REGIONAL INNOVATION SUPPORT SYSTEMS IN SOUTH KOREA AND GERMANY COMPARED

With 2 figures and 3 tables

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Zusammenfassung: Regionale Systeme zur Innovationsförderung in Südkorea und Deutschland im Vergleich

Seit Anfang der 1990er Jahre ist in den Industrieländern eine deutliche Verlagerung der Ziele der Regionalpolitik zu erkennen: von der Minderung regionaler Ungleichheiten zu der Entwicklung aus sich selbst herauswachsender klein- und mittelständischer Unternehmen (KMU) und zu mehr Innovation in den Regionen durch regionale Systeme zur Innovationsförderung. Systeme zur Innovationsförderung werden definiert als eine Gruppe aktiv kooperierender Organisationen, die die Innovativität der KMU unterstützen. Ein System zur Innovationsförderung besteht aus Beratungsstellen, die die folgenden drei unterstützenden Dienste bieten: die Bereitstellung allgemeiner Informationen, technologische Beratung und gemeinsame Forschungs- und Entwicklungsprojekte zwischen KMU, Hochschulen und öffentlichen Forschungseinrichtungen. Akteure innerhalb dieser Stadien versuchen, Innovationsprobleme von hauptsächlich der Technologiebranche zugehörigen KMU zu lösen, indem sie diese selbst beraten oder die KMU in einem fortgeschrittenen Stadium an andere Beratungsstellen verweisen. Dieser Aufsatz vergleicht diese regionalen Systeme zur Innovationsförderung in Südkorea und Deutschland, und zwar in Hinblick auf die angewandten Instrumente, ihren Einfluss auf die regionalwirtschaftliche Entwicklung, das Ausmaß ihrer institutionellen Einbettung in die Region und die Möglichkeiten der Regionen, innovationsunterstützende Politik zu koordinieren. Schlussfolgerung des Aufsatzes ist, dass es in beiden Ländern Gemeinsamkeiten bezüglich der regionalen Systeme zur Innovationsförderung gibt, aber dass sich die Länder hinsichtlich ihres Ausmaßes der institutionellen Einbettung und der Möglichkeiten der Regionen, innovationsunterstützende Politik zu koordinieren, unterscheiden. Darüber hinaus zieht der Autor die vorläufige Schlussfolgerung, dass in Ländern, in denen Regionen die Möglichkeit haben, die Politik in integrative Systeme zur Innovationsförderung einzubinden, der Einfluss auf die regionalwirtschaftliche Entwicklung im Regelfall größer ist als in Ländern, in denen diese Möglichkeiten fehlen, das heißt, in denen dirigistische und „Graswurzelsysteme" *(grassroots support systems)* vorherrschen.

Summary: Since the beginning of the 1990s, one can observe a clear shift in the aims of regional policy in industrialised countries from reducing regional inequalities to developing endogenous small and medium-sized enterprises (SMEs) and innovation in regions through regional innovation support systems. Innovation support systems are defined as a group of actively co-operating organisations that support the innovativeness of SMEs. An innovation support system consists of all agencies found in three support stages, namely the provision of general information, technological advice and joint research and development (R&D) projects, between SMEs and higher education institutes (HEIs) and public research establishments (PREs). Agencies found in these stages try to help to solve innovation problems mainly of technology-following SMEs by either giving them advice themselves or by referring them to other agencies in a further stage of support. This paper aims at comparing these regional innovation support systems in South Korea and Germany, concerning the instruments used, their impact on regional economic development, their level of institutional embeddedness in regions and the ability of regions to co-ordinate innovation support policies. The main conclusions of the paper are that there are similarities between the regional innovation support systems found in both countries when it comes to policy instruments, but that the countries differ concerning their level of institutional embeddedness and the abilities of regions to co-ordinate innovation support policies. The paper also tentatively concludes that in countries where regions have the ability to co-ordinate policies into integrative innovation support systems, the impact on regional economic development tend to be larger than in countries where these abilities are lacking, that is where dirigiste and grassroots support systems prevail.

1 Introduction

Systems of innovation are formed by firms interacting with other actors in an innovation context for interactive learning. These systems have become popular as a conceptual framework for explaining differences in competitiveness both between firms and sectors, at the local, regional, national and supranational level since the beginning of the 1990s (EDQUIST 1997). Starting with national innovation systems, this approach has been extended by sectoral innovation systems and regional (subnational) or local innovation systems (EDQUIST 1997; COOKE et al. 2004; DE LA MOTHE a. PAQUET 1998; MYTELKA 2000; BATHELT u. DEPNER 2003). In general, these kind of systems are divided into two subsystems, the production system and the institu-

tional system. As this paper's core theme is innovation support systems, it will focus on the institutional part of regional innovation systems. In this paper, institutions are considered as "formal structures with an explicit purpose", also called organisations, rather than "things that pattern behavior" such as norms, rules and laws (EDQUIST 1997, 26). Innovation support systems are defined as a group of actively co-operating organisations that support the innovativeness of small and medium-sized enterprises (SMEs). An innovation support system consists of all agencies found in three support stages, namely the provision of general information, technological advice and joint R&D projects, between firms (of which technology-following SMEs are the main group) and higher education institutes (HEIs) and public research establishments (PREs). Agencies found in these stages try to help to solve innovation problems mainly of technology-following SMEs by either giving them advice themselves or by referring them to other agencies in a further stage of support. If it concerns a highly complicated technological problem, the SMEs might finally be referred to a university or PRE. The agencies can be mainly supranationally, nationally or regionally initiated.

Although regional innovation support systems have been extensively studied in a comparative way in Europe (DODGSON a. BESSANT 1996; COOKE et al. 2004; HASSINK 1997; CLEMENT et al. 1995; TSIPOURI 1999), East Asia in general and South Korea in particular have not been well covered by research on the issue. On the basis of case-studies of regional innovation support systems in Gyeonggi (South Korea) and Baden-Württemberg (Germany), this paper will shed light on how far the process of regional innovation support systems has evolved in South Korea and Germany. It aims at comparing regional innovation support systems in these countries, concerning the instruments used, their impact on regional economic development, their level of institutional embeddedness in regions and the ability of regions to co-ordinate innovation support policies[1]. This paper does not consider embeddedness as commonly seen from a firm's point of view, which stresses social interaction between the firm and its environment (GRANOVETTER 1985; OINAS 1997). As innovation support agencies in regions are this paper's topic, it will work with the notions of institutional embeddedness (BARNES 1999) and spatial (regional or national?) embeddedness (OINAS 1997). Institutional embeddedness is seen as co-operative action of individual agencies as well as several sorts of local coalitions in securing interests in processes of regional development, whereas spatial embeddedness is defined as actors "being embedded in social relations on different spatial scales" (OINAS 1997, 29). The question will be whether support agencies are deeply and firmly fixed in social relations with other institutions in the region (which is a combination of institutional embeddedness and spatial embeddedness confined to the region), so that we can speak about regional innovation support systems.

The paper will focus on the Gyeonggi Province (8.5 million inhabitants) around Seoul in South Korea and the state of Baden-Württemberg in the south-western part of Germany (10.5 million inhabitants) (see Fig. 1 and 2) for two reasons. First, they are relatively equal in size and both regarded as economic powerhouses in their country. Secondly, both regions have about the same manufacturing and institutional density, diversified production structure and a strong tradition in SME-based manufacturing.

In order to be able to present innovation support systems in South Korea in Section 3 and in Germany in Section 4 and to tackle the questions concerning institutional embeddedness of innovation support systems in Section 5, first a framework needs to be created, which will be done in the following Section 2.

2 *Theoretical concepts related to regional innovation support systems*

The recent popularity of the concept of regional innovation systems is closely related to the surge in regional innovation policies in many industrialised countries of the world. This is due to the fact that the importance of the regional level is increasing with regard to diffusion-oriented innovation support policies (JESSOP 1994; DODGSON a. BESSANT 1996, 5; AMIN 1999; COOKE a. MORGAN 1998; LAGENDIJK a. CORNFORD 2000; ASHEIM et al. 2003; FRITSCH 2004). Central governments, however, keep their key role in supporting basic, pre-competitive technologies, which have spill-over effects that go far beyond the borders of regions (STORPER 1995). Partly supported by national and supranational support programmes and encouraged by strong institutional set-ups found in successful regional economies such as Baden-Württemberg in Germany and Emilia-Romagna in Italy, many regions in industrialised countries have been setting up science

[1] Information on regional innovation support systems in South Korea was gathered in the area during 1998 and 1999, when the author carried out a research project which was sponsored by the European Union Science and Technology Fellowship Programme Korea (see also HASSINK 2000, 2001b). The German parts are based on updated research carried out by the author some years ago (HASSINK 1996).

parks, technopoles, technological financial aid schemes, innovation support agencies, community colleges and initiatives to support clustering of industries since the second half of the 1980s. The central aim of these policies is to support regional endogenous potential by encouraging the diffusion of new technologies from universities and PREs to SMEs, between SMEs and large enterprises (vertical co-operation) and between SMEs themselves (horizontal co-operation). Intermediary innovation support agencies are considered to be the core of regional innovation policies (PYKE 1994).

This increasing importance of regions for innovation policy can be considered as the outcome of a converging of regional and technology policy since the early 1980s (ROTHWELL a. DODGSON 1992; KOSCHATZKY 2003). These two policy fields converged into regional innovation policies since their aim became partly the same, namely supporting the innovative capabilities and thus competitiveness of SMEs. It also fits into what AMIN (1999) observed as a shift from a firm-centred, incentive-based, state-driven and standardised regional economic development policies to bottom-up, region-specific, longer-term and plural-actor policies. These policy trends cannot only be seen in European countries, but also in North America and some countries in Asia (MARKUSEN et al. 1999). Although we can therefore speak of a general phenomenon, there are of course large differences between individual regions and countries concerning the extent to which these trends take place. Generally, contributive factors to regional innovation policies are a federal political system, decentralisation, strong regional institutions and governance, a strong industrial specialisation in the region, socio-cultural homogeneity and thus relationships of trust, large economic restructuring problems and a strong commitment of regional political leaders (ATKINSON 1991).

Fig. 1: The location of Gyeonggi in South Korea
Die Lage Gyeonggis in Südkorea

One of the main strengths of the regional level for innovation support has been called the "garden argument" (PAQUET 1994): if the economy is regarded as a garden with all kinds of trees and plants, for the gardener (government) there is no simple rule likely to apply to all plants. Growth is therefore best orchestrated from its sources at the level of cities and regions. At this level, rather than at the national level, policy makers can better tailor policy in relation to demand (JESSOP 1994; TSIPOURI 1999; NAUWELAERS a. WINTJES 2000). Regionalisation, therefore, allows for differentiation in policies, which is necessary because of differing regional economic conditions and thus different support needs of industries and firms. Regionalisation also raises the enthusiasm and motivation of regional policy makers, as they are now able to devise "their own" policies. Moreover, because of the large variety of institutional set-ups and initiatives in Europe and North America, these laboratories of experimentation offer both national and regional policy makers plenty of institutional learning opportunities (HASSINK a. LAGENDIJK 2001; MORGAN a. HENDERSON 2002).

Closely related to this "garden argument" is the positive relationship between institutional embeddedness in regions, entrepreneurial learning processes and competitiveness (LORENZEN 2001; MASKELL a. MALMBERG 1999; COOKE a. MORGAN 1998). For their competitiveness firms depend on innovation processes. In order to come to such innovation processes firms have to exchange information and reproduce this information into knowledge, in other words they have to learn. Due to an increasing cut-throat competition and shorter product life cycles, firms, particularly SMEs, are increasingly dependent on information and knowledge sources that are only available outside the firm. Firm innovation processes therefore increasingly take place in interaction with other organisations, be it with other business partners, such as customers, suppliers or com-

petitors or with public research establishments, higher education institutes, technology transfer agencies and regional development agencies. Innovation processes hardly ever take place in isolation any more. Innovations can thus be understood as manifest results of cumulative learning processes of firms. The spatial environment provides different institutional contexts for interactive learning. These contexts differ not only nationally, but also regionally and locally from each other. Firms are therefore institutionally embedded in different contexts for interactive learning. Spatial proximity stimulates communicative interaction between actors. However, it is not a sufficient condition. In order to achieve this interaction social proximity (equal or similar characteristics such as age, vocation, language and equal or similar views on values and norms) and organisational proximity (concern structure, intra- and inter-firm network structures) are necessary factors as well. The knowledge form determines to what extent proximity is necessary for learning by interacting. Typically, innovation-relevant information is not a publicly available, codified good, but private tacit knowledge – those parts of personal knowledge as well as personal skills that cannot be communicated in an impersonal way. Only through personal, communicative interaction between actors there are possibilities to exchange, understand and to apply this kind of information. In order to communicate, tacit, and to a lesser extent codified knowledge 'code keys' are needed, which are only understandable if (social) coherence and proximity are available. Thus institutional embeddedness in regions positively affects the communication of tacit knowledge in particular and learning by interacting in general, which in turn is positive for competitiveness. Collective

Fig. 2: The location of Baden-Württemberg in Germany
Die Lage Baden-Württembergs in Deutschland

learning processes and a collective tacit knowledge are linked to the location because of the coinciding of social, cultural and spatial proximity.

Since regional innovation policies have been emerging starting in the mid-1980s, several academics have started to develop theoretical and conceptual ideas on regional innovation strategies since the mid-1990s (LAGENDIJK a. CORNFORD 2000). These concepts, which form an important part of the recently dubbed family of territorial innovation models (MOULAERT a. SEKIA 2003), that is regional innovation systems (COOKE 2004; DE LA MOTHE a. PAQUET 1998; COOKE et al. 1998), the learning region (MORGAN 1997; HASSINK 2001a; BUTZIN 2000) and the idea of institutional thickness (AMIN a. THRIFT 1994) have been partly developed for policy reasons, namely as a response to organisational and strategic weaknesses of regions. Scholars also wanted to derive conceptual policy lessons from successful regional economies and to clarify why the regional level is an important level as a source for learning and innovation.

Of the recently developed concepts, the regional innovation systems concept is most widely dealt with in the literature, both in a conceptual way (COOKE 2004; DE LA MOTHE a. PAQUET 1998) and concerning empirical case-studies, including North American and Asian ones (COOKE et al. 2004; DE LA MOTHE a. PAQUET 1998; CHUNG 1999b). COOKE et al. (1998,1581) define regional innovation systems as systems "in which firms and other organisations [such as research institutes, universities, innovation support agencies, chambers of commerce, banks, government departments] are systematically engaged in interactive learning through an institutional milieu characterised by embeddedness". The aim of regional innovation systems is to integrate traditional, context-linked, regional knowledge and codified, world-wide available knowledge in order to stimulate regional endogenous potentials.

A typology of regional innovation support systems helps to apply the concept to a broad range of regions and to clarify the 'scale' of public policy involvement, that is from mainly national to mainly local. It also clarifies the relationship between national and regional innovation support systems. Such a typology consists of grassroots systems, integrated systems and dirigiste systems (Tab. 1; for other typologies in relation to regional innovation policies see TSIPOURI 1999; NAUWELAERS a. WINTJES 2000; KOSCHATZKY et al. 2003). In grassroots systems, innovation support agencies and policy initiatives are to a large extent initiated and funded by firms supported by local or regional authorities themselves, whereas integrated systems represent a mixture of national, regional and local initiatives and agencies. Both systems deserve to be called systems, as extensive and well co-ordinated interaction between institutionally embedded agencies makes them more than just a sum of parts (which could be called an infrastructure). These two systems show similarities to what AMIN (1999) has labelled bottom-up, region-specific, longer-term and plural-actor kind of regional economic development policies. In nationally initiated dirigiste systems, on the other hand, intra-regional institutional embeddedness and "systemness" tend to be weaker. They come close to the firm-centred, incentive-based, state-driven and standardised kind of regional economic development policies (AMIN 1999).

On the basis of the theoretical framework and typology presented in this section, it will be tested whether we can find institutionally embedded innovation support systems in regions in South Korea in the next Section 3, and in Germany in Section 4.

3 Regional innovation support systems in South Korea

Thus, recent theoretical discussions (Section 2) suggest an increasing importance of the regional level for

Table 1: Typology of regional innovation support systems

Typologisierung der regionalen Systeme zur Innovationsförderung

	grassroots	*integrated*	*dirigiste*
initiation	local	multi-level	central government
funding	local agencies	diverse	national agencies
research a. support	applied/ near-market	mixed	basic
specialisation	low	mixed	high
intra-regional co-operation	high	fair	low
co-ordination	low	potentially high	potentially high, but often low

Source: adapted by the author after COOKE 2004

innovation support. On the basis of the case study Gyeonggi, this section will give practical evidence on this trend in South Korea. It will start, though, with presenting South Korea's policy framework for regional innovation support systems and subsequently the case region's economic profile.

In recent years one could observe a fundamental change of South Korea's institutional framework and the content of its industrial, technology and regional policies. This has been necessary to achieve the restructuring of its economy, from a low-technology, labour-intensive, 'mass production' type of industry to a high-technology, capital- and skill-intensive, 'flexible specialisation' type of industry (PORTER 1990). This involves a shift in emphasis from hierarchical control to decentralised governance, both at the level of the state and at the level of the firm. According to many, however, these institutional changes are taking place at a too slow pace, particularly where the central government is involved (KIM 2000). This slow pace of reforms partly resulted in the economic crisis of 1998, the worst since the Korean War in the early 1950s. During the recent economic crisis voices in favour of more market and less state and more decentralisation and less centralisation have therefore become even louder.

In the 1980s, the government gradually shifted emphasis from industrial policy to technology policy (KIM 2000). This shift in government policy led to a sharp increase in R&D expenditure levels: R&D expenditures as a percentage of GNP grew from 0.38% in 1970 to 2.46% in 1999 (KIM 1997 and Tab. 2). It now has the highest R&D intensity of all East Asian economies and even surpassed the United Kingdom (KIM 1997) and is slightly higher than in Germany (see Tab. 2). Particularly striking is the relatively low share of governmental expenditures and hence the relatively high proportion of private sector involvement in R&D investments, also compared to Germany (see Tab. 2). Not only R&D expenditures increased, also the high-tech industries' employment share of total manufacturing employment grew from 9.1% in 1983 to 16.6% in 1994 (WESSEL 1997). The strong increase in patent registrations is another important indicator of South Korea's rapid development in industrial R&D (KIM 1997). Both private R&D expenditures, high-tech employment and patent registrations are strongly concentrated in large enterprises.

Considering the fact that Korea was one of the poorest countries in the world in the 1950s with an extremely low R&D input, strong technology policy has

Table 2: R&D-related statistics of South Korea and Germany compared

Forschungs- und Entwicklungsstatistik: Südkorea und Deutschland im Vergleich

	South Korea	Germany	OECD
R&D expenditures (total)[1]	18.5	47.6	553.0
R&D expenditures[2]	2.46	2.44	–
Average annual growth rate[3]	8.69	1.41	2.78
Researchers[4]	46	59	–
Secondary education level[5]	0.6	1.9	1.0
Government financed R&D[6]	26.9	35.6	–
Government financed R&D[7]	0.5	0.8	–
Business financed R&D[8]	2.5	2.0	–

[1] In billions of dollars (1999)
[2] As per cent of GDP
[3] In the period of 1991 – 1999
[4] Per 10.000 of labour force (1997)
[5] Share of the population aged 25 – 64 with at least an upper secondary education level (1999)
[6] As a per cent of total R&D expenditures
[7] As a per cent of GDP
[8] As a per cent of the business GDP

Sources: OECD Science, Technology and Industry Scoreboard 2001
[http://www1.oecd.org/publications/e-book/92–2001-04-1–2987/]
OECD Economic Survey Korea August 2000]

led to these relatively high scores on R&D-related indicators. The main ministry involved in technology policy is the Ministry of Science and Technology (MOST). The ministry has two related institutes, the Science and Technology Policy Institute (STEPI), MOST's think tank, and the the Korea Institute of Science and Technology Evaluation and Planning (KISTEP), MOST's policy management and evaluation institute. Another player in the field of innovation support for SMEs is the Ministry of Commerce, Industry and Energy (MOCIE). Despite the increasing governmental involvement in technology policy, KIM (2000) observes several weaknesses in South Korea's innovation system: research at universities is relatively weak, there is a fundamental lack of interplay between universities and the private sector, there are relatively few technological spin-offs and there is a dearth of diffusion mechanisms to transfer research results from PREs to industry and particularly to SMEs. There are signs that the character of South Korea's technology policy is moving from a mission-oriented one, which is focusing on public research institutes and big science projects, to a diffusion-oriented one, which stresses the environment, the transfer of knowledge and technical education (HASSINK 2001b; ERGAS 1987). Recently, for instance, the central government has increasingly been supporting the innovativeness of SMEs and inter-firm networks. These SME-oriented innovation support policies are much stronger developed than one would expect after reading literature and press articles on South Korea's general economic policy. In those publications, the South Korean government is often blamed for just supporting the *chaebol* (large conglomerates) and neglecting SMEs, of which many lack boundary spanning functions, such as R&D. The strength of the Korean SME-oriented innovation support, however, is contradictory judged in the literature (see HASSINK 2001b), which might be partly caused by the lack of systematic evaluation (CHUNG 1999a). There is more agreement on what could be improved about the support policies, namely a stronger involvement of local and regional authorities (OECD 1996,174; PARK 1998; SUH 2000; OECD 2001) and a stronger voice of SMEs themselves in the agencies, which are mostly set up by the central government (PARK 1998,195).

One factor that led to the recent economic crisis are the weaknesses of the system of research institutes and universities. The latter are focused too much on teaching and too little on research. The unbalance between teaching and research at universities is illustrated by the fact that in 1994 universities employed 33% of South Korea's total R&D personnel, whereas they received not more than about 7.7% of the national R&D expenditures (KIM 1997). In addition, given the teaching orientation at universities, there is a fundamental lack of interaction between universities and the private sector and there are relatively few technological spin-offs (KIM 1997). Although the government extensively financed the establishment of a whole range of PREs (80% of public R&D spending goes to PREs, compared with 41% in Germany and 24% in the USA), these institutes lack diffusion mechanisms to transfer research results to industry and particularly to SMEs (KIM 1997).

South Korea's regional policy, another bordering policy field of regional innovation support systems, has been "heavily reliant on programmes involving construction of industrial sites and infrastructure development, as well as regulation of metropolitan growth" (HONG 1997, 421), whereas soft goals such as networking, institutional frameworks, public-private partnerships and the provision of information and consulting services have been neglected (HONG 2003). Many ministries and agencies are directly or indirectly involved in regional economic policy (no less than five ministries at the central level). In general, regional policy has had limited effect on spatial development in general and on reducing regional economic inequalities in particular (KANG 1997). It has been weakly implemented, "often succumbing to national short run economic pressures" (HONG 1997, 419). Many scholars have been arguing that regional policy should be changed from 'top-down' decentralisation policies, mainly implemented in the 1970s (large-scale heavy industrial complexes in the central and particularly south-eastern parts of South Korea) and 1980s (mainly PREs to Daedeok Science Town in Daejeon) to 'bottom-up' decentralisation policies of developing endogenous potentials (mainly SMEs) in regions (HONG 1997; KANG 1996; PARK 1998). The emergence of these latter policies have been facilitated by political decentralisation reforms in 1995 (HASSINK 2001b).

3.1 Case-study Gyeonggi

South Korea's rapid industrialisation in the 1960s and 1970s and the rise of high-tech industries from the mid-1980s onwards have caused strong concentration of economic activities in the north-western and south-eastern parts of the country and thus considerable regional disparities (OECD 2001). The heavy industrialisation in the central and south-eastern provinces also generated monostructural industrial complexes dominated by branch plants of *chaebol* which are mainly steered from Seoul. The national government and *chaebol* dominated the formation of most of these dis-

tricts. Local and regional actors, such as regional development agencies and universities, did not play an important role. The strong growth of these districts is thus almost entirely exogenously, rather than endogenously, generated.

In contrast to the spatial production structure in the south-eastern part of Korea, which has a production structure that is characterised by a strong geographical concentration of some industries in some localities (externally steered local innovation systems), Gyeonggi has a more diversified production structure. It can be regarded, together with Seoul and Incheon, as the innovation centre of South Korea. In fact, due to a decentralisation of high-tech manufacturing industries from Seoul, its position as an innovation centre has even been strengthened (PARK 2000; LEE 2001). At the same time, however, these industries are still dependent on Seoul for the supply of producer services (PARK a. MARKUSEN 1999). The strong position of Gyeonggi as an innovation centre is illustrated by several statistical data, such as its relatively high R&D intensity (number of R&D workers per 1,000 inhabitants), its high share of patents of the South Korean total, its over-representation of employment in high-tech industries and its leading position in South Korea when it comes to business start-ups (HASSINK 2001b; LEE 2001). Although Gyeonggi is characterised by a high industrial diversity and many independent, highly innovative SMEs, it has been hit relatively hard by the crisis in 1998. This might be explained by the predominance of SMEs in this region, which have suffered more from the economic crisis than the large externally controlled branch plants of the *chaebol* in the south-eastern part of the country.

The most important elements of the innovation support system in Gyeonggi stem from nationally devised initiatives, that is intermediary agencies, a consortium programme and a programme to support so-called technoparks. A smaller part consists of locally and regionally devised initiatives. In the following, a selection of recently established key innovation support agencies and initiatives in Gyeonggi will be briefly described, starting with the nationally devised ones (for detailed descriptions see HASSINK 2001b; LEE 2001).

One of the main innovation support agencies in Gyeonggi is the Small and Medium Business Administration (SMBA), an organisation which was established by the central government in 1996 and which has 11 regional offices in South Korea. The office in Gyeonggi (located in Suweon) has about 50 employees. These regional offices' main functions are to inform SMEs on the spot about national aid schemes, management and sales and purchase issues, to assess applications for aid schemes, to provide regional SMEs with technological advice and test and analysis equipment, and to refer SMEs to other agencies. Very similar to the SMBA is the Small and Medium Industry Promotion Corporation (SMIPC), which also has 11 regional offices and is also fully supported by the central government. The Gyeonggi office is located in Suweon and has about 20 employees, of which about five are technology consultants, who are, in contrast to SMBA's consultants, professional engineers with a long company experience. KIM and NUGENT (1994, 13) consider the SMIPC as the "most important public agency providing technical support exclusively for SMEs". Despite some small differences between the SMBA and SMIPC, these agencies, as well as the more densely spread offices of the chambers of commerce, are very similar to each other. Even according to some managers of the agencies, SMEs mix up these agencies.

The central government also established a network of 37 so-called Regional Research Centers (RRCs), which are located at universities across the whole country (see also LEE 2003). They are specialised in those technologies that dominate in the region's industry: in Gyeonggi, there are three RRCs: the RRC for Electronic Materials and Components in Ansan, the Center for Environmental and Clean Technologies in Suweon and the RRC on Ceramic Engineering in Yongin. The centres aim at fostering co-operation between universities and SMEs in the regions and are meant to upgrade research facilities at universities so that they become interesting partners for SMEs to co-operate with. They offer SMEs in the region the following services: technological advice, joint R&D projects, seminars, training courses and the use of scientific equipment for tests and experiments. A recent survey among SMEs in South Korea seems to confirm the success of the RRCs, as it shows that the share of SMEs co-operating with universities on innovation projects increased from 12.8% in 1995 to 28.0% in 1997 (CHUNG 1999a). Concerning the particular case of Gyeonggi, the institutional embeddedness of these centres in the region is relatively weak, as the interviewed RRCs in Gyeonggi mainly co-operate with agencies that are located outside the region. This weak intra-regional co-operation is probably due to a relatively weak industrial specialisation and clustering in Gyeonggi.

Furthermore, the central government has selected six so-called technoparks for long-term financial support, of which one is located in Gyeonggi, the Gyeonggi Technopark in Ansan. In contrast to most science parks in Great Britain and the "Gründer- und Technologiezentren" in Germany, which are mainly focusing on technology-oriented start-ups and SMEs, South Korea's technoparks are also supposed to con-

tain R&D centres and production plants of *chaebol*, pilot plants or learning factories which are both used by university students and SMEs and small business support centres. Technoparks are developed and financed by a wide range of participants including central government, local and regional authorities and universities.

In addition to the presented nationally initiated measures, locally and regionally initiated policy measures have been increasing. Gyeonggi Province (2.67%) spends about the same share of its budget on science and technology policy (S&T) as the average of all provinces (2.58%) (CHUNG 1999b). Looking at the provincial budgets for this policy, however, the lion's share is devoted to co-financing the recently developed nationally devised policy initiatives described above (HASSINK 2001b). Because Gyeonggi Province has the largest absolute S&T budget of all provinces in South Korea (CHUNG 1999b), it has more room to set up and finance some innovation policy measures. It is the only province in South Korea that has set up a regional version of RRCs. Three centres that were not selected by MOST to become an RRC received support from the province and are now called Gyeonggi Regional Research Centers (GRRCs). Furthermore, the province has established its own intermediary agency for SMEs in 1996, called the Gyeonggi Small Business Foundation (GSBF). The GSBF, which has 41 employees and has recently been renamed into Gyeonggi Small Business Center, has two aims. First, it promotes business start-ups and existing SMEs that develop new products. It has an "on-spot innovation team", consisting of engineers with extensive company experience who technologically advise Gyeonggi SMEs. Secondly, the GSBF is going to set up a science park in Suweon, the capital of Gyeonggi, within the coming two years. In contrast to the technoparks mentioned above, this science park will only provide high-tech, R&D-oriented business start-ups (so no production) with office space. In addition to the office space for about 100 high-tech business start-ups, the science park will also become a new home for 25 innovation support agencies of the Gyeonggi Province in a so-called "under-one-roof one-stop shopping center".

All in all, the strong increase in initiatives of the central government in which regions participate as co-financiers have clearly been boosting the role of regions in innovation policies. However, innovation policy still has a strong national character, as in nearly all the cases, provinces can only co-finance initiatives that are devised and implemented by the central government. South Korea's provinces clearly lack the capabilities to co-ordinate innovation support measures and to strategically and reflectively think about innovation support (see also HASSINK 2001b and LEE 2001). These lacking capabilities to co-ordinate innovation policies at the regional level show that South Korea is far from the ideal regional innovation support system, let alone a reflective learning region.

4 Regional innovation support systems in Germany

In Germany, which has a much longer history in supporting science, technology and innovation, the two federal ministries are mainly responsible for implementing the policies and providing funding. The Federal Ministry of Education and Research (BMBF), which had an annual budget of over Euro 8 billion in 2002, provides funding for education, research and development. This includes institutional funding for Germany's research organisations (jointly funded by the Federal Government and the *Länder* (regional state governments), contributions to university large infrastructure investments, priority research programmes in key sectors, and international subscriptions. The Federal Ministry of Economics and Technology (BMWi) allocates an annual 450 million to innovation in the form of support programmes for innovative SMEs, industrial collaborative research and priority projects in the area of energy and civil aeronautics. The federal and *Länder* governments have joint responsibility for a number of policies, including forward planning in education, the expansion of existing and construction of new universities and major infrastructure equipment. They jointly support Germany's research organisations, including the German Research Council (Deutsche Forschungsgemeinschaft – DFG), the Max Planck and Fraunhofer Societies and Germany's Academies of Science. They are also responsible for harmonising the regulations and syllabuses for further education and vocational training. In general, technology policy in Germany is marked by a high degree of sectoral selectivity which results from the dominance of direct project support (KLODT 1998). Its second main feature is the persistence of public research institutions, although technological priorities have significantly changed over time. According to KLODT (1998), public support to private R&D should be reoriented towards indirect measures and public research institutions should be more exposed to competition.

Due to its federal structure, many government tasks in Germany are performed by the *Länder*. Higher education and technology policy are areas in which the *Länder* have their own responsibilities. The regionalisation of technology policy soared particularly in West

Germany after Baden-Württemberg successfully started regional technology consultancy centres in the 1980s (HASSINK 1996; COOKE a. MORGAN 1998). Generally, each *Land* has selected a wide range of regional technology policy measures to assist enterprises in developing their innovative potentials, to build up a technology and science infrastructure, to transfer information, to train employees technologically and to promote business start-ups. In Germany, we can therefore find a system which lies between grassroots and integrated systems in the old established *Länder*. In the new *Länder* in eastern Germany, however, we can find a system which has, due to strong support of the federal government, more dirigiste characteristics (KOSCHATZKY 2000; PFÄHLER a. HOPPE 1997). The latter, however, are clearly moving towards integrated support systems, as the federal government is slowly decreasing its support.

Not only do *Länder* have a relatively strong position in innovation support in Germany (innovation-oriented regional policy), also the central government has recently discovered regions as an implementation platform of its innovation and technology policy, which has been labelled regionalised national innovation policy (KULICKE 2003; FRITSCH 2004; DOHSE 2001; KOSCHATZKY 2000). One prominent example of this latest trend of regionalised national innovation policy is the BioRegio contest, an initiative of the central government to boost Germany's competitiveness in biotechnology. In a competitive procedure three regions were selected for support, namely Munich, the Rhine-Neckar Triangle and the Rhineland, which were subsidised by 25.56 million Euro until 2001. According to KOSCHATZKY (2000, 17) the programme contributed to increasing Germany's competitiveness in biotechnology to a considerable extent. Other recent initiatives with similar characteristics are the EXIST-University-based start-ups and InnoRegio contests. EXIST focuses on supporting regional concepts for co-operation between HEIs, companies and other partners. The InnoRegio contest promotes regional innovation strategies in a broad sense in the new *Länder* of Germany. These three contests mark a change of paradigm in the German "technology and innovation policy", as national technology policy for the first time regards the region as a relevant platform of support programmes (KOSCHATZKY 2000, 21). In order to participate in these contests, regions need to have co-ordinative power and abilities to submit a sound proposal. These contests can lead to increasing regional inequalities, as only those regions that have both the demand for these innovation policies and the co-ordinative power can benefit from these programmes.

4.1 Case-study Baden-Württemberg

The economy of Baden-Württemberg, which has about 10 million inhabitants and is the most south-western of the old *Länder* in western Germany (see Fig. 2), has long been considered to be one of the most prosperous of Germany and even of Western Europe. Unemployment rates have been the lowest in Germany since the early 1970s. Also other indicators, such as export rates, the gross domestic product, the development of the number of employees, economic growth and the share of employees working in R&D confess the stable and strong economic position in the hierarchy of regions in Germany. By 1992, however, the region's economy found itself in the deepest economic recession since the state was founded in 1952, which is more or less over now (COOKE a. MORGAN 1998).

Industrial policy has a long tradition in Baden-Württemberg. Ferdinand von Steinbeis already supported many small craft firms in Württemberg with regard to technological knowledge, export and training in the 19th century, whereas Heinrich Meidinger was active in these fields in Baden at the same time. Also, since the mid-1970s policy makers in Baden-Württemberg have been active and innovative with regard to technology policies. Baden-Württemberg developed its own technology programme in 1976 as the first state of West Germany. Embedded in the framework of the federal and European technology policy, Baden-Württemberg's technology policy measures are developed in fields in which organisational and spatial proximity are essential. Therefore the support of SMEs and technology transfer are of main importance (STURM 2002). Although the model state is generally considered as one of the forerunners of technology policy on state level in Germany, recently critical voices show that its strength is threatened by a whole set of austerity measures pursued by the state government (IHK 2003).

Since 1987, technology policy in Baden-Württemberg, on which Lothar Späth, prime minister from 1978 until 1991, had large impact, has always been based on four features: supporting the public research infrastructure, technology transfer, technological aid schemes focused on individual firms and technology centres and business start-up support. The government of Baden-Württemberg declared technology transfer as the core area of its technology policy. Technology transfer is seen as of paramount importance, as the economy of Baden-Württemberg is dependent on the diffusion of incentives from core technologies rather than on development of core technologies themselves. The most important ministries conducting technology policy in Baden-Württemberg are on the one hand the

Ministry of Economic Affairs, and on the other hand the Ministry of Science, Research and Arts. Although Späth's policy still has a strong impact on the main line of Baden-Württemberg's technology policy, the most recent trend towards decentralisation of policies towards local levels shows that Späth's centralised approach has come out of fashion (STURM 2002; GLASSMANN a. VOELZKOW 2001).

Another important, related change, which partly occurred due to the economic recession in the 1990s, is the shift from a supply-oriented technology policy towards more demand-orientated. In order to become more oriented towards industrial demand, the so-called Joint Initiative Economy and Politics ('Gemeinschaftsinitiave Wirtschaft und Politik') was introduced (HASSINK 1996). This initiative aims at gathering the state government, firms, trade unions and intermediaries at one conference table. Due to this initiative, private involvement in technology policy initiatives has increased. Firms, albeit mainly large firms, are participating in the discussion meetings held in the framework of the Joint Initiative Economy and Politics. The initiative is meant to speed up the innovative developments that already take place on the market. In addition to discussing, the parties mentioned above also develop, implement and carry out concrete projects, such as the support of co-operation between suppliers and customers in the car industry, measures to secure competitiveness in mechanical engineering, and the multimedia pilot project. The initiative clearly strengthened the already existing institutional embeddedness in the region.

When it comes to general advice on aid schemes, business support and the referring of firms to technological experts, the main economic intermediaries are the Chambers of Commerce and to a lesser extent the Chambers of Crafts which serve small craft firms. Other centres try to solve technical problems themselves or carry out R&D-projects with firms. These technology transfer centres, which have close links with HEIs and PREs, can be divided in two groups. First, all universities and PREs, mainly concentrated in Stuttgart, Karlsruhe, Heidelberg, Mannheim and Freiburg, have their own transfer facilities trying to solve problems of firms in the state. Secondly, particularly SMEs are well served by a dense infrastructure of 250 Transfer Centres of the Steinbeis Foundation for Economic Promotion, which was founded in 1971 to promote technology transfer between polytechnics and firms (BEISE et al. 1995; PYKE 1994). By attaching these centres to polytechnics the state of Baden-Württemberg hoped to reach particularly SMEs, since practice-oriented polytechnics can overcome the initial resistance of SMEs to discuss R&D problems with research institutes. Since in many cases polytechnic professors are directors and since the centres are specialised in the technologies that prevail in the regional production structure, there are close social ties between the directors of the centres and the managing directors in the regions. This structure, therefore, guarantees a high institutional embeddedness in the region.

Steinbeis Transfer Centres can be divided in two main groups. First, 16 traditional Transfer Centres for Technology Consultancy, which have no subject orientation, provide SMEs with general advice on technological issues and refer them to other experts. Secondly, more than 230 subject-oriented Transfer Centres have been set up besides the existing centres, since the problems of firms became more specific and complex. The main activities of all Steinbeis Transfer Centres are general consultancy services, technology and marketing consultancy, R&D, and further training (workshops, seminars, conferences). The total staff of the Steinbeis Foundation increased from 830 in 1983 to 3,400 in 1998, and the budget grew from DM 8.3 million to DM 149 million (WM B-W 2000). The Foundation is nearly able to pay itself (92% of its income is earned by own activities), although one has to keep in mind that the state of Baden-Württemberg is paying the salaries of all professors at polytechnics. Although the headquarters of all individual centres in Stuttgart are supposed to co-ordinate and organise the system in order to realise a state-wide division of labour, the networking reality of the Steinbeis Foundation can be doubted, since the pressure to earn revenue induces a great deal of rivalry between the individual centres.

Finally, the state government have been supporting *Gründer- und Technologiezentren* since the end of the 1980s. These can be considered as buildings, that provide technology-oriented business start-ups with relatively inexpensive office space including services, such as a secretary, meeting rooms etc. There are now about 15 of these centres in Baden-Württemberg and the latest centres have been focusing on specific industries. There are for instance some software centres and biotechnology parks (WM B-W 2000).

5 Regional innovation support systems in South Korea and Germany compared

This paper has shown that both in South Korea and Germany policies to boost the innovativeness and competitiveness of SMEs have been strongly developed. There are striking similarities in the policy measures adopted between South Korea and Germany, as they

all have set up innovation support agencies, science parks and aid schemes to support co-operation networks between SMEs and other actors in the region. In Germany there is a long tradition concerning these kind of policies, whereas in South Korea only recently many initiatives have been devised. The most striking difference between innovation support in these countries might be the trend in Germany towards a regionalisation of national technology policies, through the contests between regions for technology support. However, to what extent are these innovation support policies institutionally embedded in regions?

By using the typology of regional innovation support systems, large differences can be observed between the studied countries concerning the institutional embeddedness of their innovation support policies (Tab. 3). In South Korea, a decentralisation of SME-oriented innovation policy has been facilitated by political reforms in 1995. The strong increase in initiatives of the central government in which regions participate as co-financiers have clearly been boosting the role of regions in innovation policies. Nevertheless, innovation policy still has a strong national character, as in nearly all the cases, provinces can only co-finance initiatives that are devised and implemented by the central government. South Korea's regional innovation support systems, therefore, are not institutionally embedded in regions and can be typified as dirigiste (Tab. 3). There are two obvious disadvantages of this kind of system. First, it generates too homogenous innovation support agencies which are not focused enough on specific regional economic demand and are too much dependent on financial support from the central government. In a society which changes at an increasingly rapid pace, central governments are less and less able to adapt their innovation support policies to the fast changing demand of companies. Therefore, the closer the proximity, geographically, socio-culturally and organisationally, between the agencies and SMEs and thus the stronger the institutional embeddedness in regions is, the more flexible and efficient they are. Too much dependence on central government support leads both to inflexibility and to rent-seeking instead of innovation-seeking behaviour of the agencies. It basically hinders intra-regional learning processes and therefore development. Secondly, this kind of system generates horizontal policy co-ordination problems, which are partly due to strong vertical dependencies of agencies in the regions to their sponsors in the central government (SUH 2000). However, as regional authorities have been getting increasingly involved in innovation support recently, there is a transition going on from dirigiste kind of support systems to more integrated ones. Gyeonggi is one of the first provinces that started to implement its own innovation support measures, such as the Gyeonggi Regional Research Centres and the Gyeonggi Small Business Center, whereas more recently other regionally initiated initiatives, such as the Milano Project in Daegu, the Gyeongnam Mechanical Engineering Industry Technobelt Project (PARK a. LEE 2000) and the initiative to strengthen the opto-electronic cluster in Gwangju (CHUNG 2001), all show a general tendency towards integrated systems in South Korea. Since these initiatives are all set up and partly financed by coalitions of regional institutions, they are much more strongly institutionally embeddeded in the regions than top-down initiatives set up by central government agencies.

In Germany, the old *Länder* such as Baden-Württemberg can be considered as integrative systems (Tab. 3). Since the old *Länder* have the ability to co-ordinate policies into integrative innovation support systems, the

Table 3: Regional innovation support systems compared

Regionale Systeme zur Innovationsförderung im Vergleich

	Gyeonggi	*Baden-Württemberg*
initiation	mainly central government, but increasing role of provincial government	mainly regional government
funding	mainly national agencies, but increasing role of provincial government	regional and national agencies
research a. support	mixed	mixed
specialisation	low	mixed
intra-regional co-operation	low	high
co-ordination	low	high
type of system	dirigiste, but moving towards integrated system	integrated

impact on regional economic development tends to be larger than in countries where these abilities are lacking, that is where dirigiste and grassroots support systems prevail. Since policies are institutionally embedded in the region in these integrative support systems, they are well co-ordinated and tailored towards specific regional industrial demand (which is not the case in dirigiste systems), which is in turn a precondition for intra-regional learning processes and hence regional economic development. At the same time, however, policies are linked to the national and international innovation systems, so that lock-ins, which might be strong in grassroots systems, can be avoided. Nevertheless, due to long-term political stability and strong autonomy in decision-making, a political lock-in in Baden-Württemberg has been looming (BRACZYK et al. 1996).

6 Conclusion

The main conclusions of the paper are that there are similarities between the regional innovation support systems found in the countries when it comes to policy instruments, but that the countries differ concerning their level of institutional embeddedness and the abilities of regions to co-ordinate innovation support policies. It can also be tentatively concluded that in countries where regions have the ability to co-ordinate policies into integrative innovation support systems, the impact on regional economic development tends to be larger than in countries where these abilities are lacking, that is where dirigiste and grassroots support systems prevail. The typology of innovation support systems has been useful to analyse these differences. However, it has also has some limitations when it comes to both recommending future development paths and explaining differences between the systems. In order to explain differences found between the systems' institutional embeddedness, future research should analyse some additional factors.

First, in the case of South Korea, there is a clear relationship between the economic development stage and the type of regional innovation support system that can be found, that is dirigiste systems in an investment-driven stage and integrated or grassroots systems in an innovation-driven stage of development (PORTER 1990). South Korea is clearly at the beginning stage of establishing institutionally embedded innovation support in regions or something like a "local developmental state" (EDGINGTON 1999, 310). Secondly, there is a clear relationship between the political-administrative system and the predominating kind of support system. In countries with a federal or similar political system such as Germany, one tends to find grassroots or integrated kinds of systems more often than in countries with a more centralised political system, such as South Korea. Supranational support frameworks, being the third explanation, however, tend to compensate for these differences in political-administrative systems. In Europe, a converging trend seems to be going on towards more integrated support systems, as regions in centralised political systems, such as the United Kingdom and the Netherlands, tend to benefit mostly from the European Union support framework. Fourthly, the different size of the countries (Germany vs. South Korea) affects their critical mass for a demand of regionalised forms of innovation policies. Particularly large countries with many SMEs and strong regional economic inequalities are suited for a regionalized and thus more customised innovation support system. Fifthly, historical reasons and industrial specialisation play their role. Germany has a tradition of supporting SMEs with the help of dense support institutional setups, which is strongly related to a traditionally strong industrial specialisation at the regional level. South Korea's industrial districts were not only developed much later (which is partly caused by the Japanese colonisation and the Korean War), they are also centrally devised and established by the central government in co-operation with large enterprises in a top-down manner. Finally, another explanatory factor might be the role of political leadership and commitment towards innovation policies (as has been seen in the often extolled Baden-Württemberg, where former prime minister Späth played a crucial role). More research is needed, however, concerning the role of these factors in order to explain both the type of systems we can find in regions and particularly their path of development through time.

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