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The Regional Innovation System of Baden-Württemberg: Lock-In or Breakthrough?

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1 Introduction

In 1995, the Centre of Technology Assessment in Stuttgart, Germany, presented a paper on the innovation system of its home region, the state of Baden-Württemberg in southwest Germany. The paper predicted a dire economic future for Baden-Württemberg – which, up to that point, had been regarded as an economic success story and a model region. Close to ten years later, we are able to look again at the economic and political situation of the region and can compare the analysis of the mid-1990s with current conditions. The central thesis of the mid-nineties' paper was that Baden-Württemberg was affected by a process of path dependent development which, although very successful in the past, would lead the region's economy into a potential dead end street. A break away from the established paths of economic development was needed to guarantee future sustainable economic growth. Now (in 2003) we should be able to ask ourselves whether this analysis was correct. Has Baden-Württemberg in fact lost its leading position due to its concentration on established strengths or have significant changes taken place that altered the contours of the Baden-Württemberg model and made it more adaptive to changes in the world economy? Additionally, what role did regional policy play in this context?

At first glance, Baden-Württemberg seems to be on the winning side again. In 1995 (especially with the most difficult year of 1993 in full view) all major economic indicators looked depressing. The performance of Baden-Württemberg was below the German average. In 2003, Baden-Württemberg is – in spite of a new economic crisis - along with neighboring Bavaria the economically most successful region within Germany. To understand, whether the case of Baden-Württemberg is an example of the rise of new approaches, a (successful) continuation of old practices, or a restructuring of these old practices, we do not seek simply to rekindle debate about whether regional policy can fundamentally change regional development paths, but to go beyond this by question-

ing and hopefully advancing underlying conceptual frameworks. In this chapter, we will first introduce the concept of path dependency, briefly review the main characteristics of the regional innovation system of Baden-Württemberg, outline the lock-ins that have been identified in the mid-nineties, look to what extent these lock-in effects have in fact been roadblocks for further developments and whether they have been removed. The main thesis of this chapter is that Baden-Württemberg's success in the last years is the result of its staying "on–course." The region has demonstrated its ability to introduce incremental reforms that combine old with new structural elements. This has been accomplished with the aid of crucial actors in the economic and political sectors who helped to change the guiding model of how to do things and who can be called "norm entrepreneurs."

2 The Concept of Path Dependency

To understand the changes that have taken place in Baden-Württemberg's economy, we refer first to the notion of path-dependency, as this is the foundation of our analytical framework. Path-dependent phenomena are caused by positive feedbacks. This implies that history matters in the sense that historical paths once chosen, even by coincidence, then rigidify and dominate future developments. A famous example of technological path-dependency is the often-quoted QWERTY phenomenon of the typewriter keyboard. The typewriter keyboard arrangement solved a temporary mechanical problem on one of the first typewriters. But soon it became the standard for generations to come, even though it has been considered by many to be inefficient and other, potentially better, solutions were available.

2.1 Regional Path-dependency

In considering how to frame and understand contemporary regional development, we begin with the assumption that in addition to technological trajectories (see Dosi, 1982), there are also regional trajectories. Technological knowledge is not only organized in large-scale technical systems (Hughes, 1987), in branches or professions, but also in regional economic areas. It can be expected that regions are also affected by path-dependency, as institutions play an important role in concepts of regional development. Moreover, they are often used as the explaining factor in these concepts. Regional trajectories consist of economic structures that have developed in relation to path-dependent technologies and embedding institutions. Existing regional structures, institutional thickness, existing relations of cooperation as well as approved policy

strategies are path-dependent – which implies, that they are hard to change.

Regional economies can also be understood as spaces of collective (technological) learning. The crucial question is how such learning can be institutionalized. Learning itself can be seen as an evolutionary process, following again path-dependent courses. Technological skills reflect local, regional, and national contexts and environments. Regions that are extraordinarily successful are those where the institutional context and regional networks closely complement the dominant industrial clusters of the region.

Regional paths of development thus refer to accumulated competencies, methods, and technologies. This regional stock of knowledge is further developed within regional networks and can be closed towards inputs from outside. These processes of closure, however, might also lead to the development of lock-in situations that prevent regional institutions from adapting to changes in the environment and from learning new knowledge.

Path-dependency can be maintained or fractured in particular ways in different locations. However, to make our position clearer, we will differentiate between three types: lock-in, incremental change and breakthrough. Breakthrough means revolutionary changes of crucial economic structures and relating institutions. Incremental changes mean evolutionary changes that do not set up new paths but try to lead old paths into a new direction (see Ackermann, 1999). Lock-ins, in contrast, are characterized by institutional and technological structures which are inefficient but cannot be changed. Grabher differentiates between three kinds of lock-ins: functional lock-in, cognitive lock-in, and political lock-in (see Grabher, 1993).

Functional lock-in means that close cooperation within strongly-tied networks impedes contacts with other regions. Future trends that occur outside these networks may be overlooked, with external resources poorly identified and used. Cognitive lock-in means that personal relations lead to shared common ideas, feelings and beliefs that prevent the adoption of new ideas. Political lock-in describes situations where historical trajectories of economic development are maintained by

cooperative relations between regional actors which are then unable to see and adopt new ways of thinking and policymaking.

Generally, it is assumed that breakthroughs are difficult to achieve in the case of existing institutional thickness and established, distinct economic structures within a certain region. To the extent this is the case in Baden-Württemberg, we have to focus on the chances for incremental change.

2.2 Guiding Models

Ideas and informal rules, despite not being written down formally, are interpreted as social institutions and a huge part of governance can be attributed to them. In analyzing path-dependency in regional development, one of the crucial questions is what role is played in regional development by informal institutions such as guiding ideas or patterns of interpretation of new economic and social phenomena. The sociology of technology works with so-called "guiding models" in order to explain the genesis and management of new technologies (see Barben, 1997: 133). We assume that the concept of guiding models can also be used in order to explain changes and developments in regional innovation systems. The notion of a guiding model encompasses two perspectives: on the one hand, we might be able to understand the genesis of new forms of economic behavior and aims; on the other hand we might be able to analyze political, economic and social interactions in managing these new forms (see Barben, 1997: 134).

The guiding model concept looks for the role of ideas about given or future possibilities on how to do things. Such ideas condense into concepts which look ahead and which act as frames for orientating interpretations, thinking, decisions, and actions for individual and collective actors within regional innovation systems (see Dierkes et al., 1992: 11). Neither markets, nor hierarchies are able to solve specific coordination problems in social networks or in regional innovation systems respectively. Instead, the existence of regional guiding models ren-

ders the available frames of orientation (see Abel, 1997: 71). In this way, guiding models manage to connect different logics of action, as this is the case in regional innovation systems, when political, economic and scientific actors meet and develop ideas on how to stimulate innovation. Thus, guiding models reflect goals, towards which discourses are directed, or lines of orientation that structure them (see Dierkes and Marz, 1992: 16).

In answering the question of how such guiding models come into existence, we have to leave the structural level and focus on the individual level, as it is usually crucial actors with the "power of definition" who shape and reshape guiding models. These actors take up ideas that are suitable to become guiding models and place them in discussions as long as they are established. However, even for very powerful actors it is not possible to just implant guiding models within a region. Instead negotiation processes between different powerful actors are needed to get relevant social groups to accept the new guiding model - and it is not before this happens, that we can consider a mere idea as a guiding model (see Abel, 1997: 74). In this perspective, guiding models can only be shaped and reshaped but never created out of nothing. This assumption brings us back to the concept of path dependency.

In the social sciences "…the role of ideas in particular has gained greater attention. Social constructivism has developed as a school of thought committed to explicating the way ideas are developed, disseminated, and implemented as public policies" (Cox, 2001: 495). Following the idea that social norms can be changed by norm-entrepreneurs, some political scientists have argued that political leaders are able to overcome the path-dependent constraints of existing policy institutions. This is consistent with our view that the relations between institutions are complementary: change in informal institutions may end up in changing formal institutions and the outlook of a regional innovation system. As guiding models can be changed by crucial actors within a society, these actors might be able to overcome the path-dependent constraints of existing policy and social institutions. By initializing new discourses, framing issues and redefining old models and ideas of how to do things, re-

gional development can be realized by integrating old and new institutions.

3 The Regional Innovation System of Baden-Württemberg

3.1 The Success Story

The federal state of Baden-Württemberg in the south-west of Germany has been looked upon by many as a regional model economy up to the early nineties (Cooke and Morgan, 1990; Gabriel, 1990; Hassink, 1992; Maier, 1989; Sabel, 1989; Schmitz, 1992; Semlinger, 1993). With low levels of unemployment, high rates of industrial investment and export, a reputation for high quality, and well-engineered products, it seemed to have overcome major problems of many regional or national economies: namely how to establish and maintain competitive advantage. A high share of specialized and export-oriented capital goods producers, a dominance of flexible small and medium-sized enterprises (SMEs), and a high capacity for technological innovation within these firms were seen as decisive characteristics. The region enjoyed decades of economic prosperity because of its skilled labor, cooperative industrial relations, well-developed research structures, state and national industrial policies, and close and long-term relations between banks and companies. Social scientists interested in explaining the region's economic success laid emphasis on institutional factors. They characterized the region as coming close to the model of an industrial district (see Sabel, 1989; Schmitz, 1992; Semlinger, 1994; Rehfeld, 1995) and endowed with a relatively self-contained regional economy and system of governance (Amin and Thrift, 1995: 7). They attributed the economic success of the region to a successful partnership among state government, dominant industries, financial institutions, research institutions, and universities (Wallace, 1994: 68).

Baden-Württemberg is one of the "Four Motors of Europe" regions – a group of European regions regarded as being particularly successful in generating economic growth. It has earned this "nomination" thanks to its outstanding economic successes. Baden-Württemberg's research intensity of 3.9 percent of its GDP (Germany: 2.3%; European Union: 1.8%) is way above average. Its employment rate (percentage of population aged 15-64) is well above the German and European level (1999: 69.5% in comparison with 65.4% and 62.8%); its unemployment rate well below these levels (1999: 5.1% in comparison with 8.9% and 9.4%); and its rate of European patent applications per million people (average for the period 1997-1999) is the highest of all European NUTS2-regions (416.4 in comparison with 227.3 in Germany and 119.4 in Europe).[1]

3.2 Revisionism

Baden-Württemberg's economic statistics are largely undisputed. However, starting in the early 1990s economic problems began to strike this model region. In these years, it became clear that we had been talking about a highly stylized success story. This story had been retold many times after the major contributions by Piore and Sabel (1984), Herrigel (1993) and others. What followed were revisionist interpretations, for example by Heidenreich and Krauss (1998), which demonstrated that some of the traits that had been considered to be the cornerstones of the Baden-Württemberg model were hard to find in empirical reality and seemed more to be properties deducted from the theory of industrial districts and flexible specialization. This section reviews several of the key features previously identified as important in the Baden-Württemberg model in the light of more recent evidence and reflection.

Cooperation. Baden-Württemberg is certainly a region with considerable institutional thickness. Intensive cooperation and communication networks within a region are supposed to give rise to synergies that, according to the concept of flexible specialization, represent an impor-

tant precondition for the success of industrial districts. In our case, however, one must clearly differentiate between vertical and horizontal cooperation patterns. In Baden-Württemberg, the significance of vertical relations between suppliers and buyers is very high. This reflects the extent to which companies in Baden-Württemberg's three core branches of automotive, electrical and mechanical engineering are tied in regional clusters. However, cooperation between potentially competing companies on a horizontal level seems rather the exception than the rule. In the industrial core sectors, relations between potential competitors are far less significant than the concepts of flexible specialization would suggest (Schmitz, 1992; Cooke et al., 1993). Based on a representative survey of West German mechanical engineering companies, Kerst and Steffensen (1995) were able to demonstrate that the number of cooperating companies in Baden-Württemberg is by no means above average. The share of cooperating mechanical engineering companies in Baden-Württemberg (1993: 37%) is on par with the West German average (36%). Therefore, it is doubtful that there is a higher incidence of cooperation activities between competing companies in Baden-Württemberg than in other German regions.

Small and Medium Sized Enterprises. The assumption that the structure of Baden-Württemberg's economy is more strongly determined by small and mid-sized "Mittelstand" companies than the rest of the German economy is also a misconception. Based on the average size of the regional companies, there is no difference between Germany and Baden-Württemberg. On the contrary, it can be argued that the prosperity of Baden-Württemberg's regional economy is based on the success of a large number of big companies (such as DaimlerChrysler, Porsche, Bosch, and IBM).

Technology Transfer. In the conventional Baden-Württemberg model, it was suggested that the region's major research universities and its universities for applied sciences were closely geared towards the demands of local industry. Large firms were believed to have close cooperative relationships with the research universities, while SMEs cooperated with the universities of applied sciences. However, our research indicates that linkages of technology and knowledge transfer differ from

this model. Bigger companies (more than 500 employees) are cooperating with the Steinbeis technology transfer centers (a system that was designed for small firms). Although most very small companies make almost no use of the institutional knowledge available in the regions, about 5 percent of the small companies (up to ten employees) in the region make use of the Steinbeis system. The importance of Steinbeis is also mirrored in data that show that 17.5 percent of the companies that are looking for support for the start of an innovation process are directing their enquiries there. At the same time, some 55 percent of the respondents, named their bank as a significant source of assistance, with 47 for chambers of industry and commerce, 23 percent for chambers of artisans, and 21 percent for trade associations (IHK, 2002:32).

Core Industries as Core Problem. Drawing on the general discussion about economic development and industrial policy in Baden-Württemberg, the critics held that Baden-Württemberg's past success might have become the very reason for the region's comparatively slow orientation towards new industries. Grabher (1993) has aptly described how the Ruhr region became locked in on a once successful path of development, leading the region into deep economic crisis. According to Morgan (1994: 11), it would be "surprising" if some of the problems described by Grabher were not applicable to the Baden-Württemberg case. Indeed, Braczyk et al. (1995) identify several of these problems. They point to the slow adaptation of Baden-Württemberg's industry to the "Japanese challenge" as a case of "cognitive lock-in" and to the bias of Baden-Württemberg's technology policy towards the core industries as a case of "political lock-in." They also detect a "functional lock-in" in Baden-Württemberg's high level of economic integration: the fact that the three industrial core sectors are so closely interwoven makes the whole region particularly vulnerable to economic crises.

In a similar vein, Heidenreich and Krauss (1998: 223) point out that the major companies in Baden-Württemberg's core sectors are quite reluctant to source services from external providers. As a result, opportunities for communication and cooperation outside the established trajectories are missed and economic restructuring is hampered by barriers to learning. Heidenreich and Krauss (1998: 229; see also ifo, 1995) further-

more show that Baden-Württemberg's system of R&D and technology transfer strongly concentrates on the three industrial core sectors and on advanced technology rather than on the most advanced areas of technology.

The symptoms of the limitations of Baden-Württemberg's regional production system became increasingly apparent in the first half of the 1990s. During the economic crisis between 1992 and 1994, the economy of Baden-Württemberg suffered more than the other states of former West Germany. The GDP declined by 4.7 percent (1993), while the unemployment rate rose from 3.7 percent (1991) to 8.7 percent (1997). This crisis primarily affected the economic core region of Baden-Württemberg, the region of Stuttgart (see Krauss, 1999: 359). The key sectors of Stuttgart's economy were greatly affected by this worsening situation. The automotive, mechanical engineering, and electronics and electrical engineering industries all underwent processes of personnel retrenchment. Between 1980 and 1995, more than 15 percent of the employment in mechanical engineering was lost; in the electronics and electrical engineering industry, the decline amounted to almost 14 percent of the jobs. Employment related to the production of electronic data processing systems declined by 10.5 percent between 1980 and 1996 (see Statistisches Landesamt, 1997). Long-term employment prognoses for these sectors were quite dim, too. In 1994, one research institute predicted employment to drop between 1991 and 2010 in Baden-Württemberg's electronics and electrical engineering industry by 9 percent, in the mechanical engineering industry by 15 percent and in the automotive industry by 26 percent (Saebetzki, 1994: 92).

The question was asked, given Stuttgart's exceptional success in capital goods industries, why its economy did not succeed in staging a stronger reorientation to sectors promising greater growth potential. It seemed that Stuttgart's economy was failing to stake out greater shares in new areas such as information and communications technology, new materials, biotechnology, environmental and power technology, microsystem technology, and production oriented services (Faust et al., 1995), although the industrial, structural, and institutional preconditions in each of the cited areas were certainly not unfavorable. These questions

lead invariably to the inertia of established production structures. Let us therefore look at the dominant features of the innovation system of Stuttgart/Mittlerer Neckar.

4 Stuttgart as the Core Region

It is apparent that when people speak of Baden-Württemberg, they are in fact talking about its core region of Stuttgart and Mittlerer Neckar. We note that Baden-Württemberg features several economic regions with very distinct characteristics and problems. However, to be consistent with past practice, in this chapter we too will focus on the core Stuttgart-Mittlerer Neckar region. Data for Baden-Württemberg will only be used if relevant data for the core region are missing and the data can be considered as adequate indicators for the core region as well.

The region of Stuttgart comprises, besides the city of Stuttgart itself, five adjacent administrative districts and is home to more than 2.5 million inhabitants. Over one million people, more than a quarter of all employees in Baden-Württemberg, are employed in that area.[2] Although there are other economic centers in Baden-Württemberg – above all the regions of Karlsruhe and Mannheim-Heidelberg – the Stuttgart region is the most important of them. The region of Stuttgart had a gross domestic product of € 55,400 per employee in 1998, which is 8 percent above the Baden-Württemberg average and 15 percent above the German average. This is impressive but has also to be seen in comparison with other German agglomerations. The comparable data for Munich is € 64,600 per employee. The lower rate for Stuttgart still reflects the major importance of the industrial sector in Baden-Württemberg. Other agglomerations have accumulated production-oriented services which feature a high gross product per employee. In Stuttgart, more than a quarter of all employees are still within the manufacturing sector. In Hamburg or Cologne, the rate is around 10 percent.

The export orientation of a region reflects its ability to stand firm in the international competition. With an export ratio of 47 percent in the manufacturing sector, Stuttgart is the most export-intensive region in Germany. Only the Munich region achieves similar success. Stuttgart's

unemployment rate is among the lowest in all of Germany. Only Munich again, as a comparable location, has a similarly low rate (4.1 percent in October 2001).

The Stuttgart-Mittlerer Neckar core area has about 45 percent of all R&D capacities of Baden-Württemberg. The research intensity of private companies in the region is 4.6 higher than the German average. It is still 2.2 times the Baden-Württemberg average. It features two universities, various universities for applied sciences, and vocational colleges. Furthermore there is a high number of institutions of extra-university research like institutes of the Fraunhofer and the Max-Planck associations, institutes of the industrial joint research group, contract research institutes at the university and a number of organizations for technology transfer most notably the Steinbeis Foundation. The Steinbeis-Stiftung für Wirtschaftsförderung (Steinbeis Foundation for Economic Development) is a statewide umbrella organization. In 1998, the technology transfer related activities became a private business activity and therefore were outsourced to a private firm called Steinbeis GmbH & Co. für Technologietransfer. This company maintains a network of about 500 centers[3] for technology transfer, in most cases close to a *Fachhochschule* (university of applied sciences). The Steinbeis-foundation over the 1990s has developed itself into a more effective, market-oriented organization. Only "successful" professors can now lead a Steinbeis center. If a center fails to win contracts in a satisfying manner for a certain period of time then the center will be closed. This is one of the mechanisms to link professors to the changing demands of industry.

5 The Present State of the Regional Economy

The assumption behind the questions asked by the critics of the regional innovation system of Stuttgart is obvious. Innovativeness is considered to be the result of communication and cooperation opportunities outside of historically evolved and institutionally and organizationally reinforced trajectories. Heidenreich and Krauss assumed that such communication and cooperation opportunities did not exist in Stuttgart. The implication was that barriers to learning and not the maturity of Stuttgart's product range formed a major obstacle on the road to new innovation-promoting company strategies.

As noted in the previous section, when looking at the situation today, there is little doubt that Stuttgart is again performing very well economically. In view of this, we have to ask whether the critical developments, which had been identified in the mid-1990s have been changed and the rule of path dependency has been broken up. The question is: what is the reason for the good economic performance? We have to answer the question whether developments can be interpreted as an example of breakthrough or incremental change: The changes we will find in our analysis will be interpreted in the context of "lock-in" or "breakthrough."

As it is difficult to indicate the exact demarcation between incremental and revolutionary changes, we assume that the variety of changes can be localized on a scale where one pole denotes a phenomenon which explicitly indicates lock-in and the other pole denotes a phenomenon which indicates an absolute breakthrough.

While the economic data seem to be comforting, some of the disturbing trends recognized in the mid-1990s have kept stable. In comparison to Germany, the Baden-Württemberg regional R&D system contin-

ues to be characterized by a specialization on technologies relevant for the construction of machines and cars. The dominance of the manufacturing sector has not been severely challenged. In Stuttgart-Mittlerer Neckar, three sectors remain particularly important measured in terms of both employment and sales: the automotive industry, the mechanical engineering and the electronics and electrical engineering industry (see Table 11.1). Among these three, the car industry stands out more than ever before. Stuttgart maintains and, indeed, has further developed "the largest, thickest, and the most powerful auto cluster in Europe" (Morgan, 1994: 37). As this cluster has strongly influenced not only the region's economy but also its institutions and culture, it is no exaggeration to still portray Stuttgart as a "car city." Let us look more closely at the three sectors and recent developments there.

Table 5.1: ***Stuttgart - Mittlerer Neckar: Employment and sales turnover of the most important sub-sectors of the manufacturing sector (2000)***

Industrial Sector	**Share of regional employment**	**Share of regional sales turnover**
Car manufacturing	25.9%	43.6%
Electrical engineering	19.2%	15.4%
Mechanical engineering	18.8%	18.8%
Manufacturing sector (total)	100 %	100%

Source: Industrie- und Handelskammer Stuttgart, various publications

5.1 Electrical Engineering

Electrical engineering comprises a wide variety of activities: the production of office equipment, computers, electronics, precision engineering and optics. This broad definition has to be kept in mind when looking at the data. Electrical engineering is – in terms of turnover – the third biggest manufacturing sector in the region of Stuttgart. With more than € 11.9 billion sales turnover, electrical engineering comprised 15.4 percent of the region's manufacturing sector. The growth rates of this sector are, however, below the German and the Baden-Württemberg average in spite of the dramatic increases during the boom years of the New Economy. Nonetheless, 56 percent of the sales are from exports, which is well above the Baden-Württemberg average. Growth in this sector is mainly due to export activities. Domestic demand is lagging behind considerably.

The sector of electrical engineering employed 75,800 people (2000). The sector is thus the second largest industrial employer. Large companies like Alcatel, Bosch, IBM, and Hewlett Packard are responsible for these figures. Part of the electrical engineering sector is strongly affiliated with the automotive sector. Besides Bosch, this is mainly due for a number of SMEs.

In spite of the fact that electrical engineering is statistically part of the manufacturing sector, growth is mostly due to growing service-oriented activities. Direct production-oriented activities continue to decline quite significantly. In the Stuttgart region, 39 percent of the people engaged in R&D activities are working in the electrical engineering sector. This fact signifies that the sector is very research-intensive. 17.3 percent of the employees are working in R&D. In the automotive sector, the respective number is 10.6 percent and in mechanical engineering 9.2 percent.

More than the mechanical engineering and the automotive sector, the field of electrical engineering has become the object of immense transformations. As is the case with the other sectors, the traditional strengths of Stuttgart were in the manufacturing realm. However, the

major companies of the region (Bosch, Alcatel, IBM, Hewlett Packard) have downscaled or completely closed down their production facilities. This loss was not compensated by increasing employment in services or content. On the other hand, this sector is also much more open to new entries. Fifty-one percent of all technology-oriented/technology-based new firm creations are IT related. The machine tool industry accounts only for 12 percent. Car manufacturing does not appear among the leading sectors for new firms. It must be mentioned, however, that a significant proportion of new firm creations nevertheless are effected by firms providing input for the car manufacturing industry, and thus are not counted as automotive but are nevertheless directly linked to it. Car manufacturing and electrical engineering are interlocked to a significant degree. Mechanical engineering and automotive also show a sizeable degree of interconnections, while this is hardly visible for mechanical engineering and electrical engineering.

5.2 Mechanical Engineering

Mechanical engineering is the second biggest industrial sector in the Stuttgart region. In 2000, about 453 companies were active in this sector with an average employment of 164 people. This illustrates the SME character of this sector. The sector is very heterogeneous, but it also features, as indicated above, a number of significant companies geared towards the automotive sector.

Contrary to electrical engineering, the mechanical engineering sector is experiencing a growth rate that is well above the Baden-Württemberg and the German average. The share of the Stuttgart region in the mechanical engineering industry in Baden-Württemberg is above one third. Similar to the electrical engineering sector, export demand is maintaining growth in the face of consistently weak domestic demand. The export rate of the mechanical engineering industry is 54 percent (2000), which is above the Baden-Württemberg average.

With respect to employment, the mechanical engineering industry is the third largest industrial sector in the Stuttgart region. In spite of the overall favorable figures, employment is shrinking. The loss of employment is significantly higher than in the rest of Germany. The continuing economic success of this sector, which does not find its imprint in the employment data, is due to a continuing high tech orientation and (resulting) significant productivity increases. Fifty-five percent of the companies in the mechanical engineering sector spend more than 3.5 percent of their turnover on R&D.

5.3 Automotive Industry

The automotive industry represents by far the most important industrial activity in the Stuttgart region. The global automotive sector is undergoing a severe process of restructuring, which has important impacts on primary manufacturers as well as their suppliers. This reorganization is taking place on a worldwide scale and along the entire value chain. However, this restructuring has helped the Stuttgart manufacturers to stay on top and strengthen their position.

There are approximately 100 companies in Stuttgart's automotive sector. They are responsible for 43.6 percent of the industrial output in the region. This signifies an important growth trend. In 1980, car manufacturing accounted for 28.7 percent of the total output. In 1992, its share has dwindled to 27.3 percent, but since then has steadily risen up to 43.6 percent in 2000. 25.9 percent of all industrial employees are to be found there. It is therefore also the biggest employer in the region. Over one hundred thousand workers were employed in 2000, with employment growing faster than in the rest of Baden-Württemberg as well as in Germany.

This development is in some way special to the Stuttgart region. Not all manufacturers in Germany and especially the core manufacturing regions were as "lucky" as Stuttgart with DaimlerChrysler, Porsche,

and Bosch (the world's second largest automotive supplier). Stuttgart did better than the rest of Baden-Württemberg as well as the rest of Germany. A special feature is again the export orientation. In 2000, exports amounted to 65 percent of all production, up from 57 percent in 1996.

Almost one-half of the employees working in the automotive sector are fulfilling manufacturing duties. As in other sectors, direct manufacturing tasks are declining, however, and services and R&D- related activities are solely responsible for the recent job growth. Car manufacturing is also very research-intensive. Close to 70 percent of companies spend more than 3.5 percent of their turnover on R&D.

As mentioned above car manufacturing has been subject to a global restructuring for some years. This global restructuring has found its imprint on the regional level. Stuttgart has benefited from both its strong export orientation in the sector as well as the decision of the major players to turn Stuttgart into a worldwide hub for car manufacturing. All the important functions for car manufacturing are present in the region. Stuttgart could well have fallen victim to the merger negotiations between Daimler and Chrysler. Stuttgart, however, succeeded to get out of these negotiations as a strengthened partner. This put the region also in contrast to the developments in Germany or worldwide, where several regions had to suffer severe losses.

5.4 Patent statistics

Stuttgart is the leading region in Germany with respect to patent activities. This holds both true for the number of patents per 100,000 inhabitants as well as employees (1998). The ratio is double the German average and 18 percent above the Baden-Württemberg average. The relative position of the region, however, has changed. Other locations like Munich have shown a higher growth rate in recent years and were able to close the gap with Stuttgart. Patent statistics also demonstrate clearly that the Stuttgart economy develops along stable trajectories. Patents are

concentrated in car manufacturing and mechanical engineering, with a somewhat lower specialization in electrical engineering. The data also show clearly, that over the last decade new patent specializations were not being established, in spite of all the political efforts to the contrary. The degree of specialization has in fact even increased for the case of car manufacturing and to a more limited degree in mechanical engineering. The most important single companies with respect to patenting activities remained Bosch, Porsche, DaimlerChrysler, and Alcatel (although the latter's significance is reducing). The technological strengths of the region undoubtedly are with car manufacturing and technologies of special relevance for car manufacturing, including auto-related IT. The combination of excellence in these fields remains an essential comparative advantage for the region.

5.5 "Old" vs. "New" Economy Trends

The data presented in previous sections show that industry sectors that were identified as in "critical" condition in the 1990s continue to dominate the Stuttgart regional economy. This also holds true for the following aspects. The share of the Baden-Württemberg economy in the worldwide trade of R&D-intensive goods has declined constantly (see Tables 11.2 and Figure 11.1). The role of Baden-Württemberg in (non-automotive) high-technology sectors has never been that strong and it continues to decline rather sharply. The most radical downturn is to be observed in the electronics sector (see Figure 11.1). Here Baden-Württemberg has fallen victim to the above-mentioned trend of a radical decrease in the employment in the hardware part of the electronics sector. The major companies (IBM, Alcatel-SEL, Bosch, Siemens, Hewlett Packard, and Sony) are still reducing their manufacturing capacities in the region (in the case of IBM none is left) and the service oriented employment in the same sector could not be built up in comparable quantities (see Seufert, 2000).

Table 5.2: ***Importance of high technology commodities in selected countries and regions (Nominal scale)***

National ranking (among G7 countries)	1991	1995	1999
Germany	3	3	3
Ranking of seven comparable small countries and regions			
Netherlands	1	1	1
Sweden	2	2	2
Switzerland	4	3	3
Finland	7	5	3
North Rhine-Westphalia	5	6	5
Baden-Württemberg	3	3	6
Austria	6	7	7

Source: OECD – International Trade by Commodity Statistics, Rev. 3, 2000: Note: For Germany the rank among the G7 countries is given. The seven other entities are compared amongst themselves.

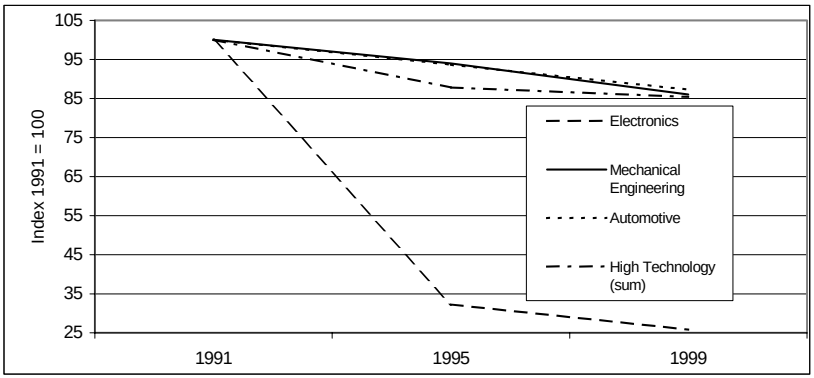

Figure 5.1: ***Products with high technology content and Baden-Württemberg's share of world exports in this category (by sector)***

Source: OECD – International Trade by Commodity Statistics, Rev. 3, 2000.

The concentration on the three core sectors mirrors another potential weakness of the regional innovation system: The economy is concentrated on markets which feature an under average growth on the world market. Goods, which experience the greatest growth potential worldwide, are only represented in a below-average degree. The even increasing concentration on core competences has led to the fact that Baden-Württemberg has lost its lead in more areas than it has achieved new leads (see Lay, Eggers, and Rainfurth, 1999). For example, the regional economy has not secured a strong position in advanced services. Of course, there has been some growth in services, but this increase mostly reflects the general German trend. Data do not reveal that, in Stuttgart or in Baden-Württemberg for that matter, services have any special, pronounced growth dynamic.

Overall, this presents us with a conflicting picture. On the one hand we see that most of the traits of Stuttgart's economy that have been considered to be problematic are still there, in certain ways even extenuated.

But we also see that the Stuttgart region remains one of the leading regions of Germany and has done better in recent years than the rest of the less industrialized and more service oriented country. The strong concentration on specific technological fields was in the second half of the 1990s a major reason for the above average performance. While some regions declined and others moved upward, Stuttgart kept its leading position. In this respect, the crisis interpretation of the mid-1990s has to be reassessed. One of the leading justifications for the assessment of the mid-1990s was that the "old" economy was on the decline. Yet, the subsequent experiences of Stuttgart demonstrated that the "old" economy was well able to stay alive and prosper – under specific circumstances. The discussion after the demise of the "New Economy" bubble has shown that the essential component for economic well-being is not a single-minded promotion of the new economy, but a blending of new and old economy elements. Here, Stuttgart's industrial sector has done quite well. It has kept its R&D expenditures high, has absorbed new knowledge for developing products that are more competitive, introduced organizational reforms, and has slowly increased its services component. Moreover, there have been other important changes that are not adequately mirrored in the statistics, which will be discussed in the next section.

6 The Norm Entrepreneurs

At an early stage, the state government of Baden-Württemberg was aware of a potential lock-in situation in the region's economic development. The person symbolizing the search for a new role for Baden-Württemberg and its core region of Stuttgart was the then minister president Lothar Späth. Already in the late-1980s, he tasked expert commissions to consider the situation and make recommendations. This resulted in a number of activities to tackle lock-in phenomena and to develop new industry and service sectors and to build up of a number of new institutions in the field of science. Most prominently among the sectors targeted were biotechnology, multimedia and producer-oriented services. Späth was aware of the potential difficulties, but reinterpreted these as opportunities worth taking a risk. In this sense, he viewed globalization as an option to be taken up proactively.

In addition, many actors in the region in the early 1990s began to share the assumption that Stuttgart faced not a temporary crisis but profound structural changes, most importantly with the trend towards the globalization of markets, towards the decline of mature industries and towards the rise of highly innovative, knowledge-intensive, and service-oriented industries (New Economy). A broad agreement gradually came into existence on the view that Stuttgart could not successfully cope with these changes merely by concentrating on its traditional key industries. Instead, the call for a fundamental restructuring of Stuttgart's regional economy became louder. In the industrial sector, Jürgen Schrempp – the most outspoken representative of treating globalization as a positive option – became the head of DaimlerChrysler. While the activities of the politicians were mainly in the realm of image building, changing the priorities of funding, looking for new policy instruments, constructing new institutions, Schrempp transformed the regionally based company

Daimler-Benz into a globally oriented and globally based company DaimlerChrysler. Let us look at these developments in more detail.

6.1 The automotive sector

Contrary to many prophecies, Stuttgart's automotive sector has not declined. Rather, it has grown in importance in recent years. Underlying this development was the strategic decision to further develop the Stuttgart region into one of the few worldwide important centers of competence for this industry. Stuttgart features a nearly unique combination of managerial, production, research, and infrastructure components. The merger of DaimlerChrysler has further strengthened the position of Stuttgart. Even a worldwide decline in the automotive sector will most probably hit Stuttgart less hard than other less well-positioned regions. Furthermore, Stuttgart has strengthened its position within Germany with respect to both turnover and employment. Compared to the recession year of 1993 in which every seventeenth job was dependent on the automobile industry, this relationship has jumped today to every fourteenth job. Considering only the manufacturing sector, dependence on automobiles has increased from every sixth to every fifth working place. It has to be said that the adaptive capacities of the industrial core are remarkable. This can be especially demonstrated for the case of the car industry by its successful turn to global markets over the 1990s. Exports rose from 43 percent (1991) to 61 percent (2000). While in 1995, 22 percent of all German exports came from Baden-Württemberg, in 2000 this figure climbed to 27 percent. Between 1995 and 2000, more than 50 percent of the increase in the region's valued-added output can be contributed to the car industry, and its share of regional industrial output has increased from 16 to 21 percent. Successful organizational reforms have been implemented, and an adaptive system of input suppliers was further developed, which expanded even more strongly than the core manufacturers. While in 1993 191,000 people were employed in the core producing companies, 84,000 (30 percent) were with the suppliers. In

1998, 193,000 were with the core producing companies and 142,000 (40 percent) with the suppliers. In the process of the merger between Daimler and Chrysler, a number of U.S. suppliers set up shop in the region of Stuttgart. This did not imply manufacturing capacities, but new marketing, service and research and development facilities.

The implication of these developments surely is that the region is very dependent on the strategies of the main companies. This is not only DaimlerChrysler but also Porsche, which staged a broadly admired turn around in the 1990s, along with three further car-producing companies. Next to these big manufacturing firms is a cluster of worldwide leading supplier firms, engineering and research companies, service companies, fuel cell cooperation networks, regional competence centers, institutes of the University of Stuttgart, traffic telematics companies, and regional pilot projects dealing with the future of mobility (e.g. STORM, Mobilist).

6.2 Parallel institution building

One means of increasing regional innovative capacity is by creating institutions. This often proves an inadequate solution, however (see Amin and Thrift, 1995). Harder to achieve is the development of a new regional identity and the generation of synergy effects between institutional and technological development paths. This is the task facing especially those regions which have been very successful up to now, and which have achieved a high level of technological competence in the so-called mature industrial sectors. For these regions, the hitherto established institutions and the institutional thickness thus achieved can even become an additional problem, since training, research and funding facilities tend to stabilize the traditional patterns of industrial development. Against a background of intensified global competition, this problem of institutional inertia and restrictions deserves special attention.

The state government of Baden-Württemberg over the last decade was fully aware of the problems of institutional inertia. This institutional inertia has been analyzed in various studies that did show that main

pillars of the Baden-Württemberg model were concentrating on the core industries and had difficulties adapting to the new industries. The Steinbeis foundation, for example, did not play any significant role in the early development of the multimedia or the biotechnology industry. The response of the state government was a strategy that combined parallel institution building with a reform of old institutions. Parallel institution building means that for the support and promotion of new industries, new institutions were created. For instance, in the multimedia sector the Medien- und Filmgesellschaft Baden-Württemberg (Media and Movie Association of Baden-Württemberg) was created. In the case of biotechnology, a state agency was established and various regional forms of institution building have been supported. It is noteworthy that these attempts – at least in the beginning - totally bypassed the established institutional structures and had few connections with these structures.

The further development of existing capacities and the search for new product and production concepts is thus being supported by many new institutions as well as by expert commissions, a dense network of regional technology transfer institutions and industry policy initiatives. The Future Commission Economy 2000, appointed in 1992, gave the starting signal for the search for "ways out of the crisis." This was followed by the Innovationsoffensive with a fund of DM1 billion (€ 0.52 billion) committed to new technical faculties, data highways, biotechnology parks, software centers. In 1994, an Innovation Council was set up and this council developed, among other things, proposals for creating a biotechnology agency, a microsystem forum and better computer facilities in schools. Within the context of a "Future Campaign" (Zukunftsoffensive) the state government has realized these proposals since 1996. An additional DM1 billion was invested in upgrading technical colleges, colleges of advanced vocational studies, universities, clinics, schools and libraries. Since 1997, the state government has supported the establishment and expansion of five biotech parks at Freiburg, Heidelberg, Esslingen and Reutlingen/Tübingen with a total of € 12.5 million. Support has also been given to business start-ups, networked research projects, and regional trade fairs. Start-up companies for example have been supported by subsidy programs, investment shares, and a venture capi-

tal fund that was set up in 1998. Within the framework of the programs "Young Innovators" and "Start-up Founders on Campus," the government supported entrepreneurs from universities and research institutes.

From the regional perspective, the most important element has been the foundation of the Association Region of Stuttgart in 1994. This was done in the form of a decision by the state government and is a unique development. No other region became equipped in a similar manner. The most important task of the association is the furthering of economic development. It was clear from the beginning that this association should be primarily concerned with new sectors and new types of activities to support structural change in the region. The association is the product of a top-down development, represents the core of a new regional order, and is in the center of other institutional reforms as well. The association was active in the development and implementation of major projects. It organized regional capacities and resources in order to be able for the region to participate in national as well as European competitions for money. Complex partnerships were built up, organized, and moderated.

The operationalization of the aims of the association was done gradually via concrete projects. In an exemplary manner one can name projects for site development, attracting new investors, network projects like the Regional Dialogue Car Production, MediaRegio Stuttgart, PUSH!, Mobilist, BioRegio, regional competence centers, the support program environmental technology and a host of marketing and image campaigns. These are still examples that show how within a short time frame the agency has developed its tasks. It also shows that in various fields there was nothing much in existence before. For example, previously site marketing was not considered necessary by the city of Stuttgart, because the local politicians believed that Stuttgart as a strong economic area would not need any further marketing.

Central fields of action are the promotion of innovations (not technologies) and the support of cooperation (see Table 11.3). On the one hand, this is the support for the development and use of new products and production processes; on the other hand, it is the instigation and support of cooperation in order to make use of potential synergetic ef-

fects in the region. In this sense, the association pursues a structural policy strategy, aiming at the support and stabilization of regional clusters, which should be accomplished by a network and innovation oriented regional policy.

Table 6.1: ***New fields of activities in the region of Stuttgart***

Cluster policy	Employment promotion
Promotion of innovations	Regional reporting on important economic trends
Marketing/image campaign	Regional competitions

The analysis of structures of regional networking has become an important topic of research over the last couple of years. Beneficial structures of regional networking might offer options for regions, for endogenous economic growth and can make available the resources for cross-regional and cross-national activities. Regional networking can become a restriction if available resources are mainly or exclusively used for a mere reproduction of existing structures and are thus literally "consumed." This will lead to dangerous lock-in effects. In this case, closely knit relationships and established structures of intertwinement facilitate a strong orientation of actors towards established paths of development and well-proven problem solutions as a result. Regional networking structures, however, may also work as a springboard for the opening up of new cross-regional markets and resources. Thus, a bridge building between regional and global economic trends can be achieved.

The success of Stuttgart was linked to the impression that there is a large degree of networking between economic actors going on. Research in the 1990s has repeatedly shown that this is a misconception. Nevertheless an objective demand developed among corporations for an increased amount of cooperation both within existing value chains (automotive sector) as well as beyond (e.g. publishing, multimedia). This

holds true both for the level of inter organizational division of labor (between companies) as well as with respect to the innovative capabilities of companies, sectors, and clusters. The Association aims at filling this gap.

Another exemplary development to be mentioned here with respect to the reform of institutions refers to the whole system of universities of applied sciences, which has undergone a process of structural change in the second half of the nineties. This type of universities was originally thought to fulfill the demands of the local industry. The severe economic crisis especially in the first half of the nineties and a rapidly decreasing demand for university graduates by regionally based companies, led to a dramatic situation (e.g. few new students) in many a university for applied sciences. The answer was twofold: on the one hand, traditional curricula have been sometimes even dramatically reduced, on the other hand new curricula have been developed, which aim at decreasing the dependency on specific regional or local demand structures. Even smaller universities are now faced with the demand to develop "world class" specializations. The regional orientation thus has been reduced and the importance of the openness to supra regional developments and actors strengthened.

7 Conclusion

Grabher (1993) differentiated between three kinds of lock-ins that were considered to be at work in the Stuttgart region: functional lock-in, cognitive lock-in and political lock-in. As previously discussed, functional lock-in implies that close cooperation within strong ties networks impedes contacts with other regions: future trends that occur outside are overlooked and external resources are poorly identified and used. With respect to functional lock-in, we have analyzed the situation especially for the case of the automotive sector, which seemed to have successfully further developed its strategic position by developing itself into a truly global player and extending regional networks into a global arena. The merger of DaimlerChrysler is a symbol for this as well as the assertiveness of the growing supplier industry.

Functional lock-ins are intensified through cognitive lock-ins. Personal relations lead to shared common ideas, feelings and believes. The fact, that entrepreneurs in Stuttgart did not notice Japanese competitors at an early stage and that they neglected to introduce countermeasures in time, was interpreted as a cognitive lock-in. Collective misinterpretations were the reasons why Stuttgart did not evaluated its industrial structure in the context of a global division of labor as well as a division of technological competences. With respect to cognitive lock-ins it can also be asserted that starting in the mid nineties Stuttgart began to reverse its image of being an old industry region. All major actors were looking towards new possibilities and options. Attempts to build up competencies beyond the core industries (as described in this chapter) are an impressive sign for this.

Political lock-ins describe situations where economic development proceeds along historical trajectories that are supported by cooperative relations between political actors, trade unions, employers associations and other embedding institutions. As a political lock-in, we identify the fact that in Stuttgart the economic and technology policy of the regional

government was limited to modernization efforts within the core branches of the old economy. These branches received political support in order to stay competitive in globalized highly competitive markets. We have seen, however, that increasingly policy strategies have been introduced, to develop economic and structural alternatives for the region in order to loosen regional dependence on established industrial clusters. In this case it must be said, that the official policy on state and regional level has clearly changed focus and is attempting to support both the modernization of the old sectors as well as the promotion of new sectors. Our analysis has showed that important aspects in this respect have been the policy of parallel institution building.

Finally, it has to be said that the analysis of the mid-1990s might have been hampered by a generally held over-estimation of the developments in the new economy. The recent demise of this sector has shown that the mature industries do not necessarily need to look "old." There is also a promising future for parts of the old industry.

Nevertheless, the picture is not only bright. The development of strategies of institutional learning remains a challenge to be mastered. While many "institutionally poor" economic regions seek to adopt the seemingly exemplary institutions of other countries, Stuttgart is faced with the challenge of restructuring and transforming an exceedingly rich institutional landscape. These challenges put the well-considered (and concerted) modernization of regional institutions at the top of the agenda. The expedient further development of communication and cooperation promoting institutions is therefore a central precondition for the design and rejuvenation of innovation-friendly environments. But it has also been demonstrated that institutional reforms and a transformation of existing productive structures is a difficult and extremely risky endeavor. Each of the three core sectors of the Stuttgart economy is following its own path of "learning" and features quite distinct paths of development. Among the three core sectors, only the automotive sector seems to be on a secure future oriented path. Furthermore, the institutional reforms, the reworking of the image of the region of Stuttgart and the establishment of new networking and cooperation structures has so far not found its imprint in the overall data on regional economic per-

formance. The success of this planned reorientation on the Baden-Württemberg model level can only be judged in the future and will be dependent on continuing efforts.

Notes

1. European Commission, Second report on economic and social cohesion, Luxembourg 2001. NUTS is an acronym for "Nomenclature of Territorial Units for Statistics" – based on territorial definitions developed by the Statistical Office of the European Communities (Eurostat) for producing regional statistics in the European Union. NUTS2 regions are sub-national units with between 0.8 million and 3.0 million inhabitants.

2. The exact figures (2000) are 1,056,363 people employed in the Stuttgart region, 3,802,494 in Baden-Württemberg. Stuttgart's share in Baden-Württemberg's employment is thus 27.8 percent. The numbers refer to persons officially employed and registered in social security schemes.

3. In 2003, Baden-Württemberg hosted 329 Steinbeis transfer centers. While Steinbeis increasingly creates new centers in other German and foreign regions, Baden- Württemberg remains the main location of this organization (there are 121 Steinbeis centers in other parts of Germany and 14 centers abroad).

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ifo Institut für Wirtschaftsforschung, *Der Wirtschafts- und Forschungsstandort Baden-Württemberg*. München (ifo), 1995.

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