

# Growth Regimes in Spatial Perspective 1: Innovation, Institutions and Social Systems

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# **Growth regimes in spatial perspective 1: innovation, institutions and social systems**

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Progress Report on “*Geographies of Production*”

for

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**Abstract.** This Progress Report discusses innovation, institutions and social systems in the context of ‘growth regimes in spatial perspective’. It raises the question as to how we should define systems in the context of innovation and makes reference to the theory of social systems. The report then emphasizes the role of institutions in enabling interactive learning and knowledge creation within a system. Using this framework, national innovation systems are defined as having the capability to reproduce their basic structure and the difference between themselves and their environment. The report argues that it is not easy to define regional systems of innovation in a similar way. Regional configurations of production and innovation rarely have the potential to retain structural independence, especially as the important institutions are typically defined at the supraregional level.

In the past two decades, a number of concepts and approaches have been developed and discussed in the literature which emphasize the importance of particular geographies of production for economic growth, especially the role of localized production configurations. Work on industrial districts (Goodman *et al.*, 1989; Pyke *et al.*, 1990), innovative milieus (Camagni, 1991; Ratti *et al.*, 1997), new industrial spaces (Scott, 1988), local nodes in global networks (Amin and Thrift, 1992), clusters (Porter, 1990; 2000; Malmberg and Maskell, 2002; Bathelt and Glückler, 2002; Bathelt *et al.*, 2003), etc. emphasize that the core of production is still heavily concentrated in particular regions and that globalization does not necessarily lead to de-territorialization (Storper, 1997). Other approaches have defined and discussed different types of innovation systems, driving specialization processes in production and institution-building. While it is increasingly difficult to clearly distinguish these concepts from one another (Moulaert and Sekia, 2003), they have become extremely important in the context of regional policy making. Although the application of these concepts can help in the formulation of policies to mobilize regional actors and initiate programs to strengthen localized production and innovation (Cooke, 2001; Asheim and Herstad, 2003), there is a danger that they are used by both policy makers and academics as ‘buzz words’ and ‘empty phrases’ without prior conceptual scrutiny. In light of this, the purpose of this and following

Progress Reports is to critically review a number of these concepts. The focus will be on growth regimes in spatial perspective, applying a relational perspective (e.g. Bathelt and Glückler, 2002; Boggs and Rantisi, 2003; Ettlinger, 2003) to the new and changing geographies of production.

## **I Introduction: globalization, contextualization and the multiplicity of innovation systems**

In the late 1980's and early 1990's, Freeman (1988), Lundvall (1988; 1992c) and Nelson (1988; 1993) laid out the foundations for a conceptualization of national innovation systems which claims that the nation-state provides a decisive basis for economic specialization and knowledge creation in production and innovation. This emphasis on the national context lies in opposition, however, to current processes of globalization which seem to threaten the nation-state as a political unit and governance system (e.g. Ohmae, 1995; Elam, 1997; Bahrenberg and Kuhm, 1999). We observe that new knowledge about production is increasingly disseminated at a global scale as firms set up production facilities in foreign countries (Maskell and Malmberg, 1999a; 1999b).

Through the same process, there is also a constant inflow of new knowledge which originates from different parts of the world and enters regional production contexts (Storper, 1997). As it is integrated in these contexts, it is combined with existing knowledge to create further knowledge and innovation in these places. This serves to strengthen regional capabilities and competitiveness (Asheim, 1999; Belussi and Pilotti, 2002). As a result of empirical studies which emphasize the significance of the regional level in economic development, approaches have been developed which aim to analyze and identify innovation systems at the regional level (Cooke *et al.*, 1997; Asheim and Isaksen, 1997; 2002; Cooke, 1998; 2001), or, more recently, the metropolitan level (Fischer *et al.*, 2001; Diez, 2002). In addition, approaches of

technological (Carlsson and Stankiewicz, 1991) and sectoral systems (Breschi and Malerba, 1997; Malerba, 2002) have been developed which use technologies and products and their value chains as a point of departure to define innovation systems. As opposed to the former, the latter approaches do not emphasize any particular spatial level of analysis over others. Given this somewhat confusing multiplicity of approaches, there is a need to clarify which conceptualizations are appropriate under which circumstances. This report particularly focuses on the territorial relationships between innovation, institutions and knowledge creation. Using an understanding of innovation as an interactive social process, innovation and production are viewed as being closely intertwined and related to one another (e.g. Arrow, 1962; Rosenberg, 1982; Malecki, 1997). In reviewing the literature, it still remains unclear whether innovation processes can be conceptualized as territorial systems which develop in particular spatial configurations. The goal of this report is to contribute to this conceptual discussion. This is, of course, not an easy task as the literature on national and regional innovation systems appears quite heterogeneous (see, for instance, Malmberg, 1997; Strambach, 1997; Dosi, 1999).

To do this, I will focus on the 'systems' notion and ask whether it makes sense to conceptualize territorial systems. To further specify and distinguish systems, the theory of social systems is used as a point of departure. The work of the German social scientist Niklas Luhmann is particularly instructive in this context to develop an understanding of social systems (Klüter, 1986; Gren and Zierhofer, 2003), different from that in traditional approaches which focuses on the internal interactions and networks, as in the work of Talcott Parsons. The problem of using such a system approach in geography, which focuses on internal structures, is that the local could easily be overemphasized because there are always local interactions which indicate some degree of local interrelatedness (e.g. Oinas 1997). In contrast, Luhmann (1984a; 1984b; 2000) defines systems in the way of how they differ from

their environment and how they are able to reproduce this difference. Although I do not follow Luhmann's conception regarding the closure of systems and his neglect of actors, I believe that this is a powerful approach to help us understand what systems are and how they differ from other systems. In what follows, I will use this as an entry point to reflect upon territorial innovation systems, from which to deviate later on.<sup>1</sup>

The next section raises the question as to how we should define systems in the context of innovation and makes reference to the theory of social systems, using its results as a point of departure for our understanding of territorial innovation systems. Section III emphasizes the role of institutions in enabling interactive learning and knowledge creation within a system. Using this framework, national innovation systems are then defined in section IV as having the capability to reproduce their basic structure and the difference between themselves and their environment. Section V argues that it is not easy to define regional systems of innovation in a similar way. Regional configurations of production and innovation rarely have the potential to retain structural independence, especially as the important institutions are typically defined at the supranational level. Section VI summarizes the argument of this report and draws some conclusions.

## **II Defining social systems**

The diversity of innovation system approaches and the overuse of such concepts in the literature suggest that we should exercise care when using this term. Especially with respect to territorial innovation systems, we should first address the question as to how a particular system is defined and related to other systems. While advocates of regional and metropolitan innovation systems focus on the subnational system level (e.g. Cooke *et al.*, 1997; Thomi and Werner, 2001; Fischer *et al.*, 2001), other scholars, such as Freeman (2002), argue that regional innovation systems could only develop if rules and regulations at the level of the nation-state establish the preconditions for this to occur.

In innovation systems, agents from different societal subsystems interact with one another (Lundvall, 1992a; Freeman, 2002). Through this, they are able to draw upon the different backgrounds of their agents in generating new knowledge. Kaufmann and Tödtling (2001: 791) emphasize the importance of boundary-crossing between different functional systems, such as industry and science, because “... the key advantage of engaging in external relations for realizing innovation projects is based on diversity, i.e. linking up different systems instead of remaining within a system’s set of routines.” A similar reasoning is given in the triple-helix approach (Etzkowitz and Leydesdorff, 2000; Schamp, 2001).

However, it is not sufficient to assume that a system exists, irrespective of the level, simply because the actors are closely interlinked through network relationships. There is a need for a more precise understanding of systems. Using the work of Luhmann (1984a; 1984b; 2000) as a point of departure, innovation systems could be conceptualized as social systems which are able to continuously reproduce their basic structure. Similar to the reproduction mechanisms of living organisms, Luhmann (1984a; 1984b) classifies systems as being autopoietic if they are separated from their environment and closed in terms of the reproduction of their very basic internal structure. As opposed to traditional systems theory, which draws attention primarily to the internal characteristics and relationships in a system, this approach focuses on a system’s reproductivity, its boundaries and the difference between its interior and exterior (Luhmann, 2000; Kaufmann and Tödtling, 2001). Luhmann (1992: 69) defines a system “not as a particular type of *object* but as a particular distinction – namely between system and environment”.

Systems collect information from their (external) environment, process and interpret this information and, subsequently, derive operations from this. The environment is, however, unable to control or determine the system’s operations. According to Luhmann (2000), systems do not directly interact with their environment. They acquire information about their

environment by means of self-observation. Through this, they are able to draw a picture of the difference between themselves and their environment ('othering'). This difference is continuously reproduced. In order to meet the challenges of a complex environment, autopoietic systems differentiate themselves into functional subsystems (Luhmann, 1977; 1984b).

In the theory of social systems, society is viewed as a supersystem of ongoing communication which is constantly being reproduced through communication (Luhmann, 1984a; 2000). In order to exist as such, social subsystems have to establish special semantics which enable them to distinguish systemic operations from general communication (cf. Klüter, 1986; 1994). This is important because social systems are organized based on the concept of meaning. Symbolic meanings help to establish order within a system through the definition of roles, priorities and routines. As a consequence, a shared set of interpretations and values is created which allows for a boundary to be drawn<sup>2</sup> between internal and external operations and the delineation between meaningful and less meaningful communication (Luhmann, 1981; 1984a; 1984b). One could say that this helps to reduce the complexity of the action framework of agents<sup>3</sup> and organizations in the system. In short, systems are organized and operate on the basis of meaning through which new meaning is constantly being recreated.

It is quite problematic, however, to simply apply this conceptualization to the context of territorial innovation systems due to its neglect of actors and its assumption of operative closure. Luhmann's notion of operative closure is quite rigid in that it does not allow for a system to operate within its environment and *vice versa*. In reacting to critiques which argue that social systems are often characterized by strong external linkages (see, for instance, Clark 2003), Luhmann (2000: 79) weakened his argument of operative closure. According to this understanding, systems should be primarily defined through their potential to reproduce their



basic structure and capability to actively maintain a distinction between the interior and exterior. Further, Luhmann (1982; 1992) did not intend to define territorial systems.

In what follows, I do not apply Luhmann's conceptualization in a strict sense but use his revised understanding of social systems as a starting point to reinvestigate territorial innovation systems.

### **III Institutions, interaction and innovation**

From the above, we can say that the boundaries of a system help regulate and reproduce the difference which separates a system from its environment. In contrast to Luhmann's notion of operative closure, actual boundaries of social systems do not, of course, terminate social interaction but are permeable. We should rather view communication media, such as love, power and money, as mechanisms which enable and ease internal, as opposed to external, interaction. Through existing communication media, agents can rely on a selective set of rules and routines. Shared mores, religious interpretations, codes of conduct, action frames, values, norms, conventions and other social rules help to deal with uncertainties and contingencies which are a consequence of environmental complexity (Willke, 2000). In accordance with the literature on innovation systems, I view these rules and agreements as social institutions.

Luhmann's (1984a; 2000) theory of social system does not elaborate on the concept of institutions because it does not build upon the intentions and purposes of human agency. In contrast, the strength of the national systems of innovation approach can be seen in its emphasis of the role of institutions in providing the basis for economic interaction and generating internal coherence. Institutions can be understood as "... the things, that pattern behaviour, e.g. routines, norms, shared experiences, morals, etc." (Edquist and Johnson, 1997: 43). They define roles and specific tasks which are associated with these roles (Willke, 2000) and often provide the basis of interfirm collaboration and learning (Lundvall, 1992b; Johnson, 1992; Amin and Thrift, 1995; Maskell, 2001; Bathelt and Glückler, 2002). A joint

institutional framework enables specialized users and producers to discuss and solve particular problems (Hodgson, 1988; North, 1991). It helps firms to understand the actions and strategies of their collaborators, as well as competitors, in innovation processes. As such, institutions allow agents to develop reasonable expectations, build trust and reduce uncertainty in economic transactions (e.g. Lorenz, 1999; Lundvall, 1999; Mossig, 2002).

An institutional framework does not, however, exist spontaneously. The existing institutional framework is the result of previous interaction and is modified through social practices in day-to-day interactions between firms and actors. In these interactions, joint problem-solving and experimentation lead to preliminary fixes which must be robust in order to survive the next series of interactions. These fixes are constantly being updated or adjusted to new goals in the innovation process (Storper, 1997; McKelvey, 1997). Through this, conventions and routines are furthered and, for instance, gradually create the ‘organizational memory’ of a firm (Nelson and Winter, 1982). Of course, institutions can also block off innovation if they are too rigid and do not allow for adjustments to changes in the economic settings (Johnson, 1992; Edquist and Johnson, 1997).

Co-presence and co-location serve as a powerful means to participate in the process of creating institutions (e.g. Storper and Venables, 2002; Bathelt *et al.*, 2003). Due to the fact that important institutions are created and regulated at the level of the nation-state, the associated institutional (Gertler, 1993; Berndt, 1999) and cultural affinity (Elam, 1997; Saha, 1998; Casson and Godley, 2000; Freeman, 2002) serve as important preconditions for firms to engage in interactive learning and knowledge creation in innovation processes. Actors and firms benefit from sharing the same language, attitudes toward technology and interpretative schemes (Lawson and Lorenz, 1999; Brown and Duguid, 2000; Gertler, 2001).

#### **IV National innovation ensembles as self-referential systems**

One of the key arguments of the work of Lundvall (1988; 1992a), Edquist (1997a), Freeman (2002) and others is that the institutional framework negotiated at the level of the nation-state creates the potential for the development of national innovation systems. As opposed to views which propagate convergence between different national growth trajectories (for a review, see Martin and Sunley, 1998; Gertler, 2001), this approach assumes that differences between national systems will persist or even be furthered because interrelations between production, innovation and institutions stimulate positive feedback loops. This serves to strengthen the conditions for self-reproduction.<sup>4</sup>

Specific national patterns of innovation develop as existing patterns of specialization prestructure the type of problems and bottlenecks in production, which are recognized as being important (Lundvall and Maskell, 2000). This leads to the establishment of specific national industrial systems. The institutional framework supports and enables particular ways of interacting, thus shaping the direction of the innovation process (Archibugi *et al.*, 1999). Patterns of interaction depend on the particular division of labor within and between firms, existing technological competencies in the workforce, the generation and reproduction of sophisticated skill levels and other aspects of the capital-labor nexus (Gertler, 1993; 1997). As a consequence of the interdependence between production, institutional arrangements and knowledge creation, actors in innovation processes tend to choose partners from within their national innovation system because they have the same understanding, know the specifics of the technologies used, ‘speak the same language’ and share similar experiences in solving problems. This serves to establish social and cognitive affinity and provides a basis for specific communication and interaction between the actors. It also supports sophisticated learning dynamics (e.g. Tracey *et al.*, 2002). One could argue that the political system of a country serves to stimulate and, at the same time, delimit interdependencies between

functional and sectoral systems through its territorial structure (Bahrenberg, 2002; Kuhm, 2002).

If we weaken Luhmann's (1984a; 2000) rigid notion of operative closure and understand social systems based on their capability to reproduce their basic structure and actively maintain a difference between internal and external operations (e.g. Willke, 2000), it is justified to accept the existence of national innovation systems (Bathelt and Depner, 2003). I would argue that such systems exist, but do not suggest that every country necessarily develops its own particular innovation system. The institutional settings within a country could be weak or structures contradictory, preventing the formation of a self-referential system (Lundvall and Maskell, 2000).

National borders mark the territory of a political system which defines the institutional foundations for economic life within its territory. A national innovation system enables communication based on previous communication and decisions to follow upon prior decisions. Reflexive processes of problem identification, experimentation and joint adjustment of action frameworks serve to establish identity and shared meaning. The consequence of this self-referential process is that communication across a system's borders is anything but automatic because it requires that fundamental differences in semantics and institutional arrangements be overcome. This does not, of course, exclude transborder interaction but serves to support a reflexive dynamic between production, institutional arrangements and innovation within the national context.

In recent years, however, the existence of national systems has increasingly been questioned in academic work. Ohmae (1995), for instance, suggests that region-states will replace today's nation-states and develop into the new political and economic entities of the future, due to the economic forces of globalization. According to this literature, nation-states lose 'power' as they can no longer fix, for instance, the economic boundaries of the global financial system

(Harvey, 1990; Dicken, 2003; Clark, 2003), giving rise to the establishment of a world society without barriers to communication (Bahrenberg and Kuhm, 1999). The conclusion of these and other studies is that national borders might lose their former role in structuring economic and social relations, while the subnational and supranational scales would gain in importance. This could lead to a shift in scales, or what Swyngedouw (1997) refers to as ‘glocalization’ (see, also, Cooke *et al.*, 1992; Ohmae, 1995; Cooke, 1998; Hess, 1998).

I believe, however, that this conclusion is somewhat premature as the nation-state is still quite strong and defines the basic building blocks of economic interaction (Gertler, 1993; 1996; Boyer, 2000). The nation-state does not disappear but seemingly reinvents itself by taking over new roles, such as enabling and supporting global economic integration through the establishment of new institutions (Gregersen and Johnson, 1997; Boyer, 2000). Of course, nation-states do not continue to exist without change. They constantly have to adjust to alterations in their environment, or else they could fall apart (Elam, 1997; Lundvall, 1999; Painter, 2000). Discussions about the future role of the nation-state stress the importance of functional integration of economic, political and scientific subsystems (Etzkowitz and Leydesdorff, 2000; Kaufmann and Tödtling, 2001) and the need to provide the foundations for the rise of the knowledge economy (Lundvall and Johnson, 1994; Lundvall, 1999). With respect to Europe, nation-states could, of course, be replaced or complemented by a new, strong European governance level in the future, although this is still open to debate.

## **V From national to regional innovation systems?**

Along a different line of reasoning, Cooke *et al.* (1997) have argued for a need to conceptualize regional innovation systems (see, also, Asheim and Isaksen, 1997; Braczyk *et al.*, 1998). They refer to empirical and conceptual work which has provided evidence that localized production configurations, such as industrial districts (Goodman *et al.*, 1989; Pyke *et al.*, 1990), innovative milieus (Camagni, 1991; Ratti *et al.*, 1997) and clusters (Porter, 1990;

Maskell, 2001; Bathelt *et al.*, 2003), have persisted or gained in importance despite economic globalization. Cooke (1998) views these developments in his seminal work as a precursor of the renewed importance of regional production contexts. In his conceptualization, he does not, however, derive regional systems analytically from the national level but assumes that a regional dimension of innovation exists *a priori*. Innovations are viewed as a result of social processes which depend on close interaction and network linkages in localized production contexts. Under particular circumstances, firms would be embedded into a homogeneous socio-cultural milieu which enables the establishment of joint attitudes, trust and routines (Cooke, 1998). Implicitly, embeddedness is viewed as being a largely local or regional phenomenon. Such a view of embeddedness can be problematic, however, as it emphasizes the regional dimension as holding decisive relational assets (Oinas, 1997; Glückler, 2001; Bahrenberg, 2002; Hess, 2003).

The systems notion is used in a pragmatic way to emphasize the importance of and linkages with regional organizations and institutions in the innovation process, such as universities, technology transfer organizations and industry associations (Cooke, 1998). Systems are not strictly defined based on social systems theory. Although it is stressed that not all regions could automatically be considered as innovation systems, regional systems are sometimes, at least implicitly, viewed as being a normality.

One of the core problems of this concept is that it portrays the region as an entity which hosts a large part of an economic value chain and has a governance structure of its own, independent from its environment. However, such regions are hard to find (Bathelt and Depner, 2003). First, even in nation-states with a decentralized governance structure, regions lack major political decision-making competencies. Second, only few regions can be characterized as being economically self-sufficient, hosting a full ensemble of related industries and services which could serve as a basis for the establishment of an innovation

system. Third, even if autonomous economic entities and strong institutional ensembles exist, the territorial dimensions of both types of governance could differ substantially. Fourth, it seems unrealistic to treat regions as largely homogeneous in terms of their industry-culture mix from which a single innovation system could potentially arise (Bathelt and Boggs, 2003). A lot of the debate about the relevance of regional innovation systems suffers from the fact that empirical work has largely focussed on exceptionally successful innovation clusters (Gertler, 1993; Malmberg, 1997), while neglecting the majority of ‘normal regions’ (Storper, 1997; Hellmer *et al.*, 1999). These regions do not fulfill the criteria of self-sustained economic specialization and political governance which would be characteristic of a regional innovation system (Howells, 1999; Thomi and Werner, 2001). Therefore, most regional ensembles of production, innovation and institutions do not establish autopoietic systems (e.g. Dicken, 2001). This is especially due to the fact that the institutional framework which enables economic interaction is largely established and defined at the national, instead of the regional, level. According to Braczyk and Heidenreich (1998: 439), “... some of the regions ... have virtually no say in the organization of their institutions and very little politico-administrative autonomy.” Important work on regional innovation systems has come to recognize this and applies a more careful approach to understand such systems, not fundamentally different from that suggested here (i.e. Cooke, 2001; Asheim and Herstad, 2003).

Large standardized surveys have, thus far, not been able to explore the systemic character of regional innovation ensembles in depth because they primarily focus on internal network relations (Fritsch *et al.*, 1998; Koschatzky, 1998; 1999; Tödtling and Kaufmann, 1999; Koschatzky and Sternberg, 2000; Arndt and Sternberg, 2000; Fischer *et al.*, 2001; Evangelista *et al.*, 2002; Diez, 2002). Seemingly, it is not that easy to identify general rules and typologies of regional innovation (Blotevogel, 1999). Some of the studies have, however, recognized that

it is necessary to exercise care in investigating supposed regional innovation systems. They distinguish different types of regional ‘systems’ (Cooke and Morgan, 1998; Tödtling and Kaufmann, 1999; Evangelista *et al.*, 2002), including a ‘no-innovation-system’ type. Instead of conceptualizing self-referential regional systems, which are hard to identify empirically, we should accept that economic value chains extend widely across regional borders (Luhmann, 1982; Dicken *et al.*, 2001) and that decisive institutional conditions are regulated at the national level (Bathelt, 1997; Bathelt and Depner, 2003). In doing this, we avoid the implementation of inappropriate policies which favor networking in closed regional circles at the expense of openness and interaction between actors and across regions.

Of course, work on regional innovation systems has recognized this and suggests that this approach be applied with caution (e.g. Cooke, 2001; Asheim and Herstad, 2003). However, I would still argue that the ‘systems’ notion can be easily misunderstood when used in a regional context. After all, regional configurations of production and innovation are deeply embedded in national systems. The national system should be viewed as a suprastructure for regional ensembles, being more than merely their sum (Freeman, 2002). Along with Kuhm (2002; 2003), one could argue that regions be regarded as structural couplings of functional systems, which have their own reproduction mechanisms. Processes affecting the spatiality of these couplings are not regional, but largely national in character. In fact, ‘regionalized national systems of innovation’ (Asheim and Herstad, 2003) might be much more common than true regional systems.

## **VI Conclusions: regional *contexts* in national *systems***

From the arguments presented in this report it seems questionable that region-specific innovation and production processes are typically associated with the existence of regional innovation systems. To assume that such small-scale systems exist bears the risk of underestimating the importance of those institutions which are negotiated and defined at the



level of the nation-state. In reality, however, regional and national innovation contexts are fundamentally different. Regional production configurations are often dependent on structures and developments which are shaped and take place outside the region. A regional ensemble can drastically change or even disappear over time if, for instance, new technologies developed outside are ignored.

Further, location decisions of large firms have a great impact on the conditions under which localized production ensembles can develop overall. There might only be very few regions which are characterized by an institutional framework, strong enough to support a self-referential context for innovation and production. In most countries, the regional level is still dependent on a supraregional institutional regime. A major challenge to regional development is, therefore, how to adapt to changes in this regime without losing regional competitiveness. Often, however, the potential of regional decision-making to deviate from this regime is fairly limited.

Based on a discussion of social systems, it seems not only reasonable to assume the existence of functional innovation systems, which are organized according to a value chain, but also conceptualize territorial systems at the level of the nation-state. Existing institutional arrangements at the national level serve to prestructure problem-solving activities and patterns of interactive learning resulting in ongoing specialization and innovation in the economic structure. Through this, the institutional framework for economic interaction is furthered in an incremental way. My argument is that this reflexive process can result in the establishment of a system of innovation and production at the nation-state level, which is organized on the basis of meaning and identity. Such a system is also capable of reproducing itself through specific communication related to a particular institutional context. This is not to say, however, that national systems of innovations would never change or exist forever. Due to

European integration, for instance, innovation systems might also develop at the supranational level in the future. To which degree this will happen remains speculative.

The outcome of this is also significant in terms of its policy implications. If we accept that regional systems of innovations rarely exist, regional policy initiatives which emphasize a region's ability to determine its own future by focussing on its existing internal strengths and the establishment of regional networks between economic, political and scientific organizations could easily fail. In addition to mobilizing internal resources, regional policies should also support agents in developing linkages and networks with external agents and markets (Bathelt *et al.*, 2003). This, of course, does not imply that regional innovation policies are obsolete. Caution should simply be exercised in prioritizing the local capabilities over non-local opportunities.

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### Notes

<sup>1</sup> Gren and Zierhofer (2003) point out that Luhmann has often been misinterpreted. He was neither a functionalist nor did he argue for normative theory. Further, Luhmann (1982; 1992) did not intend to define territorially-based social systems.

<sup>2</sup> In Luhmann's (1982; 1992) conceptualization, this boundary is strictly defined through actual communication which follows earlier communication. It is not equivalent to a spatial border (see Klüter, 1986).

<sup>3</sup> For Luhmann (1984a), however, systems exclusively consist of communication (see Willke, 2000). Agents are not part of a system because they communicate and act in many different systems simultaneously. I do not follow this view.

<sup>4</sup> Our understanding of a national innovation system should not encompass all production structures and processes within a country but rather refer to the characteristic economic structures and institutions which support specialization. National systems of innovation should not exclusively be defined in spatial terms but viewed as a combination of sectoral and functional systems with a territorial basis (Breschi and Malerba, 1997; Kaufmann and Tödtling, 2001). In Germany, the chemical, machinery and automobile industries have, for instance, developed into internationally successful, specialized industrial systems, based on close interrelations with the political system (e.g. Messner, 1995; Schimank, 2001) and the existing institutional framework in terms of labor relations, research and educational infrastructure and the like (e.g. Gertler, 1996). In this respect, sectoral and national innovation systems are mutually reinforcing, instead of excluding one another (Lundvall *et al.*, 2002; Malerba, 2002). Further, national innovation systems neither exclude foreign direct investment nor international production configurations.

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