive to bohemians and, consequently, enhance the "creative class" cluster factor?

BMW also has production facilities in Landshut and Dingolfing, which are not far from the Regensburg region, and Ingolstadt, also nearby, is home to Audi. The proximity of so many automobile production facilities is especially good for core suppliers who can serve several plants from one central facility. Evidence that this has not just happened by chance, but is instead what is termed a neighborhood effect is verified by Fritsch and Falck (2007), who state that new business formation processes in adjacent regions are not independent but related in some way. Earlier, Audretsch and Fritsch (2002) found that a certain type of growth regime tends to spread across a larger geographical area.

Along with this interregional output multiplier comes an interregional income multiplier, especially for nearby rural regions with a low manufacturing base of their own. Because of the developed infrastructure and, in particular, BMW's bus system, many workers can daily commute from their homes in adjacent rural regions into the Regensburg area to work. However, they spend a large part of their income in their home regions, which, of course, reap the benefits of this income shift. Retail and household-related services spring up and expand, and the quality of living in these regions is enhanced, leading to the result that they are desirable places to live and thus do not suffer the depopulation so common to many rural regions.

7. Implications

Dynamic clusters and thus regional growth result from the simultaneous presence of several cluster factors. Different regions are endowed with different cluster factors, which largely determines whether they will be vital and growing or stagnant and in decline. For example, big cities have many more amenities than do more peripheral areas—they possess vitality, many possibilities for social contact, and diversity. They attract new businesses as it is easy to become part of the existing network. Feldman (1994a) finds that innovative firms are more likely to settle in areas that have previously enjoyed innovative success as the region's tacit knowledge reduces the uncertainty of innovative activity. In contrast, peripheral areas are less densely populated, have fewer businesses, and are less diverse. Furthermore, there are often strong implicit norms operating in peripheral areas that act as a means of social control. These norms can have the positive effect of creating and maintaining stable and lasting business structures, but they can also have a negative impact on creativity and innovation, thus creating a less-than-dynamic environment for business growth.

Several policy implications can be derived from these findings. Cities are already doing well as far as dynamic growth goes. They already possess many of the factors that attract business and clusters. Therefore, policy should concentrate on peripheral and underdeveloped regions, perhaps by granting investment subsidies that will make these areas more competitive and lead to the development of cluster factors that will invite growth. Doing so will reduce the inequality between different regions and level the playing field when it comes to attracting new business. Investment subsidies are a tried and true way of assisting underdeveloped regions, a way of giving an unattractive area a "facelift" so to speak. However, please note that we do *not* suggest direct interference with firms' location decisions. Individual location decisions are exactly that—individual—and subject to many, many specifics that cannot and should not be influenced by government policy.

Once a business has made its location decision, policy can step in again and aid in developing the type of infrastructure that will attract additional business. If this is done correctly, chances are good that a dynamic cluster will develop—one needs only to look at what happened in Regensburg to be convinced. But what about the losers in the location game? Very often in the past, losers have received a university as a consolation prize, in the hope, one supposes, that a great deal of valuable knowledge will be produced and lead to a thriving environment. This does not happen as these universities often lack focus on leading-edge technology projects and are not sufficiently geared towards diffusing newly created knowledge to the private sector. Knowledge created in a vacuum has no way of escaping. What these losing regions need, instead, is a way of being connected to attractive, vital areas. Once again, BMW's actions in Regensburg offer an excellent template of how this can work. Something as simple as a good bus system can result in more people with better jobs being able to live in the rural places they love, thus saving these places from abandonment and ruin, and, as a further benefit, keeping the cities from becoming larger and more unmanageable than they already are. Truly a win-win situation and, really, not at all elusive.

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Table 1: Descriptive statistics, mean values

		Performance		Labor Market			Creative Class		Infrastructure		Services		Inventions	Dominant Industries (Three Largest Manufacturing Industries)				
		Employment Growth (%)	Net Entry (‰)	Share of Highly Qualified Employees (%)	Share of Engineers (%)	Share of Small Business Employment (%)	Share of Bohemians (%)	Share of Patents of Natural Persons (%)	Type of Region	Share of Patents of Universities (%)	Share of Employment in Business Services (%)	Share of Highly Qualified Employment in Business Services (%)	Patent Density (‰)	Share of Employment (%)	Share of Employment in Large Businesses (%)	Share of Engineers in Large Businesses (%)	Share of Small Business Employment (%)	Net Entry (‰)
Western Germany	I	1.98	12.33	3.36	1.95	31.03	0.99	--	3.51	--	51.22	7.62	--	19.42	52.21	73.37	10.94	-1.32
	II	-0.13	7.40	4.49	2.29	32.63	1.13	26.62	3.51	2.50	77.55	9.51	74.50	16.76	46.50	66.30	12.71	-11.96
Eastern Germany	I	1.55	104.59	1.91	0.98	31.60	1.15	--	4.14	--	47.08	3.86	--	9.71	26.55	35.23	23.11	27.00
	II	-1.70	16.45	6.02	2.45	38.87	1.24	36.98	4.14	12.04	76.24	10.68	19.93	9.08	13.70	28.42	28.81	-12.66

Table 2: Descriptive statistics, deviations from the mean values

		Performance		Labor Market			Creative Class		Infrastructure		Services		Inventions	Dominant Industries (Three Largest Manufacturing Industries)				
		Employment Growth (%)	Net Entry (‰)	Share of Highly Qualified Employees (%)	Share of Engineers (%)	Share of Small Business Employment (%)	Share of Bohemians (%)	Share of Patents of Natural Persons (%)	Type of Region	Share of Patents of Universities (%)	Share of Employment in Business Services (%)	Share of Highly Qualified Employment in Business Services (%)	Patent Density (‰)	Share of Employment (%)	Share of Employment in Large Businesses (%)	Share of Engineers in Large Businesses (%)	Share of Small Business Employme nt (%)	Net Entry (‰)
Entre-preneurial	I	1.45	6.17	-0.02	-0.19	1.07	0.06	--	-0.13	--	3.29	0.35	--	-1.92	-5.59	3.05	1.71	4.52
	II	0.64	3.09	-0.25	-0.15	0.93	0.02	1.57	0.07	-0.22	1.77	-0.22	1.33	0.04	-0.32	-0.17	0.80	5.14
Routinized	I	0.55	-5.00	-1.22	-0.60	2.98	-0.15	--	0.95	--	-4.04	-2.34	--	-1.07	-9.48	-12.70	2.94	-3.28
	II	0.29	-2.73	0.23	-0.02	1.78	-0.07	3.75	0.62	0.07	-1.69	0.50	5.19	-0.86	-3.87	-5.91	2.92	-0.49
Revolving-door	I	-0.99	3.52	1.41	0.76	-4.48	0.14	--	-1.07	--	5.32	2.59	--	1.06	11.66	7.46	-4.63	5.13
	II	-0.51	1.63	0.60	0.33	-1.78	0.07	-2.47	-0.46	-0.23	4.26	0.37	-3.23	-0.63	6.62	6.04	-2.28	1.33
Downsizing	I	-0.72	-4.63	-0.38	-0.10	1.16	-0.06	--	0.39	--	-4.92	-0.95	--	1.53	1.05	0.94	0.79	-6.51
	II	-0.75	-3.48	-0.15	0.03	-1.35	-0.03	-3.06	-0.22	0.39	-3.89	-0.23	-3.18	0.86	-1.06	0.38	-1.59	-7.53

Table 3: Number of different types of growth regimes

	Number of planning regions	
	I	**II**
Entrepreneurial	22	37
Routinized	23	17
Revolving-door	27	16
Downsizing	25	27
Upgrading	34	
Downgrading	24	
Unchanged entrepreneurial	15	
Unchanged routinized	6	
Unchanged revolving-door	8	
Unchanged downsizing	10	

Table 4: Distribution of the larges manufacturing industries

	Share (%) of planning regions where ... is one of the three largest manufacturing industries					
	Upgrading	Downgrading	Unchanged entrepreneurial	Unchanged routinized	Unchanged revolving-door	Unchanged downsizing
Chemicals	23.5	20.8	13.3	16.7	25.0	10.0
Mineral oil processing	0.0	4.2	0.0	0.0	0.0	0.0
Plastics	2.9	4.2	6.7	0.0	0.0	0.0
Rubber	0.0	0.0	0.0	0.0	0.0	0.0
Stone and clay	0.0	0.0	0.0	0.0	0.0	0.0
Ceramics	0.0	4.2	0.0	0.0	0.0	0.0
Glass	2.9	0.0	0.0	0.0	0.0	0.0
Iron and steel	5.9	4.2	0.0	0.0	0.0	0.0
Nonferrous metals	0.0	0.0	0.0	0.0	0.0	0.0
Foundries	0.0	0.0	0.0	0.0	0.0	0.0
Steel processing	2.9	8.3	0.0	16.7	12.5	20.0
Steel and light metal construction	5.9	20.8	0.0	0.0	0.0	0.0
Machinery, gears, drive units other machine parts	17.6	16.7	40.0	33.3	37.5	50.0
Office machinery and computers	11.8	0.0	6.7	0.0	12.5	0.0
Motor vehicles	79.4	50.0	73.3	66.7	37.5	30.0
Shipbuilding	2.9	0.0	6.7	0.0	0.0	10.0
Aerospace	2.9	0.0	0.0	0.0	12.5	10.0
Electronics	58.8	58.3	53.3	50.0	100.0	70.0
Fine mechanics, watches, and gauges	0.0	8.3	0.0	0.0	0.0	10.0
Iron and metal goods	2.9	4.2	0.0	16.7	12.5	10.0
Jewelry, musical instruments, and toys	0.0	0.0	0.0	0.0	0.0	10.0
Wood (excluding furniture)	0.0	0.0	0.0	0.0	0.0	0.0
Furniture	17.6	12.5	33.3	0.0	0.0	0.0
Paper making	0.0	0.0	0.0	0.0	0.0	0.0
Paper processing and board	0.0	0.0	0.0	0.0	0.0	0.0
Printing	0.0	0.0	0.0	16.7	0.0	0.0
Textiles	0.0	8.3	0.0	0.0	12.5	10.0
Leather	0.0	0.0	0.0	0.0	0.0	10.0
Apparel	2.9	0.0	0.0	0.0	0.0	0.0
Food	58.8	75.0	66.7	83.3	37.5	50.0
Beverages	0.0	0.0	0.0	0.0	0.0	0.0

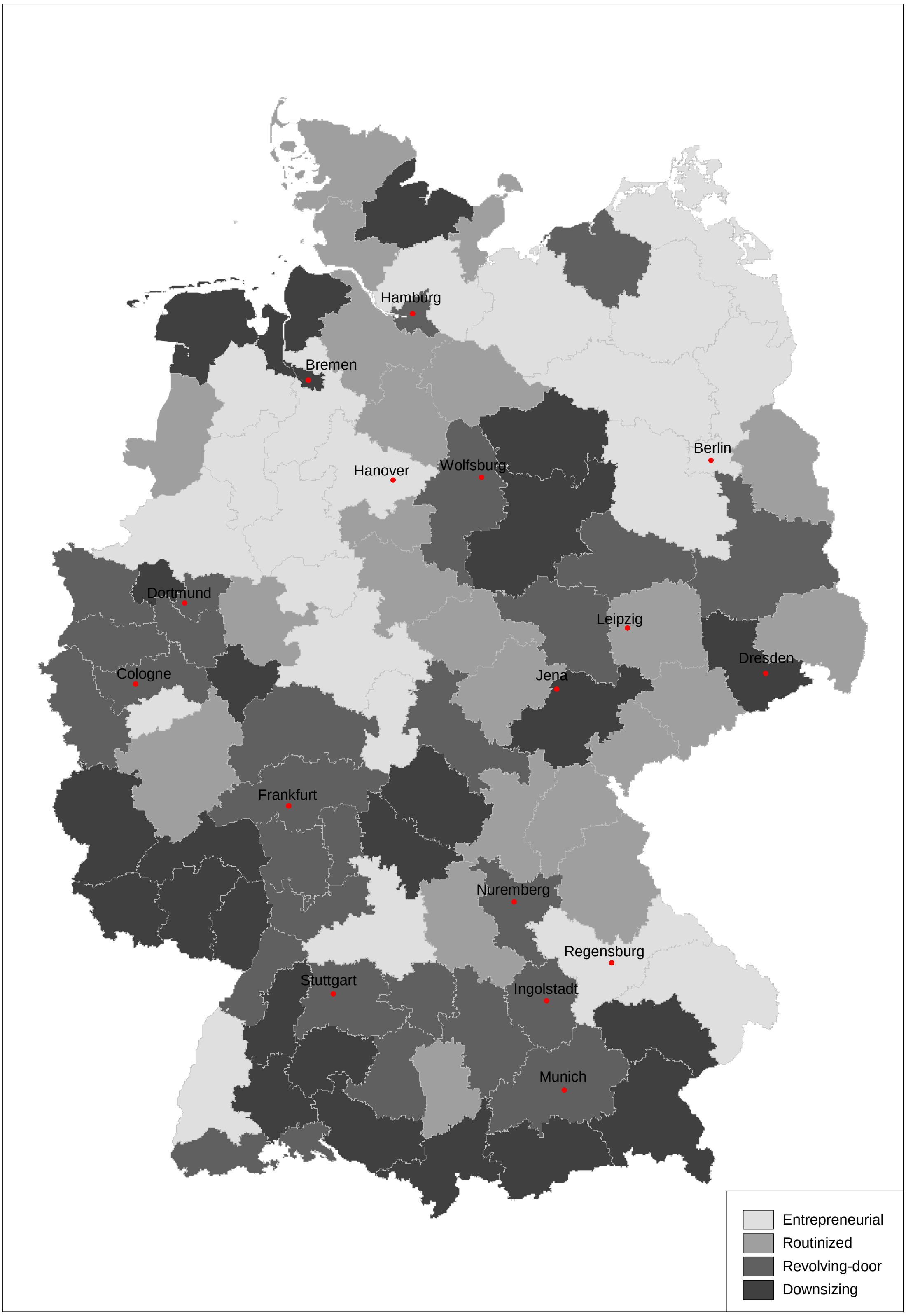

Figure 1: Spatial distribution of growth regimes, Period I

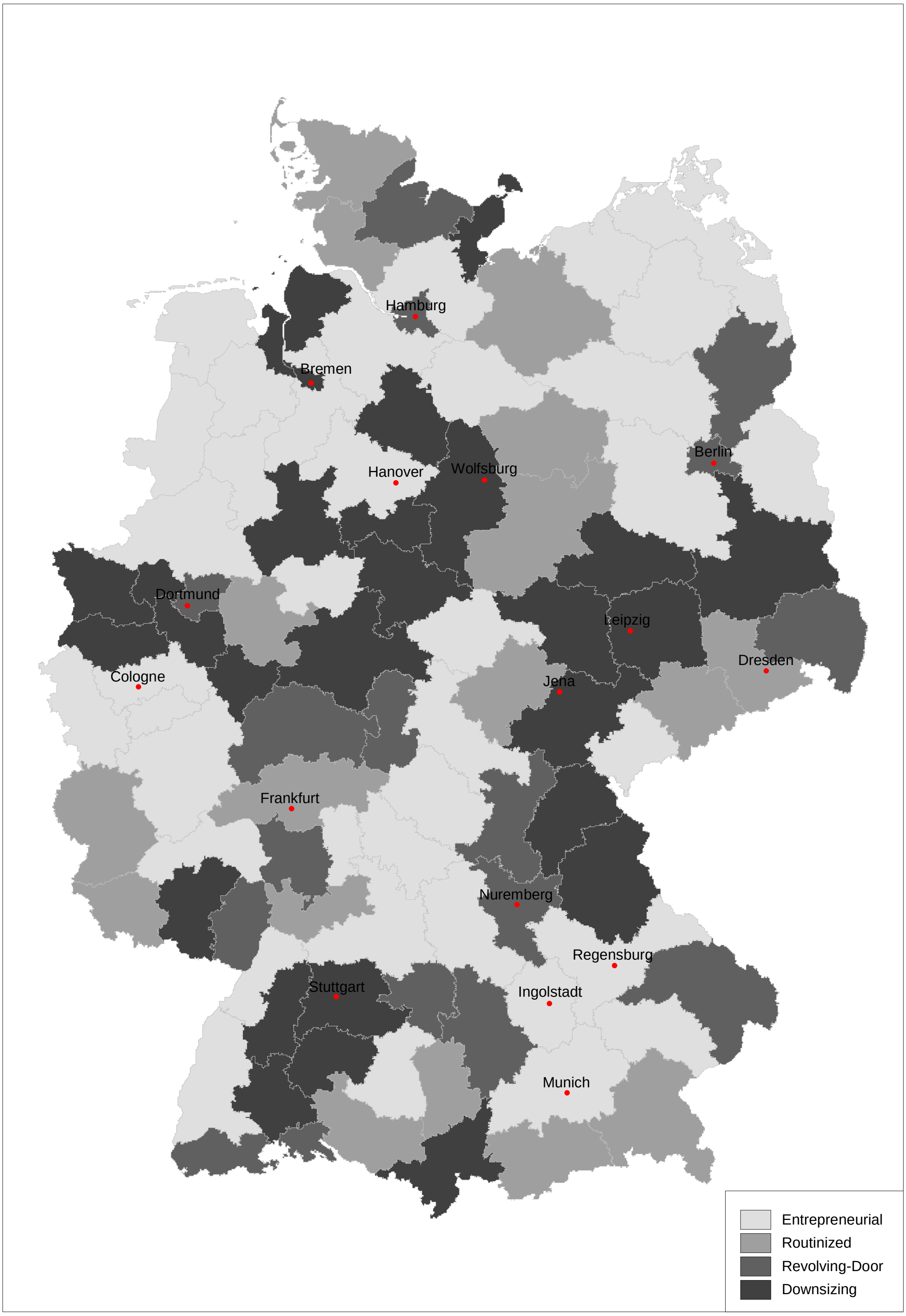

Figure 2: Spatial distribution of growth regimes, Period II

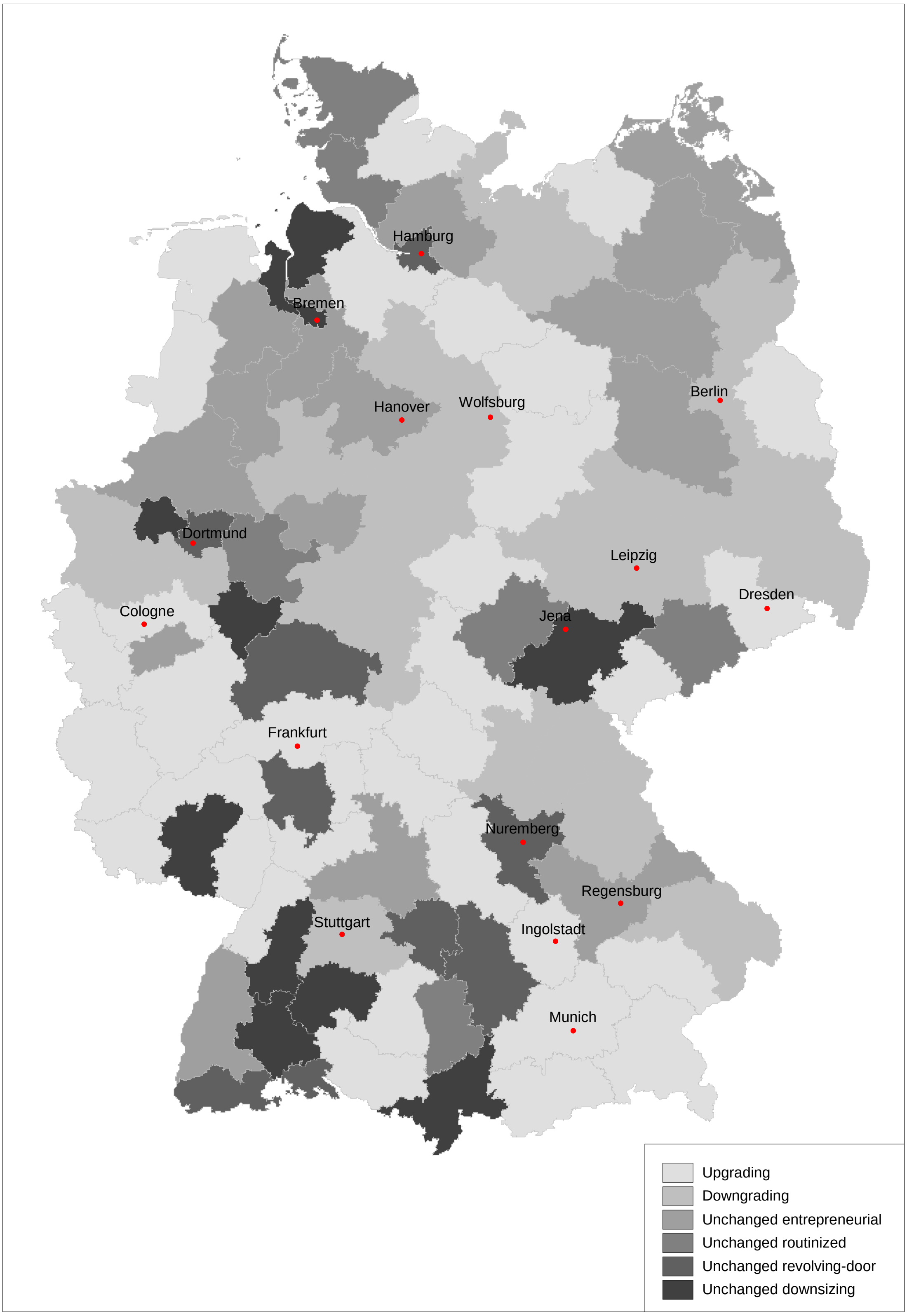

Figure 3: Spatial distribution of the dynamics of growth regimes