

Future governance of innovation policy in Europe — three scenarios

Stefan Kuhlmann*

*Department of Technology Analysis and Innovation Strategies, Fraunhofer Institute for Systems and Innovation Research (ISI),
Breslauer Strasse 48, D-76139 Karlsruhe, Germany*

Abstract

In Europe, public research, technology and innovation policies are no longer exclusively in the hands of national authorities: increasingly, national initiatives are supplemented by or even competing with regional innovation policies or transnational programmes, in particular, the activities of the European Union. At the same time, industrial innovation increasingly occurs within international networks. Are we witnessing a change of governance in European innovation policy? Based on a set of hypotheses concerning the co-evolution of “political systems” and “innovation systems” in Europe, the paper speculates about the future governance of innovation policies, trying to pave the ways for empirical analyses. It sketches three scenarios stretching from (1) the idea of an increasingly centralised and dominating European innovation policy arena to (2) the opposite, i.e. a progressive decentralisation and open competition between partly strengthened, partly weakened national or regional innovation systems, and finally to (3) the vision of a centrally “mediated” mixture of competition and co-operation between diverse regional innovation cultures and a related governance structure. © 2001 Elsevier Science B.V. All rights reserved.

Keywords: Innovation policy; Research and technology policy; European integration; Innovation system; Political system; Political governance

1. Introduction

Until recently, the research, technology and innovation policies of European countries clearly reflected the profiles of their national (and regional) “innovation systems”, understood as the various “landscapes” of institutions, corporate actors and processes contributing to industrial and societal innovation. The innovation policies of the transnational European Union (EU) — although growing in thematic width and budget size (Peterson and Sharp, 1998; Guzzetti, 1995) — played a noticeable, but not yet a dominant role in the national contexts, at least not in the bigger member states. The EU Commission’s initiatives fostered consi-

derable transborder European co-operation,¹ although the agenda-setting for most publicly funded research and innovation policy activities remained within the national “arenas” of corporatist actors and policymakers. Only recently, the Commission stated that “. . . the principal reference framework for research activities in Europe is national (. . .). It cannot be said that there is today a European policy on research. National research policies and Union policy overlap without forming a coherent whole. If more progress is to be made a broader approach is needed than the one adopted to date. The forthcoming enlargement of the Union will only increase this need” (EU Commission, 2000a, p. 7): the EU is considering

* Tel.: +49-721-6809-170/4; fax: +49-721-6809-260;
URL: <http://www.isi.fhg.de>.
E-mail address: stefan.kuhlmann@isi.fhg.de (S. Kuhlmann).

¹ See results of empirical research by Reger and Kuhlmann (1995), Larédo (1995) and Georghiou et al. (1993).

the inclusion of five to ten new member states (mostly Central and Eastern European countries) in the course of the present decade.

Such ambitions raise questions to which extent, in which ways and with which results the ongoing and accelerating process of European economic integration, meanwhile further boosted by the implementation of the common currency, will affect the future shape and the functioning of the national (and regional) innovation systems: will they merge, or on the contrary, will they sharpen their profiles in the face of increasing intra-European and inter-regional competition? How would these developments be reflected in national and European innovation policies? In other words, will the processes of European innovation policymaking in the course of this decade experience a new level of intensified integration, or will they end up in a loose combination of diverse and rather fragmented institutional settings, political arenas, cultures and related functionality?

This paper will not provide systematic and exhaustive answers to such far-reaching questions, neither can it, for obvious reasons, draw on solid empirical data. It should be read as a preliminary *outline of a research programme* rather than a report on research results already achieved: speculating about the dynamics of innovation policies in Europe, the author tries to pave the ways for future analyses by developing a set of hypotheses concerning the co-evolution of “political systems” and “innovation systems” in Europe (Chapter 2). Based on these theoretical considerations and with regard to processes of European innovation policymaking, the paper will then sketch *three scenarios* (Chapter 3): (1) an increasingly *centralised* and dominating European innovation policy arena; (2) the opposite, i.e. a progressive *decentralisation* and open competition between partly strengthened, partly weakened national or regional innovation systems and related policy arenas; (3) a centrally “mediated” *mixture of competition and co-operation* between diverse national or regional innovation cultures.

2. European political systems and innovation systems in a globalising market

Science, technology and innovations based thereon play a significant role today in the economies of

the industrialised countries and are a driving force in their international competition. In the meantime, national and increasingly also regional governments of all these countries pursue, more or less explicitly, “innovation policies”, understood here as the integral of all state initiatives regarding science, education, research, technology policy and industrial modernisation, overlapping also with industrial, environmental, labour and social policies. Public innovation policy aims to strengthen the competitiveness of an economy or of selected sectors, in order to increase societal welfare through economic success.

On top of the national and regional efforts and in parallel with Europe’s economic and political integration, one can trace the emergence of an architecture and infrastructures of a *European innovation policy-making system* (Peterson and Sharp, 1998; Grande, 1996; Guzzetti, 1995). It has been established not only in order to run the European Commission’s “framework programmes for research and technological development” (FPs) but also — according to article 130 of the Maastricht Treaty — aiming at a better co-ordination of genuine European, national and regional and policy efforts (Caracostas and Muldur, 1998, p. 127ff), i.e. at transnational governance structures. Here, questions may arise about the inter-relationship between emerging transnational political institutions and the actual policy development within national innovation systems, not at least vis-à-vis internationalising markets for technology-related products.

This latter perspective has to be taken seriously: while for the last two decades nation states increasingly tended to compete with each other in the field of innovation policy (Porter, 1990; Roobeek, 1990), strong industrial or financial capital actors have been appearing more frequently on the scene — multinational enterprises, international strategic alliances of national enterprises — who act globally and across the national innovation systems (Meyer-Krahmer and Reger, 1999). “Global players” exploit the comparative advantages of the different national infrastructures and policies, but can hardly be influenced by “local” (i.e. so far normally national) political systems, much less controlled (Pearce, 1999; Pavitt and Patel, 1999; Kuemmerle, 1999).

Such developments raise questions about the possibilities for action left open to national political sys-

tems, their authorities, and their policies, but also about the chances for transnational innovation policies in Europe that would exceed the present structure of supranational efforts, in particular the EU's FPs, the industrially oriented, supranational EUREKA initiative (covering the EU members and further European countries), and others.² In line with such concerns the EU's Commission recently required to overcome the "static structure of 15 + 1", i.e. a mere addition of the member states' plus the Commission's innovation policies, "... towards a more dynamic configuration. This has to be based on a more coherent approach involving measures taken at different levels: by the Member States at national level, by the European Union with the framework programme and other possible instruments, and by intergovernmental co-operation organisations" (EU Commission, 2000a, p. 7). Such ambitions are far-reaching, and one can ask whether at all, under which conditions, and with which effects they may come true.

In the following, two analytical systems concepts³ will be applied — "political system" and "innovation system" — coming from different theoretical angles: the one from American political science, and the other from innovation research, strongly influenced by evolutionary and neo-institutionalist economics. Both system concepts will be used in this paper with a pragmatic intention, thus, helping to differentiate between fundamental societal functional areas — in the present case, the political system and the innovation system. Further subsystems can be distinguished, like the research system, understood as a functionally differentiated, interlaced network of research institutions, including their interactions. The actual ways and mechanisms of policymaking within and between systems can be described as *patterns of governance*. In the European Union, obviously new patterns of

governance emerge (Marks et al., 1996) which can be traced also in the field of innovation policy.

2.1. Political systems: towards transnationality

What is the term "political system"⁴ worth in the given context? In the course of the 1970s the term developed into a generally acknowledged, basic concept of political science (Apter, 1996, pp. 372–374), even in everyday speech, whereby the specific, systems-theoretical reference partly faded. To the most important elements of the political system in this sense, which is not sharply demarcated from its environment, belong the constitutional legitimisation of political rule, normally expressed as the institutionalisation of the nation state, founded on the rule of law, with its guarantee of basic rights, democratic and parliamentary principles, the separation of powers, and the authorities derived therefrom, further a comprehensive catalogue of state guarantees towards society and the economy, which continued to grow into the late 20th century, as well as more or less institutionalised forms of feeding back state actions to (mostly corporatist) socio-economic interest groups or also "new social movements".

A first hypothesis is: *the category "political system" has not lost its usefulness in the analysis of transnationalising innovation policy governance structures*. On the contrary, it shows its capabilities not only in the classical comparison of political national systems (Almond and Coleman, 1960). The system perspective can form an indispensable heuristic aide for the study and description of the growing international competition of the socio-economic effectiveness of competing political (especially politico-administrative) systems, understood as "location factors" in the international economic competition, performing at least the functions of market-creating, market-sustaining,

² Funding of the various initiatives of European Community or intergovernmental scientific and technological co-operation presently amounts to some 17% of the total public expenditure on European research (EU Commission, 2000a, p. 7). See the contributions of Georghiou and of Grande to the present issue of *Research Policy*; see also Section 2.3 below.

³ As a system we understand a conglomeration of actors, institutions and processes all functionally bound together, whereby certain characteristic core functions of each form the demarcation criteria against other societal (sub)systems.

⁴ Coined in the context of functionalist social science analyses following Talcott Parson's theorizing and introduced into political science in particular by Easton (1953), Gabriel Almond — in further developing Easton's understanding in the framework of comparative policy analysis — defined the political system as that system of interaction appearing in all independent societies which fulfils the functions of integration and adaptation (internally and towards other societies) through the use (or threat) of more or less physical force. The political system is, therefore, the legitimate system in society which guarantees or transforms order (Almond, 1960, p. 7).

market-regulating and market-correcting (Scharpf, 1998, pp. 42–43). Regarding the ongoing economic and political integration of European countries, a systemic view may also reveal reciprocal dependencies on the achievements of diverse political systems and some transnational complementarity between them. Interwoven national and transnational governance mechanisms may feed the development of a transnational political system, including and building upon transformed national systems, fulfilling both “local” (i.e. regional or national) and “supra-local” functions at the same time, such as the following.

- The setting up of favourable “local” conditions for welfare and social peace as preconditions for trade and consumption, at home and also in export markets, i.e. in the sphere of influence of other political systems.
- Securing markets by regulative guarantees of market accessibility, also for foreign enterprises.
- Overcoming and avoiding global effects of locally caused disturbances to the terrestrial ecosystem.
- Or, facilitating regional, national or sectoral innovation systems, which act not only in competition with each other, but complementarily, whose special profile is, therefore, of interest for many international actors.

2.1.1. Emergence of a European political system

Analysts agree that until recently “the study of politics has got stuck in an obsolete mind-set that sees nation states and societies as discrete units, which can safely be analysed in isolation from others and in isolation from the basic structures of the international, or global, political economy” (Strange, 1992, p. 308). There is no doubt, though, that for half a century now a *European political system* has been emerging (Kohler-Koch, 1996), which is still further developing and extending sustainably over and into all participating national political systems — today visible e.g. as Brussels’s “comitology” and bureaucracy (Bach, 1997). One can hardly find any “issue area that was the exclusive domain of national policy in 1950 and that has not somehow and to some degree been incorporated within the authoritative purview of the EC/EU” (Schmitter, 1996, p. 124). Schmitter developed a table illustrating the historic dynamics of the expansion of the EU authority from 1950 until 2001 (estimates) across a full range of policy issues

(see Table 1). The scores of issues closely related with the innovation system (“education and research”; “industry”; “regional development”; “competition”) range somewhat in the middle between “commercial negotiations” at the top and “energy” at the bottom concerning the degree of European integration.

The debate about the related functions of the regional, national and transnational levels of political systems and the embedded “state functions” (“*Staatsfunktionen*”) — not only referring to innovation policy — is in full swing, and the spectrum of the remaining or even newly emerged tasks of national policy bodies is still controversial. It is hardly disputed, however, that national states remain indispensable for the present and near future: at least, they function as the “local” guarantors of the rule of law,⁵ also as the legitimator for the growing number of transnational political arrangements (Hirst and Thompson, 1996, pp. 170–194; Streeck, 1996, p. 314). Therefore, a second hypothesis says that *national political authorities continue to fulfil crucial tasks in transnationally inter-mingled socio-economic settings*. The enormous growth of transnational quasi-state functions has up to now seldom found an equivalent in politically clearly declared and widely accepted definitions of tasks (Reinicke, 1998, p. 229): where strong quasi-state bodies emerge, like in the EU, their division of competencies with national authorities is still mainly quite in-transparent (Streeck, 1996, p. 299).⁶

The theoretical writing on socio-political governance⁷ in Europe has grown enormously in the last 5 years, a “governance research agenda” on the

⁵ Despite progressively global economic integration, it is still the national states, their societies and the still nationally rooted “multinational” enterprises which compete with each other for competitive advantages, so Pauly (1999) argues; here is reflected “the continued power of at least some national authorities to steer the process of industrial development and innovation, not perhaps in an old-style dirigiste manner, but certainly in more subtle ways.”

⁶ The demand for effective transnational political control mechanisms is generally becoming louder in the face of the internationalising economy. Reinicke (1998, p. 22) states with respect to the development of “global governance”: “the current state . . . , however, at best resembles a loose set of cross-national policy patchworks conspicuous for its missing links and unnecessary overlaps”.

⁷ The term socio-political signifies that we look at governance within political and social systems, i.e. corporate governance is not a major focus of our study. Moreover, we do not use the term governance, as many scholars do, in the normative sense of “good” governance.

Table 1

Policy issue arenas and levels of authority in Europe, 1950–2001 (shortened and simplified version of a table developed by Schmitter, 1996, p. 125)^{a,b}

	1950	1957	1968	1970	1992	2001
Goods/services	○	●	⊙	⊙	⊙	⊙
Agriculture	○	○	⊙	⊙	⊙	⊙
Energy	○	●	○	○	●	●
Environment	○	●	●	●	○	○
Regional development	○	○	○	○	○	○
Competition	○	●	○	○	○	○
Industry	○	●	●	●	●	○
Money/credit	○	○	●	●	●	⊙
Education and research	○	○	○	○	●	○
Justice and property rights	○	○	○	●	○	⊙
Commercial negotiations	○	○	○	⊙	●	●
Defence and war	○	○	○	○	●	○

^a All policy decisions at national level (○); only some at EU level (●); both at national and EU level (○); mostly at EU level (⊙); all at EU level (●).

^b Source for estimates 1950–1970: Lindberg and Scheingold (1970); estimates 1992 and 2001: Schmitter (1996).

European level has been identified (Hix, 1998; Shaw, 2000).⁸ There is, meanwhile, a widespread understanding that “governance” can be defined as a process through which a socio-political community achieves binding decisions in the face of conflicting interests. The processes of consensus-building, decision-making or even implementation of decisions are not merely determined by state actors or formal governments. Rather, due to growing complexity and segmentation of modern societies and issue areas, it is the interaction of societal and state actors that defines problems, builds up the necessary degree of consensus on problems and solutions, consolidates conflicting interests and (pre-)determines political decisions. Since state actors need the co-operation of the stakeholders involved in order to come to grips with complexity and fragmentation, they have to trade much of their hierarchical power for access to interest group expertise. In innovation policy, the governance system has to deal mainly with two types of distributive conflicts reflecting two different divisions. The

first one relates to conflicts among important actors within the system (i.e. scientific or academic versus industrial interests), whereas the second refers to potential conflicts between national states as players in distributive and re-distributive games.

It is within the literature on policymaking in the EU that the concept of governance has been elaborated most. The studies on governance in the EU have two strands of origin (Eising and Kohler-Koch, 1999). One is in comparative politics, where scholars asked how societies can be controlled or control themselves when faced with fragmentation, specialisation and thus growing complexity (Mayntz, 1987; Kooiman, 1993). The other strand lies in international relations theory, where “governance without government” (Rosenau and Czempiel, 1992; Rhodes, 1995) described the observation that political decisions are reached internationally without a supranational government, but with the inclusion of state *and* societal actors.

The reasons why a governance approach is applied to the EU lie in the very structure of this “system sui generis” (Kohler-Koch) and the processes driving it. The EU is a political system without a formal hierarchical government, but with a body of legal norms that confine the room for manoeuvre of member state governments. Moreover, it produces binding decisions in a growing number of issue areas and guarantees, at least to a high degree, compliance. The EU is further

⁸ Major contributions include European Commission (2000b), Kohler-Koch and Eising (1999), Falkner (1998), Kohler-Koch and Edler (1998), Sandholtz and Sweet (1998), Kohler-Koch (1996), Marks et al. (1996), Schmitter (1996), Wallace and Wallace (1996), Peterson (1995), Rhodes (1995), Bulmer (1994), Dyson (1994) and Kassim (1994). For an attempt to give an overview on the governance literature, see Hix (1998).

characterised by a complex inter-play of state and societal actors on three different levels, where the centre is dependent on national and regional administrative and societal actors (e.g. Olsen, 2000), where interests are formulated across different levels and decisions taken at one level have repercussions on the other levels. Governance in this context implies making sense collectively of the demands and constraints of actors from various levels affected by a political issue. The emerging type of governance has repeatedly been characterised as “multi-level governance” (Hooghe, 1996; Marks et al., 1996; Cooke et al., 2000) — a governance concept which is not only complex, but very dynamic, since it is not so much legal norms, hierarchical structures and traditional power games, but living interactions among manifold stakeholders within issue networks that determine the process.

Obviously, studying governance in the European context is a complex matter: since European governance is governance without (a European) government but stretching across and beyond national governments, the ongoing process of integration is “a journey to an unknown destination” (Weiler, 1991) — the developments in the field of innovation policy may be considered as a characteristic case.

2.2. *Systems of innovation: stirred up by internationalisation*

National “*innovation systems*” were discovered by the social scientists (first of all by economists⁹), as — with the increasing significance of international hi-tech markets — explanations for the differing degrees of competitiveness of economies, especially

⁹ See, in particular, Freeman (1987), Lundvall (1992), Nelson (1993) and Edquist (1997). Lundvall and Maskell (1999) provide a reconstruction of the genesis of the expression “national innovation systems”. They all take as a theme, at least marginally, also the interface of markets and political systems (and, in particular, public policies by state governments) as a formative variable of innovation systems. Such studies became possible, after authors like North (1990) overcame the naive concept of the state held by many economists, that sees state authorities only in the role of “sweeper” in the case of “market failure”; they began to understand that no longer only a few formal but also “formless” cultural regulatives as well as public-private initiatives and institutions, that is the performance of political systems in general, are indispensable preconditions for functioning markets.

of their “technological competitiveness”¹⁰ and their ability to innovate were sought. It was recognised that differing national and regional patterns of technological and/or scientific specialisation and related “innovation cultures”, each rooted in historical origins, characteristic and unique industrial, scientific, state and politico-administrative institutions and inter-institutional networks, crucially affected the ability of economic actors and policymakers to produce and support successful innovations.¹¹ Comparative empirical studies demonstrated this even on the level of individual technological developments.¹²

The innovation system of a society encompasses, according to a meanwhile widely accepted understanding, the “biotope” of all those institutions which are engaged in scientific research, the accumulation and diffusion of knowledge, which educate and train the working population, develop technology, produce innovative products and processes, and distribute them; to this belong the relevant regulative bodies (standards, norms, laws), as well as the state investments in appropriate infrastructures. The innovation system extends over schools, universities, research institutions (education and science system), industrial enterprises (economic system), the politico-administrative and intermediary authorities (political system) as well as the formal and informal networks of the actors of these institutions, recently repeatedly also characterised as a “Triple-Helix of university–industry–government relationship” (Etzkowit and Leydesdorff, 2000). As a “hybrid system” (Kuhlmann, 1999) it represents a section of the society which

¹⁰ Under this heading, a regular report commissioned by the German Federal Research Ministry is published on the research, development and innovation efforts of German industry, also in the light of the increasing internationalisation of enterprises and the appearance of new competitors from the newly industrialised countries (BMBF, 1999).

¹¹ See Keck (1993) for the example of the German innovation system. Although not dealt with exhaustively, in the 1990s many symptoms and functions of national innovation systems were analysed comparatively, such as national research systems (van der Meulen and Rip, 1994; Whitley, 1998) enterprise cultures (Whitley and Kristensen, 1996), as well as in general the national/regional various “embeddedness of institutions” (Hollingsworth and Boyer, 1997).

¹² So, for example, Jansen (1996) for the development of the high temperature supra-conductor in Germany and Great Britain as well as the example of the biotechnology industries of the USA and Germany.

carries far over into other societal areas, e.g. through education, or through entrepreneurial innovation activities and their socio-economic effects: the innovation system has a decisive influence on the modernisation processes of a society.

Each innovation system is different, just as one society is not the same as the others.¹³ Sustainable innovation systems develop their special profiles and strengths only slowly, in the course of decades, or even centuries. They are based on stable exchange relationships among the institutions of science and technology, industry and the political system. They make possible the formation of a characteristic, system-specific spectrum of different, unmistakable role definitions of the actors actively involved herein, come up with own negotiation arenas, and stabilise mutual expectations of behaviour. Finally, they bear particular, intermediary fora and bodies which facilitate the transactions of the actors of innovation systems.¹⁴

2.2.1. Multinational enterprises

Since the 1990s, industrial innovation processes care less and less about national systems and borders (Reger et al., 1999, p. 141ff). In particular, big multinational companies developed from an “optimizing production machinery” to “globally learning corporations” (Meyer-Krahmer, 1999, p. 196). With the growing complexity of the knowledge required, isolated, individual actors are less and less in a position to master this adequately without external support. Innovation-oriented co-operation and the maintaining of corresponding networks belong meanwhile to the daily innovation routine — as horizontal co-operations within companies, as co-ordinated division of work between (even competing) companies, as well as within the framework of joint research and development projects between firms and public research institutions. The aim is the provision of “complemen-

tary assets” (Teece, 1986) in the area of technological know-how,¹⁵ increasingly also in international networks. Some indicators of a growing internationalisation of industrial innovation are the following.¹⁶

- The volume of *cross-border technology transfer* via technology-intensive trade, licensing and patents has increased continuously. The share of technology-intensive goods in world trade grew from 9.5 (1970) to 21.5% (1995).
- International strategic *technology alliances* between companies have doubled since the 1980s. Fig. 1 shows the alliances of large enterprises newly formed between 1980 and 1994. The decline of new co-operations in Europe in the 1990s does not represent a re-nationalisation, but a saturation: a growing number of transnational mergers has replaced earlier and new alliances in the meantime.
- Finally, multinational corporations have pushed on with the *transnational organisation* of their research and innovation activities — including “location optimisation”: large European companies conduct more than 22% of their research outside Europe; technical new developments, which originate from the extra-European offshoots of such concerns have increased between 1985 and 1995 by nearly 150%.¹⁷ Non-European large enterprises conduct 12% of their research in Europe (Meyer-Krahmer et al., 1998, Chapter XI).

Recent studies see in this a new model for transnational research and development (e.g. Meyer-Krahmer

¹³ Amable et al. (1997), for instance, differentiate various types of governance (“market-driven”; “government regulated”; “social democratic”; “meso-corporatist”) and of characteristics (specialisation in science and technology; sectoral specialisation; labour relations/education; financial system; performance; regulatory system; preferred innovation types, and innovative sectors).

¹⁴ In Germany, for example, the “Bund-Länder-Konferenz”, i.e. the Federal Government and the States Conference on Education Planning and Research Promotion; the German Science Council; the regular “Presidents Meeting” of the big national science organisations.

¹⁵ For details see, e.g. Mansfield and Lee (1996), Wolff et al. (1994), Rotering (1990, pp. 3–37), Link and Rees (1990, p. 28) and Haklisch et al. (1986).

¹⁶ For details, Jungmittag et al. (1999), Reger et al. (1999), Niosi (1999), Reger (1997), Gerybadze et al. (1997) and Hagedoorn and Schakenraad (1990).

¹⁷ The USA are a major recipient of foreign R&D expenditure. Companies from other nations have steadily expanded their R&D activities there, led by Germany, Great Britain and Switzerland, followed by Japan. Data from the US Department of Commerce on the R&D expenditure of foreign companies for the year 1995 show that the German companies have again considerably increased their expenditure, and spent ca. US\$ 3.9 billion on R&D (1994: US\$ 2.5 billion) (Meyer-Krahmer, 1999, p. 43f). This significant increase in the R&D expenditure of German enterprises in the USA from 1994 to 1995 is principally to be explained by the increase in company take-overs — above all in the area of pharmaceuticals, in which R&D facilities also changed into the hands of German companies.

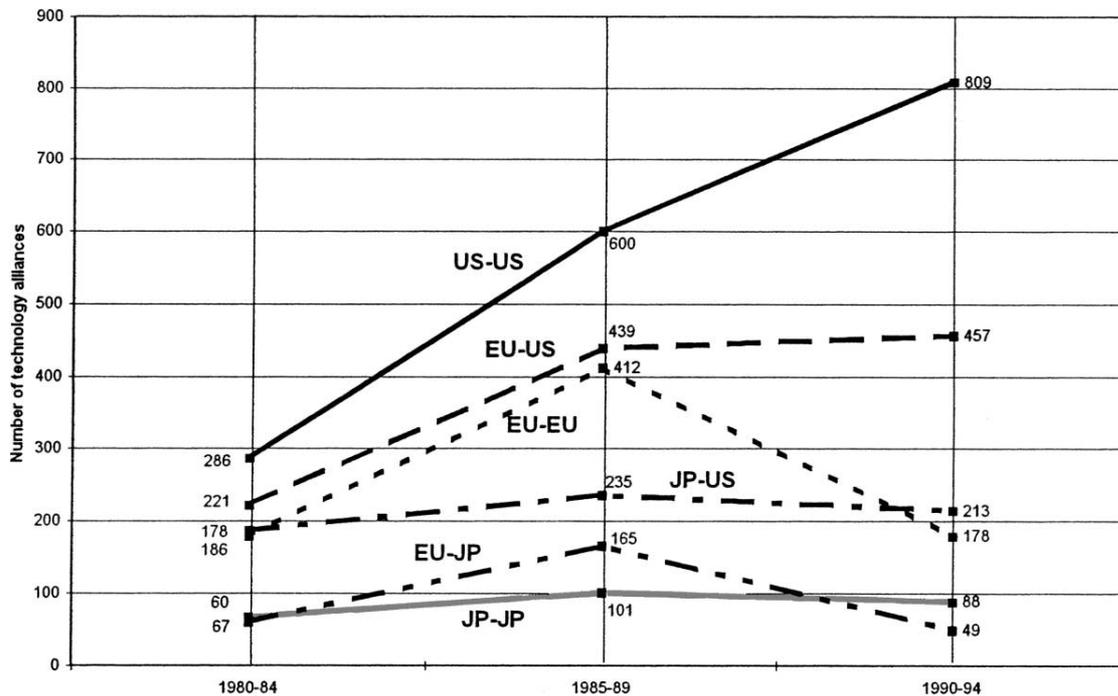


Fig. 1. Newly established international strategic technology alliances of large corporations (1980–1984, 1985–1990, 1990–1994); source: Meyer-Krahmer et al. (1998) and data from MERIT/CATI data base (Narula and Hagedoorn, 1997); basis: nearly 10,000 co-operative agreements.

et al., 1998; Gerybadze et al., 1997), characterised by stronger interactions, not only on the technology but also the market side. The connection especially to “lead markets” is seen as a decisive factor for the research and innovation of multinational concerns. Lead markets are formed by the agglomeration of future-oriented, turnover-relevant customers, whose innovation needs flow quickly and (optimally) in direct interaction into the research and innovation strategies of the producers: “the motives for establishing R&D units abroad are very much driven by learning from technological excellence *and* lead markets *and* dynamic interactions between R&D, marketing and advanced manufacturing” (Meyer-Krahmer and Reger, 1999). Corporations, in particular the larger ones, formerly rooted in national systems of innovation, are loosening or relativising their relationships with national infrastructures and innovation policies. Does public innovation policy have an important role to play any longer?

2.3. Innovation policymaking in multi-actor/multi-level settings

Historically, the hybrid infrastructures and networks of innovation systems did not come into existence spontaneously and without control: in the past 150 years, this area of society was formed by national state political interventions. The national political systems, themselves increasingly differentiated, developed innovation policy activities, in which they acted as catalysts, promoters and regulators of the innovation bodies which were emerging in many places: the establishment and growing economic significance of e.g. the colleges of engineering and the technical universities in France, Germany or in the USA document this clearly. The innovation systems of the industrialised countries have developed in the course of the 20th century co-evolutionarily with their national political systems, assumed, stabilised, and firmly established a country-specific character. It is because of

this close interweaving with the political systems that one speaks of “national innovation systems”; where regional innovation policy institutions have relatively far-reaching autonomy, elements of regional innovation systems can also be discerned (Cooke et al., 2000; Howells, 1999; Brazczyk et al., 1998; the German *Land* Baden-Württemberg is often cited here as an example).

The historical development and present shape of a “national” system of innovation reflect, to a certain extent, the character of the related political system: centralist nations like France established an innovation system focusing quite clearly on its centrally constituted political system. By contrast, the innovation systems of federally constituted nations like the USA or Germany are rooted in relatively strong regional infrastructures, institutions and related governance mechanisms. Regional political as well as research and innovation institutions (in particular universities) dispose of a high degree of autonomy; one of the major historical achievements of national governments in such environments was the establishment of considerable “transversal” infrastructures on top of the regional settings, like the national institutions for basic research (e.g. the Max Planck Society in Germany), huge national technological research centres, national project funding for industrial research, etc. Along with this “division of work” between regional and national levels, the larger federally constituted countries also developed institutional platforms for negotiations across levels and institutions. The German “Bund-Länder-Konferenz” (the Federal Government and the States Conference on Education Planning and Research Promotion) may serve as an example: for decades it has been facilitating an alignment of procedures, quality criteria, etc. for science and education between the federal states and the national government — but at the same time the in-built need for the production of consensus has brought along also a dangerous propensity to institutional conservatism, hampering, e.g. a modernisation of the university system, repeatedly and urgently required by experts.

2.3.1. Multi-actor innovation policy arenas

Obviously, the evolution of innovation-related infrastructures and actor orientations cannot be discerned from the impacts of political systems; it seems to be inevitably moulded by the interaction

with and the involvement in given patterns of political governance. In order to make this clear it might be worthwhile to step back and to assume, once again, a theoretical perspective: innovation policy-making is only seldom a matter of top-down decisionmaking and straight-forward implementation; rather it can be modelled as a process of networking between heterogeneous (corporatist) actors representing different societal subsystems (Kuhlmann et al., 1999). Frequently, policy decisions are negotiated in *multi-actor arenas* and related networks (Marin and Mayntz, 1991) which may stretch over multi-level politico-administrative systems: reaching from regional to transnational responsibilities (Grande, 1995). Negotiating actors with different responsibilities (policymakers define programmes, allocate budgets; researchers define themes, purchase equipment; industry looks for competitive advantages ...) pursue different — partly contradicting — interests, represent different stakeholders’ perspectives, construct different perceptions of “reality” (Callon, 1992), refer to diverging institutional “frames” (Schön and Rein, 1994). Thereby, given power structures and the shape of arenas may vary considerably between national states (or regions) or corporations (see Fig. 2). Normally, “state” authorities in (regional, national, transnational) multi-actor arenas of innovation policy play an important, but normally *not a dominant role*. In many cases, they perform the function more of a “mediator”, facilitating alignment between stakeholders, equipped with a “shadow of hierarchy” (Scharpf, 1993), rather than operating as a top-down steering power. “Successful” policymaking normally means compromising through “re-framing” of stakeholders’ perspectives and joint production of consensus.

Therefore, a third hypothesis of this paper is the following: the governance of public national as well as transnational innovation policy is characterised by more or less institutionalised “negotiations” between multiple self-interested groups of actors (industries, research and education institutions, policymakers) in innovation systems and between them. This consideration is an important precondition for the understanding of the remaining role of national systems of innovation and related policymaking, and also of the potential role of transnational political structures and innovation policies.

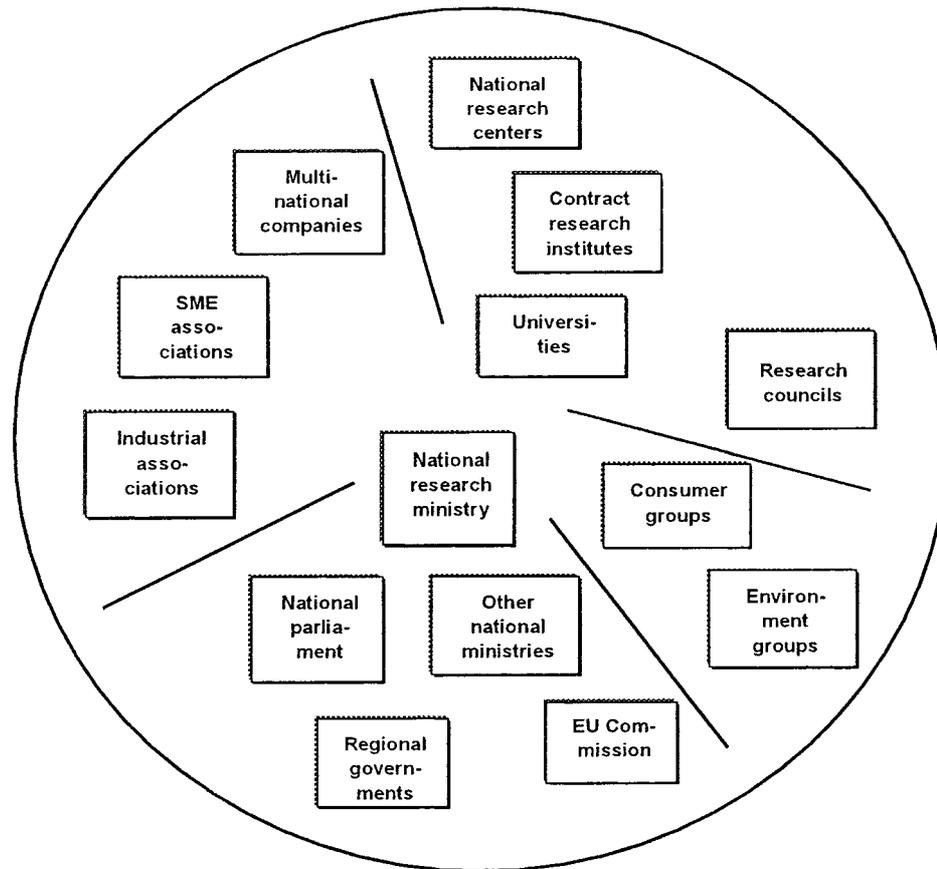


Fig. 2. Innovation policy arena: competing (corporatist) actors and no dominant player.

2.3.2. Development of innovation policy instruments

The sketched theoretical perspective may help to explain the actual historical evolution of innovation policies (at least in Europe; see, e.g. Kuhlmann, 1998a,b). After the second world war, and increasingly since the 1970s, with the triumph of “high technologies”, the industrialised countries developed a broad spectrum of technology policy intervention measures and sparked off a “technology race” (Roobeek, 1990; see also the classical overview by Ergas, 1987). The spectrum of implemented instruments of research, technology and innovation policy is widely differentiated in the meantime, reflecting the scope of institutions and interests involved (see Fig. 3): it stretches from public funding of research institutions over various forms of financial incentives

to the conducting of research and experimental development in public or industrial research labs, up to the design of an “innovation-oriented” infrastructure, including the institutions and mechanisms of technology transfer. In many European countries, these instruments dominated the practice or research and technology policy for the last three decades (e.g. Krull and Meyer-Krahmer, 1996, for Germany). As further instruments one could mention efforts to guide public demand, measures in education and further training and the regulatory possibilities available.

In the transition to the 21st century, though, the national and (regional) innovation systems are experiencing revolutionary shockwaves: the growing pull of internationalising economic relationships has mixed up traditional regional or national divisions

Instruments in a narrow sense	Instruments in a broader sense
1. Institutional funding <ul style="list-style-type: none"> • National Research Centres • Research Councils (in Germany DFG; Max Planck Society) • Applied Research and Techn. Deve-lopment Organisations (in Germany e.g. Fraunhofer Society) • Universities and other Higher Educa-tion Institutions • Others 	4. Public demand and procurement
2. Financial incentives <ul style="list-style-type: none"> • Indirect promotion programmes (e.g. CIM) • Technology promotion programmes (cooperative R&D projects) • Risk capital 	5. Corporatist measures <ul style="list-style-type: none"> • Long-term visions; technology foresight • Technology assessment • Awareness initiatives
3. Other innovation infrastructure and technology transfer mechanisms <ul style="list-style-type: none"> • Information and consultancy for SMEs • Demonstration centres • Technology centres • Cooperation, networks, people 	6. (Continuing) education; training
	7. Public policy <ul style="list-style-type: none"> • Competition policy • (De-) Regulation • Public stimulation of private demand

Source: Meyer-Krahmer and Kuntze (1992), 103

Fig. 3. Instruments of public innovation policy.

of work between industrial enterprises, educational and research institutions as well as administration and politics, and it debased many of their traditional strengths. Internationalisation, however, has so far not led to a uniformity of the national innovation systems, which would finally mean their abolition. The various national and regional innovation cultures and related policy arenas react very differently, which partly leads them into crises, partly stabilises, but partly also reveals unexpected, novel chances in a transformed international context. At the same time, European transnational innovation policies have been entering the stage, increasingly since 1985, nowadays covering the whole range of instruments as depicted in Fig. 3.

2.3.3. *Transnational European innovation policies*

The European Union’s innovation policy initiatives are, officially, restricted to and concentrated on the creation of “European added value”. They are supposed to follow the “*subsidiarity principle*”, so as to select only those objectives which are most efficiently pursued at Union level. More precisely, projects should — beyond their quality in terms of scientific

criteria, partnership, and project management — (1) contribute to create a “critical mass” of human and financial resources across all the member states; (2) or guarantee a significant contribution to the implementation of one or more community policies; (3) or address problems arising at community level including social needs, or questions relating to standardisation or the development of the European area. Moreover, community research, technology and innovation programmes and projects claim to contribute to the economy, science and technology in ways that will encourage the harmonious and sustainable development of the community as a whole. This implies that projects should concentrate on areas in which there is expansion and therefore good prospects for growth, community businesses are supposed to become more competitive, and scientific and technological progress is expected to offer a medium- or long-term potential for dissemination and exploitation.¹⁸

¹⁸ The criteria as modified by the European Council’s common position on the fifth FP based on Annex I of the Commission proposal COM(97) 142 final, 30 April 1997.

Three examples may briefly illustrate the scope and breadth of recent European transnational innovation policy initiatives are given.

1. The first “*framework programme*” for research and technology, launched by the European Commission in 1984, concentrated on industrial technologies, information technology, telecommunications and biotechnology. Each subsequent FP has been broader than its predecessor in its scope of technologies and research themes, with correspondingly higher expectations of its impact on the economy and society. As a consequence, the rationales underlying the various specific programmes under each FP have become increasingly heterogeneous and even contradictory. This complicates attempts to evaluate the overall achievements of each FP (Airaghi et al., 1999).

In addition to the target dimensions applied already in earlier FPs, the present Fifth FP, covering nearly 15 billion Euro, particularly emphasises social objectives that reflect the expectations and concerns of Europe’s citizens. It has been claimed that the Fifth FP is a “social contract” which, much more than its predecessors, will aim explicitly to create jobs, promote health and quality of life, and preserve the environment (European Commission, 1999). “Thematic programmes”, which are concerned with research and technological development itself (in such areas as “life sciences”, “the information society”, “sustainable industrial growth”, and “energy and the environment”), are intended to be complemented by “horizontal programmes”, which will promote co-operation, dissemination, and training and mobility of researchers. It is still difficult to say how radical a change in direction the Fifth FP represents, either in terms of scientific content or in organisation.

2. The European Commission developed also a variety of own *regional innovation policy* initiatives: in 1993 for example a pilot initiative called “regional technology plans (RTP)” was launched which was to initiate the development of a regional innovation policy strategy. The projects in this initiative were to be undertaken in so-called “less favoured regions”. European Commission officials who set up this initiative had perceived a lack of policy-planning culture in many regional

governments. Particularly, in the area of innovation, only little genuine regional experience had been developed so far, since this area had traditionally been the domain of national policymakers in many European member states. Particular concern related to the top-down approach normally applied in regional innovation policy initiatives either by centralist national authorities or inexperienced regional authorities. In terms of contents, the RTP prescribed a “demand-driven” analysis phase during which the “real” innovation issues in industry were investigated as a basis for policy action. In terms of process the Commission propagated instead a “consensus-based” approach, where government agencies were to involve a large group of stakeholders to discuss strengths and weaknesses of regional innovation systems, define priorities, and set out (pilot) projects. Many public-private partnerships were established as result of the RTP projects. Seven regions entered the experimental action and went through what was to become an ongoing S&T policy-planning process. The Commission played a “mentor role” in the background, the regions themselves were responsible for running the RTP projects (Landabaso, 1997).

3. Launched in 1985, the aims of the *EUREKA Initiative* are to strengthen the competitiveness and productivity of European industry through stimulation of co-operation between companies and research institutes in advanced civilian technologies. Different to the centrally driven transnational policy approaches sketched above, EUREKA is an inter-governmental initiative, not an institution of the European Union and has always had a wider membership, initially including the then EFTA countries and Turkey and later extending to the current 26 members, including Eastern Europe and Russia. The positioning of EUREKA has always been understood to be nearer to the market than the FPs, though there is some overlap. Its policy-making approach is “bottom-up” and (relatively) non-bureaucratic with a very small secretariat. In principle, EUREKA only “labels” co-operative projects, with any funding being available on the part of national administrations, and often in the context of appropriate national programmes. EUREKA has been operating in two main modes: a suite of large “strategic” projects (such as *JESSI*

in information technology and *Prometheus* in vehicle information systems) with very large budgets at their disposal and aimed to re-structure entire sectors. By contrast, “standard” projects were targeted to the needs only of their participants and could have budgets as low as a million euro or less (for details, see EUREKA, 1999; Georghiou et al., 1999; also Georghiou in the present issue of *Research Policy*).

2.3.4. European multi-level governance: an “emerging strategy”?

Despite these transnational efforts, the innovation policy of the large European member states has not yet taken the step towards a conscious and comprehensive international integration and co-ordination of their measures. The majority of public initiatives is still mainly developed in national policy arenas, offered by national institutions, and addressed to national beneficiaries, borne by the implicit assumption that the research institutes, universities and enterprises involved carry out their innovation activities entirely or for the most part within national boundaries,¹⁹ or at least with a significant relation to the own economy. The EU programmes in support of research and innovation have been increasing in volume and breadth

¹⁹ For example, since 1998 the German Federal Research Ministry has been promoting “virtual competence centres” in the area of nanotechnology, classified as a future key technology, in which “the economy, science and private capital from all over Germany is brought together, in order to open up these areas and develop new products up to market maturity. The USA, Japan and China are already investing heavily in nanotechnology”: The new competence networks should in the future also be able to play in the international “concert of the major nano-players” (press release of the Federal Minister for Education, Science, Research and Technology of 12 August 1998). However, many of the institutions participating in the competence centres have themselves long been intensively involved in international science and technology networks (according to current studies by the Fraunhofer Institute for Systems and Innovation Research, ISI): the national focus of the new promotional measure seems almost arbitrary by contrast. It must be noted, on the other hand, that — different to the still nationally focused perspectives of policymakers — a couple of public research institutions, confronted with internationalising industrial R&D, have started to look beyond their national borders, e.g. the German Fraunhofer Society is presently establishing facilities in the USA and Southeast Asia; cf. Trischler and vom Bruch (1999, p. 284ff). Also, for the last 5 years one could observe internationalisation and on the spot investments abroad of foreign — European, American, Australian — universities in various European countries.

of expertise since the end of the 1980s, their actual reach, however, was limited in the larger EU member states (in Germany, the volume of expenditure of the EU programmes up till now equalled ca. 4% of the total national expenditure on research and development). Other European, transnational initiatives like EUREKA or COST (international co-operations in long-term, application-oriented research) occasionally attain an outstanding symbolic position in the concepts of the larger European states, but in practical terms are treated as less prominent. Otherwise, in smaller countries: there the instruments of transnational European innovation policy have been regarded for years as a constitutive element of national policy, not least, because large companies with headquarters in small countries are forced to act in international dimensions due to the small domestic market (like Philips in the Netherlands or Nokia in Finland).

A “governance gap” emerges here: the presently applied “division of work” in innovation policy between regional, national and EU political levels and institutions is not yet systematically structured and determined. The subsidiarity principle has been working only as quite an abstract rule for practical policy decisions and their implementation yet. The present distribution of innovation policy responsibilities across the levels may at best be characterised as the result of an “emerging strategy” between old and newly created institutions (Edler, 2000). The arising European (innovation) political system still only partly reflects the economic and political activities within, between and across the national innovation systems. It is not by chance that the newly appointed EU Commissioner for Research said: “we need to reinforce dialogue; avoid unnecessary overlap and work with (policy) structures that are very different. Everyone is aware that it is indispensable to have a broader view” (Research Europe, 18 November 1999, p. 2).

3. Future governance in European innovation policy: three scenarios

Summing up, we can state (1) that political systems and related “state functions” are still nationally based, but are, in Europe, spreading increasingly both to the transnational and to the regional level; (2) that innovation systems are nationally, regionally or sectorally

rooted and developed in reaction to international competition; they are presently — and very likely in the future far more — stirred up by “globalising” markets as well as by the increasing socio-economic and political Europeanisation: innovation systems are challenged to adapt, to accelerate learning, to open up, to develop new patterns of specialisation, to merge internationally, etc. and (3) the necessary adaptation and integration processes of the innovation systems can obviously not be carried out completely and exclusively by the original innovation actors in industry and science on their own. Apparently, also in the future the state-based mediating and regulatory capacities of political systems will remain indispensable. Furthermore, (4) we can state that in Europe meanwhile innovation policy initiatives are pursued in parallel on the national, the transnational and the regional level, by national, as well as by transnational and by regional political actors — although so far only loosely inter-linked and scarcely matched, thereby partly competing (vertically and horizontally) against each other, but partly also complementing.

Clearly, there is an amalgamating though in many respects still scattered European political system, and its intrinsic character is not yet obvious — attempts to characterise it reach from notions like “international organisation” through “multi-level governance” to “less than a federation, more than a regime” (for a collection of denominations see Wessels, 1999, p. 713).

On a macro-level, i.e. beyond specific policy fields, social scientists have repeatedly attempted to sketch potential “futures” of the ongoing European integration process: Philippe Schmitter, for instance, asking for the *future constitutional governance* in the European political system, has offered a matrix of two different principles of aggregation — the territorial and the functional (Schmitter, 1996, p. 135f): the strongest case of political integration he calls *stato/federatio*; typical elements are definitely fixed territorial boundaries, irreversible membership, an overarching hierarchy of authority and a fixed allocation of competencies among separate institutions within a cumulative division of labour. A *confederatio* “would be a more loosely coupled arrangement in which the identity and role of territorial units would be allowed to vary, while the distribution of functional constituencies and competencies would be rigorously fixed ...”. In a *consortio* national authorities of a defined number

and identity agree to co-operate with respect to functional tasks that are variable and overlapping; they pool their capacities to act autonomously in fields that they can no longer control at their own level of aggregation. Eventually, the *condominio* would be the loosest way of integration since it allows variation in both territorial and functional constituencies; instead of the present “Eurocracy accumulating organisationally distinct but politically co-ordinated tasks around a single centre, there would be multiple regional institutions acting autonomously to solve common problems and produce different public goods”.

Schmitter’s models of governance in the EU provide helpful guidance when thinking about future developments of the “constitutional” shape of Europe’s future. The arenas of innovation policy, though, are also shaped by socio-economic factors and actors, as discussed above. Therefore, another “forward thinking” experiment can provide further insights since it focused explicitly on the relationship between *future socio-economic developments and governance structures*, thereby, clearly mentioning also the future of science and technology policy in Europe: the “Scenarios Europe 2010” of the EU Commission’s Forward Studies Unit (Bertrand et al., 1999) developed “five possible futures for Europe”: “*triumphant markets*”, assuming an unlimited dominance of global market dynamics, while public policies on national state and EU level restrict themselves to the provision of favourable conditions for innovation and economic success; “*the hundred flowers*”, assuming weak public policies on national and EU level (including innovation policies) vis-à-vis strong self-regulating grass-root initiatives in the economy and social life; “*shared responsibilities*”, assuming a modernised, multi-level system of public policymaking (governed by the principles of decentralisation, delegation, accountability and subsidiarity), facilitating also innovation in science and economy; “*creative societies*”, assuming a deep economic and political crisis leading to a thorough socio-political reform, trying to guarantee everyone in Europe, if not a job, then at least alternative means of ensuring a decent income, a minimum level of security and recognition of their social wealth — national and (well functioning) European political institutions are focusing their efforts in the sense of this “spiritual renaissance”; “*turbulent neighbourhoods*” assuming political instability, decreasing economic

competitiveness, crime and even warfare, in particular, in Eastern Europe, weakening the European institutions while strengthening the governance of the larger European countries, including their military forces.

Bertrand et al. (1999, pp. 89–94) built their scenarios on alternative developments of *shaping factors and shaping actors* of European innovation policies, a concept that might also be fruitfully applied to innovation policy scenario-building.

- First, one would have to identify the key *shaping factors*, processes and constitutive elements making up the innovation policy governance structure of the future, such as the dynamics of economic globalisation, the present and upcoming technological regimes governing the dynamics, the competition and related patterns of specialisation of national, regional or sectoral innovation systems (e.g. Lundvall and Tomlinson, 2000), and — last but not least — the potential development of the European political system vis-à-vis national and regional systems (e.g. European Commission, 2000a). The basic feature of all these factors is that they are important elements of the actors' environment. Causal or probabilistic effects could be better understood as potentially different reactions of actors to changing environments (economic, technological, political, ...).
- Second, one would have to define a set of *key shaping actors* affecting these elements and thus driving the development of innovation policy arenas and related governance structures, such as the actual orientations and strategies of multinational enterprises (“global players”), the specialisation and internationalisation strategies of higher education institutions, of (semi-)public research and technology organisations, of national or regional governmental bodies, and — last but not least — European institutions like the European Commission or the European Parliament (as depicted in a stylised manner in Fig. 2).

Approaches like Schmitter's and the “Scenarios Europe 2010” are helpful sources of inspiration when speculating about future developments. In the following, we shall speculate indeed, while doing so, concentrating exclusively on the arenas of innovation policy. What are the patterns or governance in transnational multi-level, multi-actor political systems

and in changing innovation systems? Three scenarios will be sketched.

1. An increasingly transnationally *centralised* and dominating European innovation policy arena, assuming weakened national authorities and (partly) strengthened regional autonomy.
2. The opposite, i.e. a progressive *decentralisation* and open competition between partly strengthened, partly weakened national or regional innovation systems and related policy arenas.
3. A centrally “mediated” *mixture of competition and co-operation* between diverse national or regional innovation cultures, i.e. a multi-level governance based on a “problem-driven” re-distribution of initiatives and responsibilities across levels.

The three scenarios should be read as pieces for debate, and as a point of departure for future research. In their present state, the scenarios are still mainly based on political institutional or constitutional design factors which are just one of the elements of the innovation policy governance.

3.1. Scenario: concentration and integration of European innovation policies in transnational arenas

Shaping factors in the political system: this scenario corresponds to Schmitter's “stato/federatio” scenario (while there is no obvious relation to the “Scenarios Europe 2010”). It assumes that the European political system stabilises in bearing a strong transnational governance structure based on generally acknowledged pan-European institutions, with a “European state” and the Commission as the government at its core, governing major shares of public budgets, implemented and controlled by historical and presumably centralised transnational bureaucracies. Correspondingly, the political autonomy of the national political systems would decrease. Nation states would hand over many of their responsibilities to centralist European authorities, in particular, the European Parliament as legislative and the Commission as executive bodies. Regional political authorities would probably be less affected by the transnational concentration of power, they might even take advantage of the decline of national powers by, simultaneously, gaining additional autonomy and accepting direct responsibility vis-à-vis the central

European level — “sandwich effect” is a popular characterisation in Europe of this governance model.

Shaping actors in innovation systems: quite likely, an increasingly centralised and dominating transnational innovation policy arena would emerge. The shape of national, regional or “sectoral” innovation infrastructures would now depend to a considerable extent on regulatory and investment decisions negotiated in transnational arenas and taken by strong transnational bodies. Consequently, the importance of national innovation policy arenas would fade away. Formerly strong players in national innovation systems would either become marginal or try to establish strategic coalitions or to merge in order to strengthen their negotiating power: research universities, research councils and other basic research institutions would pool their interests in a body like the “European Science Foundation”, but significantly strengthened by comparison with its present role. Industrially oriented contract research organisations like the Fraunhofer Society, TNO, VTT, etc. would amalgamate in a “European Research and Technology Society”, etc.

One can assume that, as a consequence, the diversity of the European landscape of innovation systems, often praised as a crucial source of vitality and innovation power of Europe’s economy, would suffer from this kind of strong centralisation — at least in the sense that long-standing “national styles” of dealing with research, technology and industrial innovation could be leveled out or even disappear. Regional “grass-root” initiatives, on the other hand, may evolve, driven by strong “local” industrial and political forces, and develop — probably additionally fed by EU regional support programmes — even more richly than in the old national innovation policy settings.

Evidence and future plausibility: considering the historic development of the EU’s FPs for research and technological development, their growth in size, thematic breadth and their reach in the various national innovation systems since the mid 1980s, and extrapolating the present trend in a linear way, this scenario does not look too implausible: as a matter of fact, the FPs grew steadily over the years (the First FP, 1984–1987, covered 3.3 billion ECU/euro, the Fifth FP, 1998–2002, will amount to nearly 15 billion euro), often at the cost of national efforts (in relative terms), in smaller member states more clearly than in the bigger ones. And in doing so, a considerable innovation

policymaking bureaucracy developed, centralised in Brussels, formally differentiated from national institutions by the subsidiarity principle, but in practice in many cases competing with national policies²⁰ (as e.g. in the field of innovation support for SMEs).

On the other hand, there are a couple of reasons which suggest that the concentration and integration scenario will not come true. First of all, the degree of autonomy and the will for survival of important actors — in particular major research institutions as well as politico-administrative bodies — at national levels should not be underestimated. Secondly, for the time being and quite probably in the near future, too, it will be the national political systems and their democratic institutions which alone can provide the necessary legitimisation of state action — also at transnational levels. It is hardly conceivable that let us say a 100 billion euro pan-European public research and innovation budget could be negotiated and decided only on the level of transnational stakeholder networks and by the European Parliament, without any involvement of national and regional “innovation communities”. This legitimacy problem will, thirdly, become even more insurmountable the larger the EU grows: the vast number of organised actors in the innovation policy arenas of possibly 20 member states in the course of the present decade would not allow a uni-linear top-down innovation policymaking governance structure.

3.2. Scenario: decentralisation and regionalisation of innovation policy arenas

Shaping factors in the political system: the opposite scenario corresponds to Schmitter’s “condominio” model and also to the “hundred flowers” scenario of “Europe 2010”, assuming a decentralisation and fragmentation, compared to the status the European political system had already achieved by the late 20th century: after the enlargement of the EU by several Central and Eastern European countries around the year 2005, this capacious grouping of too many economically, politically, and culturally heterogeneous members states would no longer be able to maintain and further develop a joint political identity and related institutions. The governance of the EU and its

²⁰ See e.g. the example of the industrially oriented BRITE programme which has been historically reconstructed by Edler (2000).

Commission would progressively be retreating, its transnational institutions would be shrinking, concentrating now on the maintenance of the common European market and related regulation, supported by a certain concentration of foreign policies. The majority of other important fields of public policy, though, — like tax, social, and innovation policy — would witness a continued heterogeneity of national or regional interests, political targets and strategies. The European polity would be suffering from an absence of co-ordination and a dismantling of already achieved pan-European regulation in many fields of socio-economic policy. As a consequence, partly strengthened, partly weakened national or regional political systems and powerful corporatist actors in related policy arenas would compete harder against each other, seeking to increase their political autonomy and — with respect to economic development — to enlarge their share of foreign direct investment. Serious economic and, inevitably, political conflicts between regions or nations would thrive. Some groupings of regions and nations sharing similar interests may establish strategic coalitions seeking to strengthen their economic and political negotiating power against competing groupings within the policy arena of the now emerging “condominio of Europe”.²¹

Shaping actors in innovation systems: an overcharging of existing centralised EU policymaking procedures around the year 2005 would lead to a weakening of the genuine European innovation policy institutions (in particular the related Directorates General of the EU Commission), or even their retreat from the EU policy arena. The competition of too many contradictory regional, national or sectoral interests would create an intractable deadlock situation: the European framework programmes for research and technological development, suffering from an overload of heterogeneous targets and expectations, would have to be terminated — the Council of Ministers and the European Parliament were unable to agree upon the focus, shape, size and management of the seventh FP (planned for 2006–2010).

Instead, the competition between various national and/or regional innovation policies would increase.

Smaller nations that had started to make significant investments in science, innovation and education already in the 1990s (like Finland or Switzerland, the latter still not a member of the EU), attract more and more international investment. The same holds true for some of those regions which — while being part of a nation state — enjoy a high degree of political autonomy; they used to afford and maintain for many years strong innovation infrastructures and would now be keeping abreast with the mentioned smaller nations. They may even establish inter-regional trans-border coalitions for concerted innovation policies, mutually matching local strengths and weaknesses of innovation-related institutions. They may also launch EUREKA-like “bottom-up” inter-regional industrially oriented innovation support initiatives — imagine e.g. an “innovation belt” of regions and nations surrounding the Alps, reaching from Bavaria, through Baden-Württemberg (two federal states of Germany), Switzerland (independent), Rhône-Alpes (French region), northern Italian regions like Lombardy to Slovenia (independent).

By contrast, many other regions in Europe might suffer from the new lack of transregional and transnational efforts in regional economic and innovation development, thus experiencing a growing gap between economically powerful and weaker parts of the continent. Not only would the EU’s regional initiatives have lost their thrust, but also long-standing and politically well accepted mechanisms of intra-national compensation between rich and poor regions (as were in force, e.g. in Germany for decades) would be fading away: confronted with the challenges of increased international and global competition, the national governments of the larger EU member states would have agreed with major corporatist actors (leading research organisations, industrial associations, ...) to now concentrate their public policy efforts on “promising regions” in their national innovation policy arenas. One can assume that in particular multinational enterprises would gain strong influence by playing their games in this scattered landscape of European innovation systems and related policymaking arenas.

Evidence and future plausibility: this scenario is borne by the assumption that the traditional, centralised innovation policy governance mechanisms at the national level, in particular, larger countries struggling with the internationalisation of research

²¹ While “varying and overlapping scales of territorial aggregation would interact with varying and overlapping domains of functional competence” (Schmitter, 1996, p. 138).

and innovation — and at the EU scale — at least after the enlarged membership of the Union after 2005 — will be overburdened and experience a serious functional breakdown. Since no other integrative governance mechanism is disposable, strong (inter-)regional innovation systems, in particular, if effectively interwoven with political systems, would start taking command. European economic history provides evidence of the very strong role that the endogenous dynamics of European regions have always played in economic development and industrial innovation. Many regional innovation systems are older than the nation states they presently belong to. Economically strong regions and related innovation systems, meanwhile, inter-connected by increasingly international and “virtual” markets may survive and thrive, even with relatively weak political systems at the national and European transnational levels — but at the socio-economic cost of the rest of Europe. In essence, this condominium scenario does seem less unlikely than many European policymakers presently may perceive.

3.3. Scenario: centrally “mediated” mixture of competition and co-operation in integrated multi-level innovation policy arenas

Shaping factors in the political system: the third scenario ranges somewhere between the previous two. It corresponds to Schmitter’s “confederatio” or “consortio” scenarios and also to the “shared responsibilities” scenario of “Europe 2010”, assuming a co-evolution of regional, national and European policy arenas towards an integration in, more or less, effectively working multi-level, multi-actor systems. All the three levels would undergo a re-distribution of tasks, thereby experiencing new functional and informational linkages, vertically and horizontally. Political power and policymaking competencies would not crystallise around one central European institutional core (like in the first scenario), nor would they slip away to some strong but scattered “regional” domains. Instead, power and policymaking competencies would now be distributed throughout the European political system, consequently following the subsidiarity principle: in terms of political agenda setting (regional, national or European thematic arenas), of decision

making and regulation (regional, national or European parliaments), and implementation (regional, national or European governmental institutions).

An important precondition is the general acceptance of the enduring co-existence of two, partly competing, overarching political targets. (1) The EU would continue to aim at a sustainable socio-economic “cohesion” of all European regions, i.e. political initiatives on all levels would have, in principle, to strive for the establishment of similar conditions of work and living, acceptable for all EU citizens, independent of their place of residence. (2) Interested groupings of regional, national or transnational authorities may seize at their own cost transnational strategic initiatives (regulation, funding, etc.) aiming at the creation of attractive and productive conditions for economic investments in “their” parts of Europe or “their” sectors — also if only a restricted number of EU member states is willing to join such efforts. This concept has been coined as “géométrie variable” (in Brussels emerging “Eurospeak”).

Another prerequisite — in particular for adopting policies of the “géométrie variable” type — is the effective functioning of vertical and horizontal, formal and informal networks of key actors, disposing of visible, well accepted platforms and intermediary institutions facilitating the exchange of strategic information and knowledge, allowing for “mediated contestation” between representatives of conflicting interests. Governments on all three levels may perform mediating functions in a variety of policy fields.

Shaping actors in innovation systems: innovation policies initiated and implemented would be based on a mixture of competition and co-operation between diverse but integrated regional or sectoral innovation systems and related policymaking arenas. While regional or national authorities would continue to improve the competitiveness of “local” innovation systems, national and in particular transnational institutions like the EU Commission — instead of running growing and cumbersome own funding programmes — would be in a position to “mediate” between the competitors and to “moderate” their conflicts. Public investment in, and regulation of, research, technology and innovation would originate mainly from regional or national initiatives and sources — but it would have to be concerted and matched with any parallel activities throughout Europe: e.g. core competencies

and research portfolios of publicly co-funded research institutions would have to be linked and matched across the continent in order to improve the effectiveness of efforts; national and regional funding schemes would have to be opened for applications from other parts of Europe; a variety of inter-regional or inter-national, where necessary also centrally developed initiatives would be disposable, normally following the “géométrie variable” approach.

The mediation of innovation policy would require appropriate arenas for negotiation, institutions and procedures (Caracostas and Muldur, 1998, pp. 186–190). In today’s political practice, though, hardly any “postnational” arenas have been established hitherto. At best a few “provisional models” can be identified.

- In Germany, for example, the Federal Government-Federal State Commission for Education Planning and Research Promotion (BLK), which offers a (conservative) model for aligning the various interests at the interface of regional and national actors.
- On the EU level, CREST (Scientific and Technical Research Committee) of the European Council, which provides a negotiating arena for the various national research policies. As far as general issues are concerned, however, CREST has also hardly progressed beyond the representation of national interests; a “federal system of science” (Sharp, 1999) is not yet in sight. New dynamics may, however, be sparked off by the growing involvement of the European Parliament, whose committee for Industry, Foreign Trade, Research and Energy is intervening increasingly in the innovation policy debate.

Contesting and negotiating actors in policy arenas use money, power and information as their main media. Various actors have different shares of these resources at their disposal. One important source of policy mediating authorities is the utilisation of “strategic intelligence”. *Strategic intelligence* activities may cover, e.g. information gained from exercises like policy impact evaluation, from science and technology foresight efforts or from technology assessment (Kuhlmann et al., 1999); they may support the following.

- A more “objective” formulation of diverging perceptions of (even contentious) subjects, offering

appropriate indicators and information processing mechanisms; analyses of changing innovation processes, the dynamics of changing research systems, changing functions and likely effects of public policies.

- The organisation of mediation processes and “discourses” between contesting actors (or between representations of their views).

Mediating authorities like the EU Commission — according to this scenario — would systematically facilitate the performance and the use of strategic intelligence, in particular by linking existing bodies of knowledge (and related institutions) on regional and national levels.

Evidence and future plausibility: presently, there does not seem to be much evidence for the realisation of this scenario; in particular, pro-active mediation efforts by the EU Commission are still quite rare, although the EU’s Maastricht Treaty explicitly requires an improvement of the co-ordination of the member states’ innovation policies, envisaging the EU Commission as a major co-ordinator. There is, on the other hand, some likelihood that the interest of regions and member states in this “confederatio mode” may soon increase; while they are not ready to give away their power of allocating the lion’s share of public investment in innovation, they might, nevertheless, become more interested in a mediation of conflicts among them; the transaction costs of contentious competition between scattered innovation systems may be too high in the long run. In essence, the probability of this scenario will depend on the “policy learning” capabilities of major actors in the European innovation policy arena.

4. Conclusions and outlook

In Europe, the functional spectrum and the locations of (innovation) political systems are spreading, thereby creating a new leverage potential, but also new internal contradictions. The European Union can with some justification be described as an institutional structure, which at least forms a basis — albeit fragmented — of a system of “postnational” European innovation policy governance, the characteristics of which are still quite opaque, though, and in need of

further research: we see, at the same time, horizontally and vertically interwoven multi-level innovation policymaking arenas; we notice also some already quite sustainable transnational policy structures; but simultaneously there are also undiminished national “location competition” efforts, and, in addition, an increasing number of European regions entering the postnational innovation policy arena as self-confident actors, supported by (partly new) political autonomy and, not least, promoted by the European Commission (among others, by the “Structural Fund” and a regionally oriented innovation policy). So far, there is still a significant governance gap between these levels of innovation policymaking.

This paper raised the question whether in the coming decade the processes of European innovation policymaking will experience a new level of intensified integration, or end up in a loose integration of highly diverse systems, cultures and related functionality. As stated by way of introduction, the paper did not aim at systematic and exhaustive answers to these far-reaching questions, neither could it present detailed empirical data. Instead, it wanted to sketch the preliminary outline of a research programme and, in doing so, speculate about the governance of innovation policies in Europe. Based on theoretical considerations concerning the co-evolution of “political systems” and “innovation systems”, the paper hypothetically stated that (1) that political systems are still nationally based, but are, in Europe, spreading increasingly both to the transnational and to the regional level; (2) that innovation systems are nationally, regionally or sectorally rooted and developed in reaction to international competition; (3) apparently, also in the future the state-based mediating and regulatory capacities of political systems will remain indispensable; furthermore, (4) that in Europe meanwhile innovation policy initiatives are pursued in parallel on the national, the transnational and the regional level, although so far only loosely inter-linked. Based on these assumptions three scenarios were developed: an increasingly transnationally *centralised* and dominating European innovation policy arena, assuming weakened national authorities and (partly) strengthened regional autonomy; the opposite, i.e. a progressive *decentralisation* and open competition between partly strengthened, partly weakened national or regional innovation systems and related

policy arenas; a centrally “mediated” *mixture of competition and co-operation* between diverse national or regional innovation cultures, i.e. a multi-level governance based on a “problem-driven” re-distribution of initiatives and responsibilities across levels.

Models which assign a crucial role to the Commission of the European Union within a new division of labour between regional, national and global political authorities, have so far not progressed beyond conceptual suggestions (Soete, 1999; Sharp, 1999; Peterson and Sharp, 1998; Caracostas and Muldur, 1998): our first scenario — *strong centralisation of innovation policy governance* — will quite *probably fail*, for many reasons, not least because of the sheer number of member states and the resistance of the remaining more or less strong elements of national political systems and innovation systems, but also as a consequence of an overload of policy complexity.

It is *more probable* that the second scenario — *decentralisation, increased competition of regional actors* and finally even disintegration of political and innovation systems — could come true. This scenario bears the strong risk that regions or nations with less developed innovation capabilities will fall behind, thus widening existing socio-economic gaps. The envisaged enlargement of the EU within the present decade to include the then more than 20 member states and several hundred more or less autonomous regions may support such a development — as long as no mechanisms of shared responsibilities have been established, such as depicted in the third scenario.

Although there is no immediate evidence yet, there is some *degree of probability* that some variation of this third scenario — *co-evolution of “postnational” political and innovation systems towards centrally mediated policymaking* for distributed but inter-related innovation systems — will come into existence. The EU Commission’s recent attempt to facilitate the creation of an integrated “European Research Area” (European Commission, 2000a) can be interpreted as a step in this direction. Given the institutional diversity across the present regional and national innovation systems, the prospects of this initiative might be the better the more it will be embedded in a governance of “shared responsibilities” between various types of actors and levels of aggregation and hierarchy. Whether such a new governance structure will be robust and sustainable or weak, will depend, not least, on the

“intelligence” of the involved institutions, procedures and actors of the political systems.

It seems plausible that the institutions of *national* political systems will in any case continue to play an *important role*, even if the governance of innovation policy in Europe becomes more “postnational”: nation states functioning at least ideally as guarantors of the rule of law “on the spot” as well as providing legitimisation for the growing number of transnational political arrangements. While nation state authorities have already been active for decades in providing infrastructures and in stimulating innovation-oriented initiatives — a field in which now also the regional and transnational level will become increasingly active — new tasks will devolve on nation state authorities in the field of regulation (e.g. in designing framework conditions for international research), also as catalysts and mediators between the levels — in the absence of other experienced bodies with adequate legitimate authority.

An “ideal” postnational innovation policy in an integrated Europe would strive to mobilise related institutions and actors across arenas and levels in order to create favourable conditions for the development of lead markets and simultaneously effect a balance between prosperous and “less favoured” regions through redistribution. The partly dramatic present and future economic and social exclusions and inclusions as a consequence of the increased economic integration and competition within Europe and also globally (Soete, 1999) could probably be mitigated with the help of a strategically oriented, mediated multi-level innovation policy.

Acknowledgements

This paper has benefited greatly from comments and suggestions by Jacob Edler, ISI, and an anonymous referee of this journal.

References

- Airaghi, A., Busch, N., Georghiou, L., Kuhlmann, S., Ledoux, J.M., van Raan, A., Viana Baptista, J., 1999. Options and Limits for Assessing the Socio-Economic Impact of European RTD Programmes. Report to the European Commission.
- Almond, G.A., 1960. Introduction: a functional approach to comparative politics. In: Almond, G.A., Coleman, J.S. (Eds.), *The Politics of the Developing Areas*. Princeton University Press, Princeton, pp. 3–64.
- Almond, G.A., Coleman, J.S. (Eds.), 1960. *The Politics of the Developing Areas*. Princeton University Press, Princeton.
- Amable, B., Barré, R., Boyer, R., 1997. Les systèmes d’innovation à l’ère de la globalisation. *Economica*, Paris.
- Apter, D.E., 1996. Comparative politics, old and new. In: Goodin, R.E., Klingemann, H.-D. (Eds.), *A New Handbook of Political Science*. Oxford University Press, Oxford, pp. 372–397.
- Bach, M., 1997. Transnationale Institutionenpolitik: Kooperatives Regieren im politisch-administrativen System der Europäischen Union. In: König, Th., Rieger, E., Schmitt, H. (Eds.), *Europäische Institutionenpolitik*. Campus, Frankfurt, pp. 178–199.
- Bertrand, G., Michalski, A., Pench, L.R., 1999. Scenarios Europe 2010. Five possible futures for Europe. Working paper of the Forward Studies Unit of the European Commission, Brussels. http://europa.eu.int/comm/cdp/scenario/scenarios_en.pdf.
- Bulmer, S.J., 1994. The governance of the European Union: a new institutionalist approach. *Journal of Public Policy* 13 (4), 351–380.
- BMBF (Bundesministerium für Bildung und Forschung), 1999. Zur technologischen Leistungsfähigkeit Deutschlands. Zusammenfassender Endbericht 1998. Gutachten vorgelegt durch das Zentrum für Europäische Wirtschaftsforschung, Mannheim, das Niedersächsische Institut für Wirtschaftsforschung, Hannover, das Deutsche Institut für Wirtschaftsforschung, Berlin, das Fraunhofer-Institut für Systemtechnik und Innovationsforschung, Karlsruhe, die Wissenschaftsstatistik im Stifterverband für die Deutsche Wissenschaft, Essen, das Wissenschaftszentrum für Sozialforschung, Berlin. BMBF, Bonn.
- Brazcyk, H.-J., Cooke, P., Heidenreich, M. (Eds.), 1998. *Regional Innovation Systems*. University College London Press, London.
- Callon, M., 1992. The dynamics of techno-economic networks. In: Coombs, R., Saviotti, P., Walsh, V. (Eds.), *Technological Change and Company Strategies: Economic and Sociological Perspectives*. Academic Press, London, pp. 72–102.
- Caracostas, P., Muldur, U., 1998. Society, the endless frontier — a European vision of research and innovation policies for the 21st century. Office for Official Publications of the European Communities, Luxembourg, EUR 17655.
- Cooke, Ph., Boekholt, P., Tödtling, F., 2000. *The Governance of Innovation in Europe*. Pinter, London.
- Dyson, K., 1994. *Elusive Union: The Process of Economic and Monetary Union in Europe*. Longman, London.
- Easton, D., 1953. *The Political System. An Inquiry into the State of Political Science*. Alfred A. Knopf, New York.
- Edler, J., 2000. *Institutionalisierung Europäischer Politik*. Nomos, Baden-Baden.
- Edquist, Ch. (Ed.), 1997. *Systems of Innovation. Technologies, Institutions and Organizations*. Pinter, London.
- Eising, R., Kohler-Koch, B. (Eds.), 1999. *Governance in the European Union: A Comparative Assessment. The Transformation of Governance in the European Union*. Routledge, London, pp. 267–285.
- Ergas, H., 1987. Does technology policy matter? In: Guile, B.R., Brooks, H. (Eds.), *Technology and Global Industry. Companies and Nations in the World Economy*. National Academy Press, Washington, DC, pp. 191–245.

- Etzkowitz, H., Leydesdorff, L., 2000. The dynamics of innovation: from national systems and mode-2 to a triple helix of university–industry–government relations. *Research Policy* 29, 109–123.
- EUREKA, 1999. <http://www.eureka.be/home/index.html>.
- European Commission, 1999. <http://europa.eu.int/comm/dg12/fp5.html>.
- European Commission, 2000a. Towards a European research area. Communication from the Commission to the Council, the European Parliament, the Economic and Social Committee and the Committee of the Regions, Brussels, 18 January 2000, COM (2000) 6.
- European Commission, 2000b. Governance and Citizenship in Europe. Some research directions. In: Conference proceedings, Brussels, EUR 19313.
- Falkner, G., 1998. *EU Social Policy in the 1990s: Towards a Corporatist Policy Community*. Routledge, London.
- Freeman, C., 1987. *Technology Policy and Economic Performance: Lessons from Japan*. Pinter, London.
- Georghiou, L., et al., 1993. *The Impact of European Community Policies for Research and Technological Development upon Science and Technology in the United Kingdom*. HMSO, London.
- Georghiou, L., van Batenburg, O., Chevillot, J.-P., Kuhlmann, S., Oral, M., Reeve, N., 1999. *Strategic Review of EUREKA — Building Europe's Innovation Network*. EUREKA Secretariat, Brussels.
- Gerybadze, A., Meyer-Krahmer, F., Reger, G., 1997. *Globales Management von Forschung und Innovation*. Schäffer-Poeschel, Stuttgart.
- Grande, E., 1995. Regieren in verflochtenen Verhandlungssystemen. In: Mayntz, R., Scharpf, F.W. (Eds.), *Gesellschaftliche Selbstregulierung und politische Steuerung*. Campus, Frankfurt, pp. 327–368.
- Grande, E., 1996. The state and interest groups in a framework of multi-level decision-making: the case of the European Union. *Journal of European Public Policy* 3 (3), 318–338.
- Guzzetti, L., 1995. *A Brief History of European Research Policy*. Office for Official Publications of the European Communities, Brussels.
- Hagedoorn, J., Schakenraad, J., 1990. Inter-firm partnerships and co-operative strategies in core technologies. In: Freeman, C., Soete, L. (Eds.), *New Explorations in the Economics of Technological Change*. London, pp. 3–37.
- Haklisch, C., Fusfeld, H., Levenson, A., 1986. *Trends in Collective Industrial Research*. Center of Science and Technology Policy, New York University, New York.
- Hirst, P., Thompson, G., 1996. *Globalization in Question. The International Economy and the Possibilities of Governance*. Polity Press, Cambridge.
- Hix, S., 1998. The study of the European Union II: the new governance agenda and its rivals. *Journal of European Public Policy* 5 (1), 38–65.
- Hooghe, L. (Ed.), 1996. *Cohesion Policy and European Integration*. Clarendon Press, Oxford.
- Hollingsworth, R., Boyer, R. (Eds.), 1997. *Contemporary Capitalism. The Embeddedness of Institutions*. Cambridge University Press, Cambridge.
- Howells, J., 1999. Regional systems of innovation? In: Archibugi, D., Howells, J., Michie, J. (Eds.), *Innovation Policy in a Global Economy*. Cambridge University Press, Cambridge, pp. 67–93.
- Jansen, D., 1996. Nationale Innovations systeme, soziales Kapital und Innovations strategien von Unternehmen. *Soziale Welt* 47 (4), 411.
- Jungmittag, A., Meyer-Krahmer, F., Reger, G., 1999. Globalisation of R&D and technology markets — trends, motives, consequences. In: Meyer-Krahmer, F. (Ed.), *Globalisation of R&D and Technology Markets: Consequences for National Innovation Policies. Technology, Innovation, and Policy. Series of the Fraunhofer Institute for Systems and Innovation Research (ISI) Vol. 9*, Physica-Verlag, Berlin, pp. 37–78.
- Kassim, H., 1994. Policy networks, and the European Union policy-making: a sceptical view. *West European Politics* 17 (4), 15–27.
- Keck, O., 1993. The national system for technical innovation in Germany. In: Nelson, R.R. (Ed.), *National Innovation Systems. A Comparative Analysis*. Oxford University Press, New York, pp. 115–157.
- Kohler-Koch, B., 1996. Catching up with change: the transformation of governance in the European Union. *Journal of European Public Policy* 3 (3), 359–380.
- Kohler-Koch, B., Edler, J., 1998. Ideendiskurs und Vergemeinschaftung. Erschließung transnationaler Räume durch Europäisches Regieren. In: Kohler-Koch, B. (Ed.), *Regieren in entgrenzten Räumen. PVS-Sonderheft 29*, Opladen, pp. 192–206.
- Kohler-Koch, B., Eising, R. (Eds.), 1999. *The Transformation of Governance in the European Union*. Routledge, London.
- Kooiman, J. (Ed.), 1993. *Modern Government. New Government — Society Interaction*. London.
- Krull, W., Meyer-Krahmer, F. (Eds.), 1996. *Science and Technology in Germany*. Cartermill, London.
- Kuemmerle, W., 1999. Foreign direct investment in industrial research in the pharmaceutical and electronics industries — results from a survey of multinational firms. *Research Policy* 28, 179–193.
- Kuhlmann, S., 1998a. *Politikmoderation. Evaluationsverfahren in der Forschungs- und Technologiepolitik*. Nomos, Baden-Baden.
- Kuhlmann, S., 1998b. Moderation of policy-making? Science and technology policy evaluation beyond impact measurement: the case of Germany. *Evaluation* 4 (2), 130–148.
- Kuhlmann, S., 1999. Politisches System und Innovations system in postnationalen Arenen. In: Grimmer, K., Kuhlmann, S., Meyer-Krahmer, F. (Eds.), *Innovationspolitik in globalisierten Arenen*. Leske + Budrich, Leverkusen, pp. 9–37.
- Kuhlmann, S., et al., 1999. *Distributed Intelligence in Complex Innovation Systems. Final report of the Advanced Science and Technology Policy Planning Network (ASTPP)*, Karlsruhe. <http://www.isi.fhg.de/abt/g/ti/pb.html/final.pdf>.
- Landabaso, M., 1997. The promotion of innovation in regional policy: proposals for a regional innovation strategy. *Entrepreneurship and Regional Development* 9, 1–24.
- Larédo, P., 1995. *The Impact of Community Research Programmes in France*. Paris (Les Presses de l'Ecole des Mines).
- Lindberg, L., Scheingold, S., 1970. *Europe's Would-be Polity*. Prentice-Hall, Englewood Cliffs, NJ.

- Link, A.N., Rees, J., 1990. Firm size, university based research, and the returns to R&D. *Small Business Economics* 2, 25–31.
- Lundvall, B.-Å. (Ed.), 1992. *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*. Pinter, London.
- Lundvall, B.-Å., Maskell, P., 1999. Nation states and economic development — from national systems of production to national systems of knowledge creation and learning. In: Clark, G.L., Feldmann, M.P., Gertler, M.S. (Eds.), *Handbook of Economic Geography*. Oxford University Press, Oxford.
- Lundvall, B.-Å., Tomlinson, 2000. On the convergence and divergence of national systems of innovation. Paper presented at the Volkswagen Foundation Symposium on Prospects and Challenges for Research on Innovation. Berlin, 8–9 June, 2000.
- Mansfield, E., Lee, J.-Y., 1996. The modern university: contributor to industrial innovation and recipient of industrial R&D support. *Research Policy* 25, 1047–1058.
- Marin, B., Mayntz, R., 1991. *Policy Networks. Empirical Evidence and Theoretical Considerations*. Campus, Frankfurt, Westview Press, Boulder.
- Marks, G., Scharpf, F.W., Schmitter, Ph.C., Streeck, W., 1996. *Governance in the European Union*. Sage, London.
- Mayntz, R., 1987. Politische Steuerung und gesellschaftliche Steuerungsprobleme — Anmerkungen zu einem theoretischen Paradigma. In: Ellwein, Th., et al. (Eds.), *Jahrbuch zur Staats- und Verwaltungswissenschaft 1. Nomos, Baden-Baden*, pp. 89–110.
- Meyer-Krahmer, F., 1999. Was bedeutet Globalisierung für Aufgaben und Handlungsspielräume nationaler Innovationspolitiken? In: Grimmer, K., Kuhlmann, S., Meyer-Krahmer, F. (Eds.), *Innovationspolitik in globalisierten Arenen. Neue Aufgaben für Forschung und Lehre: Forschungs- und Technologiepolitik im Wandel*. Leske + Budrich, Leverkusen, pp. 35–65.
- Meyer-Krahmer, F., Reger, G., 1999. New perspectives on the innovation strategies of multinational enterprises: lessons for technology policy in Europe. *Research Policy* 28, 751–776.
- Meyer-Krahmer, F., Reger, G., Archibugi, D., Durand, Th., Molero, J., Pavitt, K., Soete, L., Sölvell, Ö., 1998. Internationalisation of Research and Technology: Trends, Issues, and Implications for Science and Technology Policies in Europe. ETAN Working Paper EUR 18762, prepared for the European Commission, Brussels.
- Narula, R., Hagedoorn, J., 1997. Globalization, Organisational Modes and the Growth of International Strategic Technology Alliances. MERIT Research Memorandum, Maastricht.
- Nelson, R.R. (Ed.), 1993. *National Innovation Systems: A Comparative Analysis*. Oxford University Press, Oxford.
- Niosi, J. (Ed.), 1999. The Internationalization of Industrial R&D. *Research Policy (Special Issue)* 28 (2–3), 107–336.
- North, D.C., 1990. *Institutions, Institutional Change and Economic Performance*. Cambridge University Press, Cambridge.
- Olsen, J.P., 2000. Organizing European Institutions of Governance. In: European Commission (Ed.), *Governance and Citizenship in Europe. Some research directions; proceedings of a workshop held in Brussels on 8–9 September 1999*, pp. 9–16.
- Pavitt, K., Patel, P., 1999. Global corporations and national systems of innovation: who dominates whom? In: *Innovation Policy in a Global Economy*. Cambridge University Press, Cambridge, pp. 94–119.
- Pauly, L.W., 1999. Globalisation and the multinational corporation. Paper presented at the conference National Systems of Innovation and the Idea-Innovation Chain, Netherlands Institute for Advanced Study in the Humanities and Social Sciences (NIAS), Wassenaar, 27–29 January, 1999.
- Pearce, R.D., 1999. Decentralised R&D and strategic competitiveness: globalised approaches to generation and use of technology in multinational enterprises (MNEs). *Research Policy* 28, 157–178.
- Peterson, J., 1995. Policy networks and European Union policy making: a reply to Kassim. *West European Politics* 18 (2), 380–407.
- Peterson, J., Sharp, M., 1998. *Technology Policy in the European Union*. St. Martin's Press, New York.
- Porter M.E., 1990. *The Competitive Advantage of Nations*. Macmillan, London.
- Reger, G., 1997. *Koordination und strategisches Management internationaler Innovationsprozesse*. Dissertation, University of St. Gallen. Bamberg, Difo-Druck.
- Reger, G., Kuhlmann, S., 1995. *European Technology Policy in Germany*. Physica/Springer series Technology, Innovation, and Policy, Vol. 2, Heidelberg.
- Reger, G., Beise, M., Belitz, H. (Eds.), 1999. *Internationalisierung technologischer Kompetenzen: Trends und Wirkungen in den Schlüsseltechnologien Pharmazie, Halbleiter und Telekommunikation*. Physica/Springer, Heidelberg.
- Reinicke, W.H., 1998. *Global Public Policy. Governing without Government?* Brookings Institution Press, Washington, DC.
- Rhodes, R.A.W., 1995. The new governance: governing without government, revised version of a lecture delivered to the RSA/ESRC Joint Initiative on The State of Britain. RSA, London, 1995, p. 24.
- Roobeek, A.J.M., 1990. *Beyond the Technology Race. An Analysis of Technology Policy in Seven Industrial Countries*. Elsevier, Amsterdam.
- Rosenau, J., Czempiel, E.-O. (Eds.), 1992. *Governance without Government: Order and Change in World Politics*. Cambridge University Press, Cambridge.
- Roterberg, Ch., 1990. *Forschungs- und Entwicklungskooperationen zwischen Unternehmen. Eine empirische Analyse*. Poeschel, Stuttgart.
- Sandholtz, W., Sweet, A.S., 1998. Integration, supranational governance, and the institutionalization of the European polity. In: Sandholtz, W., Sweet, A.S. (Eds.), *European Integration and Supranational Governance*. Oxford University Press, Oxford, pp. 1–26.
- Scharpf, F.W. (Ed.), 1993. *Games and Hierarchies and Networks*. Campus, Frankfurt, Westview, Boulder.
- Scharpf, F.W., 1998. Globalisierung als Beschränkung der Handlungsmöglichkeiten nationalstaatlicher Politik. In: Schenk, K.-E., Schmidtchen, D., Streit, M.E., Vanberg, V. (Eds.), *Jahrbuch für Neue Politische Ökonomie, Vol. 17, Globalisierung, Systemwettbewerb und nationalstaatliche Politik*. Mohr, Tübingen, pp. 41–66.
- Schmitter, Ph.C., 1996. Imagining the future of the Euro-Polity with the help of new concepts. In: Marks, G., Scharpf,

- F.W., Schmitter, Ph.C., Streeck, W. (Eds.), *Governance in the European Union*. Sage, London, pp. 121–150.
- Schön, D., Rein, M., 1994. *Frame Reflection. Toward the Resolution of Intractable Policy Controversies*. BasicBooks, New York.
- Sharp, M., 1999. The need for new perspectives in European Commission innovation policy. In: Paper presented at the European Socio-Economic Research conference, Brussels, 28–30 April, 1999.
- Shaw, J., 2000. The governance research agenda and the constitution question. In: Proceedings of a Workshop held in Brussels on 8–9 September. European Commission, Governance and Citizenship in Europe. Some research directions. 1999, pp. 22–25.
- Soete, L., 1999. The new economy: a European perspective. Paper presented at the European Socio-Economic Research conference, Brussels, 28–30 April, 1999.
- Strange, S., 1992. The Transformation of Europe from an International Perspective (Abstract). In: Kohler-Koch, B. (Ed.), *Staat und Demokratie in Europa*, Vol. 18. Wissenschaftlicher Kongress der Deutschen Vereinigung für Politische Wissenschaft. Leske + Budrich, Opladen, pp. 308–310.
- Streeck, W., 1996. Public power beyond the nation state: the case of the European Community. In: Boyer, R., Drache, D. (Eds.), *States Against Markets. The Limits of Globalization*. Routledge, London, pp. 299–315.
- Teece, D., 1986. Profiting from technological innovation: implications for integration, collaboration, licensing and public policy. *Research Policy* 15 (6), 285–305.
- Trischler, H., vom Bruch, R., 1999. In: Beck, C.H. (Ed.), *Forschung für den Markt. Geschichte der Fraunhofer-Gesellschaft*. München.
- van der Meulen, B., Rip, A., 1994. *Research Institutes in Transition*. Eburon, Delft.
- Wallace, H., Wallace, W., 1996. *Policy-Making in the European Union*, 3rd Edition. Oxford University Press, Oxford.
- Weiler, J.H.H., 1991. The transformation of Europe. *Yale Law Journal* 100, 2403–2483.
- Wessels, W., 1999. Das politische system der Europäischen Union. In: Ismayr, W. (Ed.), *Die politischen Systeme Westeuropas*. Leske + Budrich, Opladen, pp. 713–745.
- Whitley, R., 1998. Innovation Strategies, Business Systems and the Organisation of Research. Paper prepared for the Sociology of Sciences Yearbook meeting held at Krusenberg, Sweden, 24–27 September, 1998.
- Whitley, R., Kristensen, P.H. (Eds.), 1996. *The Changing European Firm: Limits to Convergence*. Routledge, London.
- Wolff, H., Becher, G., Delpho, H., Kuhlmann, S., Kuntze, U., Stock, J., 1994. *FuE-Kooperation von kleinen und mittleren Unternehmen. Bewertung der Fördermaßnahmen des Bundesforschungsministeriums*. Physica/Springer, Heidelberg.