Knowledge Economies

Clusters, learning and cooperative advantage

Philip Cooke

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Today, concerns about national competitiveness and economic development are closely linked to notions of the information society and knowledge-based economies. Some see the emergence of a 'new economy', which is based on information, communication, media and biotechnologies. As in previous bursts of economic growth, these innovative industries emerge and grow in specific geographic locations, now called 'clusters'. The well-known case of Silicon Valley was merely the first of a large number of such clusters to have developed in recent years. It is argued that clusters are characterized by cooperative and competitive, trustful and rivalrous, exchange and favour-based business interactions.

This book traces the theoretical explanation for clusters back to the work of classical economists and their more modern disciples who saw economic development as a process involving serious imbalances in the exploitation of resources. First, natural resource endowments explained the formation of nineteenth- and early twentieth-century industrial districts. Today geographical concentrations of scientific and creative knowledge are the key resource. But these require a support system, ranging from major injections of basic research funding, to varieties of financial investment and management, and specialist incubators for economic value to be realized. These are also specialized forms of knowledge that contribute to a serious imbalance in the distribution of economic opportunity.

The key question is whether the techniques of cluster building can be learned and promotional policies implemented to offset the natural imbalances in the distribution of these specialized knowledge resources. Developing on the idea of multi-level governance and policy-making, *Knowledge Economies* reviews cases where national governments working intelligently with regional, local and, in Europe, supra-national governance organizations, have been able to implant clusters in places that previously did not have them. Learning about the nature of clusters, and from experiences in developing them with the help of policy intervention, will assist the process of strengthening existing ones, developing new ones and revitalizing older ones. In the process, the goals of regional equity and competitiveness should be enhanced.

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Abbreviations

BMBF	Ministry of Education, Science, Research and Technology (Germany)
BTH	Biotechnology Centre Heidelberg
CAE	Cambridge Advanced Electronic
CNOC	Company Network Operations Command Centre
DKFZ	(Helmholtz) Cancer Research Centre
DTI	Danish Technological Institute
ERBI	Eastern Region Biotechnology Initiative
ERP	Enterprise Resource Planning
EU	European Union
FE	further education
FISPA	Finnish Science Park Association
HE	higher education
HI	Heidelberg Innovation GmBH
ICT	Information and Communication Technology
IDB	Industrial Development Board
IPO	initial public offering
IPR	intellectual property rights
IRTU	Industrial Research and Technology Unit
IZB	Biotechnology Innovation Centre
KP	Kleiner Perkins
LEDU	Local Economic Development Unit
MDA	Multimedia Development Association
MIT	Massachusetts Institute of Technology
MMI	Molecular Machines and Industries
MNC	multinational corporation
MPI	Max Planck Institute
NEIS	New Economy Innovation System
NIC	Newly Industrialized Country
NISPF	Northern Ireland Science Park Foundation
NIST	National Institute of Standards and Technology
NRW	North Rhine-Westphalia
OECD	Organization for Economic Cooperation and Development

PCB	printed circuit board
PCI	Italian Communist Party
POP	point of presence
PSI	Italian Socialist Party
R&D	research and development
RIS	Regional Innovation System
RITTS	Regional Innovation and Technology Transfer Strategies
RLB	Rover Learning Business
ROI	Republic of Ireland
ROW	Rest of World
RTZ	Rechtrheinisches Technologie Zentrum
SBIR	Small Business Innovation Research
SME	small and medium-sized enterprise
SONET	Synchronous Optical Network
TBC	Technology Business Council
TEC	Training and Enterprise Council
TEKES	Finnish Technology Development Centre
TI	Texas Instruments
TMT	technology, media and telecoms
TPZ	Future Technology Programme
TTN	Technology Training Network
TVEP	Thames Valley Economic Partnership
VC	venture capital
VTT	State Technical Research Centre (Finland)

1 Clusters, collective learning and disruptive economic change

Introduction

This book explores a particular economic phenomenon of our time, the emergence and development of industry *clusters*, asking the question why this kind of industrial organization reappeared in the advanced economies after it had more or less disappeared in the mid-twentieth century. It sets that question in the framework of a much larger one that has troubled many development economists, regional scientists and politicians with a concern about social and geographical inequality since Malthus first asked Ricardo why some nations are rich and others poor. This larger question was investigated recently and not entirely satisfactorily answered by David Landes (1998) who explained it in terms of the presence or absence of a cultural will to 'live for work'. Tautology apart, to live for work entails some things that this book is also interested in, namely, capabilities of learning and innovation as key economic instruments. These two concepts are at the heart of the idea of a 'knowledge economy'. But what Landes and others, like Fukuyama (1995; 1999) regard as normal, that is, individualistic competition in an ordered, economic equilibrium where thrift and honesty are justly rewarded, the argument that develops over the next eight chapters takes as abnormal. The knowledge economy consists of fragmentary 'knowledge economies'. This is for three key reasons concerning, first, *disequilibrium* or economic and social imbalance, which is not presumed to be unusual but quite the contrary. Second, *collaborative* economic action, is presented here as the most important organizational aspect of modern capitalism, but also one that has been vital to market economies from the start, despite the presumption in much economics that only individuals matter. While, third, the *systemic* nature of strategic competitiveness in the capabilities of specific groups of private and public actors to produce and implement actions based on consensus is of more importance than individual opportunism.

These are not particularly original points of divergence from orthodoxy. They are shared widely among a wide range of more heterodox thinkers who are interested in the social economy and take an evolutionary perspective on economic change, influenced particularly by the ideas of Joseph Schumpeter about the causes of such change. As is well known, Schumpeter was interested

in *entrepreneurship*, but became even more interested in understanding innovation as a process that certain kinds of entrepreneur facilitated. Hence, he also fell into the trap of focusing on disruptive economic change as an effect of heroic individual genius. This was the legacy of the influence of Nietzsche's philosophy on his work, as is shown in Chapter 2. That this never really left him is testified to by the displacement of entrepreneurial heroism from the individual innovator to the R&D engineer in the large corporation, where his studies in the USA led him to conclude the modern wellsprings of innovation lay. In this book the real sources of contemporary innovation are shown residing in neither the individual entrepreneur nor the research laboratories of large firms but in networks of social relationships between such organizations and others of consequence to the discovery being sought and commercialized. Revealing the circuitry of knowledge economies is a complex task because it means finding out how the processes of knowledge generation and transfer to the point of exploitation function.

Recent research on what are popularly called 'new economy' industries like Internet content provision show the importance of knowledge networks and the very high value within them of enterprise support contacts, notably varieties of investment manager, 'venture catalyst', and 'incubation' or early-stage venture capitalist (Cooke, 2000; Zook, 2000; Keeble and Nachum, 2001; Sternberg, 2001). These are valued most for their scarce management expertise, despite a common assumption that it is their investments that count most. High, localized correlations between such businesses and services outweigh those between dot.coms and scientific or technological labour. However, occasionally the circuitry can be illuminated by exploring how it doesn't function or ceases to function when it once did. Much of the research that helps to do this is discussed in Chapters 7 and 8. Proving the negative is more difficult than demonstrating the positive, and researching failed cases is far less glamorous or marketable than disclosing 'new industrial spaces' which is why there is less material to call on to explain failures. Nevertheless, the book explores some in the homeland of industry clusters, the 'industrial age' districts near Manchester and Birmingham in the UK.

What the book tries to show as convincingly as possible is that clusters are crucial to economic imbalance, that they rest upon collaboration of a generally non-market-destroying type that is simply essential for modern economic organization, and that clusters have systemic organizational characteristics that go against much economic orthodoxy. For example, in Norton's (2000) book on the 'new economy,' he draws on Micklethwait and Woolridge's (2000) book which summarizes the economy culture of Silicon Valley as conveying a sense of loyalty to the place rather than the firm. This is expressed in such practices as reinvestment in the community, collaboration and 'tolerance of treachery'. The last of these lends a certain Hobbesian flavour to the composition and provokes a query about what is often said to be a key character of clusters in such places, their high ratio of trust in business transactions. Yet it is consistent with the thesis that *knowledge is in the networks* because each move in the interactive

innovation process requires learning from others than those involved in the preceding move. So dropping a partner, competing against them for a contract, but maybe returning to them for its implementation, or for a future contract bid are not seen as bad form. On the contrary, these are the means by which the wellsprings of creativity flow and a key source of the 'spillovers' (Anselin *et al.*, 1997) that knowledge economies need and clusters supply. Recognition of the need to reproduce that characteristic is captured in the practice of reinvesting individual wealth generated back into the community, often as business angel investment. But collaboration is a key means by which that wealth is accumulated in the first place.

This brings us to the geographical dimension of clustering for learning, knowledge transfer, collaboration and the exploitation of spillovers. The argument here is that clusters are geographically localized and this causes imbalances between local areas that have them and those that do not. This has repercussions upwards to regions within countries and between countries themselves when the clusters in question have sufficient economic weight. London's financial cluster and Silicon Valley's Information and Communication Technology (ICT) cluster have a disproportionate impact on the trade balances of the UK and the USA. Italy's cluster areas in its north-central belt are far more prosperous than the Mezzogiorno region where they do not exist, something which is reversed in Germany where the south with automotive and ICT clusters is richer than the north whose 'industrial age' clusters are in decline.

Because clusters are focused geographical settings where industry specialization occurs, they develop external economies of scope and scale that it was once thought only single, large firms could manage. Modern ICT assists the routine part of this such as transmission of software, databases, designs and other forms of codified knowledge. But proximity in a cluster offers the opportunity for tacit knowledge exchange or 'treacherous' learning that may be hindered in large firms by 'group-think' and corporate culture. This is what accounts for the observation by de Geus (1997) that the average age of most large firm identities is around forty years. Large firms that do not conform to that fate change themselves, like Nokia, and survive much longer. So, in general, under contemporary knowledge-intensive market and competitiveness conditions it pays to be in a cluster or to simulate the kind of synergies from corporate re-design and re-invention that cluster networks supply.

This brings us to a key point about knowledge economies and their definition. Clearly, all human economic activity depends upon knowledge so, in a trivial sense, all economies are 'knowledge economies'. But because knowledge cannot be possessed in the way, for example, gold can, it can be appropriated by anyone capable of using it. This is despite the fact that it must be protected by patents. These after all are mainly a means for securing some economic return to invention rather than keeping knowledge confidential. There are three key issues: first, knowledge ages and is superseded by new knowledge that ideally requires what Johnson (1992) calls 'creative forgetting', namely, the stowing away of redundant knowledge and the learning of new. This can be a long and

painful process, an illuminating, failed example of which is given in Chapter 7 where the massive gap between management rhetoric about the imperative to become a learning organization at the Rover car company and its actual practices in the succeeding decade bears witness to at best management inadequacy and at worst, deep managerial cynicism of a kind that typically accompanies inability to learn how to implement actions arising from new knowledge. Second, the kind of knowledge that is frequently high value nowadays is scientific, including social scientific. This is not new existentially but its scale and economic penetration are. Thus, so-called 'scientific management' was practised at Ford plants in the first quarter of last century, ultimately proving fatal to craft-based production methods in the car industry. Innovations from the Gilchrist-Thomas to the Bessemer processes and beyond in steel-making were scientifically knowledge-intensive, but new knowledge of electric arc production, for example, meant steel did not need to be produced mainly in ever-expanding works but in more localized, customized mini-mills where economies of scope (variety) could outweigh those of scale. This arose from the interaction of scientific knowledge about production and social scientific about management and markets.

A good example of an 'old economy' industry that has become more scientifically 'knowledge-embedded' is food production. It is shown in Chapter 6 how important agricultural research institutes in East Anglia continue to be to the development of agro-food businesses in the UK, not least in their questionable contribution to the application of biotechnology to this industry. In a more wide-ranging analysis of the embedding of scientific research in a specific food industry value-chain, Smith (2000) and colleagues mapped the nine key stages in the Norwegian chain and related these to their knowledge-content and knowledge suppliers. For preparation of raw materials, processing, preservation and packing thirteen different private and public laboratories were engaged. For hygiene and food safety, eleven, including some of those involved in preparation, etc., were involved, and for quality control, logistics, marketing and sales, eleven, again including some used in previous stages, were found to be knowledge suppliers. Thus the food industry in Norway and conceivably elsewhere in comparably developed economies is knowledge-intensive and relies on this characteristic to be competitive. But, as Smith points out, it is not a particularly research and development (R&D) intensive industry and its workforce is not in itself directly processing scientific knowledge, making as Castells (1996, p. 17) puts it: 'the action of knowledge upon knowledge itself as the main source of productivity'. The modern food industry is thus knowledge-using but not knowledge-creating, it learns but does not necessarily tutor scientifically and this must be one of the reasons why it is placed, and possibly misplaced, in the low-technology manufacturing category of the OECD (1999) index of 'knowledge-based industry'.

Thus, third, knowledge economies are not defined in terms of their use of scientific and technological knowledge, including their willingness to update knowledge and 'creatively forget' old knowledge through learning. Rather, they

are characterized by exploitation of new knowledge in order to create more new knowledge. This need not be scientific or technological alone, it can be creative knowledge in the artistic, design or musical senses of knowledge. An example of this occurs with 'sampling' in music, which gives an innovative, creative role to knowledgeable deejays who, instead of merely plugging mass-produced records in linear fashion according to formulaic corporate interpretations of popular taste, deploy their own musicologies to evolve a new form from the imaginative appropriation of authentic sources, thereby creating a new authenticity. This is reminiscent of post-modern architecture, except that its realization in built form was not normally accompanied by the elevation of the property agent to star status in place of the architect. In the technological sphere, an example of knowledge acting upon itself as the main source of productivity is software engineering where written code forms the knowledge base for applications in the form of new code. Another is in biotechnology where the discovery of the genetic code structure allows 'sampling' or the recombination of DNA to produce therapeutic products for healthcare or food product application, while the de-coding of the human genome both creates opportunities for value-creation and opens up the need to discover the biochemistry of proteins, giving rise to the new knowledge field of proteomics. To the extent genomics and proteomics give rise to superior tests or drugs to those presently available at comparable cost, knowledge is acting on knowledge itself to enhance productivity.

In yet another version, the Digital Economy, the digitization of knowledge, meaning its transformation from analogue, real-world images, voice or text into digitized form on-line, on a CD-ROM or floppy disk means the initial form of the knowledge becomes a resource in a value chain. The next step after compression and storage of the digitized knowledge (as yet a resource to be mined, rather than knowledge having been acted upon to create new knowledge value) is for a knowledge-bearing user to access those elements in the digitized resource that they aim to transform into a new product. The entrepreneur will seek to make a profitable product, the organization may only seek to produce a socially useful product. The product could be a new media 'open learning' training course, a television programme or a cultural product, combining in a creative and imaginative way possibly dusty archive material into Internet or off-line content. The producer may contract to a marketing agent or publisher to sell the product and at each transactional point value accrues from knowledge acting upon knowledge. At specific points, such as that which demands a new or enhanced technology to 'mine' or locate the sought-after elements in the digital resource, innovative knowledge from, say, the software industry is brought into a conceivably high value adding but temporary (if the digital resource locator is itself commodified) position in the digital value chain (Williams, 2000). Customer and supplier may have found each other in Yellow Pages or, more likely, they may have been put together by a venture-manager with equity shares in both and who gains value from traded interdependencies. Far less likely, they might reciprocate without arm's-length exchange, at least in the customer exchanging their tacit knowledge of what service is required to

mine the data 'warehouse', thereby giving the supplier the idea for a profitable innovation, in a relationship of untraded interdependencies. Either way, this is how clustering occurs in Knowledge Economies. The Digital Economy is an aspect of and electronic underpinning to Knowledge Economies, and they constitute what is often more popularly called the New Economy.

The imbalance problem and its governance

If clusters create imbalance and reinforce a predominant tendency present in market economies, what should be done to go beyond Malthus' question to develop some policy prescriptions for moderating the disparities they produce? This is really a different and much asked question of regional and industrial policies as well as those concerning development disparities at an international scale. Either the problem is insoluble, something the theoretical burden of the book presses ineluctably on the mind in Chapter 2, because it is an endemic feature of the generic mode of economic organization, or it is, if not soluble, capable of reversal in certain times and places. If there are cases of that, they can be investigated and lessons learned. They may not be directly applicable everywhere, but the notion that a policy accomplishment in one setting is not transferable to another both belies economic history and denies human ingenuity. How did Japan develop in the second part of the twentieth century? By copying the West. How did Japan industrialize in the second half of the nineteenth century? By copying the West. How did South Korea develop economically? By copying Japan. The economic history of every economy is littered with borrowings, some successful, many not, from other countries.

One of the problems of copying rather than learning and adapting with constant monitoring is revealed in the recent history of Japan. A thoughtful contribution by Nonaka and Reinmöller (1998) refers to the legacy of learning in the present Japanese downturn, which stemmed from a too obsessive copying of Western growth characteristics in mass-production industries. This required vast mobilization of national resources to stimulate consumer goods industries and the capital goods production to sustain them. But as hindsight shows, big investments in the West were being made, mainly by public investment in scientific research, that gave birth to industries now central to the New Economy, or the TMT sectors of telecoms, media and technology, where Japanese firms are not as strongly represented. The former is what Porter *et al.* (2000) call the uncompetitive half of the two economies of Japan. It is not so long ago that similar things were being said about the US economy's manufacturing weaknesses but less is heard about that presently (Dertouzos *et al.*, 1989). The key to overcoming the legacy of learning according to Nonaka and Reinmöller is recognition that no matter how great the efficiency and speed of exogenous learning, it is no substitute for endogenous knowledge creation. In Japan, the development strategy was insufficiently regionalized, too centrally managed and accordingly, too dependent on learning from other countries. Now policy needs to support regionalized knowledge creation to raise the diversity of possible

innovations by stimulating inter-organizational interaction in networks and clusters. The case of Taiwan is presented as one in which such an approach was successfully pursued.

This is the central issue to be explored in this book, namely, to what extent can a decentralized industrial policy bring about regionalized industrial diversity by promoting networking and clustering and, by contrast, to what extent are such processes inaccessible to policy intervention? If the former is found to be feasible, in what ways have policy practices helped, and if the latter, are there specific points where policies are necessary even though the whole process is mostly market-driven? But to begin to answer such questions a good understanding is needed of reasons why cluster formation has become more pronounced, often characterizing Knowledge Economies, than for a century and what modern governance mechanisms need to be capable of if they are to have any role in moderating effects of imbalance while still assisting the processes in question. Nowadays, this needs to be understood particularly in the context of *regional* imbalance. Thus, in an increasingly information-saturated society and an advanced knowledge-based economy, it is fairly obvious that regions with universities have more potential to promote cluster-building activities than those that do not. Usefully, in terms of imbalance theory the university is one kind of innovation-supporting organization that is located in wealthy and poor, urban and rural locations. Hence, an equally obvious policy recommendation would be to ensure universities are present in all regions in a given country. But with a few exceptions, research shows universities to be less impressive than companies at stimulating fast-growth spin-out firms of the kind that produce functional clusters.

This is not an either/or position, as examples discussed in Chapter 7 show. But for the political process in many countries, cost-conscious decision-making has made too many governments trade off one option for another. In the university versus corporate trade-off, most governments would tend to shrink at the cost implications of investment in new universities but feel comfortable incentivizing firms in lagging areas to spin out new ones. In reality, a successful strategy can be shown to have both options rather than one or the other because start-up firms benefit from proximity to a knowledge centre that is familiar to their founders as an academic community, with all the networking opportunities and inherited social capital implied by that. Social capital is the extra value gained from interactions with familiar, trusted networks of acquaintances. But such firms also benefit from proximity to a customer from whom small commissions are vital in developing experience and a track record. Both large bodies will also benefit from interactions around research commercialization and the whole has the look and feel of a virtuous circle. A third dimension to add to the firm and academic aspects of this relationship is that of government itself as facilitator and financier of actions based on consensus. Regional governments may have influence over even rather expensive investments like universities and scientific research, but the big budgets for this kind of activity are usually national. National governments are good at setting frameworks for action but less so at

detailed strategy in contexts with significant geographical variation, so here joining up government actions involves horizontal and vertical governmental relations, just as clustering does. This approach is usefully alluded to in the work on the 'triple helix' edited by Etkowitz and Leydesdorff (1997), but the regional governance and clustering dimensions are scarcely touched upon.

In the first two chapters of this book, the nature of economic imbalance is explored theoretically with a view to finding why it has been considered heterodox to place disequilibrium concerns at the forefront of economic development theory and to assess the relevance to the concerns of this book of those authors who have taken the heterodox approach. This means the work of Marshall (1916; 1919) plays an important role. As well as being a good industrial economist giving detailed accounts of latter-day clusters or 'industrial districts', he was one of those responsible for the marginalist revolution that took economic theory away from an understanding of disequilibrium by conveniently assuming the world of economic relationships operated in equilibrium. Nevertheless, it is the emphasis in his work on understanding the role of external economies, knowledge transfer, skills and learning among firms in geographically proximate settings that is of importance for our project from the outset. Marshall's belief in the market mechanism as the ultimate coordinator of highly complex inter-firm relationships is correct but it blinded him to the non-market exchanges that made them possible, and to which he referred as being 'in the air'.

This redolent phrase is of abiding fascination, as the neo-Marshallian research in Italy conducted by authors such as Becattini (1989) and Brusco (1989) demonstrates. It means people are talking freely about their business, that it is feasible for innovations to occur because, simultaneously, different entrepreneurs may deduce the same discovery from the collective humming of ideas and information, and anticipate the rest by getting a new product or service into production. It is a useful way of capturing the free goods quality of information that is immediately lost if a firm re-locates. It is fundamental to the supposed dynamic externalities capable of being creatively re-interpreted in conditions of proximity.

Yet there is also the nagging question whenever Marshall's notion of valuable knowledge being 'in the air' arises of just how much that was really valuable was in that ethereal condition. In those times, when technology was truly transformative in its effects on wealth and poverty, first governments of the day placed barriers on the export of machinery and knowledge, hence industrial espionage as well as emissaries were deployed by other countries to learn the secrets of the new forms of production. Moreover, within the clusters of the day it is probable that firms worked in complementary relationships that sometimes were a precursor to the formation of groups after acquisition, even if these may have been family-inspired initially. Accordingly, such techno-economic knowledge may not have circulated as freely as more generalized information. Finally, business associations were often the exclusive clubs of entrepreneurs in which innovations were formally and informally discussed prior to eventual proto-

typing and production. But while principles would be discussed openly, patenting would protect against illegal knowledge application. In modern industrial districts in Italy it is argued that knowledge circulates freely because workers have to know their technologies thoroughly, and this must have been true to some degree in older ones elsewhere, hence the large amount of start-up activity typical of old and new clusters. But whether that extended to the capability to replicate from memory, drawings or, as occurred in Belgium, through the theft, over time, of enough mechanical parts to reconstruct a whole Yorkshire weaving machine remains open to question.

Schumpeter is clearer on this but not necessarily more accurate. His key contribution to the question of knowledge transfer was to introduce the notion of disruptive change or 'creative destruction' as the energizing process explaining capitalist development. An entrepreneur or R&D team of engineers makes a discovery and transforms it into a commercial innovation sold on the market. This is quickly followed by a swarm of imitators producing the same thing at less cost because they have been given the original idea and can reverse engineer it. This is what causes clustering in geographical space, although Schumpeter neither precisely wrote about such concrete spatial phenomena nor did he have much geographical sensibility generally, judged from his writing. More to the point, here is his discussion on monopoly and perfect competition. Both are limited in their real impact, the former because learning will occur, the latter because 'perfectly free entry into a *new* field may make it impossible to enter it at all'. Time and innovation erode monopoly while time prevents innovation 'perfectly promptly' being imitated (Schumpeter, 1975, pp. 104–5).

This gives us a most important clue about the reason why firms cluster. It is, on the one hand, to gain knowledge that can help them break monopoly through, on the other, seeking as near as humanly possible to gain something approximating perfect competition. The creative origin of the specific know-how being sought is spatially specific, so firms swarm around that geographical point. Capital is mobile, new knowledge is comparatively immobile. In knowledge economy contexts, in the age of the Internet, information is ubiquitous but knowledge is scarce. Thus, even if the human genome is put on the Internet, certainly this author would not and it is doubtful if many readers of this book would know what to do with it. Here lies the origin of economic and geographical imbalance.

The governance of this process is an extremely delicate matter. Landes (1998) argues that governments court danger when they intervene to effect institutional borrowing and when they try to force development by inducing change when institutions have not developed the required learning disposition or 'absorptive capacity' (Cohen and Levinthal, 1990). But it can be worse if governance bodies wait to be told by industry that they must do x, y or z to create the right conditions for innovation, clusters or entrepreneurship. Two examples are discussed in Chapters 3 and 7. The first concerns the way the European Commission was persuaded that it had an important potential role in developing a science and technology policy. This was done through the association of what, at the time,

were Europe's 'Big Twelve' roundtable of technology firms, presenting an attractive vision of a new and powerful role for a body in search of distinctive functions that the states it represented had not pursued in this specific way. Approval was set against the perceived weakness of the 'Big Twelve' compared to American and Japanese firms at the time regarding technological innovation. Funds were earmarked for competitive bidding by cross-national business and research consortia for investment in applied technology projects that the Big Twelve were well positioned to win. In the two decades since then the innovation gap between the EU and its main competitors has not closed, except in mobile telephony, an industry that post-dates the establishment of the fund and is dominated by two states that were not members at the time. The second example can be briefly stated. For years Germany lagged behind the USA and the UK in biotechnology. This was of concern to the Federal Science Ministry that from the 1980s launched numerous programmes to promote commercialization of research it had also been funding in public and university laboratories. The ministry had no in-house researchers or special experts in the subject, relying for advice from large German pharmaceuticals companies. These had low absorptive capacity for biotechnology because their disciplinary origins lay outside the field. But they had an interest in accessing funding to promote their capabilities to use biotechnology and many of the grants they won from the ensuing contests went into investments in entrepreneurial biotechnology firms in the USA. When challenged about this state of affairs their response was that they would like to work with German firms but they were not as good as American ones.

'Rent seeking', a polite term economists use to describe economic practices of which these are both examples, is a kind of entrepreneurship but not one that is designed to meet the objectives of policies to correct economic imbalances. Both instances show the inappropriateness of managing innovation support programmes from a high governmental level where a natural business constituency is multinational firms with their own powerful agendas. Learning has occurred so that in both cases newer versions of policies adopt far more of a multi-level governance approach involving partnership between national and regional bodies. In this way, the specificities of local nuances can be incorporated much better. That is not to say that such policies are now immune from criticism and some are made in the relevant chapters. However, greater inclusivity of both the lower governance levels and the small and medium-sized enterprises (SME) sector are now features of both kinds of policy setting. One problem slowly and unevenly receding is that regional administrations are not everywhere as well organized and empowered as they are in federal settings or those where there is relatively strong regionalist political sentiment. Even in regions such as these, the promotion of innovative clusters has not been something which administrations traditionally had the competence to manage. That is changing, especially in the EU, where various innovation networking programmes at regional level have grown in take-up by regional governance bodies to over one hundred implemented regional projects by the turn of the

present century. More regional authorities now have greater competence and confidence to conduct audits, build consensus and seek funding for actions to be implemented than hitherto.

This means the regions of the EU have developed some capabilities comparable to those practised by states and provinces in federal countries like Australia, Canada and the USA. In the latter, it is possible to have organizations conducting sophisticated knowledge-based industry audits, as the Massachusetts Technology Collaborative does, and state administrations committed to networking and cluster-building to enhance the innovative infrastructure by implementing policies based on such audits. Moreover, localized tax abatements and credits have been introduced to give incentives to investment in research and innovation. Planning deals have been done whereby individual firms can gain permission to develop knowledge-based industry in non-designated areas in exchange for offering free educational tours around the facility to science classes from local schools. Other planning issues are dealt with through consultation with municipalities so that those welcoming cluster developments receive new businesses and those wishing to conserve their character do not. This obviates the necessity for costly and conflictual decision-making that has slowed the process of establishing the infrastructure to enable rapid commercialization of the UK's global lead in some aspects of genomics in locations near to rural Cambridge. Issues of regional involvement in the complex governmental process of investing in and supporting science, technology and innovation are explored with the help of a multi-level governance approach in Chapter 3.

Social capital, trust and networks in learning economies

One thing concluded from research examined in discussing multi-level governance in the European Union is that regions showing greater mobilization and receptivity towards developing new forms of support for economic development were those with a well-developed sense of political identity. This could come from having clear, delegated powers that are comparable to those possessed by all regional administrations in a given country, as happens in federal states, or because of a strong sense of identity for socio-cultural reasons. In both types of case, capacity for lobbying superior power-centres is more pronounced as are levels of policy intelligence of relevance to developing innovative strategies or taking advantage of new opportunities. This links the argument of the book to a concept which bridges the spheres of governance and that of the economy and in Chapter 4 due attention is paid to *social capital* as a possible 'missing ingredient' from previous efforts to develop sustained economic development capabilities among firms at the regional and local levels.

Social capital is the expression of norms of reciprocity and trust between individuals and organizations that are embedded in a system of cooperation and favour exchange which gives advantage to those that belong, usually, to a particular locality or non-proximate community linked by ethnicity or religion. It has come to be analysed from an economic perspective as a consequence of