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European Cities in the Knowledge Economy: Towards a Typology

Willem van Winden, Leo van den Berg and Peter Pol

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Summary. The shift towards a knowledge-based economy seems to favour some well-endowed urban areas. However, not all cities benefit equally. This paper discusses the shift towards a knowledge-based economy in different *types* of European city, and derives policy conclusions for local and national governments. An integrative frame of analysis is developed and applied to a number of cities in north-west Europe. The paper reveals large differences in the ability of cities to benefit from the shift towards a knowledge economy and describes and comments on current policy responses.

1. Introduction

European leaders have been concerned for some time about the continent's relatively poor economic performance in terms of growth and employment. It is believed that Europe should speed up its transition towards a 'knowledge-based economy' in order to match the growth levels of the US and emerging Asian countries. Under the umbrella of the 'Lisbon Agenda', Europe's governments are committed to increase their spending on R&D and education, to promote the commercialisation of research and innovation, and to invest more in information and communication technology. These initiatives and policy efforts are underpinned by evidence of the relation between productivity growth and investments in R&D and education (van Ark, 2000).

Debates about the transition process towards a knowledge-based economy tend to focus on national economies and national policy responses. Within countries, however, marked differences in performance between urban regions can be observed. At the positive

end of the spectrum, we find urban regions that benefit from the increased knowledge-intensity of economic processes: they manage to attract human resources and investments, create high-level jobs and show high growth rates and innovation levels. At the negative end, we find cities whose economies are far from becoming more knowledge-intensive: rather, they face economic decline and degradation and lose vital human resources.

The central goal of this paper is to shed more light on the differences between cities in their transition path towards a knowledge-based economy. On the basis of a literature study and a number of case studies, it describes and analyses how well different types of city are positioned in the emerging knowledge-based economy. Also, it discusses current policy responses on the national and urban levels. The empirical part of the paper is based on a large comparative study on the development of the knowledge-based economy in a number of north-west European cities (van den Berg

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et al., 2004) and a follow-up study on related governance issues (van Winden and van den Berg, 2004).

The paper is set up as follows. In the conceptual part, we discuss the ambiguous term 'knowledge-based economy' and define how we use it in this paper. Secondly, without claiming to be exhaustive, we review theoretical and empirical studies about knowledge-based development in cities and factors that explain the differences between cities. We integrate and recombine crucial insights from this literature into a coherent and applicable framework of analysis. In the framework, we identify a number of place-specific characteristics (termed 'knowledge foundations') that are conducive for knowledge-based development and suggest a link between these foundations and the actual economic performance of cities. The framework enables us to make a meaningful comparison between cities and provide more subtle insights into the position and dynamics of various *types* of city. Next, the framework is applied to our 11 case study cities that were part of the study. For each of the cities, we show how they score on their 'knowledge foundations', and link this score to their economic performance. On the basis of the findings, we propose a tentative typology of cities and their performance. Finally, we discuss some policy implications and suggest issues for further research.

This study distinguishes itself from other studies in at least three respects. First, in our study, instead of focusing on a specific aspect of the urban knowledge economy, we take an integrative approach, linking many aspects to one another in a comprehensive framework. Secondly, we take an international comparative perspective by analysing cities in five different European countries. Until now, there have only been very few international comparative studies on the urban knowledge economy. Thirdly, we analyse different *types* of city (in terms of size, economic base and place in the national urban grid): this helps to highlight the substantial differences in the way cities are affected by the transition towards a knowledge economy.

Selection of Case Studies and Data Sources

This paper contains an analysis of 11 cities in north-western Europe. We selected the following case study cities: Aachen, Amsterdam, Dortmund, Eindhoven, Enschede, Helsinki, Leuven, Manchester, Munich, Münster and Rotterdam. This is an interesting mix of cities in several respects. First, the cities form different groups in terms of their function in the national and European urban system: the set contains two national capitals (Helsinki and Amsterdam), a 'semi capital' (Munich, capital of the Freestate of Bavaria and seat of the Bavarian government), three secondary cities (Rotterdam, Dortmund, Manchester) and five tertiary or 'provincial' cities (Enschede, Aachen, Eindhoven, Leuven, Münster). Moreover, the cities have different positions in their urban networks. Six of our cases are part of dense polynuclear urban networks: Amsterdam, Rotterdam (part of the highly urbanised Randstad region), Dortmund (Ruhr area), Leuven (not far from Brussels), Manchester (part of the heavily urbanised North-West region). The other five cases are not part of such a dense polycentric system and have bigger non-urban hinterlands: Munich, Eindhoven, Helsinki, Münster and Enschede. The mix is also interesting with respect to the industrial structure of the cases. It contains five cities with an industrial tradition (Manchester, Dortmund, Rotterdam, Enschede, Aachen), two cities with a strong service orientation (Amsterdam, Münster) and four cities with a strong 'high-tech' image (Eindhoven, Munich, Helsinki, Leuven).

To describe, compare and analyse the case studies, we have used various methods. For all of the cities, we have collected comparable statistical data from a number of sources. Also, in each city, we have collected studies, reports and monographs on the local economy and local policies. Furthermore, in each city we conducted a dozen semi-structured expert interviews with representatives from business, academia, local government and intermediary organisations (chambers of commerce, incubators, venture capitalists). The semi-structured and open-ended character

of the interviews gave scope to obtain unexpected information and yielded important insights. Because of space constraints, in this paper we cannot present our findings in full detail.

2. Perspectives on the Knowledge-based Economy

There is not a single and widely accepted definition of what a knowledge economy is. At least two perspectives co-exist. In one dominant perspective, the knowledge economy is regarded as a separate section of the economy, the one in which new (technological) knowledge is generated. In this first approach, the knowledge economy comprises advanced activities in science, technology and innovation. In essence, the knowledge economy is seen as the 'top section' of the economy. Central actors are universities and corporate research establishments that conduct fundamental or applied research. They produce the knowledge that ultimately leads to new products, production methods and productivity growth. From this perspective, the performance of nations and regions in the knowledge economy is typically measured in terms of patents, R&D spending and innovations.

In policy circles, this perspective is dominant. The EU and OECD rankings are largely based on indicators that measure the creation of scientific or technological knowledge (see EU 2002). Also, government strategies to boost the knowledge economy aim to increase R&D spending, facilitate patenting and promote technological innovation. The idea underlying these strategies is that western Europe will inevitably continue to lose activities to emerging economies in other parts of the world (not only manufacturing but also services that can be delivered over long distances, such as call centres, or even higher-order services). Therefore, Europe's economy should focus on high-level innovative activities. The top section of the economy is assumed to produce positive effects for the economy at large.

When this narrow perspective on the knowledge-based economy is taken, the consequences for urban economies are mixed. On the one hand, some cities—especially those with good universities and research institutions—may benefit from their particular ability to produce new knowledge. But many other cities lack such endowments and, as a result, will face negative consequences: they will lose manufacturing and lower-level services to other countries and have few opportunities to compensate for this loss. Also, within cities, there could be a growing social and economic divide between thriving knowledge-based segments, on the one hand, and stagnating sections on the other.

This perspective on the knowledge-based economy can, however, be criticised on several grounds. First, it is assumed that R&D spending and patenting are the drivers of the knowledge-based economy. However, a recent study among the top 1000 global corporate innovation spenders (Jaruzelski *et al.*, 2005) found that there is no direct relationship between R&D spending and measures of corporate success, such as profits, turnover growth or shareholder return. How the money is spent is more important than how much is spent. Secondly, it is increasingly recognised that knowledge is not 'out there' waiting to be explored but is instead the product of a far more embodied social process, in which knowledge is stored and interpreted in the brains of individuals or in communities of practice (Hepworth and Spencer, 2003).

A second perspective on the knowledge-based economy is more inclusive and addresses these shortcomings. It regards the knowledge economy as one in which knowledge is becoming a more dominant factor *throughout the economy*. Dahlman and Anderson define the knowledge economy as

one that encourages its organisations and people to acquire, create, disseminate and use (codified and tacit) knowledge more effectively for greater economic and social development (Dahlman and Anderson, 2000, p. 32).

An essential difference with the first perspective is that not only is the production of new scientific or technological knowledge regarded as a driver of growth, but so is the use and valorisation of knowledge in economic processes and the acquisition of skills. They define four 'pillars' of the knowledge economy

- (1) an economic and institutional regime that provides incentives for the efficient use of existing knowledge, the creation of knowledge and entrepreneurship;
- (2) an educated and skilled population that can create and use knowledge;
- (3) a dynamic information infrastructure that can facilitate the effective communication, dissemination and processing of information;
- (4) a system of research centres, universities, think-tanks, consultants, firms and other organisations that can tap into the growing stock of global knowledge, assimilate and adapt it to local needs and create new local knowledge.

From this perspective, how well-placed are different types of city to benefit from the transition towards a knowledge-based economy? Compared with the first perspective, a different picture is likely to emerge. It is not necessarily only cities with a strong 'formal' knowledge base but also those specialised in advanced services, creative industries or innovative manufacturing sectors that may emerge as successful 'knowledge cities' (see for example, Hepworth and Spencer, 2003, for an analysis of UK regions).

The fundamental question may be raised (and many economists do so) whether it makes sense to speak about a 'knowledge-based economy' at all, arguing that nothing has changed inherently: as in the past, economic growth depends on productivity increases, which are generated by technological progress and the upgrading of human capital. In our paper, we take for granted the basic notion of productivity as a driver of growth (witness also the frame of reference). However, we maintain that the role of knowledge (its generation, dissemination and use,

tacit and codified) as driver of growth has increased so significantly in the past few decades that it makes sense to speak of a knowledge-based economy and to study its specific spatial dimensions in more depth. In the rest of this paper, we adhere to the second, more inclusive, perspective of the knowledge economy. In the next section, we present a framework of reference that enables us to describe and analyse the position and development of urban regions in the knowledge economy.

3. Cities in the Knowledge Economy: A Framework of Analysis

There is a rich and growing literature that seeks to describe and explain the urban dimension of the transition towards a knowledge-based economy. Several theoretical and empirical studies have focused on the role of the local knowledge base as a determinant for urban economic development (Lawton Smith, 2003; Goldstein and Renault, 2004). Another strand discusses the importance of local knowledge spillovers and analyses the relation between local and non-local linkages for innovation processes (see, for instance, Simmie, 2002; Simmie *et al.*, 2002; Howells, 2002). Florida (2000) has catalysed discussions on the crucial role of human capital in the urban economy and the ability of urban regions to attract talent. There is a large literature on the development of knowledge-based clusters in cities in urban regions (for an overview, see Baptista, 2000; or van den Berg *et al.*, 2001). Other recent contributions focus on governance issues related to the local knowledge economy (Knight, 1995; Kearns and Paddison, 2000; Docherty *et al.*, 2004). This list can easily be extended.

We have used many of the recent insights to construct a coherent framework that helps to assess, compare and analyse the development of the knowledge-based economy in urban regions. The framework (see Figure 1) consists of two core building blocks. On the left-hand side, on the basis of the available literature, we identify the components of the first

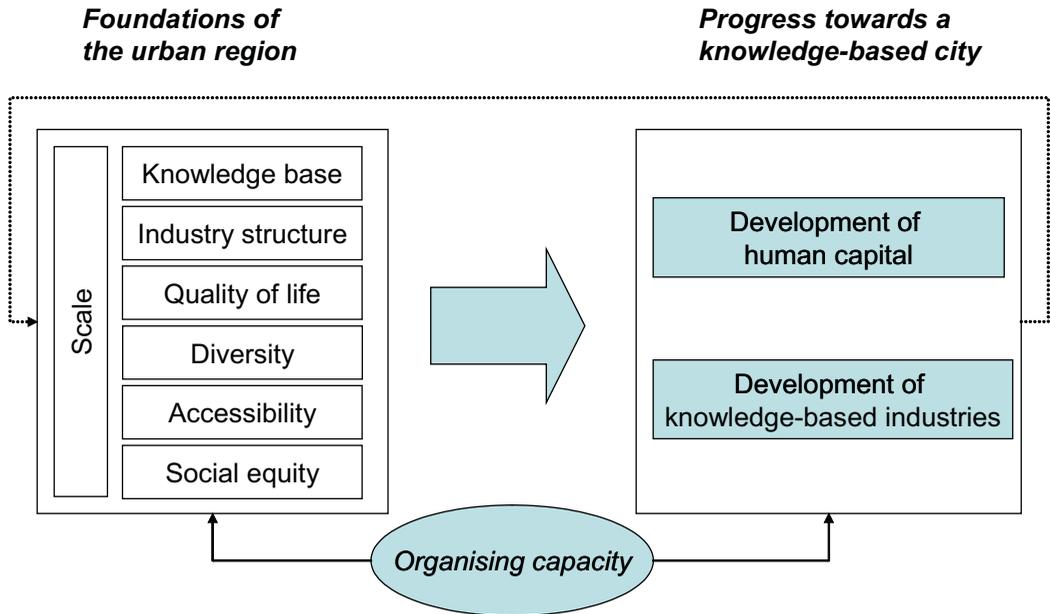


Figure 1. Cities in the knowledge economy: a framework of analysis.

of these blocks, which comprises those structural characteristics of urban regions that are conducive to the city's ability to acquire, create, disseminate and use (codified and tacit) knowledge effectively for greater economic and social development. We call these the 'foundations' of the urban knowledge economy. As we will see later, different city types have different mixes of foundations.

On the right-hand side of the framework, the second building block represents the progress towards the knowledge economy. In our perception, this includes two dynamic aspects of the urban knowledge economy. The first of these is the development of the human capital stock in the urban region—is the population of the cities becoming more 'knowledge-intensive'? The second is the development of the knowledge intensity of the business sector—to what extent are new knowledge industries emerging and/or are 'old' industries becoming more knowledge-intensive?

We assume a strong relationship between these two components. There is also a feedback mechanism (represented by the dotted line): in the longer run, the development of

the progress indicators will affect the foundations. Furthermore, the framework suggests that the quality of governance (here termed 'organising capacity') of the urban region has an influence on both the foundations and the progress indicators, which will each now be discussed in more detail.

Foundations

We discern seven structural characteristics that are conducive to the city's ability to acquire, create, disseminate and use (codified and tacit) knowledge effectively for greater economic and social development. They are based on a thorough review of the available academic literature of the role of cities in the knowledge economy.

1. The knowledge base. This comprises the universities, polytechnics and other public and private R&D activities in the urban region (knowledge infrastructure), as well as the educational level of the population. Several studies see a link between the knowledge infrastructure and urban economic development: Matthiessen *et al.* (2002) analyse the scientific output of 40 cities and

find that a solid knowledge base is reflected in the economic life of a city and that it is of increasing importance for urban economic growth and change. However, as the interaction between universities and the business sector is far from optimal, in many cities this potential remains largely unused. A key challenge for urban governance is therefore to improve the alignment between research, education and the regional business sectors. Another challenge is to counter the fragmentation within the knowledge base: large urban areas typically have a number of knowledge institutes that operate independently from one another and overlap in terms of educational and research programmes. Secondly, in the urban knowledge base we include the educational level of the population and the stock of creative knowledge. Many studies suggest that cities with a high share of workers with tertiary education, in general, show a better performance on many economic parameters (for the link between human capital and urban economic growth, see for instance, Glaeser *et al.*, 1995; and Simon,

1998). Data on a number of OECD metropolitan regions show that differences in skills explain about 36 per cent of the observed differences in productivity (see Figure 2).

Concerning creativity, Florida (2002) demonstrates the economic importance of a class of creative people who write software, songs and stories, create designs and discover new ways to combine elements. Based on the literature, it is reasonable to assume that these components play a crucial role in a city's ability to attract human capital and to develop knowledge-intensive business. In our study, as proxy indicators of the urban knowledge base, we have used the absolute number of university students, the degree of specialisation of the knowledge base and the percentage of the population with tertiary education.

2. *The industrial structure.* This deeply affects the starting position of the urban knowledge economy. Cities with a weak industrial structure (i.e. specialised in traditional industry and port activities) have many interrelated problems (Turok and Edge, 1999; Cheshire and Gordon, 1995): their economic base is

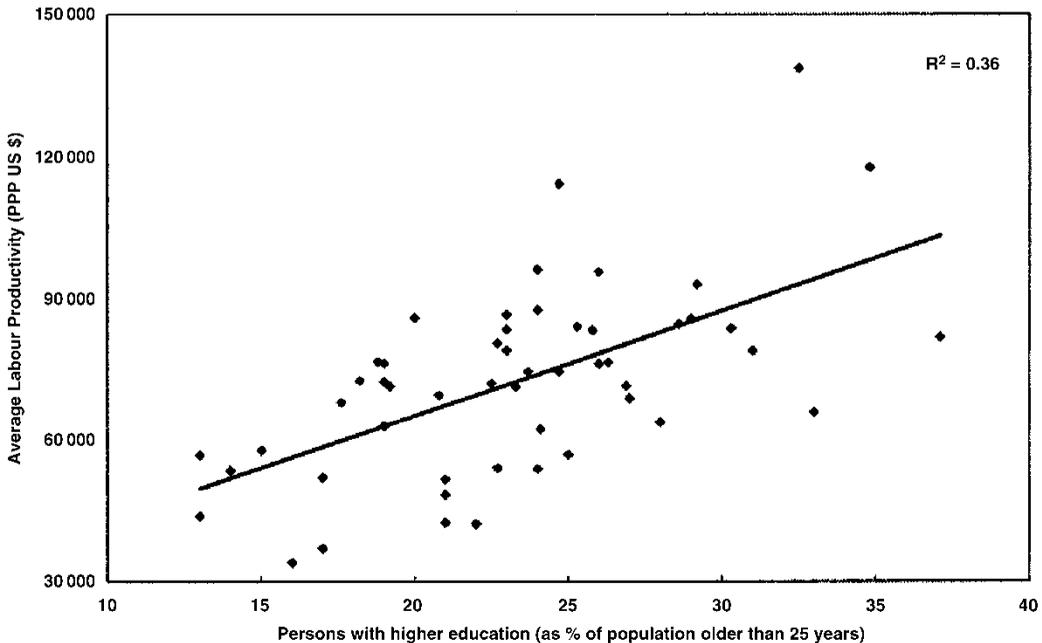


Figure 2. Productivity and educational attainment in selected OECD metropolitan regions, 2001. *Source:* OECD (2004, p. 47).

associated with a lower-educated workforce, fewer high-level amenities and a housing stock of poor quality. Often these cities suffer from a bad image. Compared with regions with a healthier economic base, this makes it extremely difficult to retain or attract knowledge workers or knowledge-intensive companies. The assets that once counted in the industrial age (proximity to raw materials, seaports) have lost much of their value.

Another aspect of the industrial structure is the degree of specialisation. Small and medium-sized urban regions tend to be more specialised than large metropolitan areas (Henderson, 1997). However, some larger urban regions are also relatively specialised—for instance, Frankfurt (finance), Helsinki (ICT)—whereas others lean on a broader variety of sectors. One of the debates in the literature is about the pros and cons of diversification or specialisation of the urban economy (Duranton and Puga, 2000). A diversified economic base offers clear advantages: it is less vulnerable in rapidly changing economic circumstances, whereas urban economies depending on one economic sector can be confronted with huge socioeconomic problems when that sector goes into decline. Moreover, a diversified economy offers more scope for incubation and cross-fertilisation between sectors, leading to innovations and new business. A diversified economy has advantages, but smaller cities typically lack the scale to sustain a broad range of economic sectors. For those cities, having a strong economic specialisation is an asset.

A third aspect of the industrial structure is the innovativeness of the firms (regardless which sector they belong to). Cities are very different from each other in this respect. Some cities have relatively high shares of innovative and knowledge-intensive businesses, in contrast to cities dominated by traditional, non-innovative SMEs. From this perspective, defining the industrial structure in terms of the sectoral composition of the economy can be misleading: within sectors,

there can be marked innovation and productivity differences.

3. Urban amenities and quality of life. These are key factors to attract and retain knowledge workers. The urban knowledge economy thrives on talented people who create new knowledge and ideas. From this perspective, Florida finds that quality of life in a place is a key determinant to attract and retain these people.

Talented people do not simply select a place to work based on the highest salary, they are typically concerned with a whole series of place-based characteristics (Florida, 2000, p. 6).

Florida (2000) found empirically that cultural activities and amenities are increasingly central determinants of urban competitiveness. Talented people are attracted by places where they can enjoy life (Castells, 2000). There is also a cumulative effect: as Florida puts it “talent tends to attract talent” (Florida 2000, p. 15). Many empirical studies confirm the link between human capital and urban economic growth (see, for instance, Glaeser *et al.*, 1995; and Simon, 1998). The results of the Urban Audit convincingly demonstrate that the higher educated have a preference for urban living (Dijkstra, 2004). Attributes of quality of life are: an attractive built environment; high-quality houses; attractive city parks; attractive natural surroundings; the absence of pollution; a rich variety of cultural institutions; and also high-quality hospitals and (international) schools. To compare our cities on this foundation is almost impossible given the lack of comparable objective data. We have used two proxies: an indication of whether the atmosphere of the city is provincial or ‘metropolitan’; and, subjective assessments of the quality of life of the city by the interviewees.

4. Accessibility. This is crucial for a city’s ability to acquire, create, disseminate and use (codified and tacit) knowledge effectively for greater economic and social development. The knowledge economy is a networked economy. Simmie (2002) argues that international contacts and networks conducted by

face-to-face contacts facilitated by international hub airports are critical factors for international knowledge transfer. Successful cities manage to combine both rich local knowledge spillovers and international best practice in the design and specification of innovations. Good international, regional and multimodal accessibility is therefore crucial for successful knowledge cities. For smaller provincial cities, the lack of international transport connections can be a key barrier to economic development.

In our case cities, we have assessed the respective cities on their international connectivity. This is measured in terms of access to international airports and high-speed-train connections.

5. Urban diversity. This promotes creativity (Jacobs, 1961). The diversity of inhabitants and types of economic actors facilitates the interactions that generate new ideas. Florida (2000) regards diversity as a measure of the degree of system openness. The places that attract diverse groups of people (by ethnicity, nationality, gender and sexual orientation) have an environment that is easy to plug into and low entry barriers for talent. Several empirical studies have found that diversity fosters growth in cities (Glaeser *et al.*, 1995) or at least in their most innovative sectors. It is important to note that cultural diversity is not always an asset: many problem neighbourhoods in European cities are inhabited by immigrants with low educational qualifications who are poorly integrated in the economy and society. Nevertheless, in our case studies, we have measured diversity in terms of the percentage of the population who are of foreign descent.

6. Scale. Scale is important, as several studies suggest that the sheer size of the city matters as an attraction factor for both companies and knowledge workers. First, scale matters for companies: in a larger city, it is easier to find specialised staff and suppliers¹ and make connections (see Buck *et al.*, 2002, for a study about London's scale advantages). The density and heterogeneity of firms are sources of dynamism and creativity (Simmie *et al.*, 2002). Secondly, scale matters to

attract and retain knowledge workers. Being in a large metropolitan area increases the variety of jobs available and hence the chance of finding the right job. This is especially relevant for the increasing number of households with two knowledge workers. Thirdly, a large urban size supports facilities and amenities that are conducive to attracting knowledge workers and firms: larger cities tend to have bigger airports from which more destinations can be reached and many of them are nodes on a high-speed rail network; and size is needed to support international sub-cultures and amenities such as international schools. It is important to note that smaller-sized cities, located in or close by (and well connected to) relatively large metropolitan areas, can also benefit from these scale advantages.

7. Social equity. This is desirable for sustainable urban growth. For one thing, high levels of poverty and social exclusion may evoke tensions between 'haves' and 'have-nots' and between different ethnic groups, with negative impacts on the safety perception of urban inhabitants, workers and visitors. Increasingly, the perceived safety of a place is becoming an important location factor for companies and citizens (van den Berg *et al.*, 2002). Furthermore, high levels of social exclusion may imply that the talents of a large part of the urban population are insufficiently used.

We assume that the seven foundations do not have equal weight. The knowledge base and the industrial structure are probably more important. Cities without sound scores in these fields will find it very difficult to build up successfully and maintain a knowledge economy. The factor of scale is linked to other factors: scale is usually positively linked to urban diversity (bigger cities are more diverse) and to accessibility (bigger cities are more likely to have an international airport and HST connections). The other five factors are supportive.

Progress towards a Knowledge Economy

In our framework, we take it for granted that a city's 'foundation mix' is a key determinant

for the ability of a city to thrive in the knowledge economy. But how do we know whether a city has progressed towards a higher level of knowledge intensity? Assuming the importance of the knowledge base and the economic base, and taking into account the availability of data and information, we focus on two 'progress indicators': the development of human capital in a city; and, the development of knowledge-based industries in a city. For the cases, we have taken a reference period of 5 years, from 1996 to 2001: this was the period for which we could obtain comparable data for all the case cities included in the analysis. Where possible, we compared the score of every individual city region with the national average of its home country, as a way to see whether the city was outperforming or underperforming.

1. Development of human capital. Our first progress indicator is the net accumulation of human capital in the city. The development of the human capital stock is influenced by the development of the educational qualifications (or skill levels) of the existing population and the migration surplus of more highly educated workers. In our research, for each city we have focused on the question of the extent to which it manages to keep higher-educated people in the region, or attract them from outside. For reasons of convenience, we have measured the development of human capital roughly as the development of the share of the urban population with tertiary education.

2. Development of (new) knowledge industries. This second progress indicator comprises the degree to which an urban region manages to develop new growth industries (defined as high-tech industries, advanced services and creative industries) or to increase the knowledge intensity of traditional industries. A second transformation process in this category concerns an increasing knowledge intensity of 'traditional' sectors (heavy industry, textile industry, transport and logistics). This progress indicator is difficult to quantify in a comparable manner. We have done our best to make a judgement based on available local studies and information from interviewees.

The Role of Organising Capacity

In our framework, we assume that the quality of urban governance (here termed 'organising capacity') has an impact on the foundations and the progress indicators. Organising capacity is understood as the ability of those responsible for solving a problem to convene all concerned partners (public and private, internal and external), in order to generate jointly new ideas and formulate and implement a policy that responds to fundamental developments and creates conditions for sustainable economic growth. Organising capacity refers to the entire process: from the identification of certain needs, to the development of strategies and policy, on to the implementation of the policy, finally ending with the monitoring of the results (van den Berg *et al.*, 1997). Key tools for organising capacity are vision, strategic networks, leadership, political support, societal support and communication. As the knowledge economy is a network economy, investing in strategic networks appears to be crucial for knowledge cities. In each of the cities, we have analysed knowledge-economy-related policies and strategies, and whether stakeholders in the city (private firms, universities, other authorities in and outside the urban region) were involved in policy design and implementation. Also, we have checked whether there was clear leadership by key persons in the region.

Some Problems in Making the Framework Operational

To make the framework operational and apply it to urban regions, we developed a number of proxy indicators for the various foundations and progress indicators (see Table 1), many of which we have already introduced. We encountered several difficulties in measuring the various indicators. First, very few comparable statistics are available at the level of urban regions. It is only very recently that the EC has published comparative statistics at the level of cities and urban regions, including GDP/capita, educational levels, foreign

Table 1. Operationalisation of foundations and success indicators

	Indicators used	Categories	Sources used
<i>Foundations</i>			
1. Knowledge base	Absolute number of students	High (>68 000) Medium (33 000–68 000) Low (<33 000)	Individual case city statistics, Web resources
	Degree of specialisation of the knowledge infrastructure	Specialised (highly specialised university) Medium (several academic disciplines) Diversified (full range of disciplines)	Web resources, interviews, individual case city statistics
	Percentage of population with tertiary education	High (>20 per cent) Medium (12–20 per cent) Low (<12 per cent)	Urban Audit II
2. Industrial structure	Legacy of declining industries	High, Medium, Low	Individual case city statistics Interviewees' perceptions
	Dominant sector	Yes; which one? No	Individual case city statistics
	(GDP/capita 2000)	High (>38 000) Medium (23 000–68 000) Low (<23 000)	Urban Audit II ODPM Publications by individual cities
3. Quality of life/amenities		High/medium/low	Quality of life rankings and interviews
		Urban vs provincial	Observation; interviews

4. Accessibility	Access to international airport and/or HST connection	High: international airport <i>and</i> HST connection Medium: international airport <i>or</i> HST connection Low: neither international airport <i>nor</i> HST connection	Observation, Internet, interviews
5. Diversity	Percentage of foreign population	High (> 12 per cent) Medium (4–12 per cent) Low (< 4 per cent)	Urban audit; individual city statistics
6. Scale	Absolute population in urban region/network	Large (> 1.5 million) Medium (0.7–1.5 million) Small (< 0.7 million)	Urban audit
7. Social equity	Percentage on benefits	High/medium/low	Urban audit; individual city statistics
	Unemployment rate	High (> 10 per cent), medium (5–10 per cent), low (0–5 per cent)	Urban audit; individual city statistics
<i>Progress indicators</i>			
1. Development of human capital	Ability to attract and retain higher educated workers in the city 1996–2001	High/medium/low	Individual city statistics, interviews
2. Development of knowledge-based industries	Increase in knowledge-based industries 1996–2001	High/medium/low	Individual city statistics, interviews

population and accessibility (collected in the Urban Audit II, 2004). However, data on knowledge production and innovation are unavailable at that spatial level. The EU publishes such data at the level of NUTS 2 regions only (EU, 2002), in its regionalised “trend chart on innovation”. For all Europe’s regions, this chart contains data on high-tech employment, R&D expenditures, patent applications and the educational levels of the workforce. However, the NUTS 2 level is inadequate for our purposes: the size of the regions is too large. For Germany, for instance, the NUTS 2 regions are the *Länder*, which are very large areas that include very different types of urban region.

To compensate for the lack of ‘hard’ data, we have collected information of a more qualitative kind: for instance, about quality of life, governance and the share of declining industries. We have held about 12 semi-structured interviews in each city. It should be noted, therefore, that this evidence remains circumstantial.

Another issue concerned the delimitation of the urban region. This is unproblematic for agglomerations with a relatively large non-urban hinterland (i.e. Munich, Münster, Eindhoven, Aachen, Helsinki): here, most of the linkages and interdependencies are found at the level of the urban agglomeration. However, when cities are part of very dense urban networks (i.e. Dortmund in the Ruhr area; Rotterdam and Amsterdam in the Randstad region; Leuven, which is very near the Brussels agglomeration), it is harder to delimit the functional urban region. Although cities in such networks have their own (strong) identity and administrative powers, they share many amenities at the network level, such as airports or international schools; they have highly integrated labour markets, with criss-cross commuting flows; and often they are regarded as one urban zone by corporate decision-makers. For these case cities, for reasons of convenience, we have collected information at the level of the urban agglomeration. However, in our interviews, we have paid ample attention to the wider scale and the role of the city in the urban network.

4. Findings

The cities differ markedly in terms of their knowledge base (Table 2). First, there are substantial differences in the educational qualifications of the workforce. Helsinki tops the list: 28 per cent of its resident population have tertiary education. The cities of Amsterdam and Munich also have quite a large proportion of highly educated residents, 24 per cent and 22 per cent respectively. Of the smaller cities, Leuven and Münster score well. Both cities have a large and dominant university and the highly educated workforce mostly consists of researchers employed by the university or associated research institutes. At the bottom of the list, we find cities with a legacy of declining industries. In Dortmund, only 11 per cent of the population have tertiary education. Rotterdam and Enschede score only slightly better, 14 per cent and 12 per cent respectively.

The cities exhibit some interesting differences in their university infrastructure. Some cities have a long tradition as an academic centre and typically offer a wide range of academic disciplines. This holds for the universities in the capital cities Amsterdam and Helsinki, but also for Munich. The smaller cities of Leuven and Münster also have very old universities. In the industrial cities, universities are typically much more recently established (most of them were founded in the 1950s and 1960s) and tend to be specialised in applied and technical disciplines. They were founded for practical reasons—i.e. to educate engineers for the emerging local industry (Dortmund, Eindhoven) or to promote regional development (Enschede). Some technical universities or faculties developed out of existing technical schools (Munich, Aachen, Manchester). Some have diversified to some extent and currently also offer social sciences and business economics (Enschede and Dortmund). In Manchester, the University’s history is closely linked to Manchester’s emergence as the world’s first industrial city. Manchester businessmen and industrialists established the Mechanics Institute to ensure that their workers could learn

Table 2. Findings

Indicators used		Amsterdam	Rotterdam	Eindhoven	Enschede	Munich	Dortmund	Münster	Aachen	Manchester	Helsinki	Leuven
<i>Foundations</i>												
1. Knowledge base	Number of students	+	0	-	-	+	0	0	0	+	+	0
	Degree of specialisation of university	medium	medium	high	high	low	medium	medium	high	low	low	low
	Percentage of population with tertiary education	+	-	0	-	+	-	+	0	0	+	+
2. Industrial structure	GDP/capita	+	0	0	-	+	-	+	0	-	+	0
	Legacy of declining industries	+	0	+	-	+	-	+	-	-	+	+
	Dominant sector	Finance	Port industry	Hightech industry	No	No	No	(public) services	no	No	ICT	No
3. Quality-of-life image	Attractiveness as residence	+	0	0	0	+	-	+	+	0	+	+
4. Accessibility	Feel: urban/provincial	Urban	Urban	Provincial	Provincial	Urban	Urban	Provincial	Provincial	Urban	Urban	Provincial
	Access to international airport and/or HST connection	+	+	-	-	+	+	-	0	0	0	0
5. Diversity	Percentage of foreign population	+	+	-	-	+	+	0	0	+	-	0
6. Scale	Absolute population in urban region/network	+	+	-	-	+	+	-	0	+	+	+
7. Social equity	Percentage of population on benefits	0	-	+	0	+	0	+	-	-	+	+
	Unemployment rate	+	0	+	-	+	0	0	0	0	+	+
<i>Progress indicators</i>												
1. Development of human capital	Ability to attract and retain higher-educated workers in the city	+	-	+	+	+	0	0	0	+	+	+
2. Development of knowledge-based industries	Increase in knowledge-based industries	+	-	+	0	+	+	0	0	0	+	+

the basic principles of science. In 2004, the technical school merged with the Victoria University.

Our study suggests a strong link between academic tradition and educational level. Without exception, in cities with a long academic tradition, the population is more highly educated than in those with newer universities.

One aspect that deserves some extra attention is the role of the technical university, especially given the alleged lack of co-operation between universities and firms, and the limited ability to translate academic research into new products. Our study suggests that university–industry synergies vary strongly with the urban economic context. For instance, in the city of Eindhoven (with its large high-tech sector), the specialised technical university perfectly complements the high-tech industry base in the region and there are many fruitful interrelations between business and academia. The technical university is considered highly important by local high-tech firms as a partner for contract research and as a supplier of new staff and trainees. Also, it is the cradle of new businesses and start-ups. The environment for these new firms is favourable, as the urban region has a rich pool of potential clients, suppliers and dedicated service providers. Several well-functioning business support networks are in place, with active participation of the local technology sector and academic institutions.

A similar story can be told of Munich, Helsinki and Leuven, where the (technical) universities are well integrated into the urban economic fabric. In these cities, we also found well-functioning transfer institutions.² Our interviewees in the three cities suggested that venture capital is relatively abundant: venture capitalists go where the interesting projects are. Large technology firms based in those cities play an important role (Philips in Eindhoven, Siemens and BMW in Munich, Nokia in Helsinki) as sponsors of university chairs, as providers of equipment (state-of-the-art labs that can be used by the university or by start-up firms), as partners in contract research or other co-operation

projects, as clients for innovations, or as investors in start-up companies. Thus, those multinational companies not only tap knowledge from the university but also bring in knowledge from which the university benefits.

The situation is radically different in some other, often smaller, cities in our study (notably Aachen, Enschede, Münster). In each of these cities, the university delivers high-quality research and education, but there are fewer links with local business, simply because there is much less local business. For the university, there are fewer opportunities for contract research. Furthermore, for university start-ups, this environment is also less favourable, with fewer clients, suppliers and forms of support from existing business. Also in these cities, companies complained more frequently about the lack of venture capital. Notwithstanding this, it is remarkable that, in these cities, local authorities still expect their universities to be drivers of local economic development: they regard the university as a source of new business and growth, and put strong efforts into promoting start-ups and linking business and academia. Some city councils even invest in research facilities (for instance, the city of Münster invested in a centre for nanotechnology). The city of Leuven is a special case. This city does not have a technology sector that can match the size of Munich or Helsinki, and there are no ‘home-grown’ high-tech multinationals in the region either. However, during the past two decades, the city has managed to develop a considerable high-tech profile. Several world-class private-sector research labs have located in the city: they were attracted mainly by the excellent public research infrastructure.³ The university’s technology transfer policy is considered highly successful. In the past 20 years, 50 spin-offs have been created from the university. By 2004, these companies had a combined turnover of €350 million and employed over 2000 people.

Our study confirms that a single-sided focus on high-tech companies and promotion of technological innovation ignores the importance

of innovations in services, concepts, design and other areas as crucial activities in the knowledge economy. Some of our case cities, such as Amsterdam (strong in financial and business services) and Manchester (creative industries), create a great deal of new knowledge of this type but nevertheless obtain a low score in the common rankings of innovative regions (for instance, the EU's Top 50 European Innovation Index). In a recent article, Den Hartog *et al.* (2003) confirm this point.

Not surprisingly, Table 2 suggests that the five cities with an unfavourable sector mix and a legacy of declining industries (Rotterdam, Enschede, Dortmund, Aachen and Manchester) also tend to have relatively high unemployment rates, a high percentage of people on benefits, a low-educated population and a low score on quality of life. An interesting question concerns the degree to which these cities are making progress towards a more knowledge-based economy—i.e. to what extent they are improving their human capital stock and developing new growth industries. Of our industrial case cities, only Manchester has significantly increased its relative attractiveness for the higher-educated. There are some indications that the city is attractive to the higher-skilled because of its improved amenities (thanks to substantial investments in culture and events) and housing (the reconversion of industrial property into loft apartments in the city centre has been a great success). The city's image has improved dramatically in the past 10 years and the brain-drain to London has decreased sharply. The other industrial cities have developed less favourably, despite heavy policy efforts to promote growth industries and improve their attractiveness. Smaller industrial cities with a technical university (Aachen and Enschede) have made strong policy efforts to capitalise on their university by promoting entrepreneurship, encouraging contract research and spin-offs, and attracting knowledge-intensive firms, but the results in terms of employment creation are minor. The larger cities (Rotterdam and Dortmund) have to deal with a negative image and high proportions of

low-skilled immigrants. Dortmund has been relatively successful in developing new industries. Over 7000 jobs have been created in target industries: ICT, nanotechnology and logistics. In the period 2000–04, the growth of service-sector jobs was three times the German average and the number of start-up companies is one of the highest in Germany. A highly visible success is the development of the Phoenix area: on the site of a former large steel factory (it moved to China), clean-rooms, labs and offices are being built for firms in the microsystems sector (*Die Zeit*, 2004). However, the city has problems in attracting or keeping the higher-skilled: many of the new knowledge workers in Dortmund prefer to commute from other places in the Ruhr area.

Of our case studies, those cities with the most modern economic structure (Amsterdam, Helsinki and Munich) also have the highest score on progress indicators (Table 2): they managed to attract and retain both human capital and knowledge-based industries⁴ on top of their already very strong starting position. One side-effect of this success is an increase in the cost of living in these cities (compared with their national average), mainly because of their booming property markets and increasing rent levels.

Our findings point to significant differences between metropolitan and non-metropolitan cities in terms of their 'foundations'. Metropolitan cities score well on accessibility (international airports, HST connections): they are linked-up globally. They have a large and diversified knowledge base (universities, etc.), a big and diverse labour market and high levels of diversity. All of them offer an international infrastructure (schools, clubs, communities, etc.) which helps to attract talent from abroad. The non-metropolitan urban regions lack these advantages. They lack fast international transport connections;⁵ they have a relatively small (although sometimes rather specialised) labour market,⁶ a lack of access to metropolitan amenities and international infrastructures and communities.⁷ As their economies are smaller and less diversified, they have less of a climate

conducive to ‘new combinations’. On the other hand, these cities typically offer a quiet and green atmosphere, they have low levels of congestion and crime, and relatively low costs of living. Also, there is a strong local community and identity. Typically, the organising capacity of these regions is strong. Leaders from business, academia and local government tend to know one another well and are able and ready to act jointly for the benefit of the region.⁸ We conclude, cautiously, that they have a governance advantage over larger cities.

5. Towards a Typology of Cities

The previous section highlighted the differences between cities in their transition path towards a knowledge-based economy. In this section, based on the case material, we make an effort to generalise the findings by proposing a typology of urban regions. The proposed typology can be considered as a first attempt to classify cities in terms of their position in the knowledge-based economy. Evidently, more research would be needed further to refine and elaborate the typology, as it is only based on a small set of cities confined to the north-western part of Europe. Although any typology is very tentative and open to discussion, it can help to structure our thinking about the development paths and opportunities of different types of places.

On the basis of our case study findings, we suggest six types of city:

- Stars*: these are large cities that score highly on virtually all foundations and progress indicators: Amsterdam, Helsinki, Munich.
- Metropolises in transition*: large cities with a lower score on quality of life, struggling with a legacy of declining sectors and having a lower performance: Dortmund, Rotterdam, Manchester.
- Knowledge pearls*: smaller cities with a high score on virtually all foundations, that are located very near a big agglomeration, with a good performance record: Leuven.

—*Star nicheplayers*: specialised cities in terms of their knowledge base and economic base. They score well on progress indicators: Eindhoven.

—*Nicheplayers in transition*: cities with some degree of specialisation (either in the knowledge base or the economic base), that have to deal with a legacy of declining industries: Enschede, Aachen.

—*Intellectuals*: cities with a strong university but without a knowledge-intensive business sector: Münster.

In Figure 3, they are grouped along two axes: metropolitan versus non-metropolitan; and, their score on the progress indicators: weak progress vs strong progress. We will now discuss each type of city in more depth.

Stars

Examples of ‘stars’ are Amsterdam, Munich and Helsinki. These are large cities with strong foundations. They are endowed with a strong and diversified economy, a strong knowledge base and a long-standing role as an intellectual centre. Importantly, they do not suffer from an economic legacy of heavy industries or other declining sectors. Typically, these cities have several universities that together offer the full range of disciplines. The cities are well-connected to the rest of the world by airports and HST links. They are a natural magnet for talent: their economy, universities and metropolitan ambiance are assets that attract people; foreigners feel at home because of the diversity and international infrastructure. These cities have relatively high shares of highly skilled immigrants with well-paid jobs in the internationally oriented firms. Also, their wealth attracts lower-skilled immigrants who hope to find a job in the expanding personal services sectors. ‘Stars’ offer innovative milieus: There are many synergies between academic institutions and private companies. More generally, the sheer diversity of economic, cultural and scientific activities in the city and the high level of openness and connectivity constitute a fertile ground for all kinds of innovations.

	Metropolitan	<i>Scale</i>	Non-metropolitan
Strong	Stars (Amsterdam, Helsinki, Munich)		Star Nicheplayers (Eindhoven)
	Pearls (Leuven)		
<i>Progress</i>			Intellectuals (Munster)
	Metropolises in transition (Rotterdam, Manchester, Dortmund)		Nicheplayers in transition (Enschede, Aachen)
Weak			

Figure 3. Typology of cities.

The strong knowledge foundations of these cities are reflected in their performance: in the past decade, they have performed very well in terms of GDP/capita, unemployment rates, and education levels of the population, on top of their already strong position. In their respective countries, these cities were leaders concerning the growth of new knowledge-intensive sectors such as ICT and biotechnology. In terms of policies, these cities focus on creating conditions to accommodate growth. Compared with the ‘metropolises in transition’ (see next sub-section), they do not pursue aggressive policies to attract new industries or develop new growth clusters: their ‘natural’ attractiveness reduces the need for such policies. However, increasingly they face the threat of losing certain categories of crucial workers in the city: for teachers, nurses or policemen, these cities are relatively expensive places as their salaries are determined at a national level. For students as well, these cities have become less attractive (see van den Berg and Russo, 2004). To keep these people, cities subsidise student housing (Munich), or create specific housing projects for public servants (Amsterdam).

Metropolises in Transition

Examples are Dortmund, Manchester and Rotterdam. These cities are medium-sized (over 500 000 inhabitants, with the metropolitan region typically over 1 million inhabitants), they have an urban atmosphere with many urban amenities; and, they are easily accessible and well connected to international transport systems. They share the problem of having traditional manufacturing sectors that are in decline or that have strongly declined in recent decades. These cities have relatively large problems of unemployment and social exclusion, and relatively large low-skilled migrant communities. Attracting talent (highly skilled) is a problem for these cities. They tend to suffer from a ‘working-class’ image and negative perceptions concerning pollution and crime; they have a relatively poor-quality housing stock (former working-class neighbourhoods), and fewer cultural amenities than the ‘stars’.

In these transitional cities, the development towards a knowledge economy typically produces a dual economy where large parts of the population are insufficiently skilled to match the changing needs of the firms. All

of these cities have good universities, but they continue to lose talent to booming capital regions. In terms of economic development policies, these cities are very active. They are trying very hard to develop new economic growth clusters, to compensate for the loss of economic activity in declining sectors. Examples are Rotterdam (this city wants to develop the audio-visual sector) and Manchester (creative industries, ICT sector). However, despite strong policy efforts, they are less successful in this respect than the 'stars'. Typically, these cities are making efforts to become more attractive to the higher-skilled. They seek to change their image, to upgrade their housing stock and to improve their amenities. Rotterdam's policy priorities, for instance, are to reduce crime, to demolish poor-quality housing estates and replace them with high-quality apartments, to invest in culture and to change the image of the city through media campaigns.

Interestingly, our interviews suggest that these cities are 'early movers' when it comes to the development of integrated knowledge economy strategies. They are strongly aware that the structural changes that the knowledge economy entails require an integrated approach. In 'metropolises in transition', the growth of GDP per capita and employment is less than that of the 'stars', with positive exceptions and notable successes in some sectors.

Knowledge Pearls

These are smaller cities with a strong knowledge base. They are located very near a major city and enjoy many of its benefits (its amenities, facilities, an international airport, a big labour market), without having its problems (congestion, pollution, crime). An example is Leuven (near Brussels). Typically, these cities have renowned universities that dominate the city and in fact constitute much of its image. These universities are the magnets for top students and academics and for knowledge-intensive business. Historically, they attract top scientists and students from everywhere and often develop scientific

centres of excellence of world reputation. The increasing internationalisation of education enables them to capitalise further on their reputation and attract the best students from around the globe. These cities are also increasingly developing business out of their knowledge base: in the past decade, their academic centres have produced successful start-up companies and also have attracted private research institutes and companies to the cities. This has strongly strengthened the local economy. These cities do not have serious problems of social exclusion, although there often is a cultural gap between the academic community and the rest of the population. 'Knowledge pearls' have shown very good progress indicators. The fact that such cities are part of a wider metropolitan network (the 'chain') is decisive: it compensates for crucial scale disadvantages. This is the fundamental difference with the more provincial university cities that will be discussed later. The policy focus in these cities is to capitalise further on their strong knowledge base. A relevant policy option is to intensify the co-operation within the metropolitan area on which they depend so strongly.

Star Nicheplayers

'Star nicheplayers' have a specialised university of high quality and also can boast a strong and specialised business sector. An example from our set of cases is Eindhoven. Typical of these cities is the excellent co-operation between business, university and local government. Our interviews revealed that personal and institutional networks are very dense; there is a shared feeling of local pride and identity; and, key actors are willing to embark on projects for the benefit of the city. Big corporations play an important role (Philips in Eindhoven): they have many international connections that bring new knowledge and innovative practice into the region; they put high demands on the local knowledge base; they are an important source of spin-off companies; and, they attract suppliers. For the university, they are a valuable partner

for internships, professorships and contract research. These cities tend to do very well in their niche and manage to attract engineers not only from inside but also from outside the region, or even from abroad. Their specialisation is their strength, but also their weakness: these cities are very vulnerable to the volatility of the high-tech sector and, more specifically, to the performance of the leading company. Also, globalisation puts pressure on these cities. To remain 'top' in certain technology fields, even more specialisation might be needed. Co-operation with other cities and universities may help in this respect and can also compensate for scale disadvantages. Another problem of these cities is their weak international accessibility. The on-going process of internationalisation of business and science puts them in an increasingly disadvantageous position *vis-à-vis* better-connected metropolitan areas. In Eindhoven, policy-makers stress that improving international accessibility is a priority in order to remain 'leading in technology' (the slogan of the city). They are lobbying intensively with national policy-makers to get a better connection to the HST system.

'Star nicheplayers' manage to attract engineers, but they have more problems attracting other sections of the 'creative class', such as artists, marketeers, designers, etc. This may be a problem, as new product development increasingly asks for innovative combinations of 'hard' technology and soft aspects (design, marketing). To develop their soft side, some 'star nicheplayers' are pursuing policies to attract this complementary breed of knowledge workers, *inter alia*, by investing in culture and leisure facilities.

Nicheplayers in Transition

'Nicheplayers in transition' are similar in many respects to the 'star nicheplayers'. One crucial difference is the industrial structure. 'Nicheplayers in transition' have a much weaker industrial structure, either because of a legacy of declining industries or because of an absence of an 'engine firm'. Examples are Enschede and Aachen.

These cities tend to have relatively high unemployment rates and high levels of social exclusion. They attract students to their universities, but have difficulty in retaining talent because of the weaker industrial structure. For these cities, the (technical) university is the key asset for urban development. Urban policies very actively support start-ups from the university and encourage university–business co-operation of all kinds. In some cases, we observed unrealistic expectations among policy-makers concerning the potential of the university to revitalise the local economy. In Aachen for instance, in the past decade much public money has been invested in incubators and knowledge transfer activities, but the employment growth in high-tech industries has been disappointing and unemployment levels among the low- and medium-skilled are still high. Now, economic development agencies are shifting their focus to the creation of jobs for these people by attracting not-so-sophisticated industries and improving the link between universities and medium-tech firms. The combination of high-tech and industrial traditions offers opportunities for new niche markets.

Intellectuals

Typical of these towns is that they are relatively small and dominated by a big 'general' university. The student population makes up a large part of the city and the amenities in the cities are highly geared towards their needs and preferences. The economic structure of these cities is diverse. Normally, such cities do not have such a strong technology bias compared with the former two types. Münster is a good example of this city type. One problem for these cities is how to capitalise on their knowledge base. Students come to the city during their study period, but leave after graduation because there are so few jobs. Levels of interaction between university research teams and local business are relatively weak because of the small industrial base in the city.

Dynamics and Perspective

The typology proposed here is preliminary and certainly needs further elaboration. As it is based on a small number of cases, it cannot claim to be comprehensive. Including more cities—especially smaller, provincial cities—could increase the number of city types. The typology should be regarded only as a first step to highlight some crucial differences in the position and perspective of different types of cities in the knowledge economy. Moreover, it is not meant to be a static account: over time, cities may move from the one type to the other, either because of strong and consistent policy interventions or because of structural technological and economic changes. Some shifts are more likely and probable than others, however. Clearly, provincial towns cannot hope to become metropolitan areas at short notice. ‘Metropolises in transition’ may shift towards ‘star’ status when they manage to repair their quality-of-life deficit and deal effectively with their economic legacy. Some cities have already moved far along this road: well-documented European examples are Glasgow, Antwerp, Lille and Manchester. Likewise, ‘nicheplayers in transition’ may tread a similar path when they manage to upgrade their industrial structure and align it with their knowledge base. Also, smaller cities may engage in strategic co-operation with other cities: for instance, by sharing facilities, joint lobbying or by aligning the research and education programmes of their universities. These may be the first steps to overcome scale disadvantages. Several medium-sized cities are moving in this direction: Eindhoven is seeking to link up with Leuven and co-ordinate research activities and Münster has started to work with Enschede. Table 3 gives an overview of the different city types, including typical foundations, a progress indication and perspectives.

6. Concluding Remarks

In this paper, we have shown the large variation between city types concerning their potential to thrive in the knowledge

economy. For policy, this diversity suggests that bottom-up approaches may be more effective than top-down national policies. Regional/urban actors know best what the specific opportunities and threats are. To capitalise on this, national governments could make more use of their knowledge, energy and networks. They could encourage local actors to develop regional strategies in public private partnerships and support these strategies in different ways. The governments of the Netherlands and France have recently adopted this approach. The Dutch Ministry of Economic Affairs plans to reduce financial aid to the rural parts of the Netherlands and instead support innovative knowledge-based strategies of specific urban regions. One of the priorities in this policy is to promote co-operation within the urban region, as, currently, adjacent cities often compete instead of co-operating to attract firms and skilled people. Similarly, the government of France has started to support strong knowledge regions. It recently identified six leading knowledge regions with world-class competences in specific sectors. These urban regions will receive considerable financial support further to improve their position as international centres of excellence. Another 61 ‘poles of competitiveness’ were selected. Total public expenses to support these poles amounts to a substantial €1.8 billion (*Financial Times*, 2005; *Le Figaro*, 2005).

This paper suggests that the transition towards a knowledge economy is causing shifts in Europe’s urban system. The best cards seem to be in the hands of internationally connected metropolitan areas that have a diversified economy, a strong knowledge base and a high quality of life. In the coming years, these cities’ relative position is likely to improve further: with increasing internationalisation of research and business, their cultural diversity and accessibility are clear assets to attract (foreign) firms and personnel; in addition, they will benefit from the trend of improving co-operation between universities and business, because they are strong on both sides. If this is true, a key policy question for national governments is whether to back

Table 3. Different city types: an overview

	Typical foundations	Progress	Perspective
<i>Metropolitan</i> ‘Stars’ (<i>Munich, Amsterdam, Helsinki</i>)	Strong and diversified economy Strong and diversified knowledge base High educational levels High ‘urban’ quality of life High levels of diversity Good external accessibility	High levels of new knowledge creation and application Very successful in attracting talent Growth of new industries ‘Growth management’: Some cities develop policy to keep crucial lower-income jobs (nurses, teachers, policemen, etc.) in the city	Their diversity is a fertile ground for further innovation Their ability to attract talent is a crucial asset for further growth Their ‘critical mass’ brings many advantages in the knowledge economy They face a risk of crowding out of crucial workers (nurses, policemen, teachers)
‘Metropolises in transition’ (<i>Manchester, Dortmund, Rotterdam</i>)	Good knowledge base Relatively low educational levels Weaker industrial structure Good external accessibility Quality-of-life problems Low quality of housing stock Unemployment and social exclusion Poor image	Problems in attracting and retaining talent Arduous efforts to diversify their economies and develop new growth industries, but few results Strong efforts to improve image and quality of life	Active policies may solve image and quality-of-life problems There are chances for reinventing industrial traditions Their low factor costs and the availability of industrial heritage offer scope for innovation and experimentation An improved link between their knowledge base and industrial structure can bring further growth
‘Pearls’ (<i>Leuven</i>)	Excellent knowledge base Knowledge-intensive industry structure High quality of life Good accessibility Benefit from advantages of nearby metropolis Low levels of social exclusion	High levels of knowledge creation and application Attract academic talent and high-tech business Capitalise on the knowledge base Policy efforts to improve business-university links	The high-quality knowledge base is likely to attract private business, notably research labs University and knowledge institutes offer scope for spin-offs and new business development Their high quality of life combined with their position in metropolitan networks gives a head-start in the knowledge economy

(Table continued)

Table 3. Continued

	Typical foundations	Progress	Perspective
<i>Non-metropolitan</i> 'Star niche players' (Eindhoven)	Specialised (high-tech) knowledge base Strong knowledge-intensive industrial structure, often with dominant company Quality-of-life keywords: green, spacious, quiet, non-metropolitan Relatively poor international connections	Cities tend to have very good business–university links They are good at producing technological innovations and new products They manage to attract engineers, but have difficulties in attracting the creative class; therefore, they invest in culture and leisure They successfully develop new clusters built on local economic and technological competences	The combination of a strong knowledge base and a strong industrial structure gives them a favourable starting position in the knowledge economy A further elaboration/refinement of their technological focus can bring growth, but specialisation also makes them vulnerable They may engage in strategic networks with other cities to compensate for scale disadvantages
'Nicheplayers in transition' (Enschede, Aachen)	Specialised high-tech knowledge base Unfavourable sector mix with legacy of 'old industries' Industrial structure dominated by small firms Quality-of-life and image problems: regeneration challenge Relatively poor international connections	There are good business-university links Much innovation in SMEs They have problems in attracting/keeping talent, especially the 'creative class' Development of growth clusters out of excellent research groups, but the size remains very tiny	They may create more high-tech employment, but the challenge is to create jobs for the lower-skilled as well Cities face the challenge of creating a variety of jobs The combination of high-tech and industrial traditions offers opportunities for new niche markets There is potential for start-ups from the university They may engage in strategic networks with other cities to compensate for scale disadvantages
'Intellectuals' (Münster)	Strong knowledge base, big university Quality-of-life keywords: green, spacious, quiet, non-metropolitan Healthy industrial structure Relatively few high-tech companies, mostly SMEs Relatively poor international connections	Ability to attract academic talent, although somewhat hampered by lack of size Business–university interaction hampered by lack of business partners Development of growth clusters out of excellent research groups, but the size remains very small	Their strong knowledge base is an asset to attract private (research) firms and strengthen the industrial structure They may nurture start-ups from the university to develop the local economy They may engage in strategic networks with other cities to compensate for scale disadvantages

the winners (a strategy that seems to be gaining ground) or help the losers—in other words, whether to invest in the already-thriving places, or in the weaker areas.

Backing the winners would lead to a further concentration of human capital and knowledge-intensive business in already-thriving metropolitan areas; these regions could become even more attractive for investments from abroad. Concentration has a price, too, in terms of congestion and crowding-out effects. Also, it may further hollow out the knowledge base of provincial cities and disrupt the spatial balance.

The position of non-metropolitan urban regions needs specific policy attention. They are a vital part of Europe's urban system and typically have an important function for large hinterlands. To safeguard the vitality of these cities, policies need to be formed that strengthen their specialisation. If they want to maintain a spatial balance, governments could encourage smaller, non-metropolitan cities to develop specific niches and specialisations in a creative way and to engage in strategic partnerships with other cities. Or, they could directly invest in facilities in fields where the region has potential. By doing this, they may create critical mass in some specific fields, which is increasingly needed in the knowledge economy.

There are several examples of emerging city networks (some of them transborder) that have the potential to achieve this. However, this comes at a price: more specialised regions are more vulnerable to economic shocks. Another way national governments can counter the trend of mega-urbanisation is by encouraging and facilitating the roll-out of top-level electronic infrastructure in non-metropolitan regions. This can help them at least partly to overcome their accessibility deficit. Without policy intervention, these cities will lag further behind, as market actors tend to 'cherry pick' and prefer densely populated metropolitan areas (see van Winden and Woets, 2004).

In defining the geography of the knowledge economy, it is fruitful to think in terms of networks consisting of nodes and linkages. Rather than defining space on the basis of

individual cities or city-regions, it is possible to conceive regions in terms of access to specialised knowledge resources. Looking at Europe's urban system in this way, Europe has extensive knowledge networks with enormous knowledge resources and potential. If these resources were better aligned with each other, the potential can be fully reaped. Some companies are starting to push local authorities to align their strengths in order to create a more favourable research environment: the electronics company Philips recently encouraged the cities of Eindhoven, Aachen and Leuven to align their R&D and education spearheads.

This paper is largely explorative and leans heavily on case studies. It touches upon many issues that need further elaboration. An issue for further research is how to refine our measurement of the performance of urban regions in the knowledge economy. Given the different starting positions of cities, it would be useful to speak of relative performance rather than absolute performance: the cities play in different leagues because their initial positions are so different. It would be interesting to measure traditional economic performance indicators (developments in (un)employment, GDP/capita, productivity) alongside additional ones (share of innovative/knowledge-intensive industries) and social exclusion measures. The frame of analysis and the typology can serve as a basis for a larger quantitative assessment and may help to design and monitor policy.

More in-depth research is needed into the governance of the knowledge economy. One finding in this study is that traditional administrative borders—that are the basis for policies—coincide less and less with the reality of 'knowledge regions' and 'knowledge networks', which are often cross-border. This raises a number of questions. How can we define and measure knowledge regions and networks? How can the governance of such areas or networks be improved? What are the implications for national and European policy? Another relevant topic is the alignment of national policies and local needs. This paper touches upon the way national policies affect

the local knowledge economy, but more research is needed, in more European countries, to discover differences and good practice. Another relevant topic is the potential for urban networks. Our research indicates that cities are aware of the need for strategic partnership with other cities, but they are struggling to give substance to urban networks. More research into this topic could describe options, bottlenecks and best practice, and generate ideas for 'next practice'. A final topic concerns the extent to which the private sector—i.e. larger companies—can be involved in knowledge economy strategies.

Notes

1. Glaeser (2000) found that it is the need to access common pools of labour rather than suppliers and customers that drives the tendency of firms to cluster together in cities.
2. The quality of the knowledge and technology transfer system is a location factor for (foreign) companies: Munich's good score in this respect was one of the reasons for General Electric to choose Munich as a base for its European headquarters.
3. The Catholic University is a top-ranking university; also there are several independent public research institutes. The most important one is IMEC, Flanders independent research centre in microelectronics, nanotechnology and related technologies. This centre works closely together with private firms, and has attracted specialised high-tech companies that want to be located in the vicinity of the centre.
4. The ICT industry shows how well these cities are able to develop new growth industries: in their respective countries, these cities showed the highest growth rates of ICT employment. Helsinki and Munich were also number one in biotechnology.
5. For the city of Enschede, the lack of international connectivity is a key barrier to attracting international business: the nearest international airport is Schiphol, at 1.5 hours driving distance, and the city is not connected to the high-speed rail network.
6. To illustrate this point: an interviewee from the University of Münster told the authors that in previous years several professors had left the university because their partners could not find an appropriate job in the region.
7. Eindhoven is an exception. Despite the city's small size, its foreign workforce is large

enough to support a primary and secondary international school. Interviewees stressed the crucial importance of this school in attracting researchers from abroad.

8. Eindhoven is a good illustration. A small group of key decision-makers (consisting of leaders from the industry, the president of the university and the mayor) meet frequently and jointly develop initiatives and generate resources to support the local economy. Recently, they initiated an ambitious programme that aims to increase the supply of skilled labour, to increase the commercialisation of technology, to diversify the economy away from only technology sectors, to develop a 'high-tech campus' (an open campus model with excellent research facilities for academia and companies) and to raise the international profile of the region in order to attract foreign firms and knowledge workers.

References

- ARK, B. VAN (2000) Measuring productivity in the new economy: towards a European perspective, *The Economist*, 148(1), pp. 87–105.
- BAPTISTA, R. (2000) Do innovations diffuse faster within geographical clusters?, *International Journal of Industrial Organisation*, 18, pp. 515–535.
- BERG, L. VAN DEN and RUSSO, A. P. (2004) *The Student City: Strategic Planning for Students' Communities in EU Cities*. Aldershot: Ashgate.
- BERG, L. VAN DEN, BRAUN, E. and MEER, J. VAN DER (1977) *Metropolitan Organising Capacity: Experiences with Organising Major Projects in European Cities*. Aldershot: Ashgate.
- BERG, L. VAN DEN, BRAUN, E. and WINDEN, W. VAN (2001) *Growth Clusters in European Metropolitan Cities*. Aldershot: Ashgate.
- BERG, L. VAN DEN, POL, P. M. J., WINDEN, W. VAN (2002) *The safe city: a research proposal on safety and urban development*. Euricur, Rotterdam.
- BERG, L. VAN DEN, POL, P. M. J., WINDEN, W. VAN and WOETS, P. (2004) *European Cities in the Knowledge Economy: The Cases of Amsterdam, Dortmund, Eindhoven, Helsinki, Manchester, Munich, Münster, Rotterdam and Zaragoza*. Rotterdam: Euricur.
- BUCK, N., GORDON, I., HALL, P. ET AL. (2002) *Working Capital: Life and Labour in Contemporary London*. London: Routledge.
- CASTELLS, M. (2000) *The information city, the new economy, and the network society*. Paper presented at the Conference *People, Cities and the New Information Economy*, Helsinki, December.

- CHESHIRE, P. and GORDON, I. (Eds) (1995) *Territorial Competition in an Integrating Europe*. Aldershot: Avebury.
- DAHLMAN, C. and ANDERSON, T. (2000) *Korea and the knowledge-based economy: making the transition*. IBRD, World Bank, Washington, DC.
- DEN HARTOG, P., BROERSMA, L. and ARK, B. VAN (2003) On the soft side of innovation: services innovation and its policy implications, *De Economist*, 4, pp. 433–452.
- Die Zeit (2004) Dortmund: Neuer Mut nach dem Absturz, 39, p. 32.
- DIJKSTRA, L. (2004) European cities in a dynamic, knowledge-based economy, *Kaupunkiseutujen kasvun aika*, pp. 14–17.
- DOCHERTY, I., GULLIVER, S. and DRAKE, P. (2004) Exploring the potential benefits of city collaboration, *Regional Studies*, 38, pp. 445–456.
- DURANTON, G. and PUGA, D. (2000) Diversity and specialisation in cities: why, where and when does it matter?, *Urban Studies*, 37(3), pp. 533–555.
- EU (EUROPEAN UNION) EUROPEAN TREND CHART ON INNOVATION (2002) *2002 European innovation scoreboard: EU regions*. Technical Paper No. 3, 28 November (http://www.strinop.net/downloads/results/EU_RegionsInnovationScoreboard2002.pdf).
- Financial Times (2005) France names six target areas for growth, 13 July.
- FLORIDA, R. (2000) *The economic geography of talent*. Heinz School of Public Policy and Management, Carnegie Mellon University, Pittsburgh, PA.
- FLORIDA, R. (2002) *The Rise of the Creative Class*. New York: Basic Books.
- GLAESER, E. L. (2000) The new economics of urban and regional growth, in: G. CLARK, M. GERTLER and M. FELDMAN (Eds) *The Oxford Handbook of Economic Geography*, pp. 83–98. Oxford: Oxford University Press.
- GLAESER, E. L., SHEINKMAN, J. A. and SHEIFER, A. (1995) Economic growth in a cross-section of cities, *Journal of Monetary Economics*, 36 pp. 117–143.
- GOLDSTEIN, H. A. and RENAULT, C. S. (2004) Contributions of universities to regional economic development: a quasi-experimental approach, *Regional Studies*, 38(7), pp. 733–746.
- HENDERSON, V. (1997) Medium size cities, *Regional Science and Urban Economics*, 27, pp. 583–612.
- HEPWORTH, M. and SPENCER, G. (2003) *A regional perspective on the knowledge economy in Great Britain*. Report of the Local Futures Group for the Department of Trade and Industry, DTI, London.
- HOWELLS, J. R. L. (2002) Tacit knowledge, innovation and economic geography, *Urban Studies*, 39, pp. 871–884.
- JACOBS, J. (1961) *The Death and Life of Great American Cities*. New York: Random House.
- JARUZELSI, B., DEHOFF, K. and BORDIA, R. (2005) *The Booz Allen Hamilton Global Innovation 1000: money isn't everything*. Booz Allen Hamilton.
- KEARNS, A. and PADDISON, R. (2000) New challenges for urban governance, *Urban Studies*, 37, pp. 845–850.
- KNIGHT, R. V. (1995) Knowledge based development: policy and planning implications for cities, *Urban Studies*, 32, pp. 225–260.
- LAWTON SMITH, H. (2003) Knowledge organisations and local economic development: the cases of Oxford and Grenoble, *Regional Studies*, 37, pp. 899–909.
- Le Figaro (2005) Le plan de Villepin pour réveiller la France industrielle, 13 July.
- LEVER, W. F. (2002) Correlating the knowledge-base of cities with economic growth, *Urban Studies*, 39, pp. 859–870.
- MATTHIESSEN, C. W., SCHWARZ, A. W. and FIND, S. (2002) The top-level global research system, 1997–99: centres, networks and nodality—an analysis based on bibliometric indicators, *Urban Studies*, 39, pp. 903–927.
- OECD (ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT) (2002) *Territorial review of Helsinki, Finland*. OECD, Paris.
- OECD (2004) *Territorial review on Montreal, Canada*. OECD, Paris.
- SIMMIE, J. (2002) Knowledge spillovers and reasons for the concentration of innovative SMEs, *Urban Studies*, 39, pp. 885–902.
- SIMMIE, J., SENNETT, J., WOOD, P. and HART, D. (2002) Innovation in Europe: a tale of networks, knowledge and trade in five cities, *Regional Studies*, 36, pp. 47–64.
- SIMON, C. (1998) Human capital and metropolitan employment growth, *Journal of Urban Economics*, 43, pp. 223–243.
- TUROK, I. and EDGE, N. (1999) *The Jobs Gap in Britain's Cities: Employment Loss and Labour Market Consequences*. Bristol: Policy Press.
- WINDEN, W. VAN (2003) *Essays on urban ICT policies*. Tinbergen Institute, Rotterdam.
- WINDEN, W. VAN and BERG, L. VAN DEN (2004) *Cities in the knowledge economy: new governance challenges*. Research Paper for the Urbact project STRIKE (Strategies of Regions in the Knowledge Economy), Euricur, Rotterdam.
- WINDEN, W. VAN and WOETS, P. (2004) Urban broadband Internet policies in Europe: a critical review, *Urban Studies*, 41, pp. 2043–2060.
- WINDEN, W. VAN, BERG, L. VAN DEN and MEER, A. VAN DER (2004) The development of ICT clusters in European cities: towards a typology, *International Journal of Technology Management*, 28, pp. 356–387.