

Clusters in the EU-10 new member countries

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Executive Summary

Regional clusters, the geographic concentration of economic activities in a specific field connected through different types of linkages, from knowledge spill-overs to the use of a common labour market, are increasingly viewed as an interesting conceptual tool to understand the economic strength or competitiveness of a region. In recent years, this view has also motivated more and more policy makers and economic development practitioners to turn to cluster-based concept as new tools to strengthen regional economies.

While clusters are part of regional economies in countries across the globe and at all stages of economic development, there are indications that they might be particularly important for understanding and addressing the economic challenges that Europe is facing. Many Europeans are concerned that their prosperity, productivity, and innovation levels fail to keep pace with the United States and increasingly with competitors from other parts of the world like Asia. While the overall levels of skills, infrastructure, and institutional capacity in Europe seem to be on par or even better than elsewhere in the world, many researchers have identified rules and regulations that hamper flexibility, for example on the labour market, or reduce incentives, for example through high tax rates, as potential reasons for the European performance gap. The recent work on clusters and competitiveness suggests that differences in regional specialization patterns across cluster categories could be an additional, potentially very powerful driver of this gap. Regional clusters enable companies to reach higher levels of productivity and be more innovative – this is what the available research indicates. If European regions suffer from weaker regional clusters and cluster portfolios than their peers elsewhere in the world, this might be an important factor keeping them behind in global competition.

The EU-10, the group of ten countries that have joined the European Union in 2004, have faced more barriers to an efficient geographical allocation of economic activities across regions than their peers in the EU-15. All have

faced some level of trade, investment, and labour mobility barriers towards the EU and each other. And the eight central and eastern European countries in addition faced the legacy of a planned economy system that determined locations for economic activities based on political decisions, not based on economic efficiency or entrepreneurship. While these countries differ significantly from the EU-15 in terms of flexibility, incentives, and other business environment conditions, they were equally or even more affected from barriers to geographical efficient allocation of economic activity.

This report presents the first systematic mapping and analysis of regional clusters across the EU-10. It uses a classification system that allocates employment to four broad sectors of the economy, and within one of them, the cluster sector, to 38 cluster categories. This classification system is then applied to the 41 NUTS 2 regions of the EU-10 countries. This data, supplemented by 10 regional cluster case studies and an assessment of relevant national institutions and policies, is then analyzed from two perspectives: First, the report takes the perspective of the region and describes the patterns of economic specialization across the 41 NUTS 2 regions, the changes that have occurred in regional specialization in the course of the last few years, and the relationship between the strength of regional cluster portfolios and indicators of economic performance.

- 367 regional clusters meet at least one of the hurdle rates for absolute size, specialization or regional importance. These regional clusters represent 5.86m employees, about 58% of total employment in the cluster sector of the EU-10
- The capital regions of the largest countries among the EU-10 lead the ranking of regions by cluster portfolio strength: Budapest (rank 1), Warsaw (2), and Prague (4). Only Lithuania breaks into the ranks of these cities and of other metropolitan regions from Poland and the Czech Republic that dominate the first dozen ranks.
- Lithuania tops the country ranking in terms of cluster strength by countries' average region. Slovenia

and Latvia also rank high, based mainly on their large absolute size. Hungarian regions and Malta rank high on measures of relative specialisation and dominance of regional clusters. Cyprus and Estonia register the weakest overall cluster portfolios.

Second, the report takes the perspective of cluster categories and describes the differences of regional specialization across the 38 cluster categories, the changes that have occurred in cluster specialization patterns in the last few years, and the nature of the leading locations across individual cluster categories.

- The largest seven cluster categories (sorted by employment: Processed Food, Heavy Construction Services, Transportation and Logistics, Financial Services, Hospitality and Tourism, Metal Manufacturing, and Building Fixtures, Equipment and Services) account for 50% of all cluster sector employment across the EU-10
- The cluster sector gained a total of 1 million jobs between 2000 and 2004, an increase of about 10%.^{*} Employment growth was registered by 27 cluster categories, with six of them (sorted by employment change: Hospitality and Tourism, Transportation and Logistics, Processed Food, Heavy Construction Services, Automotive, Business Services) accounting for close to 50% of the gains. Eleven cluster categories registered employment losses, with two of them (Footwear, Production Technology) accounting for close to 50% of the losses
- In relative terms, seven cluster categories gained significant position in terms of their share of cluster sector employment (sorted by relative change: Hospitality and Tourism, Business Services, Distribution Services, Automotive, Forest Products, Information Technology, Furniture, and Transportation and Logistics). The cluster categories that lost relative importance in terms of employment are Apparel, Education and Knowledge Creation, Footwear, Textiles, and Production Technology

Third, the report concludes with a summary of observations and recommendations for policy and research. The analysis presented in this report provides a powerful tool to understand the industrial dynamics of the regional economies across the EU-10. And it gives an indication that the lack of regional specialization

might be an important factor in explaining the European competitiveness gap towards leading global peers:

- The EU-10 has a specialization profile that remains distinct from more advanced economies like the United States or Sweden, countries for which comparable data is available. We find that the EU-10 still has a far stronger natural resource-driven sector than these other economies. And we find that the EU-10 have within the cluster sector a much stronger bias towards labour-intensive and manufacturing-driven cluster categories, while being relatively weak in advanced services and knowledge-intensive cluster categories
- As in other geographies, that there are large differences within the EU-10 across regions as well as across cluster categories in terms of their degrees of specialization and geographic concentration. The absolute employment level in a region or a cluster category is one important driver for these differences but the data strongly suggest that other factors are important as well. Legacy, location, and specific business environment conditions, policies and institutions are candidates to explain region or cluster-specific outcomes.
- The economies of the EU-10 countries have undergone a period of tremendous structural change. The data both on regional economies and on regional clusters shows a high level of change over time. Interestingly, these changes suggest that there are opportunities as well as threats for all regions and regional clusters. Initial conditions in terms of total size or established position do not guarantee success or predetermine failure.
- The strengths of regional cluster portfolios and of individual regional clusters are important determinants of economic performance. As in all other countries in which comparable cluster mapping data has been analyzed, we find a strong positive relationship between a measure of cluster portfolio strength and prosperity.
- The EU-10 exhibits much lower specialization on specific regional clusters within regions and much lower geographic concentration on specific regions within cluster categories than the U.S. economy. If, as suggested by the conceptual framework and confirmed by the data presented here as well as in

^{*} Note that this increase is driven by an increase in coverage of Polish employment that accounts for about 90% of the change, double the 45% share that Poland has in the 2004 total cluster sector employment across the EU-10.

other cluster mapping data research, higher levels of specialization and concentration enable higher productivity and innovation, this is a serious concern. Interestingly, we also find initial indications that this is a problem not only of the EU-10 but also of the EU-15 countries – an observation at least fully consistent with the performance gap relative to the United States.

Based on these observations, three key policy recommendations are identified:

- First, enhancing geographical specialization and the efficient allocation of economic activity across space needs to be a core element of the European competitiveness effort. This is an area in which Europe is behind and the more specific performance weaknesses of the European economies, like the insufficient translation of scientific ability into economic innovation and value, are directly related to the functions regional clusters perform. The European Union can improve the conditions for an efficient allocation of economic activity through further dismantling trade (especially in services), investment, knowledge, and labour mobility barriers across Europe. The EU-10 countries are well positioned to take advantage of the opportunities that increasing integration provides, being in the midst of a large-scale economic and political change process.
- Second, where regional clusters are present, cluster initiatives, organized efforts of companies, regional government agencies, and research and educational institutions, can increase their economic benefits. They can improve linkages and increase spill-overs, mobilize joint action to improve critical areas of the cluster-specific business environment in the region, and increase the international visibility of a regional cluster. The European Union can strengthen the quality of these efforts by providing knowledge and tools, not by directing them. This is especially important in the EU-10 countries that tend to have relatively weaker public institutions that in addition

have a larger gap of missing trust between them and private companies to overcome.

- Third, many policies influence the quality of the regional business environment that affects whether or not regional clusters can succeed and grow. Innovation policies, regional policies, SME policies, investment attraction policies and many more are important tools already used by government agencies that can be leveraged to strengthen and develop regional clusters. The European Union, too, has a large number of such policies under its control; for some the challenge is to avoid having them work against the natural evolution of strong regional clusters, while for others the opportunity is to use regional clusters as an instrument to increase the effectiveness of policy tools available. The EU-10 countries are even more affected by these policies, as the EU's structural funds provide both in absolute and in relative terms account for a much higher share of government spending in these countries.

This report gives an indication of the decision-oriented analysis that can be conducted if systematic data about regional clusters becomes widely available. And it provides clear evidence that while cluster-based economic policies based on this analysis is not a panacea it is a very powerful tool that especially the European Union with its clear competitiveness challenges can ill afford to ignore. To improve Europe's innovative capacity in particular, more resources for science and R&D will not be enough. The focus needs to shift to the microeconomic capacity of European regions: quality and specialisation of factor conditions, sophistication of demand, quality of firm strategies and entrepreneurship, and presence and depth of clusters. These are the qualities of the business environment that enable the transformation of scientific knowledge into new products, services and competitive firms.

Chapter 1 Clusters, Innovation and Competitiveness

This report describes the key research findings from our work of statistically mapping the geographic profile of clusters and the economic composition of regional economies across the 41 NUTS-2 regions of the ten countries that joined the European Union (EU-10) on May 1st 2004. It provides the first comparable data set on employment by cluster and region to track the economic specialization patterns of these countries, for many of them a decade after their transition to a market economy.

A. The importance of clusters for European competitiveness and innovation

An increasing amount of research indicates that geographic proximity of related economic activities enables higher levels of productivity and innovation. Clusters, i.e. geographically co-located end producers, suppliers, services providers, research laboratories, educational institutions, and other institutions in a given economic field, are important drivers of dynamic regional economies. Recent trends in management, such as the focus on core activities/competencies and the move towards open innovation have increased companies' reliance on partners in close proximity.

Cluster and the broader patterns of economic specialization across geographies have become an important concern for European policy makers. One motivation is the set of ambitious goals on productivity growth and innovation that European leaders have defined for the EU in the Lisbon-Agenda. Europe tends to rank high on the quality of institutions and many factor conditions, but low on its ability to mobilize these inputs through entrepreneurship, new firm formation and corporate renewal. Europe also tends to rank high on R&D spending and scientific capacity but low on its ability to turn research into economically valuable innovations. As a consequence, progress on the Lisbon-Agenda has fallen behind schedule and is insufficient to meet the 2010 goals. Clusters have the potential to transform out comes in

both dimensions: Healthy clusters provide an accessible network of skills and capabilities, i.e. a microeconomic business and innovation environment that enable entrepreneurs to move from an idea to a business activity. And healthy clusters provide an efficient environment to move from a scientific advance or new business concept to a market test.

Another motivation is the impact of globalization on the nature of competition between regions. Falling transport and communication costs and the reduction of trade barriers have exposed larger segments of regional economies to global competition. Improvements in business environments and company practices in many parts of the world, too, have increased competitive pressure. With an increasing number of locations providing attractive conditions for investments, regions in Europe (as in other parts of the world) need to define the unique value they are offering to companies looking to locate business activities. Clusters have the potential to be a key dimension of a region's value proposition: Healthy clusters provide higher value for companies that are active in the economic fields in which they operate. And, through a region's portfolio of clusters, they provide a unique mix of skills and capabilities that are in its entirety very hard to match by competing locations.

The regions of Central and Eastern Europe that, together with Cyprus and Malta, are the object of this study have been exposed to these changes with exceptional force. Their level of productivity and innovation still lags significantly behind Western Europe. A low cost position gives them currently an edge in attracting new investment but it is ultimately a sign of the long path that these countries have ahead of themselves to fulfil their citizens' desires for standards of living at the level of Western Europe. Low wages are over time inconsistent with the aspirations to achieve catch-up to the prosperity levels of the old EU member countries. This goal will only be reached if the new EU members create the conditions for rapid

productivity growth. The Central and Eastern European regions have a past as planned economies in which economic activities were located based on political much more than on economic considerations. The transition to high-productivity economies involves increased levels of geographical specialization. Few countries, let alone regions, can reach high levels of productivity and prosperity if they aim to compete across a full range of industries.

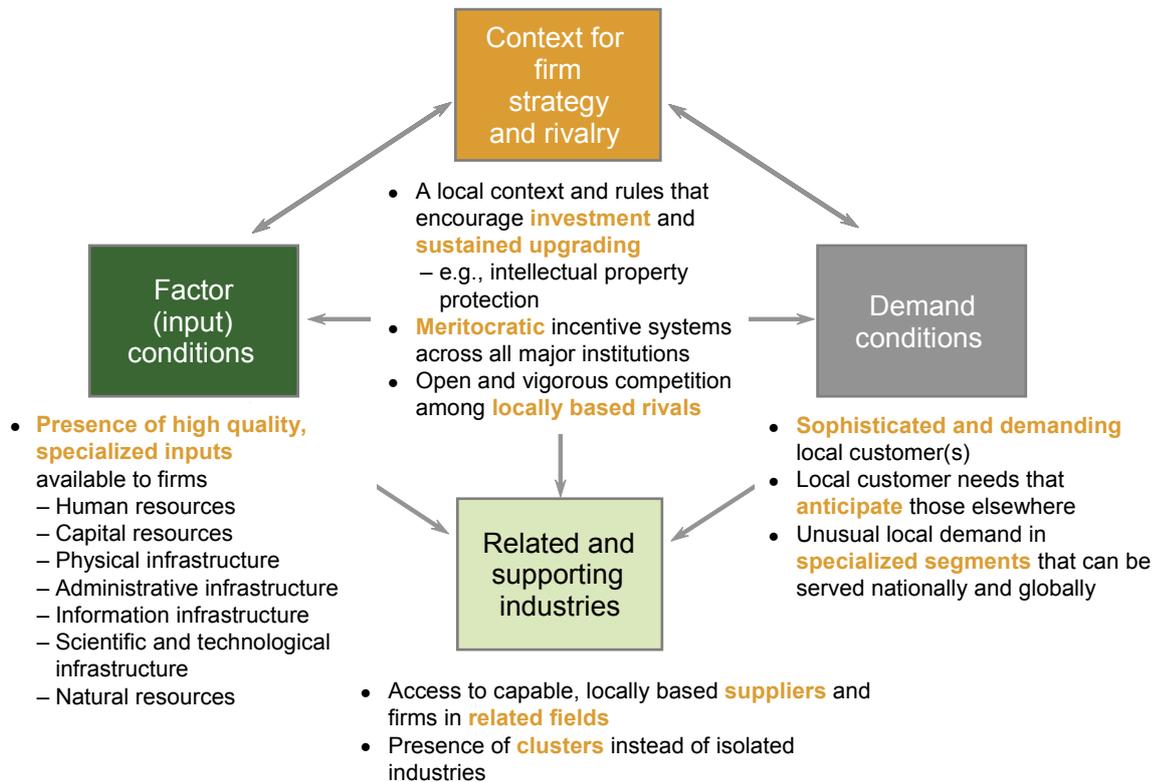
B. Clusters' role in a broader concept of competitiveness

Clusters are part of a broader conceptual framework to understand the drivers of regional and national competitiveness. This framework, grounded in Michael E. Porter's "The Competitive Advantage of Nations", provides a connection between firm-level behaviour and economic policy at the micro- as well as the macroeconomic level. Porter argues that to understand value creation in an economy, it is essential to understand the drivers that affect of value creation and innovation at the company level. He distinguishes between two sets of factors: The first set includes the overall macroeconomic, legal, social, and political context. This is an area in which over the last few years theory and practice have moved towards a consensus about what constitutes best practice. In Europe, much effort was put into creating more stable macroeconomic conditions by setting clear goals for monetary and fiscal policy consistent with this consensus. While a stable context is clearly beneficial, the experience of many countries, not only in Europe, has also shown that it is not sufficient. A stable context creates opportunities for companies to raise productivity, innovation, and value creation, but it does not create value itself.

This is why the second set of factors - Porter calls them the microeconomic capacity of an economy - is so important. Microeconomic capacity includes both the sophistication with which companies compete and the quality of the microeconomic business environment that surrounds them. The microeconomic business environment, sometimes referred to as the "diamond" of competitiveness, integrates a number of different perspectives that have been discussed in depth in the literature:

- First, factor input conditions in a given location, like the quality of the infrastructure, the skill base of the labour force, and the access to capital, are clearly important for the level of productivity that companies can reach there.
- Second, rules and regulations surrounding the nature of competition at this location, like competition laws, trade policy, incentive effects of taxes as well as the strategies that companies compete with, the transparency of their corporate governance, and the presence of dominant business groups are critical to enable and push companies to use existing assets and factor input in the best way.
- Third, clusters – the local presence of specialized suppliers, services providers, etc. - are catalysts for providing companies with inputs, pressure, and incentives in the most effective way. The portfolio of clusters present in a given location creates unique opportunities for new activities to emerge at their intersections.
- Fourth, local demand conditions, the sophistication of advanced local needs that foreshadow global preferences, are another driver to push companies to higher performance and, even more importantly, to generate an environment in which new ideas can develop.

Figure 1: The role of clusters in the “diamond” of competitiveness



Source: Michael E. Porter (2004)

Growing and innovative cluster environments are typically driven by a strong “diamond”, which involves:

- Intense local rivalry involving battles of prestige and “feuds,” stimulating continuous upgrading creating a foundation for a more advanced and diverse supplier base.
- Dynamic competition emanating from the entry of new firms, including spin-offs from larger incumbents.
- Intense cooperation organized through various institutions for collaboration such as professional organizations, chambers of commerce, cluster initiatives, etc. Dynamic clusters also exhibit intense informal interaction based on personal networks.
- Access to increasingly specialized and advanced factors of production (human capital, financial capital, infrastructure) and for many clusters, linkages with universities and public and private research institutions.
- Linkages to related industries, sharing pools of talent and new technological advancements.
- Proximity to sophisticated and demanding buyers

A location’s microeconomic capacity is set by choices made from a wide range of players on different geographic levels. Public policy set by the EU, national governments, state governments, local governments, and many semi-independent government agencies affect all parts of the diamond. Institutions with cross-regional responsibilities like the EU are faced with the challenge of how to apply tools and programs – be it structural funds, science and technology programs or SME network efforts – in ways that meet the specific needs of individual regions and regional clusters and that integrate well with the efforts taken by governments at lower geographic levels. This requires a new policy approach, transforming the EU’s role and its collaboration with member countries.

Globalization has led to questions of whether the local conditions companies face at their sites are still important when they can easily access skills and assets around the globe. Globalization has, somewhat ironically, actually increased the relative importance of location: While in the past locational choice was limited – serving a market required a significant presence of activities there, and allocating individ-

ual activities within a company's value chain across many locations was economically not sensible – location is now becoming a key tool for companies to achieve and sustain a unique strategic position in the market. The challenge for companies is to tie a global network of activities in locations to their leverage their respective unique qualities in order to reach optimum overall efficiency and innovative capacity.

C. Objective and structure of this report

This report provides a new tool for the European Commission that is central for its ability to leverage the presence of clusters throughout European regions in the design and implementation of EU policies. It also provides a critical element of a new “language” to enable a more precise and fact-driven discussion about the drivers of productivity and innovation at the microeconomic level and about the patterns of structural change across Europe. The work on the ten new EU member countries presented here provides an opportunity to test the robustness of this concept in a part of Europe that, as has been noted above, has been subject to particularly dramatic changes in its industrial and cluster composition. Ultimately a complete mapping of clusters across Europe will be needed to reap the full potential benefits of this data.

The report documents the findings of the analysis of a new database created in this project that allocates employment at the detailed industry level in each of the 41 NUTS-2 regions of the new member countries to 38 cluster categories, like automotive, biotechnology, financial services, or hospitality and tourism. These cluster categories and their respective lists of individual industries originate from a multi-year study undertaken at the Institute for Strategy and Competitiveness (Harvard Business School) that looked at the actual co-location of employment in individual industries across U.S. regions. The U.S.-based definitions were then adopted for Europe to arrive at the 38 cluster categories used in this project.

The report draws on a number of additional sources to provide further context for the analysis of the new database:

- Ten case studies of specific regional clusters in the new member countries

- A documentation of national institutions and policies affecting the development of clusters in the ten new member countries
- Data on the microeconomic capacity of the ten new member countries drawn from the 2005 Global Competitiveness Report
- Data on the export performance of the ten new member countries by cluster category provided by the Institute for Strategy and Competitiveness

The report discusses the key findings of our analysis from two dimensions: Individual regional economies (Chapter 3) and sectoral distribution across EU-10 (Chapter 4). On the level of regional economies, the report allows the Commission to better understand the relationship between the nature of regional cluster portfolios and indicators of economic and innovation performance. Sectoral distribution describes the degree of geographical specialization the new member countries have reached, a measure that can be compared with the United States and ultimately with the EU-15 countries. Both analyses enable the Commission to get more accurate insights in the role of the geographic patterns of economic activity as a driver of lower economic and innovation performance in Europe relative to the U.S. The data can also be provided to individual regions to give them a better understanding of the cluster composition of their economies – critical information in order to develop a unique regional position and an effective economic strategy.

The remainder of the report is organized in four chapters. Chapter 2 describes the methodology and the data used in the report. Chapter 3 takes the perspective of national and regional economies and reviews the strength of cluster portfolios across the ten new EU member countries. Chapter 4 turns to the sectoral perspective and analyzes the geographic patterns of economic activity in individual sectors. Chapter 5 summarizes the key observations from the analytical work, discusses the policy recommendations on the national and EU level, and makes suggestions on further data analysis.

Intermediate progress reports from this project are available for download at www.europe-innova.org, www.cluster-research.org and www.sse.edu/csc.

Chapter 2 Methodology

Clusters have been around for hundreds of years and efforts to leverage clusters as a tool for economic policy have been increasing in number since the early 1990s. Only recently, however, has the analysis of clusters moved beyond individual case studies. The present report falls into this new tradition of quantitative studies based on larger sets of empirical data.

The report uses five sources of data. The first, data on employment by clusters and regions in the ten new EU member countries, provides the basis for our analysis. It establishes the current presence and strength of clusters across these countries. Wherever possible, we use employment data on the 4-digit industry level. We constructed data sets for 2000 and for 2004, although differences between the sources for this data provide a challenge for the comparisons. Unfortunately, we could not obtain comparable data on wages, value added, or productivity at the level of regions and detailed industries.

The four other sources of data used fall into three different categories. First, the case studies aim to provide a sense of the power and limitations of the statistical cluster definitions. The statistical definitions provide the best average allocation of individual industries to cluster categories across regions, but might miss some of the unique features of a specific regional cluster. Second, the data on exports by cluster category aim to provide an additional perspective on the economic success of the regional clusters identified. The ability to successfully compete on world markets is one of the possible indicators to gauge the performance of regional clusters. Third, the data on national business environments and on the presence of policies and institutions affecting cluster development aims to provide insights into the factors that drive the evolution of regional clusters and regional cluster portfolios.

As a relatively young field of systematic research, the analysis of clusters and cluster-based policies still suffers from a significant amount of confusion related to the use of key terms. This report uses a number of such terms that are defined below:

- **Cluster categories:** Cluster categories are defined as lists of specific industries that empirically tend to co-locate. In this report, we operationalize this notion through the definition of 38 cluster categories, based on the cluster category definitions developed at the Institute for Strategy and Competitiveness, Harvard Business School. These original cluster category definitions were based on the US SIC industrial classification system and were then translated into the European NACE system.
- **Cluster sector:** The cluster sector includes all industries assigned to any of the 38 cluster categories defined above. We use this term to differentiate employment in this sector of an economy from local industries or other economic activities.
- **Regions:** The region is the specific geographic area in which the different types of externalities that give rise to the development of clusters are strong enough to materially affect the location of economic activities. In this report, we operationalize regions through the 41 NUTS-2 regions that the European Union has defined to subdivide the ten new EU member countries for statistical purposes.
- **Regional cluster:** Michael Porter defines cluster as “geographically co-located end producers, suppliers, services providers, research laboratories, educational institutions, and other institutions in a given economic field”. In this report, we operationalize this notion as the presence of a cluster category within a specific region.
- **Cluster initiatives:** Cluster initiatives are defined in the Cluster Initiative Greenbook as “organized efforts to increase the growth and competitiveness of a cluster within a region, involving cluster firms, government, and/or the research community”. In this report, we do not make the existence of a cluster initiative a precondition for calling the presence of co-located economic activities within a region a cluster.

A. Cluster level analysis

Statistical cluster mapping

Cluster mapping is a relatively new approach to derive a better understanding of the presence, profile, and economic performance of clusters.

The use of the word “mapping” relates to two aspects of this research method: First, cluster mapping is based on the mapping of the industrial classification code into clusters. And second, cluster mapping data allows the mapping of clusters across geographies, indicating which clusters are present where.

Cluster mapping efforts are differentiated by the approach used to allocate individual industries to specific cluster categories. In the past, this was often done on a case-by-case basis based on the knowledge of industry experts that were assumed to have a good sense of the level of linkages between industries. Other studies tried to look more systematically at specific types of spill-overs, for example by using input-output relationships, the movement of key individuals, or the evidence on knowledge spill-overs as evident in patent filing. The approach taken here, described in more detail below, is different because it does not rely on individual judgment nor does it make prior restrictions on the type of spill-overs that might exist. Instead, it is based on the revealed effect of spill-overs that becomes apparent in the actual locational decisions that companies take. At its core, it allocates industries to the same cluster category in the cluster definitions, if there is a high statistical correlation between their actual geographic locations.

The key advantage of the cluster mapping approach is its comparability across regions and its grounding in actual company behaviour. Without general definitions as developed for the cluster mapping, the comparisons between regions and between specific clusters suffered from arbitrary and inconsistent ways to define cluster boundaries. And while definitions based on the measurement of specific linkages (like supplier-buyer relationships) are interesting, that fail to communicate the importance of these linkages for the locational decisions companies take.

The key disadvantages of the cluster mapping approach are related to limitations inherent in the data. First, the cluster definitions miss the region-specific dimensions of a cluster. In a region dominated by financial services (for example the City of London) it is fair to assume that

a large part of the ‘Business Services’ cluster should be subsumed into the financial services cluster. A more detailed industry classification system would get around this by assigning, for example, lawyers to specific practice areas. In this report, we aim to get a sense for this issue by using case studies to test the validity of the statistical cluster definitions in specific cases. Second, relying on employment data instead of wages or productivity creates a bias towards employment-intensive industries driving the cluster mapping. Clusters such as biotechnology with few highly paid employees who create significant value, are getting underrepresented.

The data from a cluster mapping exercise is an important element to understand the regional composition of an economy and the geographic patterns of economic activity in a cluster category. It needs to be combined with other data, however, to get a rich understanding of the economic performance of a cluster, of the factors that explain the cluster’s profile and performance, and the key challenges it faces.

Creation of cluster definitions

The cluster definitions used in this report are based on cluster definitions developed at the Institute for Strategy and Competitiveness, Harvard Business School, from an analysis of the geographic distribution of economic activity by detailed industry across the 50 U.S. states. The United States provides a natural experiment of a large integrated market in which industries have for many decades been free to choose their locations based on economic considerations in the absence of trade and investment barriers. Cluster definitions based on actual locational patterns in the U.S. are therefore much more likely to reflect the true underlying forces of linkages between industries than locational patterns in the European Union (and in particular in the new member countries) where traded barriers and many other political interferences are likely to have had a substantial impact on current locational patterns.

As a first step in the generation of cluster definitions, Professor Porter and his team looked at the geographic distribution of employment. This analysis enabled them to identify three

types of industries with very different geographic profiles:

- **Local industries** are present at roughly the same density in all regions of the U.S., indicating that they serve local markets and are not exposed to direct competition across regions. Such industries, examples are local retail and other local services, account for about two thirds of all employment but have lower wages, productivity, and rates of innovation than the economy on average.
- **Traded cluster-industries** are concentrated geographically; industries in this category have a choice as to where to locate and serve markets across regions. Such industries, examples include financial services and automotive, account for close to one third of U.S. employment but register above average wages, productivity, and innovation.
- **Natural resource-based industries** are concentrated geographically as well but have to locate where the deposits of natural resources happen to be. They serve global markets but don't have much locational choice. In the U.S., they account for less than 1% of employment.

While our analysis focuses on industries that geographically concentrate, i.e. are parts of clusters, we also document the relative employment shares of local and natural-resource based industries across the regional economies of the ten new EU member countries.

The translation of the U.S.-based cluster definitions was done in three broad steps: First, we needed to translate the U.S. industrial classification systems SIC into the European NACE classification. Unfortunately there is no simple translation key between the American SIC system and the European NACE, and as a consequence the translation has to go through the UN based ISIC system. The translation between NACE and ISIC is simple. However, between ISIC and SIC there exists a many-to-many relationship, meaning that one ISIC category can be assigned to many SIC categories, and one SIC category can be assigned to many ISIC codes. The translation from SIC to NACE requires some adjustments and simplifications of the cluster definitions. With a few exceptions described below, this report follows their trans-

lation of SIC to NACE. It should be noted that this translation is not perfect. However, the level of details of the various classification systems differs to such an extent that any translation always will cause problems of adjustments. There is an ongoing project to harmonize the American and the European classification systems, which will eventually enable more simple and accurate comparisons between Europe and the U.S. industry data.

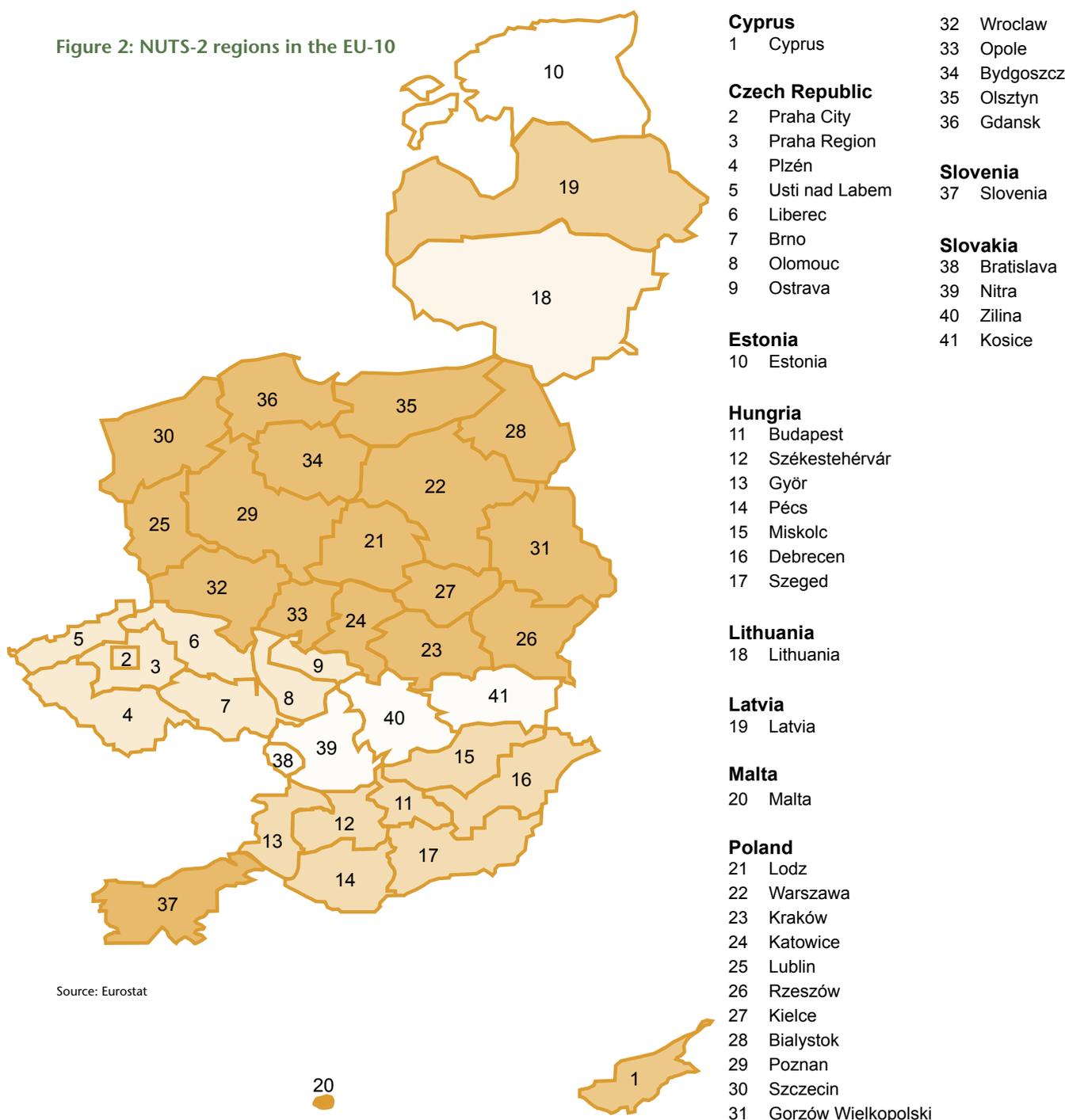
The translation from SIC to NACE necessitates some changes in the cluster definitions. First, the SIC system includes industry categories for "Aerospace engines" and "Aerospace, vehicles and defence" respectively. To obtain a better fit with the NACE system these two clusters have been consolidated to one. Second, the clusters "Prefabricated enclosures" and "Motor-driven products" are affected by the translation in a way that their relevance can be questioned. The industries that make up these clusters are accordingly allocated to other clusters. Overall, we thus use 38 cluster categories in this report, compared to the original 41 used in the U.S. cluster mapping. The number of industries by cluster varies between 37 and 1.

Due to the data constraints the original 4 digit NACE clusters had to be transformed further into clusters based on 3 digit NACE codes. The adjustment is of different importance across clusters; some clusters are unaffected while others change more significantly. Overall, our results show that there is a difference of around 10 to 15 percent in employment between 3 and 4 digit clusters, for those regions where we have been able to control for both 3 and 4 digits data. This means that while the aggregate level of an economy is very accurate, specific clusters can vary more significantly. Small clusters are relatively more sensitive. The transformation is done in a way that 3 digit industries are split into four digit ones. The split is done proportionally, meaning that half of a 3 digit industry is given to a 4 digit industry if there are two four digit codes under a 3 digit one, that one third of a 3 digit industry is given to a 4 digit code if there are three four digit codes under a 3 digit one, etc.

Second, we needed to define an appropriate definition of geographic regions. Regions in Europe are divided according to the NUTS system, a nomenclature of territorial units for statistics. As a hierarchical classification, the NUTS system subdivides each EU member country into NUTS 1 regions, each of which is in turn subdivided into NUTS 2 regions. The EU has been divided into a total of 254 NUTS 2 regions. The different criteria used for subdividing national territory into regions are normally split by normative and analytical criteria. Normative regions are the expression of a politi-

cal will; their limits are fixed according to the tasks allocated to the territorial communities, according to the sizes of population necessary to carry out these tasks efficiently and economically, and according to historical, cultural and other factors. Analytical (or functional) regions are defined according to analytical requirements; they group together zones using geographical criteria (e.g., altitude or type of soil) or using socio-economic criteria (e.g., homogeneity, complementarity or polarity of regional economies).

Figure 2: NUTS-2 regions in the EU-10



Source: Eurostat



In this report we use the concept of NUTS 2 regions, including 41 regions in the 10 countries studied (see figure 2 above). Six (Cyprus, Estonia, Latvia, Lithuania, Malta, and Slovenia) out of the 10 new member countries only have one NUTS 2 region, meaning that this region equals the whole country. Slovakia has four NUTS 2 regions, Hungary seven, the Czech Republic eight, and Poland sixteen. The size of regions in the 19 new EU member countries varies significantly from Malta with a population of some 400,000 to Warszawa, Poland with more than 5 million inhabitants.

Third, we aimed to obtain employment data at the highest available level of industry granularity. The U.S. cluster definitions used 4 digits SIC codes on a regional level. It was not possible to obtain reliable and comparable data for the 10 countries at this level of detail. EU employment data is collected from two different sources: from the Labour Force Survey (LFS) and from the Structural Business Statistics (SBS), both administrated by Eurostat. LFS is a quarterly survey given to a sample of the population living in private households. The LFS includes data on at most 3-digit NACE level for most, but not all, NUTS 2 regions. SBS statistics is mainly sourced from business registers and includes structural data over the economy. On NUTS 2 regional level Eurostat only administers data on NACE 2 digit level. 4 digit level data are collected on national level, but not for all NACE categories. The 4 digit level is in turn available for NUTS 1 regions (countries) but not for NUTS 2 regions. The best compromise taking both industry and geography into consideration has shown to be the use of 3 digit NACE data on NUTS 2 level breakdown. This data is included in the LFS.

The system of collecting data on 3 digit NACE level on NUTS 2 breakdown was implement-

ed in 2001, and some countries are still not processing this kind of data. In these cases we have received data from each National Statistics Institutes (NSI). For data for 2004 the NSI's of Estonia, Latvia, Cyprus and Slovenia were consulted. Hence, for four NUTS 2 regions the 2004 data source is not Eurostat. The data received by the NSI's typically comes from business registers, and as a consequence do not cover the whole economy. For example, self-employed persons, family workers and workers in small companies are not always included in the data. Moreover, there are in some cases problems of confidentiality. These situations arise when the information comes from only a few sources, usually less than 3 or 5 (firms).

The data from the NSI's has been controlled and compared with NACE 2 digits data from the LFS and Eurostat, and has in many cases thereafter been upgraded with data coming from the LFS. In total this data comprises at worst around 85% of the working population, while the data from the LFS is complete. It must therefore be noted that the results of Cyprus, Estonia, Latvia and Slovenia could be improved.

Concerning historical figures it was not possible to get accurate data for Poland. The data received from Estonia, Latvia and Cyprus had poor quality, mostly due to confidentiality problems, and could not be considered as accurate; these are hence not presented in this report. For Malta the historical year is 2002.

In 2002 the NACE system was upgraded to NACE rev. 1.1 (replacing NACE rev. 1). Data before 2002 is classified in the old system and data after 2002 is coded into the new system. The cluster definitions have been adjusted to this upgrading, without any important changes.

Table 1 below shows the 38 cluster categories that have been used throughout the project.

Table 1: Definition of cluster categories

Cluster category	Examples of industries	Cluster category	Examples of industries
Aerospace	Aerospace industry, aerospace engines	Heavy Construction Services	Construction businesses, rental of construction machineries
Analytical Instruments	Measurement instruments, process control	Hospitality & Tourism	Hotels, taxies, amusement parks
Apparel	Clothes	Information Technology	Electronic components, computer manufacturing
Automotive	Motor vehicles, components	Jewellery & Precious Metals	Jewellery, cutleries
Building Fixtures, Equipment & Services	Kitchen furnishing, plaster	Leather Products	Bags, furs
Business Services	Management consultancy, rental of office machinery	Lighting & Electrical Equipment	Lamps, electricity distribution's equipment
Chemical Products	Chemicals, nuclear fuels, industrial gases	Construction Materials	Scrap, ceramic sanity fixtures
Communications Equipment	TVs, Cable, telephony equipment	Medical Devices	Medical equipment, wheelchairs
Processed Food	Beer, dairies, glass packages/wrapping	Metal Manufacturing	Rolling mills, casting, tools, screws
Agricultural Products	Sugar, agricultural services, alcoholic drinks	Oil & Gas Products and Services	Refineries
Distribution Services	Mail order, wholesale trading	Biopharmaceuticals	Pharmaceuticals
Education & Knowledge Creation	Universities, libraries	Plastics	Plastics, colours
Entertainment	Video- and music recording, sport events	Power Generation and Transmission	Generators, isolators
Heavy Machinery	Forest machinery, tractors, locomotives	Production Technology	Bearings, tanks, machine tools
Financial Services	Banks, insurance companies	Publishing & Printing	Publishing services, printing
Fishing & Fishing Products	Fishing, hunting	Sporting, Recreational & Children's Goods	Bicycles, toys
Footwear	Shoes	Textiles	Fabrics
Forest Products	Paper machines, pulp	Tobacco	Cigarettes, snuff
Furniture	Furniture, laminated boards	Transportation & Logistics	Inventories, air transports

Source: Authors' calculations, Institute for Strategy and Competitiveness (2004)

Evaluation of regional cluster strength: 3 Star Clusters

A number perspectives are important to evaluate whether the presence of employment in specific industries belonging to a cluster category within a given region reaches sufficient 'specialized critical mass' to develop the type of spill-overs and linkages that create positive economic effects:

- **Size;** if employment reaches a sufficient absolute level, it is more likely that meaningful economic

effects of clusters will be present. In this report, we operationalize this notion by giving a star rating for regional clusters that have more than 15,000 employees at a location. This number reflects the top 10-percentile of all clusters in the new member countries sorted according to this measure.

- **Specialization;** if a region is more specialized in a specific cluster category than the overall economy across all regions, this is likely to be an indication that the economic effects of the regional cluster have been strong enough to attract related economic

activity from other regions to this location and that spill-overs and linkages will be stronger. In this report, we operationalize this notion by giving a star rating for regional clusters that reach a specialization quotient of more than 1.75, i.e. which have at least 75% more employment within a given cluster category than the average of all regions would suggest given their size. This number again reflects the top 10-percentile of all clusters in the new member countries sorted according to this measure.

- **Dominance**; if a cluster accounts for a larger share of a region's overall employment it is more likely that spill-over effects and linkages will actually occur instead of being drowned in the economic interaction of other parts of the regional economy. We operationalize this notion by giving a star rating for regional clusters that reach 7% or more of regional cluster sector employment in a location. This number again reflects the top 10-percentile of all regional clusters in the new member countries sorted according to this measure.

As a result, up to three stars can be given for any regional clusters. In total, the ten new EU member countries could have 1,558 regional clusters (38 cluster categories across 41 regions). In 2000, 28 regional clusters of this theoretical total achieved the highest ranking of three stars.

Alternative approaches used in the literature are the, for example, measures of employment concentration (Gini coefficient or similar measures) or the share of employment in regional clusters identified as strong. The employment concentration measure can be applied either within the regional economy or within the cluster category across regions. In the first instance it comes close to our measure of 'Dominance', in the second to our measure of 'Specialization'. The share of employment in strong

clusters measure comes close to a combination of our measures of 'Size' and 'Specialization'. In our view the '3 Star' approaches offer a new way to combine these perspectives. Directionally the three approaches give comparable results, although on a more detailed level some differences can occur.

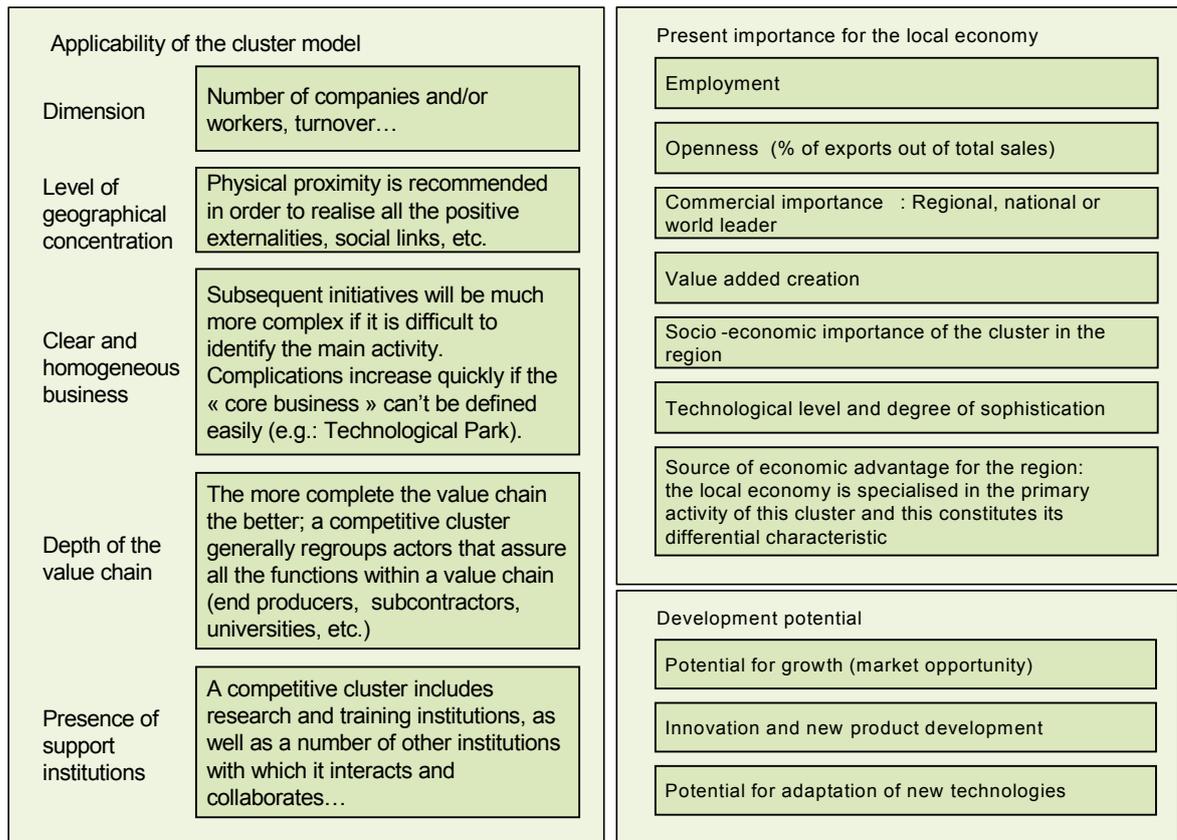
Data limitations restrict us to the use of employment data to identify and evaluate clusters. This creates a certain bias in our measures towards employment-intensive clusters, especially on the metrics for size and dominance. Only the measure for specialization is unaffected by differences of employment intensity across cluster categories. It would have been preferable to use data on wage bill, productivity, or value added, which would have shifted the balance in favour of capital- or knowledge-intensive cluster categories such as biopharmaceuticals. Hopefully such data will be available for future analysis.

Cluster case studies

The objective of the cluster case studies was to look at particular clusters in the new member states in order to assess whether clustering has encouraged greater innovation within the companies that form each cluster, and whether the benefits that are presented under the conceptual framework can be realised in the context of the EU-10.

Clusters were selected in each country in order to illustrate the country and innovation assessments with specific examples. These examples have been selected with the recommendations of the Panel Group of Experts (see appendix 1 for members) and taking into account the cluster's characteristics.

Figure 3: Selection criteria for cluster case studies



Source: Authors

After an initial approach based on statistical analysis, resulting in the identification of relevant “statistical clusters” for every country, a further in depth analysis of one specific cluster case study per country was carried out in order to pass from “statistical clusters” to “recognized clusters”, from employment figures to institutions, companies to be analysed and persons to be interviewed.

Once the case study cluster was identified, further analysis was performed using proven analytical tools that could be generalized and eventually applied to other clusters.

This analysis has been performed at two levels:

- Most of the modules use the national level to understand the recognized clusters, the policies that affect

them and the strengths and weaknesses of the institutions and agents in charge of supporting them

- A specific cluster level analysis of the innovation capabilities in the case study cluster.

Information for these two levels of analysis was collected mainly through interviews at the cluster level: meetings and visits to leading companies, cluster managers, technological centres and other agents.

These interviews have provided a valuable insight as to the relations that exist amongst them, the structure of the value chain of each cluster and those parts of the value chain where innovation can take place. Impact of policies has been assessed where relevant and further needs identified.

Table 2: Case studies of regional clusters

Country	Region	Cluster
Cyprus	Cyprus	Financial services
Czech Republic	Prague region	Automotive
Estonia	Estonia	Information technology
Hungary	Budapest	Biopharmaceuticals
Latvia	Latvia	Furniture, Forest products
Lithuania	Lithuania	Analytical instruments
Malta	Malta	Tourism
Poland	Rzeszow	Aerospace
Slovakia	Bratislava	Automotive
Slovenia	Slovenia	Metal manufacturing

Source: Authors

B. National level analysis

Two types of data that we used to inform our analysis were only available on the national level. This was not a problem for the six countries that coincided with NUTS 2 regions but is an issue for the four larger countries, where the national data gives only a summary view of all the regions that make up the national economy.

Data on national competitiveness

We have access to two sets of quantitative data on the national level: cluster-specific export performance and microeconomic business competitiveness.

First, we use a data set generated as part of the International Cluster Competitiveness Project at the Institute for Strategy and Competitiveness, Harvard Business School. This data set reports the cluster composition of a country exports. Exports are, alongside the employment patterns analyzed at the core of this project, an interesting indicator of cluster presence and competitiveness. The ability to sell on international markets is a sign that companies located in a country can successfully compete on world markets.

The data set is based on detailed export statistics by country and industry available from the WTO/UNCTAD trade centre. Unfortunately, the last year for which the full data is available is 2002. Also, sufficiently detailed industry-level data is only available for goods exports; we

report only those in our analysis. The higher level of detail for goods exports is a legacy of the historically differentiated tariff rates on different product groups that made statistics on such a detailed level necessary. The Central European countries have a goods share in their exports of about 80%, higher than the European average.

The industry-level export data is aggregated in clusters using an allocation of the industry codes used in the international trade statistics to clusters. It is driven by the cluster definitions used in the core module of our project where we are looking at employment patterns. Smaller differences arise from the differences in the underlying industrial classification systems used for employment and for exports; they don't affect the overall structure of the cluster data or analysis.

The data set thus derived includes export volumes per cluster for each country in the data set. We also calculate the share each country has in the world export market of a particular cluster category as well as overall, and the change of these market shares over time (1997 to 2002 period). The three data points per cluster (value, market share, and change in market share) are used to generate an export cluster portfolio per country that are then compared to the presence of clusters as revealed in the cluster mapping.

Second, we use the data collected in the Global Competitiveness Report on different aspects of national competitiveness, in particular the

data used for the calculation of the Business Competitiveness Index (BCI). Business environments and clusters are mutually related: strong business environments enable the evolution of clusters, and strong clusters are a key element of an advanced business environment.

The BCI draws on a survey of business executives that are asked to evaluate the sophistication of companies and the quality of the business environment at their own country relative to international competition. Each country is ranked based on a set of more than 40 questions covering the main dimensions of company behaviour and the diamond.

Survey data is used for a number of reasons: First, for many of the factors relevant for micro-economic competitiveness there is just no other data available – either not at all, or only with a significant time lag, or only for a small sample of countries. Second, getting the perspective of business executives that will base their decisions on the assessment they report – whether in line with underlying facts or not – has a value in itself. And third, many of the factors that ultimately drive company behaviour and productivity are the complex sum of many “hard facts” and thus difficult to accurately represent – this is a problem when, for example, one is trying to get a sense of labour market flexibility by looking at labour market legislation alone.

Data on national policies and institutions affecting cluster development

National policy cases were developed to assess the relevant policies that have been implemented in each country, and how these have affected the development of clusters and the innovation that takes place within them, as well as take stock of the main institutions that are involved in cluster development policies in each country or region, identifying their strengths and weaknesses

To reach the objective stated above a direct contact with the realities of the new member countries has been necessary. This has been achieved through the guidance and expertise found in the Panel Group of Experts, as well as a series of country visits which have been carried out.

To dwell on the different levels of knowledge needed to carry out this specific analysis, the country visits have addressed two different types of sources for interviews and information.

National Authority level interviews

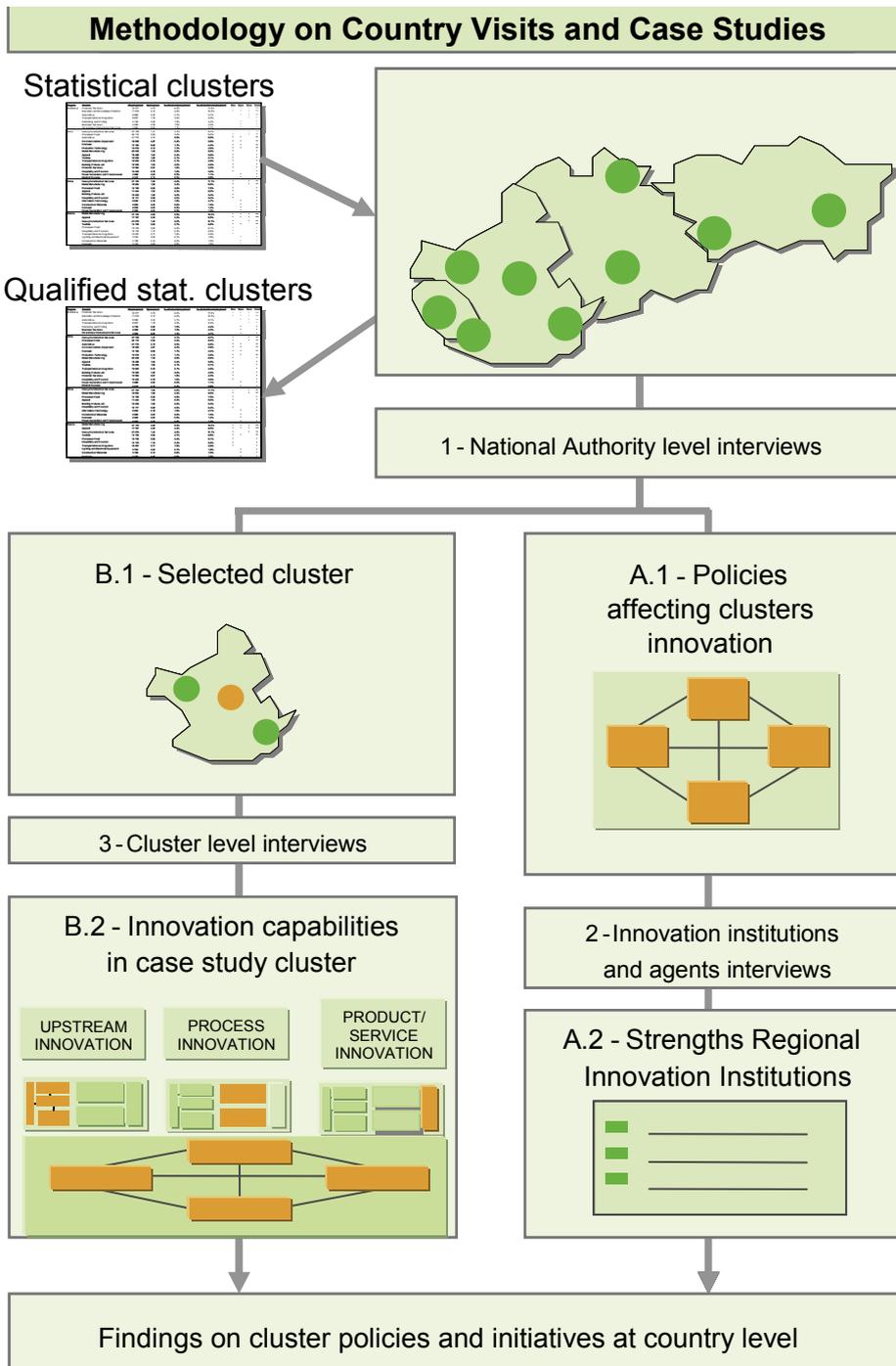
The wide range of policies affecting clusters' competitiveness and innovative capacity are analysed using their impact on the “Diamond of National Advantage” . Special emphasis has been placed in the analysis of specific cluster based policies and on innovation support policies. Interviews with national government representatives aimed to obtain information on innovation policy implemented in each country – if at all – and whether this policy has been articulated through clusters. Interviews also provided an approximation as to the public administration's opinions and views with regards to applicability of clusters as an aggregation unit for policy measures.

Innovation institutions and agents interviews

Interviews were conducted with the representatives of government agencies involved in the delivery and support of innovation policies and researchers following their work. The specific lists of interviewees varied from country to country, including think tanks, university professors, associations, consultants and other relevant specialists. The interviews provided an insightful, independent perspective on specific policies and institutions shaping cluster development across the EU-10. The country visits were further complemented by extensive desk research.

Figure 4 below provides an overview of the approach taken for the case studies of regional clusters and the country analysis.

Figure 4: Methodology for country and regional cluster analysis



Source: Authors

Chapter 3 Regional economies' cluster portfolios across the EU-10

Regional economies are the key geographic level to understand competitiveness on a micro-economic level; this is one of the key findings of much recent work on competitiveness. Economic outcomes differ a lot within EU member countries, reflecting differences in the quality of regional microeconomic business environments and in the composition of regional economies. The recent focus of European policies to harmonize national business environments (Common currency on monetary policy, Stability and Growth Pact on fiscal policy, Common market on many microeconomic policies) has decreased the level of differences between national laws and regulations. But this harmonization of context might have raised the relative importance of the still remaining differences across regions within and across EU member countries.

This chapter will take a closer look at the composition of regional economies across the 10 new EU member countries. The chapter is organized into four parts:

- First, we will discuss the role that clusters play in the regional economies of the 10 countries, separating them from employment in local industries and in natural resource-related industries
- Second, we will focus our analysis to these clusters and look at the strength of the cluster portfolio across regional economies. We will also provide an aggregated view of cluster portfolio strength at the level of nations and relate these results to findings on the quality of national business environment conditions most critical for clusters
- Third, we will discuss the changes in regional cluster portfolios that have occurred in this part of Europe over the last few years, tracking the extent and direction of structural change
- Fourth, we will provide data on the relationship between cluster portfolio strength and economic performance across regions. For parts of that analysis, we will again move to the national level to relate average cluster portfolio strength in a nation to national cluster export performance

Overall, we find the EU-10 to have a cluster sector broadly of the same relative size as other economies for which cluster mapping datasets have been developed using a comparable methodology. We identify regions and countries that lead the EU-10 in terms of the strength of their cluster portfolio presence and find that the quality of cluster-related business environments is an important factor to understand their position. We document that large amount of structural change that has affected the EU-10 countries between 2000 and 2004, and find that these changes have created opportunities for all regions independently of their initial cluster portfolio strength. Finally, we show that an indicator of cluster portfolio strength is significantly correlated with prosperity and prosperity growth. Together, these observations clearly support the view that an analysis of geographic patterns of cluster specialization needs to be an important part of the decision process when setting economic policy.

A. The importance of clusters across EU-10 regions

The composition of regional economies within a nation tends to differ quite significantly, and the 10 new EU member countries are no exception to this general pattern. We look at the relative importance of employment across four categories (see methodology chapter for more details):

- **Cluster sector;** all industries allocated to a cluster category based on the cluster definitions
- **Local sector;** all industries identified as local based on similar presence across all regions
- **Natural resource sector;** all industries restrained in their locational choice by the need to be close to natural resource deposits
- **Public administration;** all industries defined as public administration with location determined by political choice instead of economic considerations

Overall, the **cluster sector** accounts for 32% percent of all employment across the 10 new EU member countries. This is remarkably similar to the relative size of this sector of the economy in other countries for which comparable data is available, i.e. Canada,^{xiv} Sweden, and the United States.

The cluster sector is often described as the 'engine' of a regional economy. In the U.S., the cluster sector record significantly higher wages, productivity levels, and innovation rates than the average of the economy^{xv}. It shows most directly how companies operating under the specific conditions of the regional business environment succeed in international competition. And it provides the inflow of income that is necessary to cover purchases from other regions, but also sets the level of purchasing power available for local consumption.

Looking across the 41 NUTS 2 regions of the ten new EU member countries, the share of the cluster sector in total employment varies between 47.6% (Slovenia) and 23.5% (Lublin, Poland) with the median region at 36.4% (Cyprus). The distribution overall is pretty uniform as table 3 below indicates.

Table 3: Distribution of relative size of the cluster sector, EU-10 regions, 2004

Share of cluster sector in regional employment	Number of regions
30% or less	5
30% to 35%	10
35% to 40%	14
40% to 45%	9
45% or more	3

Source: Authors' calculations

Two factors are important for the differences across regions: First, the cluster sector is overall relatively manufacturing-driven with pretty much all manufacturing industries allocated to the cluster sector. Regions that have not developed a strong manufacturing presence, independently of specific clusters, tend to have a lower cluster sector share (and vice versa). Second, the cluster sector competes with the natural resource-driven industries for employees that leave the local industries. Regions that

have strong natural resource deposits or are otherwise strong in natural resource-driven industries will register less employment in the cluster sector.

The **local sector** accounts for 42% percent of all employment across the 10 new EU member countries. This is somewhat lower than in the advanced economies for which comparative data is available.

The local sector is important because it drives the level of actual prosperity that the population can enjoy. A small and inefficient local sector does provide little opportunity to turn income – even high income from employment in a very efficient cluster sector – into a high standard of living. Over time, an inefficient local sector can also become a burden on the cluster sector. Companies in the cluster sector will be at a disadvantage to their peers elsewhere, if their local costs are higher due to inefficient basic local services.

Across the 41 analyzed regions, the share of the local sector in total employment varies between 54% (Prague City, Czech Republic) and 41% (Białystok, Poland) with the median region at 45% (Gorzów Wielkopolski, Poland). The variance across regions is lower than in the cluster sector, with 30 out of the 41 regions registering an employment share of the local sector between 40% and 50%.

Two factors are important considerations in interpreting this data: First, the local sector is relatively less affected by region-specific business environments than the cluster sector. It consists of activities that are needed everywhere and that are not in direct competition across regions. The smaller variance in the size of the local sector across the regions of the ten new EU member countries is consistent with this view. Second, the local sector is relatively more service-driven than the rest of the economy. Private sector services were the part of the economy that was most underdeveloped in the eight Eastern European economies in the group at the end of the pre-1990 planned economy era. Cyprus (7 out of 41) and Malta (15) still rank relatively higher in terms of the share of their local sectors in their respective

economies. The low average share of the local sector in the new EU member countries might thus be a legacy of the planned economy system in their past.

The **natural resource sector** accounts for 20% percent of all employment across the 10 new EU member countries. This is significantly higher than in the advanced economies for which comparative data is available.

The natural resource sector tends to be important only in a few regions where significant deposits of natural resources are available. In these regions, the natural resource sector plays a role quite similar to the cluster sector elsewhere: It generates revenue from selling goods to other regions, providing income for local inhabitants. It differs from the cluster sector in the sense that most of the value is derived from exchanging assets into cash inflows, not from creating new value. And it suffers from a much higher exposure to price fluctuations on international commodity markets where the natural resources are being traded.

Across the 41 analyzed regions, the share of the natural resource sector in total employment varies between 39% (Lublin, Poland) and 1% (Cyprus) with the median region at 10% (Ostrava, Czech Republic). While 29 regions have less than 15% natural resource sector employment (20 less than 10%), there is a long tail of three regions with more than 30% and four regions of between 20% and 30% employment in this sector of the economy. All regions with very high natural resource employment shares are in Poland, only Lithuania (9 among 41 regions) and Latvia (13) break into the list of Polish regions dominated by this sector.

There are a number of factors that have an effect on the relative importance of the natural resource sector: First, low population density tends to increase the relative size of this sector, as the chance of having natural resource deposits is related to geographic size but not to population. Second, geographical location distant from population and economic centres plays a role, as it tends to reduce the opportunities for activities in the cluster sector. Third, there is a role for chance, as natural resource

deposits come in 'lumps' that are not distributed purely according to geographic size. Finally, and this could play a role in this part of Europe, there was a general tendency in planned economies to organize many activities that in a market economy are provided by separate firms through in-house departments. If there are reminiscences of that in Poland, it would drive an overrepresentation of the natural resource activities much beyond the actual core of employment related to mainly coal mining.

Finally, **public administration** accounts for 6% percent of all employment across the 10 new EU member countries. This is comparable to Sweden, which reports 5.4% percent of all employment in public administration (the share of employment in the public sector is much larger at 34%; this includes all employment in government-owned activities that are not public administration, like health care services).

The public administration sector does not tend to be important as a source of employment (even though government-owned institutions might very well be; see above). Geographic patterns of employment in this sector reflect political choices, not the quality of regional business environments.

Across the 41 analyzed regions, the share of the administration sector in total employment varies between 14% (Cyprus) and 4% (Kra-kow, Poland) with the median region at 6% (Nitra, Slovakia). 10 regions report a public administration sector employment share of less than 5% (not counting Estonia, which is not reporting data in this category), and 21 regions report between 5% and 7.5%. Regions with higher public administration sector employment shares include capital cities like Bratislava (rank 2 out of 40 regions with data) and Warsaw (4) as well as Malta (5) but also a number of Hungarian regions outside of Budapest (ranks 3, 6, 8, and 9).

The share of public administration employment is driven by the natural demands of core public sector functions. There are political factors that can increase its relative size, for example higher spending for security in regions suffering from internal or external unrest or the higher

burden from the fixed cost of central government functions in small economies. There are also efficiency factors, if the public administration is strongly overstaffed. But overall these effects tend to be limited. It is important to note, however, that this category does not include employment in government-owned industries that are part of any of the other three broad sectors of the economy. That is where one would find attempts by the government to prop up employment that is not competitive under market conditions. We hope that future analysis can draw on more detailed data to look at the extent of this issue.

B. The strength of cluster portfolios across EU-10 regions

Within the cluster sector of a regional economy, recent research has indicated that the strength of the cluster portfolio is an important factor to understand the impact of the cluster sector on the economic performance of a region.^{xvii}

The methodological challenge is to find a single measure that summarizes the overall distribution of employment across cluster categories within a regional economy, keeping into account the profile of cluster category employment across all regions. We use the notion of stars for regional clusters that exceed specific cut-off points for size (absolute employment), specialization (share of employment in this cluster category across all regions), and dominance (share of employment across all cluster categories in this region); see the methodology chapter provides for more detail.

Overall, 367 regional clusters receive at least one star for exceeding one of the cut-off points; this corresponds to 23.5% of the 41 regions x 38 cluster categories = 1558 theoretically

possible regional clusters. The 367 regional clusters identified represent 5.86m employees, about 58% of the total employment in the cluster sector of the EU-10. We will discuss the data from two different perspectives:

- First, taking regions as the key unit of analysis, we look at the overall number of stars registered by individual regions. Then we take a closer look at whether these stars are concentrated on a few clusters or come from a broader number of clusters. This is followed by an analysis of the metrics that drives the stars registered, i.e. whether they are based on size, specialization, or dominance
- Second, aggregating our findings to the level of nations, we provide summary statistics by country. This data is then related to the assessment of national business environments in the Global Competitiveness Report as well as our observations from the mapping of relevant national institutions and policies

Star-spangled regions

Table 4 below provides a ranking of the 41 regions in our sample based on the level of total stars they have earned for the strength of their regional cluster portfolio.

We find the capital regions of the largest countries among the new EU members topping our list: Budapest (rank 1), Warsaw (2), and Prague (4). Only Lithuania breaks into the ranks of these cities and of other metropolitan regions from Poland and the Czech Republic that dominate the first dozen ranks. On the bottom of the ranking are less densely populated regions in the north-east of Poland, the south-east of Hungary, and the border regions between Poland and the Slovak Republic. Malta and Cyprus also rank relatively low.

Table 4: Cluster portfolio strength across EU-10 regions, 2004

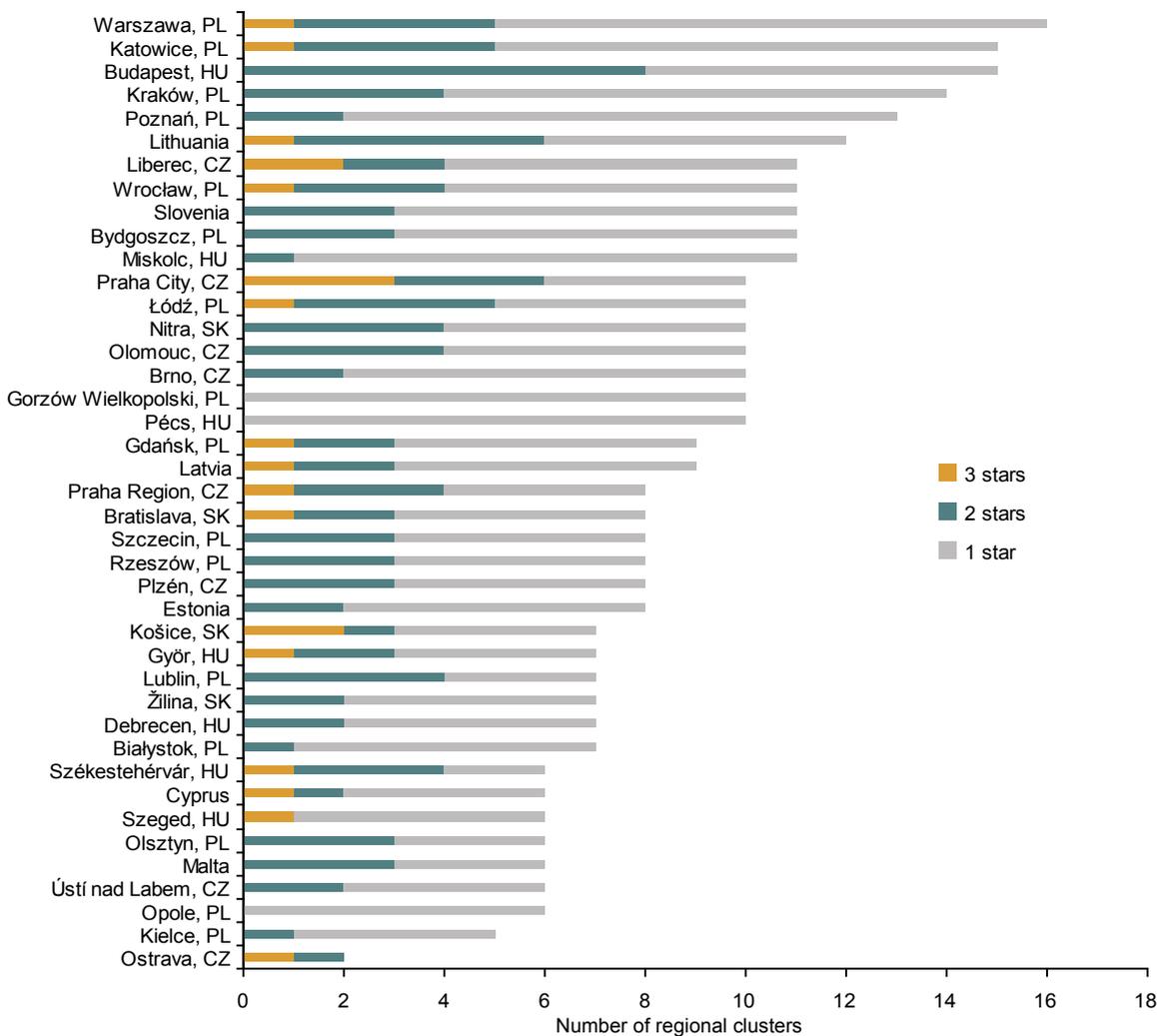
Rank	Region	Country	Number of stars	Average stars per regional cluster	Share of regional clusters with stars in regional cluster sector employment
1	Budapest	Hungary	23	1.53	77%
2	Warszawa	Poland	22	1.38	77%
3	Katowice	Poland	21	1.4	81%
4	Praha City	Czech Republic	19	1.9	78%
5	Lithuania	Lithuania	19	1.58	70%
6	Kraków	Poland	18	1.29	68%
7	Liberec	Czech Republic	17	1.55	62%
8	Łódź	Poland	16	1.6	71%
9	Wrocław	Poland	16	1.45	60%
10	Poznań	Poland	15	1.15	72%
11	Nitra	Slovakia	14	1.4	60%
12	Bydgoszcz	Poland	14	1.27	58%
13	Slovenia	Slovenia	14	1.27	56%
14	Olomouc	Czech Republic	14	1.4	45%
15	Latvia	Latvia	13	1.44	62%
16	Gdańsk	Poland	13	1.44	59%
17	Praha Region	Czech Republic	13	1.63	43%
18	Bratislava	Slovakia	12	1.5	65%
19	Brno	Czech Republic	12	1.2	56%
20	Miskolc	Hungary	12	1.09	51%
21	Košice	Slovakia	12	1.71	45%
22	Plzeň	Czech Republic	11	1.38	48%
23	Rzeszów	Poland	11	1.38	47%
24	Szczecin	Poland	11	1.38	47%
25	Székesfehérvár	Hungary	11	1.83	45%
26	Lublin	Poland	11	1.57	44%
27	Győr	Hungary	11	1.57	39%
28	Estonia	Estonia	10	1.25	52%
29	Gorzów Wielkopolski	Poland	10	1	49%
30	Pécs	Hungary	10	1	47%
31	Cyprus	Cyprus	9	1.5	62%
32	Malta	Malta	9	1.5	54%
33	Olsztyn	Poland	9	1.5	48%
34	Žilina	Slovakia	9	1.29	36%
35	Debrecen	Hungary	9	1.29	31%
36	Białystok	Poland	8	1.14	48%
37	Ústí nad Labem	Czech Republic	8	1.33	38%
38	Szeged	Hungary	8	1.33	33%
39	Kielce	Poland	6	1.2	47%
40	Opole	Poland	6	1	42%
41	Ostrava	Czech Republic	5	2.5	33%

Source: Authors' calculations

Moving to the second level of regional analysis, figure 5 below tracks whether stars are registered from relatively few clusters or from a broader base. Looking at the number of regional clusters that have gained stars across all regions, we find that Warsaw (Poland) tops the list, gaining stars from 16 regional clusters while Ostrava (Czech Republic) comes at the bottom with just 2 regional clusters^{xviii} meeting any of the star benchmarks. The average number of stars achieved by any of these

regional clusters (reported in table 4 above) gives a sense of the level of concentration in a region's economy activity. Prague City (Czech Republic), Székestehérvár (Hungary), Košice (Slovak Republic), Prague Region (Czech Republic), and Łódź (Poland) register the highest number of stars per cluster for regions with at least five clusters meeting one of the star benchmarks, indicating a relatively high concentration of cluster activity within a few regional clusters.

Figure 5: Cluster portfolio strength across EU-10 regions, 2004



Source: Authors' calculations

Moving to the third level of regional analysis, we look at whether stars registered are mainly based on size, specialization, or dominance. Table 5 below identifies the regions that register

the highest/lowest share of the overall number of the stars registered by their regional clusters in these three categories.

Table 5: Drivers of cluster portfolio strength, Top/Bottom five regions of EU-10

Rank	Size	Specialization	Dominance
1	Poznan, Poland	Szeged, Hungary	Kielce, Poland
2	Katowice, Poland	Pécs, Hungary	Opole, Poland
3	Nitra, Slovakia	Gorzów Wielkopolski, Poland	Cyprus, Cyprus
4	Warszawa, Poland	Miskolc, Hungary	Usti nad Labem, Czech Rep.
5	Brno, Czech Rep.	Bratislava, Slovakia	Estonia, Estonia
37	Bratislava, Slovakia	Ostrava, Czech Rep.	Warszawa, Poland
38	Pécs, Hungary	Lodz, Poland	Budapest, Hungary
39	Gorzów Wielkopolski, Poland	Kielce, Poland	Brno, Czech Rep.
40	Malta, Malta	Katowice, Poland	Nitra, Slovakia
41	Opole, Poland	Poznan, Poland	Poznan, Poland

Source: Authors' calculations

The region of Poznan, for example, registers twelve stars for regional clusters that have at least 15,000 employees, but only two (Building materials, food products) of them account for more than 7% of regional employees in the cluster sector and only one (agricultural products) has a specialization quotient of more than 1.75. The absolute size of the region, which ranks 4th in terms of total employment in the cluster sector among all 41 regions, clearly drives these results; Katowice ranks 2nd, Nitra 9th, Warsaw 1st, and Brno 10th.

A very different picture appears when looking at Szeged: This region registers five stars for specialization but only two stars for dominance and one for size. Szeged has relatively small overall employment in the cluster sector (rank 30th among all regions) with some of its main cluster positions in oil and gas products, agricultural products, and tobacco, all clusters with small overall size (rank 33, 22, and 38 respectively in terms of employment in the EU-10; see chapter 4 for more detail). The only exception is the regions strong position in food products, actually the cluster category with the highest employment across all EU-10 regions.

Finally, Cyprus and Estonia are examples of another type of region: Both get five stars for dominance, three stars for specialization and two (respectively one) for size, indicating strong reliance on regional clusters that are large across all EU-10 regions. For Cyprus, these regional clusters are financial services (rank 4 of all cluster categories in terms of overall employment across the EU-10 regions) and hospitality & tourism (5). For Estonia, they are construction materials (2) and transportation & logistics (3).

Star-spangled nations

Regional economies and their cluster portfolios are the core units of analysis for this report. Some of the additional data we would like to relate the cluster mapping data to is, however, available only on a national level, so also provide data on the average region per country for comparison. Table 6 below reports the overall number of stars received by regional clusters as well as a break-down by dimension; the figures in brackets behind the country names are a reminder of the number of NUTS 2 regions per country.

Table 6: Average strength of regional cluster portfolio by EU-10 country, 2004

	Stars per average region				
	SUM	Size	SUM (without size)	Specialization	Dominance
Lithuania (1)	19.0	9.0	10.0	5.0	5.0
Slovenia (1)	14.0	8.0	6.0	3.0	3.0
Latvia (1)	13.0	7.0	6.0	3.0	3.0
Poland (16)	12.9	5.6	7.3	3.7	3.6
Czech Republic (6)	12.4	4.8	7.6	4.0	3.6
Hungary (7)	12.0	3.0	9.0	5.6	3.4
Slovakia (4)	11.8	3.8	8.0	5.0	3.0
Estonia (1)	10.0	2.0	8.0	3.0	5.0
Cyprus (1)	9.0	1.0	8.0	3.0	5.0
Malta (1)	9.0	0.0	9.0	5.0	4.0

Source: Authors' calculations

Lithuania, Slovenia, and Latvia rank highest overall in terms of the number of stars registered by average region. Slovenia and Latvia profit especially from their large absolute size; they rank 2nd and 3rd among the ten countries in terms of average cluster sector employment per average region in the country. Lithuania ranks 1st on employment size as well as on stars received for size, but the country comes out on top also if looking only at the measures for specialization and dominance.

Hungary and Malta rank, behind Lithuania, highest on the number of stars excluding size. Malta is the smallest of all countries in average cluster sector employment per region, but has meaningful positions in hospitality & tourism, information technology, and transportation & logistics. Hungarian regions are of average size compared to their peers in the EU-10 and the data indicates that they tend to be specialized in cluster categories of small employment size.

Table 7: Global Competitiveness Report questions relating to cluster strength

- State of cluster development
- Local supplier quantity
- Local supplier quality
- Local availability of specialized research and training services
- Local availability of process machinery
- Local availability of components and parts
- Extent of collaboration among clusters

Source: Global Competitiveness Report

As the *second* step of the analysis, we relate the data on actual cluster presence derived from the cluster mapping database to data on the business environment conditions relevant for clusters from the Global Competitiveness Report (GCR).^{xix} The GCR includes in its measurement of business competitiveness^{xx} a number of questions relate specifically to the strength of related and supporting industries that companies in a given country can draw on (see table 7 above).

Based on this selection of questions, table 8 below reports the ranking of the ten new EU member countries in the sample of 93 countries included in the 2004 Global Competitiveness Report. Three different groups of countries can be identified:

- First, Poland and the Czech Republic rank much better on clusters than they rank on overall national business environment quality (NBE) or business competitiveness (BCI)
- Second, for Malta, Estonia, and, to a lesser degree, Slovenia and Hungary the picture is reversed, with cluster-specific conditions worse than the overall NBE and BCI ranks
- The other countries have a largely balanced profile, with Lithuania ranking equally on clusters and the BCI and Latvia, the Slovak Republic and Cyprus marginally weaker on clusters than on BCI

Table 8: Ranking of EU-10 countries in the Global Competitiveness Report

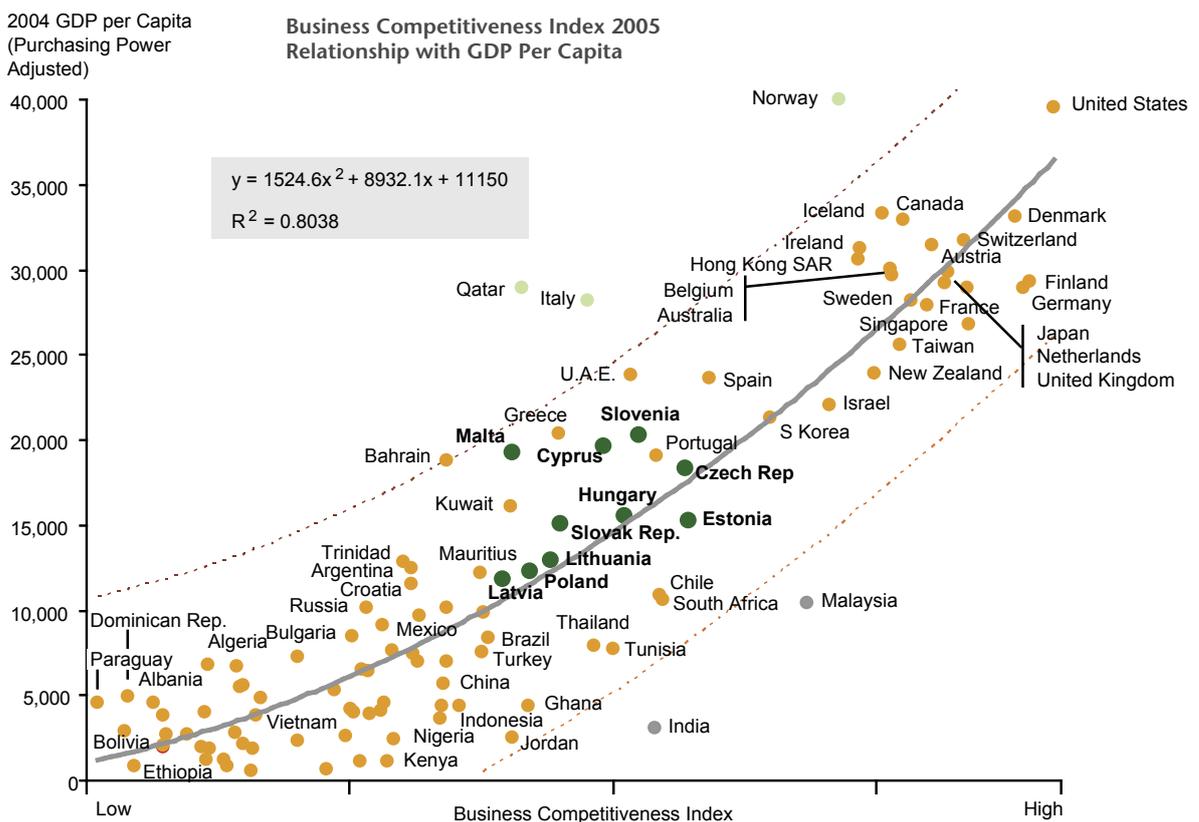
	Cluster	NBE	BCI
Czech Republic	31	35	34
Lithuania	35	33	35
Slovak Republic	41	37	38
Poland	43	62	55
Slovenia	44	32	30
Estonia	45	24	27
Latvia	49	46	47
Cyprus	50	39	43
Hungary	54	36	40
Malta	78	47	48

Source: Authors' calculations

The measure for business competitiveness (BCI) is a significant indicator, because it registers a strong correlation with the level of prosperity, measured by GDP per capita adjusted for purchasing power, countries can sustain. Figure 6 below indicates that this relationship holds across the overall sample of 110 countries included in the Global Competitiveness Report – the cross-country variation BCI explains 80% of the variation in prosperity – as well as for the EU-10 countries. Malta, Cyprus, and Slovenia register a level of prosperity that is higher

than expected given the quality of their business environment. The cross-country data suggest that such a deviation is only sustainable, if permanent factors like remittances or foreign investment inflows explain the difference. Estonia registers a level of prosperity below what seems possible given its business environment quality. This can be indication of upside potential in the wake of recent business environment improvements that haven't yet been fully leveraged by companies in the country.

Figure 6: Business Competitiveness and Prosperity





As a *third source* of data, we draw on a review of national policies and institutions relevant for cluster development, adding further context to the data on actual cluster presence and cluster-relevant business environment conditions. This review suggests that the countries can be organized in three groups with different approaches towards cluster development. We discuss the available data from the three different sources by country within each of these groups:

First, the Czech Republic, Hungary, and Slovenia all have well established cluster programs in place.

- The **Czech Republic** ranks average on measures of cluster presence; somewhat higher on measures related to size and lower on those related to specialization and dominance.

On measures of cluster-relevant business environment conditions the country ranks high, both in absolute terms and relative to its overall competitiveness. The country has the potential to develop strong regional clusters but so far this potential does not seem to have been fully exploited.

The National Cluster Policy 2005 – 2008, an ambitious and far-reaching program run by CzechInvest, is an encouraging sign that policy makers are now taking this opportunity more serious than in the past.

- **Hungary** ranks relatively high on measures of cluster presence related to specialization and dominance; the country falls behind on the absolute size of its regional clusters.

On measures of cluster-relevant business environment conditions it ranks low, both in absolute terms and relative to its overall competitiveness. This is consistent with positions in some regional clusters that, however, are the exception rather than the rule when looking at the overall competitiveness of the country's regions.

The Ministry of Economy has had a cluster program since 2001, closely connected to other regional policy measures such as the creation of more than 170 industrial parks. EU structural funds are since 2004 a new source of support for clusters. While there have been some clear cases of success, that overall these

policies were not sufficiently integrated with overall regional economic strategies and did not always apply stringent test on what network could be considered a cluster initiative.

- **Slovenia** ranks relatively high among the EU-10 countries on measures of cluster presence related to size, reflective the absolute size of its economy. It ranks lower on measures of specialization and dominance.

The country ranks stronger on the quality of its general business environment than on cluster-relevant business environment conditions. The country seems to have benefited more from its economic size and the general quality of its business environment than from the strength of its clusters.

The Ministry of Economy has had an active cluster program since 1999. While changes in government have changed the energy put behind these efforts at some intervals, the cluster initiatives created as a consequence are very active. There are concerns about whether the cluster initiatives have been too much focused on creating networks of domestic companies, rather than reaching out to foreign investors and upgrading the regional business environments.

Second, Latvia and Poland have a mixed approach of some cluster-based efforts within an overall strategy more focused on general competitiveness upgrading.

- **Latvia** ranks relatively high among the EU-10 countries on measures of cluster presence related to size, reflective the absolute size of its economy. It ranks lower on measures of specialization and dominance.

The country ranks similarly below the EU-10 average on both the quality of its general business environment and on cluster-relevant business environment conditions. The country seems not to have leveraged clusters as a key element of economic policy.

The Ministry of Economy used the PHARE program to launch an initial cluster program in 2000. After the initial EU funding ran out, however, only two (IT, forest products) of the four cluster initiatives started continued to be active in some form. Given the lack of resources domestically available, policy makers

seem sceptical about whether cluster programs should be given priority.

- **Poland** ranks average on measures of cluster presence; like the Czech Republic somewhat higher on measures related to size and lower on those related to specialization and dominance.

On measures of cluster-relevant business environment conditions the country ranks relatively high, more so compared to the country's overall competitiveness than compared to its peers. The country has the potential to develop strong regional clusters but needs to overcome the challenges of its relatively weak general business environment.

Poland has recently started a number of cluster programs. Traditionally they have been the result of initiatives at the local and regional level, although currently two national ministries are getting involved in cluster efforts as well. It will be important to integrate the different efforts and make them part of a consistent national policy.

Third, Estonia, Lithuania, Slovakia, Cyprus, and Malta have mostly focused on cross-cutting economic development strategies rather than on specific cluster efforts.

- **Estonia** ranks relatively low among the EU-10 countries on measures of cluster presence, largely driven by its small size. It ranks higher on measures of specialization and dominance.

The country ranks much stronger on the quality of its general business environment than on cluster-relevant business environment conditions. It seems that the country focused largely on a cross-cluster based economic strategy. Some clusters have developed naturally, taking advantage of these overall improvements, but clusters have not been central to economic policy. Estonia's focus on IT, widely used to shape the international perception of the country, has affected many parts of the economy, from financial services to e-government, not just the vibrant but relatively small IT cluster.

- **Lithuania** ranks high among the EU-10 countries on all measures of cluster presence and of cluster-relevant business environment conditions. It seems that the country has managed to translate the opportunities of its business environment into the natural emergence of regional clusters.

The country has no overall cluster policy, although there are some individual efforts related to technology parks that aim to become cluster locations.

- **Slovakia** ranks relatively high on measures of cluster presence, especially on measures related to specialization and dominance.

On measures of cluster-relevant business environment conditions the country ranks also high, especially in absolute terms. The country has managed to translate the opportunities of its business environment into the natural emergence of regional clusters, leveraging the attraction of foreign direct investment.

- **Cyprus** suffers from its small size in terms of cluster presence, but ranks relatively well on specialization and dominance.

The quality of its business environment is slightly below average among the EU-10 countries, and even weaker on cluster-relevant dimensions. The country has managed to create positions in a few regional clusters but these developments haven't moved beyond a narrow segment of the overall economy.

Cyprus does not have an active cluster policy but the country has identified a number of key sectors in which government agencies are active.

- **Malta** is in a similar position to Cyprus, but all the weaknesses are more severe. It is of even smaller size and suffers from even lower overall business environment quality. The country has, as Cyprus, managed to create positions in a few regional clusters but these developments haven't moved beyond a narrow segment of the overall economy.

C. Dynamics of structural change across EU-10 regions

The regions of the EU-10 countries have in the last decade undergone an enormous amount of structural change, reacting to the move from a planned to a market economy in the eight former Communist countries and to the overall integration of markets with Europe and globally across all of them.

We discuss these changes based on the cluster mapping data generated in this project from two perspectives:

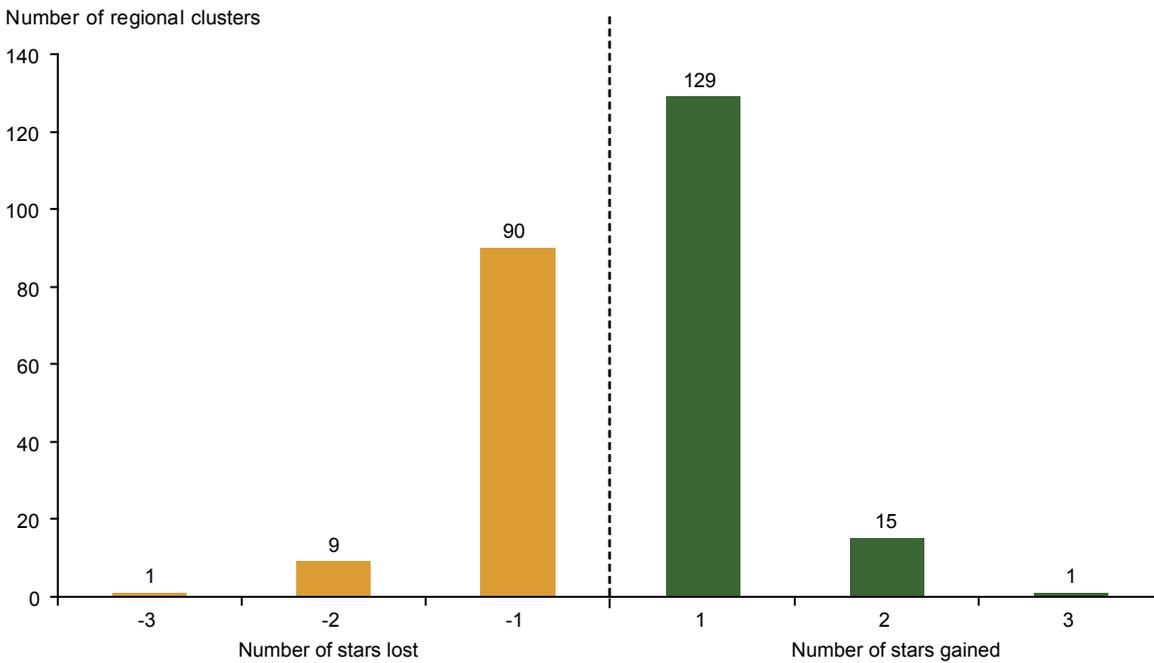
- Overall intensity of changes in regional cluster portfolio strength
- Regions that have increased/decreased their level of cluster portfolio strength

Extent of structural change across the EU-10

Our data comparing the geographic patterns in cluster categories across the 41 regions of the ten new EU member countries between 2000 and 2004 reveals a high level of change, indicating the fast pace of structural transformation that is reshaping these regional economies. Our data also indicates that regions across the EU-10 have strengthened their cluster portfolios in this time period.

Overall, 245 out of the 511 regional clusters that have received at least one star in 2004 have seen their number of stars change relative to 2000. In the median region, 53% of all regional clusters with stars had changed their star ranking. The distribution of changes is highly skewed towards regional clusters gaining or losing one star, but the table below shows that there has also been a significant number of regional clusters that experienced more dramatic changes in evaluation. On the one extreme, the Wroclaw automotive cluster in Poland has gained three stars between 2000 and 2004; on the other extreme, the Debrecen apparel cluster in Hungary lost three stars during the same period (see a more detailed analysis in chapter 4).

Figure 7: Dynamics in strength of regional clusters, 2000-2004



Source: Authors' calculations

Relative to 2000, the total number of stars awarded in 2004 increased by 51; figure 7 provides a breakdown by change of stars per regional cluster. Part of that increase is driven, however, by a significant increase in the coverage of employment in the Polish economy, driven by the use of different data sources in the two time periods. Polish regions have gained 36 of the additional stars awarded; almost all of them, however, have been awarded for clusters now exceeding the cut-off level for absolute employment within a regional cluster. Discounting these changes, we still observe an increase of 15 stars in other regions that is not driven by changes in overall size.

Regional differences in structural change across the EU-10

Looking across the individual regions of the EU-10, we observe significant differences in the amount of structural change.

In terms of the average region by country, regions in Slovakia, Poland, and Slovenia experienced the highest absolute amount of change in terms of stars. In Slovakia and Poland the average region gained 2.5 (2.3) stars, in Slovakia through net gains across all star categories and in Poland through strong net gains in the 1-star category. Slovenia registered a loss of two stars

in the 1-star category. Hungarian regions lost stars in the 3-star category but gained in the 1-star category. In Estonia the changes went in the opposite direction, with two 1-star clusters gaining one star and one 1-star cluster losing its star. Table 9 below provides the changes for all 41 regions.

We also analyzed whether gains in stars received were related to the initial level of stars that a region had registered in 2000. This would have been an indicator of regions with already strong cluster portfolios pushing ahead further, while regions without such strong starting positions losing out. We ranked the regions by 2000 number of stars and defined four quartiles with an average number of stars of 16.6, 12.4, 9.5, and 6.7. The gains that have by 2004 been achieved in terms of number of stars were at +2.1 actually highest in the fourth quartile, followed by the third (+1.5) and first quartile (+1.1). Only regions from the second quartile registered virtually no net gains (+0.1). This analysis indicates changes of cluster portfolio strength across the entire spectrum of regions. In an environment of massive overall structural changes in the EU-10 countries, all regions seem to have the opportunity to develop stronger cluster portfolios, even those that start from low initial levels.

Table 9: Changes in cluster portfolio strength by region, 2000-2004

Region	Country	3-star	2-star	1-star	net gain
Bydgoszcz	Poland	0	1	5	7
Katowice	Poland	0	1	4	6
Kraków	Poland	-1	0	8	5
Wroclaw	Poland	1	-1	4	5
Kosice	Slovakia	1	0	2	5
Budapest	Hungary	0	0	4	4
Rzeszów	Poland	-1	2	3	4
Miskolc	Hungary	0	-1	5	3
Szeged	Hungary	0	0	3	3
Lublin	Poland	0	2	-1	3
Lodz	Poland	-1	2	1	2
Poznan	Poland	0	0	2	2
Olsztyn	Poland	0	2	-2	2
Nitra	Slovakia	0	2	-2	2
Bratislava	Slovakia	0	1	0	2
Liberec	Czech Republic	1	-1	1	2
Pécs	Hungary	0	0	2	2
Warszawa	Poland	-1	0	4	1
Plzeń	Czech Republic	0	0	1	1
Estonia	Estonia	0	2	-3	1
Szczecin	Poland	-1	2	0	1
Zilina	Slovakia	0	-1	3	1
Białystok	Poland	0	0	1	1
Praha City	Czech Republic	-1	1	2	1
Olomouc	Czech Republic	0	0	1	1
Gorzów Wielkopolski	Poland	0	-1	2	0
Malta	Malta	0	-1	2	0
Székesteheóvár	Hungary	-2	3	0	0
Cyprus	Cyprus	0	0	0	0
Ostrava	Czech Republic	0	0	0	0
Györ	Hungary	0	1	-3	-1
Gdansk	Poland	-1	0	2	-1
Praha Region	Czech Republic	0	-1	1	-1
Lithuania	Lithuania	0	0	-1	-1
Latvia	Latvia	0	-1	1	-1
Kielce	Poland	0	1	-3	-1
Opole	Poland	0	0	-1	-1
Brno	Czech Republic	0	0	-1	-1
Slovenia	Slovenia	0	0	-2	-2
Debrecen	Hungary	-1	1	-2	-3
Usti nad Labem	Czech Republic	0	-1	-1	-3

Source: Authors' calculations

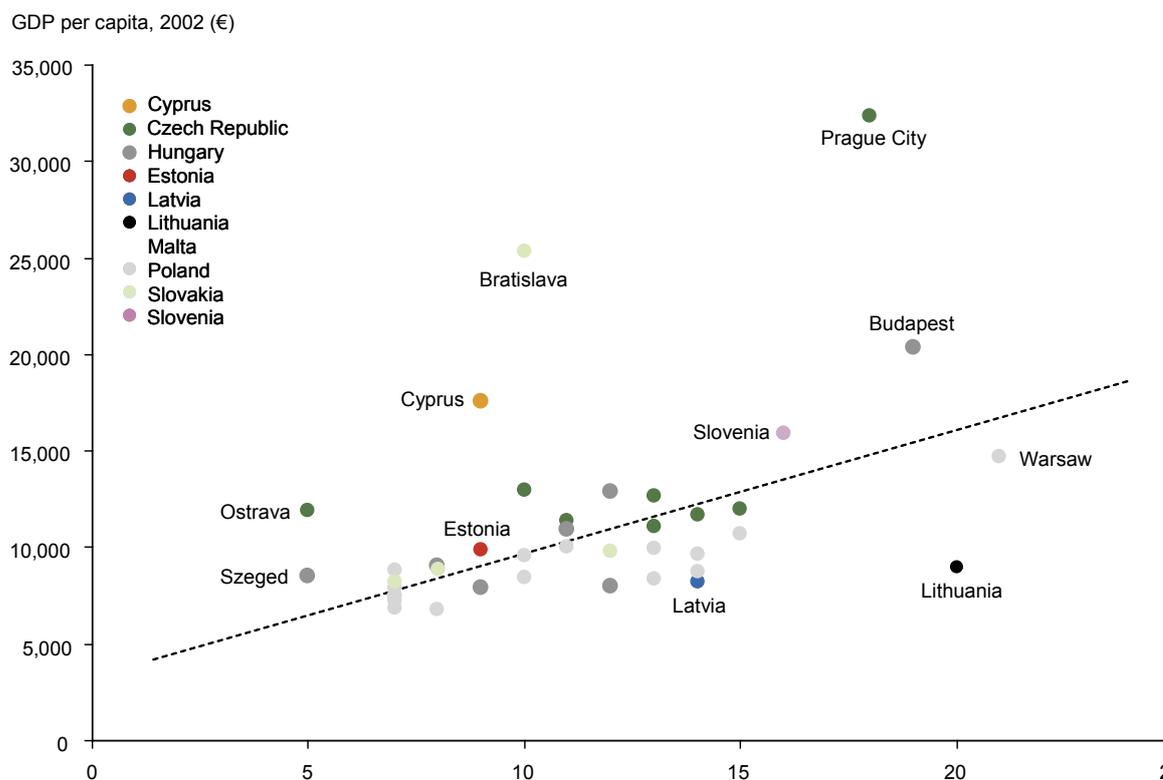
D. Economic performance and cluster portfolio strength

The ultimate test for the relevance of clusters as a means to understand and improve regional economies is their ability to support higher levels of prosperity and other measures of economic performance. We look at whether the strength of regional cluster portfolio drives prosperity, prosperity growth, and export profile.

Prosperity, prosperity change, and the strength of clusters

The best measure for prosperity is the level of GDP per capita that citizens within a region will enjoy. There are number of factors that influence this measure in a given region, in particular the overall level of labour force mobilization, the level of prosperity in different sectors of the economy, and the relative importance of these sectors in the overall regional economy.

Figure 8: Cluster portfolio strength and prosperity

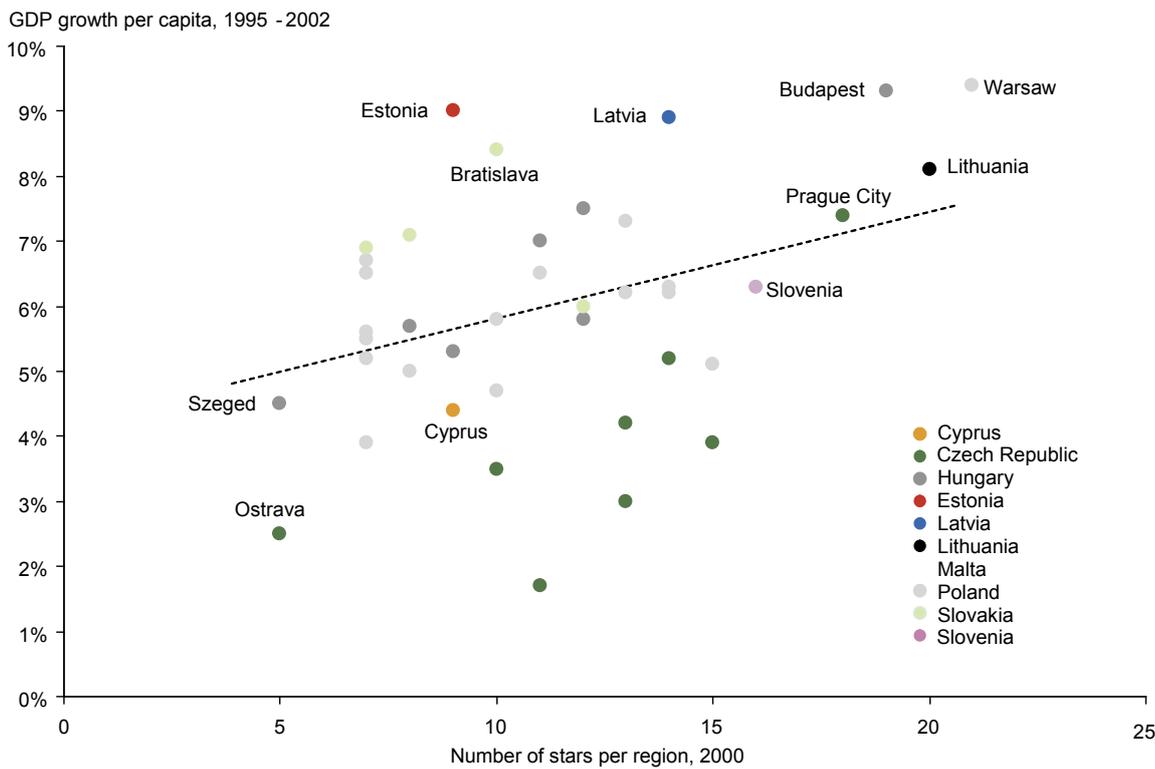


Source: Eurostat, authors' calculations

Our conceptual framework suggests that the strength of the regional cluster portfolio will influence the average level of productivity in the cluster sector. The framework also suggests that the strength of the cluster portfolio is driven by the overall quality of the business environment which in turn will affect productivity throughout the regional economy. We operationalize these notions by running a regression of the number of stars per region in 2000 as a measure of cluster portfolio strength on the level of GDP per capita in 2002. Figure 8 above indicates the strong and significant relationship between these two measures. 19.6% of the variation in regional GDP per capita levels is statistically explained by variations in the number of stars per region.

The conceptual framework also suggests that stronger cluster portfolios might be associated with higher prosperity growth because strong clusters provide a better context for innovation as well as business formation. Using the same data for cluster portfolio strength per region and GDP growth per capita between 1995 and 2002 we test the strength of this relationship. Figure 9 below indicates the strong and significant relationship between these two measures. 17.6% of the variation in regional GDP per capita growth is statistically explained by variations in the number of stars per region.

Figure 9: Cluster portfolio strength and prosperity growth



Source: Eurostat, authors' calculations

The data does not prove that a strong cluster portfolio explains or is the cause of higher prosperity or higher prosperity growth. As noted above, the conceptual framework of competitiveness that we apply in our work does not make such single-causality claims. Many other

factors alongside clusters have an impact on prosperity. The data indicates, however, that cluster portfolio strength is a strong candidate for explaining regional economic performance. There is clear evidence that clusters are significantly related to prosperity and should

thus be considered as a central part of any regional economic strategy.

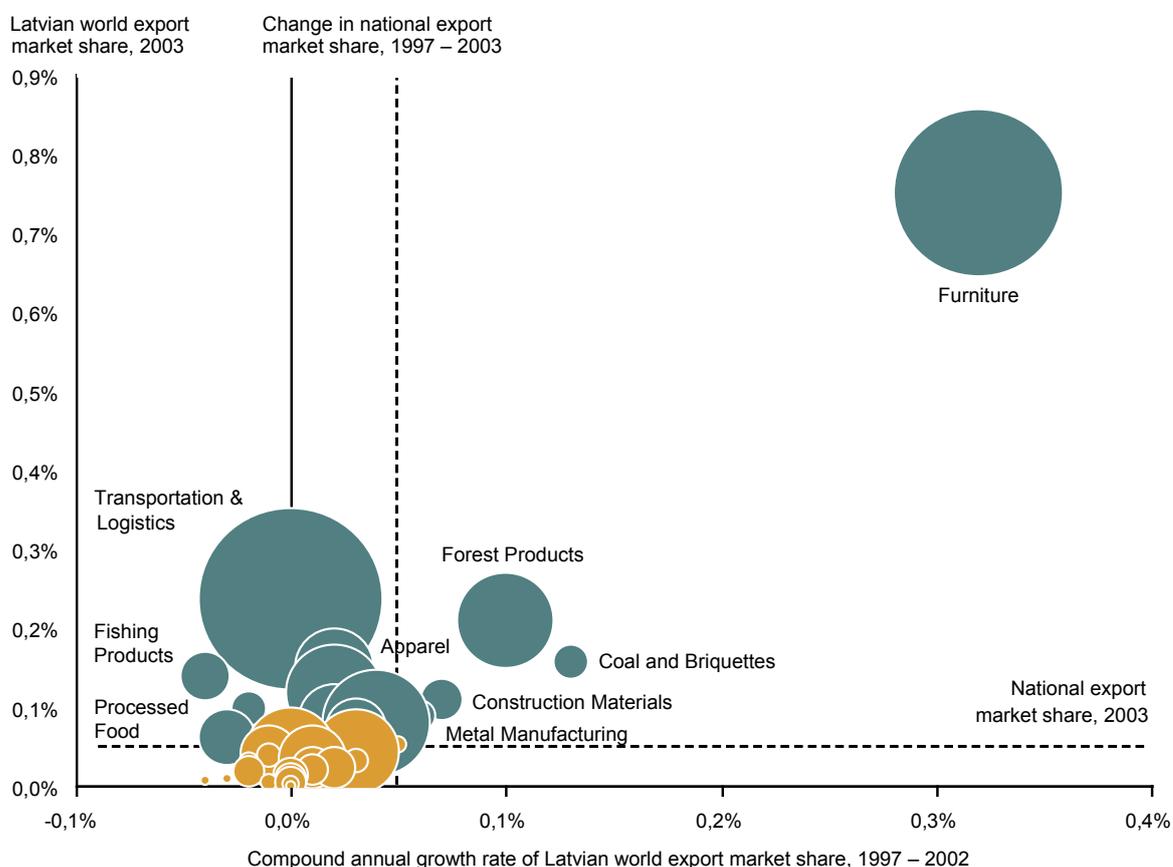
Cluster strength and export performance

Another potential indicator of the economic impact of clusters is export performance. Overall exports and the level of the trade balance in particular are affected by a number of conditions different from cluster portfolio strength. And the relationship between export success and prosperity does not always hold. Nevertheless, strong cluster portfolios and the higher

relative productivity they allow should enable relatively more export success.

We operationalize this notion by looking at a country's exports in cluster categories in which it registers above average world market shares (or technically: in which a cluster category has a revealed comparative advantage or $RCA > 1$). Unfortunately we do not have access to regional export data; we hope to have such data available for future research.

Figure 10: Latvian exports by cluster category, 1997 - 2003



Note: Bubble size is proportional to absolute export value; cluster with $RCA > 1$ in green
 Source: UNCTAD Trade Data; International Cluster Competitiveness Project at ISC (HBS)

All EU-10 countries have more than 2/3s of their respective exports within clusters in which they register a revealed comparative advantage. A good example is Latvia (see figure 10 above): The country had in 2003 a share

of 0.053% of total world exports, an increase of 0.0095% compared to 1997. In 15 cluster categories Latvia reached a world market share above 0.053%, i.e. it registered a $RCA > 1$. These cluster categories accounted for close

to 75% of the country's total exports. Similar graphs and further detail on other countries is available at the web site of the Institute for Strategy and Competitiveness (HBS).

Table 10 below summarizes country-specific data: Cyprus has the most concentrated export cluster portfolio, with 92% of its exports de-

rived from just 7 clusters. Poland is on the other extreme with 69% of its exports in cluster categories where the country has a revealed comparative advantage and these exports spread across 19 different cluster categories. Hungary provides a third type, with an even lower share of 71% of exports from this category but a concentration on 14 cluster categories.

Table 10: Exports in clusters with a revealed comparative advantage, 2003

	Clusters with RCA > 1		
	Share of country exports	Number of clusters	Share of country exports per cluster
Malta	93%	15	6.20%
Cyprus	92%	7	13.20%
Slovenia	84%	22	3.80%
Latvia	75%	15	5.00%
Lithuania	75%	17	4.30%
Hungary	71%	14	5.10%
Slovak Republic	71%	16	4.40%
Czech Republic	71%	19	3.80%
Estonia	70%	19	3.70%
Poland	69%	19	3.60%

Source: Institute for Strategy and Competitiveness (2005)

Linking this data with the cluster mapping findings reported in chapter 3.B, we see a pattern emerging that provides more context on the nature of regional clusters within a country. Malta, for example, ranks high on measures of cluster presence unrelated to size and also ranks high on cluster export specialisation. The smallest economy of the EU-10 has focused its limited resources on a few export-oriented clusters. Poland, in contrast, ranks low on measures of cluster presence unrelated to size and also ranks low on cluster export specialisation. The largest economy of the EU-10 seems to have developed few clusters that in turn are mostly oriented towards the domestic market.

Moving to an additional level of detail, the export data also allows a comparison between cluster categories in which a country has strength in terms of employment and those in which it has strength in terms of exports. Table 11 below compares the leading cluster categories per average NUTS 2 region in each EU-10 country by employment (Stars: total number of stars; SQ: specialization quotient) to those by exports (export value, world market share). For the countries with more than one NUTS 2 region, the table also reports the top regional clusters by specialization quotient for the top region per cluster category.

Table 11: Top regional clusters by cluster category, EU-10, 2004

	Stars	SQ	Export Value	World Market Share		Stars	SQ (average region)	SQ (top region)	Export Value	World Market Share
Cyprus					Czech Republic					
1	Hosp	Hosp	Hosp	Cnst	1	Cnst	Aero	Aero	Auto	Build
2	Fin	Tob	Trpt	Hosp	2	Food	Auto	Metl	Metl	Pwr
3	Food	Fin	Bus	Trpt	3	Metl	Metl	Tob	Hosp	Pub
4	Cnst	Distr	Fin	Bus	4	Trpt	Prod	Auto	IT	Elect
5	Trpt	Trpt	Cnst	Fin	5	Auto	Jewl	Jewl	Prod	Coal
Estonia					Hungary					
1	Cnst	Fish	Trpt	Furn	1	Food	IT	Lthr	Auto	Comm
2	Trpt	Instr	Comm	Comm	2	Cnst	Lght	Tob	Comm	Elec
3	Build	Furn	Hosp	Fish	3	IT	Tob	Lght	Hosp	Ent
4	Food	Aprl	Furn	Trpt	4	Metl	Lthr	Medi	IT	Build
5	Hosp	Oil	Agri	For	5	Lght	Foot	IT	Agri	Auto
Lithuania					Latvia					
1	Aprl	Oil	Oil	Mar	1	Ent	Fish		Trpt	Furn
2	Food	Aprl	Trpt	Fur	2	Food	Ent		Furn	Trpt
3	Cnst	Fish	Aprl	Aprl	3	Trpt	Distr		Metl	For
4	Trpt	Text	Hosp	Trpt	4	Cnst	Trpt		For	Coal
5	Edu	Tob	Furn	Oil	5	Edu	Furn		Aprl	Build
Malta					Poland					
1	Trpt	Sprt	IT	IT	1	Tob	Tob	Tob	Auto	Mar
2	Hosp	IT	Hosp	Pub	2	Furn	Furn	Aero	Metl	Build
3	IT	Medi	Trpt	Hosp	3	Fish	Fish	Fish	Hosp	Coal
4	Fin	Hosp	Bus	Sprt	4	Food	Food	Oil	Build	Furn
5	Medi	Trpt	Aprl	Cnst	5	CMtr	CMtr	Aprl	Agri	Cnst
Slovenia					Slovakia					
1	Trpt	Instr	Auto	Build	1	Cnst	Oil	Oil	Auto	Build
2	Cnst	Lthr	Hosp	Mot	2	Metl	Foot	Foot	Metl	Foot
3	Metl	Powr	Mot	Furn	3	Auto	Comm	Comm	Trpt	Auto
4	Food	Pharm	Metl	Pwr	4	Aprl	IT	Fin	Prod	Metl
5	Fin	Metl	Build	Bio	5	Food	Lght	Metl	Build	Cnst

Sources: Authors' calculations; export data from Institute for Strategy and Competitiveness (2006)

For most of the countries, the data indicates modest to significant differences in terms of their employment versus export profiles across cluster categories:

- For Estonia, Hungary, Poland, and Slovenia, only one cluster category registers as a relative strength on both dimensions. This indicates an economic profile in which the globally competitive activities are concentrated in cluster categories that employ a relative small share of domestic cluster sector employment, either because these activities are capital intensive or the overall economic size of the cluster category is limited.
- The Czech Republic, Lithuania, Latvia, and Slovakia have a larger overlap. These countries have achieved significant export positions in more employment-intensive cluster categories, which could be the consequence of their inherent specialization patterns or of more progress in terms of adjusting economic composition to world market needs.
- Cyprus and Malta have the highest overlap between employment and export specialization by cluster category. These are the two of the new EU member countries that happen to have been exposed to the forces of global competition for longer than their central and eastern European peers.

Chapter 4 Clusters in the EU-10 new member countries

In this chapter, we take the perspective of the 38 cluster categories and document how economic activity in these categories is geographically located.

Part A of this chapter profiles the 38 cluster categories in terms of their geographic presence across the regions of the EU-10 countries. While all cluster categories are by definition composed of industries that have a significant level of geographic concentration, there are clear differences among them. These differences can be driven by size – clusters with little overall employment in the EU-10 will have a tendency to appear concentrated as they are present only in a few regions –, by technology – the strength and relative importance of region-specific linkages will differ across cluster categories depending on knowledge intensity, machinery applied, etc. –, and by other factors.

Part B of this chapter turns to the level of individual regional clusters within each of the cluster categories. Within each cluster category, individual locations and the regional clusters they host have a position in the overall network of activities. Understanding the core regional clusters within a category can provide further insights into the dynamics of locational competition that exist within this market. Such insights are critical in order to develop effective strategies that position a specific location successfully relative to its peers.

A. Clusters in 38 cluster categories across the EU-10

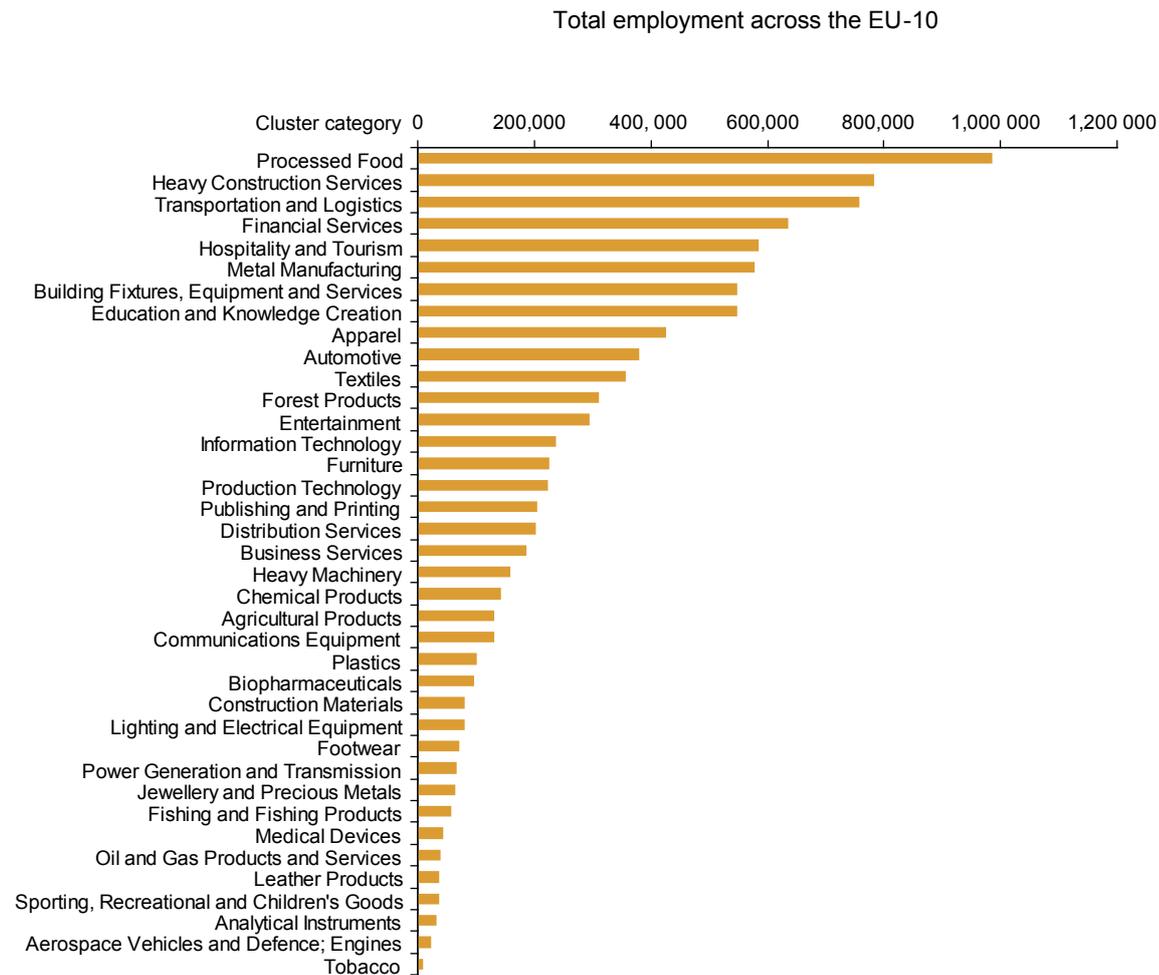
In profiling the geographic distribution of economic activity within the 38 cluster categories defined for the cluster mapping (see methodology for a description of the approach) we proceed in three steps:

- First, we look at the overall size of employment to get a sense of the absolute importance of each cluster category
- Second, we look at different measures of geographic concentration within each cluster category to understand the locational profile of regional clusters
- Third, we look at the changes in employment over time in each of the cluster categories and on their impact on specialization patterns

Importance of cluster categories in the EU-10 cluster sector

The 38 cluster categories identified differ widely by total employment (see figure 11 below). Regional clusters in the largest category, processed food, employ close to 1 million people throughout the EU-10 while in the smallest category, tobacco, less than 10,000 people are employed. The distribution of employment across cluster categories is slightly one-sided, with a larger number of small employment cluster categories and a relative smaller number of large employment cluster categories.

Figure 11: Total employment by cluster category, EU-10, 2004



Source: Compiled by authors

It is instructive to compare the relative importance of specific cluster categories with those in other countries for which similar data is available. Table 12 below ranks cluster categories based on the difference between their size rank in the EU-10 versus the average of their size ranks in the United States and Sweden.

The data shows the EU-10 countries to be significantly more specialized in labour-intensive cluster categories like textiles, apparel, footwear, and processed food. Conversely, much less of employment in the EU-10 is in advanced manufacturing like analytical instruments, aerospace and defence, and medical devices and advanced services like business services, a cluster category that accounts for 13.6% of U.S. cluster sector employment, 6.7% of Swedish employment in this category, but only 1.9% of EU-10 cluster sector employment.

There are, however, also a number of more surprising results. The EU-10 countries rank as high on *information technology* as the United States, significantly above Sweden. Most likely this reflects employment in the EU-10 in the labour-intensive parts of the IT cluster category, while in the U.S. a higher share of this employment will be in higher value-added activities. But it might still provide opportunities for future upgrading based on the positions that the EU-10 countries have already managed to establish. Another example is *financial services*, again an area where the EU-10 reports an employment rank relative to its overall cluster sector close to the U.S. level and above Sweden. Again this is likely to reflect other activities than in the United States and can also be driven by inefficiencies in this cluster category in the EU-10.

Table 12: Cluster categories ranked by total employment across countries

<i>sorted by difference EU-10 vs. US & Sweden</i>	Ranked by employment		
	EU-10	United States	Sweden
Apparel	9	18	32
Textiles	11	23	27
Footwear	28	38	38
Building Fixtures, Equipment and Services	7	16	16
Furniture	15	25	20
Information Technology	14	14	29
Agricultural Products	22	30	28
Processed Food	1	9	7
Construction Materials	26	32	30
Jewellery and Precious Metals	30	34	35
Forest Products	12	24	8
Financial Services	4	2	11
Fishing and Fishing Products	31	36	31
Heavy Construction Services	2	6	2
Hospitality and Tourism	5	3	9
Leather Products	34	33	37
Transportation and Logistics	3	7	1
Heavy Machinery	20	22	19
Chemical Products	21	20	21
Metal Manufacturing	6	8	3
Biopharmaceuticals	25	31	17
Sporting, Recreational and Children's Goods	35	35	33
Lighting and Electrical Equipment	27	28	23
Production Technology	16	17	12
Tobacco	38	37	36
Automotive	10	10	5
Entertainment	13	11	10
Oil and Gas Products and Services	33	27	34
Power Generation and Transmission	29	29	24
Publishing and Printing	17	12	15
Education and Knowledge Creation	8	4	4
Communications Equipment	23	21	14
Medical Devices	32	26	25
Plastics	24	13	18
Distribution Services	18	5	13
Aerospace Vehicles and Defence; Engines	37	19	26
Business Services	19	1	6
Analytical Instruments	36	15	22

Sources: Institute for Strategy and Competitiveness (2005), Sölvell/Malmberg/Lindqvist (2005), authors' calculations

On the opposite end of the spectrum, the EU-10 countries rank relatively low on employment in the *distribution services* cluster category. Given their much better position on transportation & logistics, this signals an opportunity to combine the hard infrastructure-related employment in transportation & logistics with the more advanced services, largely provided by private companies, in the distribution cluster category. The *education & knowledge creation* cluster category is smaller in the EU-10 countries than in the United States and Sweden. Partly, this is clearly a reflection of lower investments in research and development. But given the traditional relative strength of many of the EU-10 countries in their education system, it is still an indication that the legacy of a high skill level in these economies can not be taken for granted.

Geographic distribution of employment in cluster categories across the EU-10

Industries that are allocated to cluster categories have by design employment profiles with clear geographic specialization. In this section, we document the differences in geographic distribution of employment in the EU-10 across the 38 cluster categories.

An important measure to describe geographical specialization of sectors and cluster categories is the Gini coefficient. A Gini coefficient of 0 implies that economic activity in a certain cluster category is spread out proportionally among a set of regions according to the size of each region. The more geographically concentrated employment is, the higher the

Gini coefficient. Purely random patterns of geographical dispersion lead to measures of around 0.3. Therefore, it is fair to say that cluster categories within advanced multi-regional economies - where products, factors of production and firms can move between regions - should reach Gini values of above 0.3. A Gini value of 1 indicates that all economic activity within a cluster category is concentrated in one region.

Table 13 below compares the distribution of employment by cluster category across the 41 NUTS 2 regions of the EU-10 to the distribution across the 50 states of the United States and to the 119 NUTS 2 regions in 7 countries of the EU-15 (France, Spain, Italy, Portugal, Germany, Luxembourg, and Austria) as revealed by Gini values.

In terms of average geographic concentration across the cluster categories, we find economic activity across the EU-10 to be least geographically concentrated. While the difference to the U.S. is significant, however, the difference to the 7 EU-15 countries for which we have comparable data is surprisingly small.

The most concentrated cluster categories in the EU-10 are tobacco and aerospace & defence, both of which are small in absolute size. Clusters categories in which the EU-10 has a high proportion of cluster sector employment tend to be much less geographically concentrated. Exceptions are information technology, automotive, and communication technology which all have relatively high levels of geographic specialization while being of significant overall size across the EU-10.

Table 13: Geographic concentration of economic activity, Gini coefficients

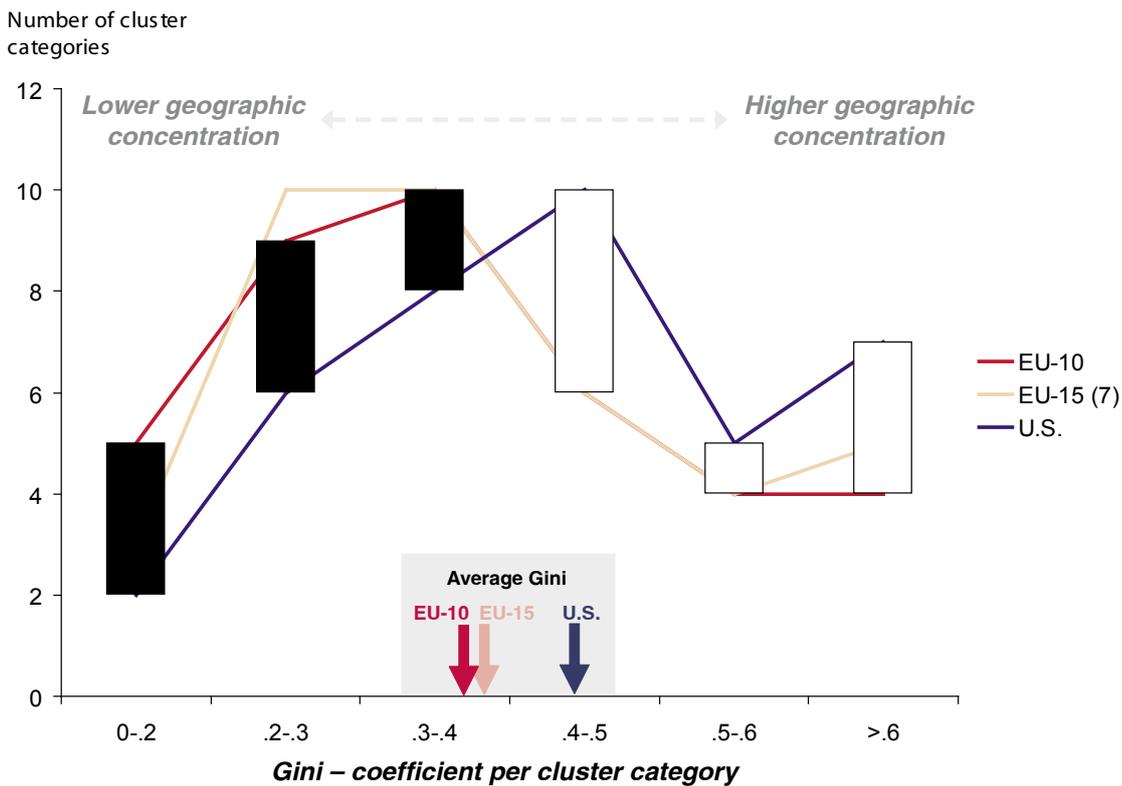
Cluster	EU-10	EU-15 (7)	U.S.-50	
Tobacco	0.75	0.73	0.67	
Aerospace Vehicles and Defence	0.72	0.66	0.76	
Fishing and Fishing Products	0.66	0.72	0.85	
Oil and Gas Products and Services	0.61	0.53	0.77	
Footwear	0.59	0.84	0.79	
Analytical Instruments	0.55	0.50	0.37	
Lighting and Electrical Equipment	0.53	0.43	0.45	
Information Technology	0.51	0.34	0.55	
Communications Equipment	0.48	0.34	0.44	
Medical Devices	0.47	0.44	0.43	
Automotive	0.47	0.46	0.53	
Leather Products	0.44	0.65	0.32	
Biopharmaceuticals	0.44	0.38	0.49	
Sporting, Recreational and Children's Goods	0.42	0.58	0.45	
Power Generation and Transmission	0.39	0.39	0.27	
Metal Manufacturing	0.37	0.37	0.42	
Construction Materials	0.37	0.45	0.43	
Jewellery and Precious Metals	0.34	0.43	0.70	
Production Technology	0.33	0.36	0.39	
Apparel	0.33	0.54	0.55	
Chemical Products	0.31	0.35	0.42	
Heavy Machinery	0.31	0.37	0.50	
Furniture	0.31	0.36	0.54	
Textiles	0.31	0.46	0.73	
Business Services	0.29	0.26	0.23	
Publishing and Printing	0.28	0.27	0.26	
Plastics	0.27	0.36	0.32	
Entertainment	0.24	0.23	0.28	
Financial Services	0.23	0.20	0.23	
Education and Knowledge Creation	0.22	0.20	0.34	
Agricultural Products	0.22	0.22	0.46	
Forest Products	0.22	0.29	0.47	
Transportation and Logistics	0.20	0.17	0.30	
Building Fixtures, Equipment and Services	0.19	0.24	0.25	
Hospitality and Tourism	0.18	0.24	0.36	
Heavy Construction Services	0.17	0.17	0.17	
Distribution Services	0.16	0.18	0.18	
Processed Food	0.16	0.21	0.36	
	Average	0.369	0.393	0.448
	Median	0.330	0.365	0.430
	Standard deviation	0.160	0.170	0.179

Sources: Institute for Strategy and Competitiveness (2005), authors' calculations

Figure 12 gives a graphical representation of this data and indicates the clear differences among the U.S. and the different parts of the European Union. The figure represents the number of cluster categories across six intervals of Gini-coefficients. The U.S. registers a higher number of cluster categories in all intervals with .4 and higher Gini-coefficients (the white

bars indicate the gap to the EU-10), while the EU regions are ahead in the three intervals with lower Gini-coefficients (black bars indicate the gap to the U.S.). The graph also shows the surprisingly small differences between the EU-10 and the seven EU-15 countries for which we have data.

Figure 12: Cluster categories by Gini-coefficient, EU versus U.S., 2004



Sources: Authors' calculations

Analyzing the differences between the EU-10 and the United States in terms of the level of geographic specialization of economic activity at the more detailed level of individual cluster categories, we find an interesting pattern:

- Analytical instruments, leather products, power generation & equipment, lighting & electrical equipment, and tobacco exhibit higher levels of geographic specialization in the EU-10 than in the U.S. Each of them accounts for less than 1% of total EU-10 employment in the cluster sector so

concentration is to a large degree a function of no employment in most regions.

- On the opposite side of the spectrum, textiles, jewelry & precious metals, forest products, agricultural products, and furniture to the list of cluster categories in which economic activity across the EU-10 is much less geographically concentrated. These are all cluster categories that rank much higher in terms of employment in the EU-10 cluster sector than in the United States.

Table 14: Strength of regional clusters across cluster categories, EU-10, 2004

Cluster categories	Size	Number of stars		SUM
		Specialization	Dominance	
Processed Food	29	1	33	63
Heavy Construction Services	28	0	29	57
Transportation and Logistics	20	2	21	43
Metal Manufacturing	17	2	13	32
Financial Services	15	4	12	31
Hospitality and Tourism	15	2	9	26
Building Fixtures, Equipment and Services	17	1	7	25
Automotive	8	9	6	23
Education and Knowledge Creation	12	2	8	22
Information Technology	3	9	3	15
Apparel	6	3	3	12
Textiles	6	4	1	11
Footwear	0	10	0	10
Tobacco	0	10	0	10
Construction Materials	0	9	0	9
Entertainment	4	3	2	9
Aerospace Vehicles and Defense; Engines	0	8	0	8
Lighting and Electrical Equipment	0	8	0	8
Oil and Gas Products and Services	0	8	0	8
Medical Devices	0	7	0	7
Communications Equipment	1	6	0	7
Furniture	1	6	0	7
Fishing and Fishing Products	0	6	0	6
Leather Products	0	6	0	6
Publishing and Printing	3	3	0	6
Analytical Instruments	0	5	0	5
Power Generation and Transmission	0	5	0	5
Sporting, Recreational and Children's Goods	0	5	0	5
Biopharmaceuticals	1	4	0	5
Production Technology	1	4	0	5
Business Services	2	3	0	5
Plastics	0	4	0	4
Chemical Products	0	3	0	3
Jewelry and Precious Metals	0	3	0	3
Distribution Services	1	2	0	3
Forest Products	1	1	1	3
Agricultural Products	0	2	0	2
Heavy Machinery	0	2	0	2

Sources: Authors' calculations

For the EU-10 we also looked at the distribution of stars as indicators of strong regional clusters across cluster categories. Table 14 above provides this data, breaking the total of stars per cluster category down into the three separate dimensions. Cluster categories with large overall employment dominate based on the stars registered for overall size and regional dominance. But two cluster categories stick out that register a significant number of stars across all categories, indicating the presence of a solid number of strong regional clusters in these areas: Automotive and information technology. These seem to be parts of the economy in which the EU-10 countries have been particularly successful in developing true pockets of regional strength that employ significant numbers of people.

Overall, the data indicates that the regions of the EU-10 still has a long structural change process ahead of themselves to achieve a pattern of specialization that enables them to reach the levels of productivity regional clusters in the U.S. have been able to register. While the significant differences between the EU-10 and the United States are not a big surprise given the strong legacy effects that have an impact on locational patterns of economic activity in the new EU member countries, it is striking that the preliminary data about the old EU member countries suggests much smaller differences between them and the new members. This data suggests that the old EU member countries have made surprisingly little headway in optimizing the geographic distribution of economic activity across their regions, despite decades of European integration.

Employment growth across cluster categories in the EU-10

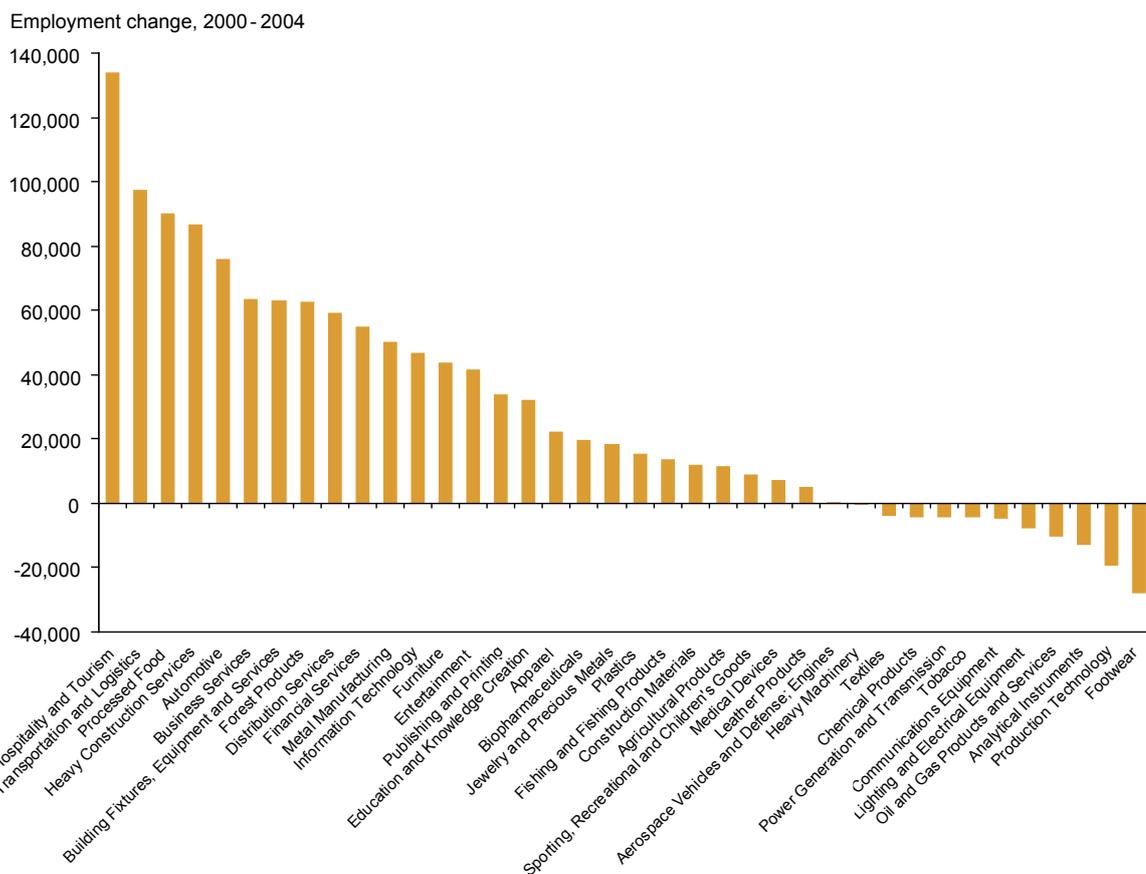
The cluster mapping data set generated for this project enables us to take a closer look at the dynamics of structural change over time from the perspective of cluster categories. Overall, the cluster sector in the EU-10 registered a net gain of about 1 million employees. Roughly 90% of this gain comes from Poland, however, where we have concerns about data integrity over time. Poland accounts for about 44% of all cluster sector employment across the EU-10 so while it is certainly feasible for Poland to account for 90% of all gains, this is data that will need to be verified from other sources in future research.

Comparing changes in employment number across cluster categories, significant differences emerge. Figure 13 sorts cluster categories by absolute employment change across the EU-10 countries.

Processed food and information technology registered the largest relative increase, both more than doubling their employment between 2000 and 2004. This is particularly impressive for processed food, which is one of the largest cluster categories in terms of overall employment. Hospitality & tourism registered the highest absolute employment gain, which represented a growth of 70% in absolute employment. Business services and building fixtures are two other cluster categories that registered more than 40% employment growth with each adding more than 60.000 jobs.

The largest relative employment loss was registered by tobacco, one of the smallest cluster categories. Footwear and production technology are the two cluster categories that register both high absolute (-30.000; -20.000) and relative (-28%, -8%) employment losses.

Figure 13: Employment change across cluster categories, 2000-2004, EU-10



Sources: Authors' calculations

Overall, this data indicates the structural changes in the EU-10, shifting employment towards cluster categories that have been traditionally underrepresented (e.g., business services), that provided easy opportunities for new companies (e.g., hospitality and tourism), and that leveraged the existing profile of competitiveness strengths and weaknesses (e.g., automotive).

The overall changes in employment by cluster category across the EU-10 have been the result of individual regional clusters gaining or losing employment. Table 15 below tracks the net change of stars by cluster category.

Changes in overall employment by cluster category are naturally accompanied by changes in

stars for size. This drives the gains in stars for heavy construction services, hospitality & tourism, transportation & logistics, and metal manufacturing. Another pattern can be observed in cluster categories like automotive and construction materials, where relocation of employment towards stronger regional clusters was more than or as important as net overall gain. Finally, financial services is a cluster that registered overall star gains for size but lost stars on specialization – this is consistent with growth in a number of new regional clusters as well as at least one existing regional cluster.

The cluster mapping data provides the infrastructure for further more in-depth analysis of changes in locational patterns of economic activity in each of the 38 cluster categories defined.

Table 15: Change of regional cluster strength by cluster category, 2000-2004

Cluster category	Size	Net change of stars		SUM
		Specialization	Dominance	
Heavy Construction Services	8	0	2	10
Hospitality and Tourism	8	-2	4	10
Transportation and Logistics	5	0	4	9
Automotive	1	4	2	7
Building Fixtures, Equipment and Services	8	1	-2	7
Footwear	0	4	0	4
Construction Materials	0	4	0	4
Metal Manufacturing	5	-1	0	4
Information Technology	1	1	1	3
Oil and Gas Products and Services	0	3	0	3
Sporting, Recreational and Children's Goods	0	3	0	3
Tobacco	0	3	0	3
Aerospace Vehicles and Defence; Engines	0	2	0	2
Forest Products	1	0	1	2
Furniture	1	1	0	2
Communications Equipment	0	3	-2	1
Processed Food	2	-1	0	1
Medical Devices	0	1	0	1
Plastics	0	1	0	1
Power Generation and Transmission	0	1	0	1
Publishing and Printing	1	0	0	1
Analytical Instruments	0	0	0	0
Agricultural Products	0	0	0	0
Financial Services	4	-1	-3	0
Lighting and Electrical Equipment	0	0	0	0
Biopharmaceuticals	1	-1	0	0
Chemical Products	0	-1	0	-1
Fishing and Fishing Products	0	0	-1	-1
Jewellery and Precious Metals	0	-1	0	-1
Production Technology	-1	0	0	-1
Textiles	0	1	-2	-1
Business Services	1	-3	0	-2
Distribution Services	0	-2	0	-2
Entertainment	-1	-1	0	-2
Heavy Machinery	0	-2	0	-2
Leather Products	0	-2	0	-2
Apparel	0	0	-4	-4
Education and Knowledge Creation	-1	-3	-5	-9
TOTAL	44	12	-5	51

Sources: Authors' calculations

B. Leading regional clusters across the EU-10

Largest regional clusters by employment size

To provide a better sense of the profile that strong regional clusters have, the cluster mapping data set can be used to identify the leading regional clusters within each cluster category.

Table 16: Top regional clusters by cluster category, EU-10, 2004

	Top regional clusters by total employment				
	1	2	3	4	5
Aerospace Vehicles and Defense	Rzeszów	Praha City	Warszawa	Bydgoszcz	Budapest
Analytical Instruments	Slovenia	Budapest	Bydgoszcz	Katowice	Poznan
Apparel	Lodz	Lithuania	Poznan	Nitra	Kosice
Automotive	Katowice	Liberec	Praha Region	Wroclaw	Poznan
Building Fixtures, Eq. and Services	Poznan	Katowice	Lithuania	Warszawa	Bydgoszcz
Business Services	Budapest	Warszawa	Praha City	Lithuania	Latvia
Chemical Products	Warszawa	Katowice	Liberec	Usti nad Lab.	Kraków
Communications Equipment	Nitra	Székestehérvár	Liberec	Poznan	Plzén
Processed Food	Katowice	Poznan	Warszawa	Lodz	Bydgoszcz
Agricultural Products	Warszawa	Poznan	Katowice	Lithuania	Kraków
Distribution Services	Warszawa	Lithuania	Katowice	Latvia	Budapest
Education and Knowledge Creation	Warszawa	Budapest	Katowice	Lithuania	Kraków
Entertainment	Budapest	Latvia	Praha City	Katowice	Warszawa
Heavy Machinery	Poznan	Katowice	Warszawa	Brno	Liberec
Financial Services	Warszawa	Budapest	Katowice	Praha City	Lodz
Fishing and Fishing Products	Gdansk	Latvia	Szczecin	Lithuania	Estonia
Footwear	Nitra	Kraków	Debrecen	Warszawa	Györ
Forest Products	Poznan	Lithuania	Slovenia	Katowice	Liberec
Furniture	Poznan	Lithuania	Szczecin	Brno	Latvia
Heavy Construction Services	Lithuania	Katowice	Brno	Kraków	Budapest
Hospitality and Tourism	Warszawa	Budapest	Katowice	Lithuania	Gdansk
Information Technology	Budapest	Székestehérvár	Warszawa	Györ	Praha City
Jewelry and Precious Metals	Liberec	Katowice	Warszawa	Lodz	Poznan
Leather Products	Kraków	Slovenia	Wroclaw	Lithuania	Pécs
Lighting and Electrical Equipment	Budapest	Wroclaw	Györ	Liberec	Miskolc
Construction Materials	Szczecin	Wroclaw	Praha Region	Gdansk	Poznan
Medical Devices	Lodz	Katowice	Brno	Debrecen	Budapest
Metal Manufacturing	Ostrava	Katowice	Slovenia	Kosice	Kraków
Oil and Gas Products and Services	Warszawa	Rzeszów	Lithuania	Kraków	Bratislava
Biopharmaceuticals	Warszawa	Budapest	Kraków	Lodz	Slovenia
Plastics	Bydgoszcz	Warszawa	Katowice	Rzeszów	Slovenia
Power Gen. and Transmission	Slovenia	Olomouc	Brno	Budapest	Kraków
Production Technology	Katowice	Brno	Nitra	Olomouc	Plzén
Publishing and Printing	Budapest	Warszawa	Katowice	Praha City	Poznan
Sporting, Rec., and Children's Gds	Katowice	Kraków	Budapest	Poznan	Slovenia
Textiles	Lithuania	Lodz	Liberec	Katowice	Nitra
Tobacco	Warszawa	Lublin	Bialystok	Debrecen	Kraków
Transportation and Logistics	Warszawa	Budapest	Gdansk	Lithuania	Katowice

Sources: Authors' calculations

Table 16 above identifies the top five regional clusters by total employment in each cluster category. We find the large metropolitan regions of Poland to dominate across many of the categories: Katowice is among the top five locations in 23 out of the 38 cluster categories, Warsaw in 21, Poznan in 14, and Krakow in 12. Only Budapest with 17 and Lithuania with 15 top regional clusters break into this list.

But apart from these regions with large overall size there are also a number of regions that are clearly specialized in one or a few related regional clusters:

- Székestehérvár, Hungary, ranks second on both its regional communications and its information technology cluster. The region has not other of its regional clusters in the top five of any cluster category
- Győr, Hungary, ranks third in lighting & electrical equipment, fourth in information technology, and fifth in footwear. The regional clusters in Győr reflect the different stages of foreign direct investment into the region.
- Usti nad Labem, Czech Republic, ranks fourth in chemical products but does not get into the top five in any cluster category
- Bratislava, Slovakia, ranks fifth on oil and gas products and services but due to its small overall size not in any other category
- Rzeszów, Poland, ranks first for its aerospace cluster (mapped in one of our case studies for this project) but also ranks high on the regional oil & gas products and its related plastics cluster.

Three-star regional clusters: Presence and changes

Earlier in the report, we have introduced the notion of three-star clusters to identify top re-

gional clusters by combination of measures that are likely to provide a more accurate indication of strong cluster effects than absolute employment size alone. Using this method, we find that 11 out of the 38 cluster categories have three-star clusters. Table 17 below identifies these leading regional clusters: Five in automotive, three in financial services, three in apparel, and one in six further clusters categories. These clusters are the leading ones within EU-10 in their respective sectors. They all have a critical mass of employees, they are specialised, and they dominate their regional labour markets.

The automotive cluster category (cars, trucks, buses, engines and other subsystems and components) is among the most advanced and geographically specialized economic activities. Some of the regional clusters survived from the era of Soviet style planning, whereas some are new:

- In the Czech regional clusters one can find companies such as Skoda, Citroen, Peugeot, VW and Toyota. Foreign automotive component manufacturers include Kostal, Ricardo, Robert Bosch, TRW, Valeo and Visteon. One of our regional cluster case studies looked in more depth at the Jaromer automotive packaging sub-cluster
- In the Polish regional clusters, General Motors has invested heavily in an Opel plant in the Special Economic Zone in Katowice. Other significant investments in the region relate to Japanese Isuzu Motors (production of new generation high-pressure engines) and Delphi Automotive Systems. Fiat-GM Powertrain Polska has begun production of modern turbo diesel engines, and Japanese NGK Ceramics has started production of automotive ceramic filters
- The Hungarian regional clusters include Audi, Suzuki and Ignis, and component manufacturers such as Continental, Denso and Knorr-Bremse

Table 17 Three-star regional clusters by cluster category, 2004

Cluster category	Region	Stars
Apparel	Košice, SK	***
Apparel	Lithuania	***
Apparel	Łódź, PL	***
Automotive	Győr, HU	***
Automotive	Katowice, PL	***
Automotive	Liberec, CZ	***
Automotive	Praha Region, CZ	***
Automotive	Wrocław, PL	***
Education and Knowledge Creation	Praha City, CZ	***
Entertainment	Latvia	***
Entertainment	Praha City, CZ	***
Financial Services	Bratislava, SK	***
Financial Services	Praha City, CZ	***
Financial Services	Warszawa, PL	***
Hospitality and Tourism	Cyprus	***
Information Technology	Székestehevár, HU	***
Metal Manufacturing	Košice, SK	***
Metal Manufacturing	Ostrava, CZ	***
Processed Food	Szeged, HU	***
Textiles	Liberec, CZ	***
Transportation and Logistics	Gdansk, PL	***

Sources: Authors' calculations

Of all star-rated clusters some have gained and some have lost position (for a full list see the appendix). On the one extreme the Wrocław Automotive cluster in Poland has gained three

stars between 2001 and 2004. On the other extreme the Debrecen Apparel cluster in Hungary lost three stars during the same period (see table 18).

Table 18 Regional clusters gaining/losing 2 or more stars, 2000-2004

Cluster category	Region	Change in stars
Apparel	Košice, SK	+++
Apparel	Debrecen, HU	---
Automotive	Wroclaw, PL	++++
Automotive	Katowice, PL	+++
Automotive	Bratislava, SK	+++
Automotive	Székesteheérvár, HU	--
Automotive	Rzeszów, PL	--
Building Fixtures, Equipment and Services	Rzeszów, PL	+++
Communications Equipment	Nitra, SK	+++
Communications Equipment	Malta	--
Communications Equipment	Székesteheérvár, HU	--
Distribution Services	Lithuania	--
Education and Knowledge Creation	Lublin, PL	--
Financial Services	Bydgoszcz, PL	+++
Fishing and Fishing Products	Malta	--
Forest Products	Olsztyn, PL	+++
Processed Food	Székesteheérvár, HU	+++
Heavy Construction Services	Székesteheérvár, HU	+++
Heavy Construction Services	Debrecen, HU	+++
Hospitality and Tourism	Malta	+++
Metal Manufacturing	Székesteheérvár, HU	+++
Metal Manufacturing	Praha Region, CZ	--
Textiles	Gorzów Wielkopolski, PL	--
Transportation and Logistics	Lódz, PL	+++
Transportation and Logistics	Lublin, PL	+++
Transportation and Logistics	Malta	+++

Sources: Authors' calculations

Chapter 5 Observations and policy recommendations

A. Observations on regional economies and clusters across the EU-10

This report has provided the first systematic analysis of regional clusters across the 10 new EU member countries. Five observations stand out from the breadth of detailed data discussed:

- The EU-10 has a *specialization profile* that remains distinct from more advanced economies like the United States or Sweden, countries for which comparable data is available. We find that the EU-10 still has a far stronger natural resource-driven sector than these other economies. And we find that the EU-10 have within the cluster sector a much stronger bias towards labour-intensive and manufacturing-driven cluster categories, while being relatively weak in advanced services and knowledge-intensive cluster categories
- Within the EU-10, there are large differences across regions as well as across cluster categories in terms of their degrees of *specialization* and *geographic concentration*. The absolute employment level in a region or a cluster category is one important driver for these differences but the data strongly suggest that other factors are important as well. Legacy, location, and specific business environment conditions, policies and institutions are candidates to explain the differences in region or cluster-specific outcomes
- The economies of the EU-10 countries have undergone a period of tremendous *structural change*. The data both on regional economies and on regional clusters shows a high level of change over time. Interestingly, these changes suggest that the change process creates opportunities as well as threats for all regions and regional clusters. Initial conditions in terms of total size or established position do not guarantee success or predetermine failure
- The strengths of regional cluster portfolios and of individual regional clusters are important *determinants of economic performance*. As in all other countries in which comparable cluster mapping data has been analyzed, we find a strong positive relationship between a measure of cluster portfolio strength and prosperity across the regions of the EU-10
- The EU-10 exhibit much *lower specialization* on specific regional clusters within regions and much *lower geographic concentration* on specific regions within cluster categories than the U.S. economy. If, as suggested by the conceptual framework and confirmed by the data presented here as well as in other cluster mapping data research, higher levels of specialization and concentration enable higher productivity and innovation, this is a serious concern. Interestingly, we also find initial indications that this is a problem not only of the EU-10 but also of the EU-15 countries – an observation at least fully consistent with the performance gap relative to the United States

The qualitative studies that have accompanied the quantitative cluster mapping data analysis have provided additional context to the observations above. In particular, they have helped to identify a number of key factors in the evolution of the 10 new EU member countries, the eight former planned economies in particular, that are worth noting:

- A relevant factor to understand the development of competitive industries and regional clusters is the way the *privatisation process* has been organized. In Slovenia, for example, the privatisation process favoured management buyouts that allowed local companies to tap into established networks of contacts in their respective regions. In other countries, for example Estonia, the privatization process was much more focused on attracting new foreign owners. This created quick inflows of new capital and know-how, and provided linkages to many global markets. The development of regional clusters, however, might take more time as new foreign-owned subsidiaries will need to build linkages and learn to work together and with local partners to increase and leverage cluster effects
- A second relevant factor in ex-communist countries is how the *Academy of Sciences*, the main research body in all of these countries, has evolved. In

countries where the Academy has continued to be protected and supported there remains a wide gap between research and commercial applications. In other countries where the scientists ran out of budget overnight, for example Lithuania, researchers have been forced to either start companies or reach out to the business community to secure funding. A large number of studies, including the regular performance benchmarks undertaken by the European Commission, indicate that all EU-10 countries suffer from low innovative capacity. It remains to be seen whether an approach focused on safeguarding core research capabilities or an approach based on forcing research to be directly linked to business applications will be more successful in the long run.

While there are clearly significant differences between the EU-10 countries and the EU-15 as well as within the EU-10 countries in terms of policies and institutions affecting the development of regional clusters and strong regional cluster portfolios, the case studies indicate that the challenges faced by regional clusters organizing efforts to improve competitiveness are similar across many countries:

- Regional clusters have to overcome the barriers of collective action, especially the lack of trust between the public and the private sector. This is particularly challenging in the environment of the eight former planned economies among the EU-10 where company executives vividly remember their treatment by state officials in the past and where after the dramatic shift to competition as the organizing principle it is hard to also see the benefit and legitimacy of cooperation
- Regional clusters than have to identify the unique strengths and weaknesses of their location, decide upon a strategic positioning for their regional cluster within the network of locations in their cluster category that is feasible as well as attractive, and design and execute an action agenda that enables them to achieve this positioning. This is challenging everywhere, but the EU-10 countries might have the advantage that they have a strong motivation to succeed in pursuing the opportunities they failed to have in the past

We believe that these observations from the quantitative as well as from the qualitative parts of our analysis provide important new informa-

tion for European policy makers. They add to the stock of knowledge about the economies of the EU-10 but move significantly beyond the traditional performance outcome and factor input analysis to add actionable information on economic composition.

Innovation is a key example: There is abundant data showing that the EU-10 countries invest less in R&D and generate less innovation, at least of the science-driven type that dominates the rankings, than their peers in the EU-15. But given the current level of resources available and the overall business environment conditions present in these countries, the pressure from EU institutions to act has met either silence or largely ineffective action. Regional clusters are a key source of innovation and leveraging their potential can be an important step towards overcoming this impasse.

B. Policy recommendations

The observations in this report, especially the findings on the low present level of regional specialization relative to the United States and the correlations between regional specialization and economic performance, suggest that the policies pursued by EU institutions should focus on enhancing the process of geographical specialization of industries within Europe. Second, EU institutions should develop data, tools, and methodology to enable cluster initiatives within member nations to become more effective. And third, EU should focus its own policies on enhancing the microeconomic capacity of its member countries and their regional economies.

Enhancing Geographical Specialization

One of the main conclusions from this report is that geographical specialization will and should continue to increase in the EU-10 countries. Higher levels of specialization and concentrations are critical to raise levels of productivity and innovation.

The European Commission should focus on three issues in particular to enable structural change to continue:

- *European market integration*; the further removal of barriers to trade, investment, and migration within Europe remains the most critical factor for achieving a more efficient distribution of economic activity across geography. The recent watering down of the service directive, the debates about a number of recent cross-European mergers and take-overs, and the continued use of temporary rules to close many western European labour markets to employees from the new EU member countries are all signs of activities going into the wrong direction, inhibit cluster development. EU institutions need to deliver on their mission in these key areas of European integration; otherwise there is little hope of regional clusters in the EU-10 growing dynamically
- *European policies facilitating structural change*; the pace of structural change in the EU-10 has been dramatic throughout the last 15 years. In the run-up to accession the populations in these countries were largely willing to accept change as a condition for joining. But with EU membership achieved, the memory of stagnation under the planned economy-regime of the past fading, and change having been the only constant for many years, public pressure for slowing the pace of structural change is likely to increase. EU institutions can help to alleviate that pressure by helping member countries design policies that provide effective support for employees and regions affected by structural change without creating barriers for this change to occur
- *Remove barriers to structural change inherent in EU policies*; EU institutions have over the years implemented a wide range of policies. While many, especially those related to the single market, are beneficial for an effective geographic distribution of economic activity, this is not true for all. There are two main reasons for this. First, one of the key policy objectives of the European Union is cohesion across countries and regions. This has sometimes been interpreted to imply redistribution of resources from rich to poor regions, a process that in practice often works against effective structural change. Second, the European Union has followed a policy model of defining similar policies throughout Europe, benchmarking all member countries against a common goal. This is an effective tool towards eliminating market barriers. But it can be interpreted in ways that work against the development of regional economies that are increasingly more different to exploit economies of specialization.

These three broad recommendations are in our view beneficial for the development of strong regional clusters in the European Union at large, not only in the EU-10. But because the EU-10 countries are for historical reasons faced with a geographic distribution of economic activity even less efficient than in the old EU member countries, they might have even more to gain from following these recommendations.

Provide process support for regional cluster development initiatives

The process of structural change that our report describes for the EU-10 countries occurs largely naturally, with many individual decision makers across companies, research institutions, and government agencies making independent decisions. The experience of other countries and regions suggests that cluster initiatives can be an effective tool to speed up and improve the outcomes of structural change. Cluster initiatives can now be found everywhere around the globe, and many such initiatives exist or are being launched throughout the EU-10.^{xxii}

The European Commission should provide data, tools, and methods that improve the quality of such cluster initiatives across Europe, the EU-10 in particular, focussing on the following five areas:

- *European cluster mapping database*; effective cluster-based economic policy depends on accurate, timely, and widely available cluster data. Eurostat and the European Commission should launch an action program to make sure that regional data on a broader set of indicators (employment, productivity, wages, export/import and so on) is available at the four digit industry level. The lack of such data limited the type of analysis that was possible in this project. More importantly, however, it will hurt the credibility and effectiveness of cluster-related data and ultimately of cluster-based economic policies throughout the European Union.
- *Cluster policy impact assessment*; with cluster initiatives and other cluster-based economic policies increasingly common across EU member countries, there is a growing demand for a systematic assessment of their impact. Individual countries, for example Austria, and groups of European regions, for example Catalonia,

Sweden and Yorkshire,^{xxiii} have already initiated such efforts. But there would be a huge advantage from designing and organizing such a monitoring effort from a central and neutral position.

- *European cluster initiative alliance*; many individual cluster initiatives and cluster policy programs throughout Europe are currently underway, facing the same questions about “organizational and process best practice” for cluster initiatives. The European Commission can provide regular workshops and fora for practitioners from these efforts to help them share their experiences and learn from success as well as failure. The INNO nets currently under discussion are a positive initiative in this direction.
- *Methodology tool box for regional cluster development and cluster initiatives*; while cluster initiatives are still a relatively new policy tool, there is an increasing amount of knowledge on practices that can be successfully used everywhere. The European Commission can work with networks of practitioners^{xxiv} in this field to identify such practices and make them available throughout EU member countries. This might also include training courses that the EU can organize for practitioners.^{xxv}
- *Networks of regional clusters*; regional clusters can improve their attractiveness, if they find good levels of integration with other regional clusters that provide complementary activities or advantages. The EU can help provide an environment that makes it easier for regional clusters to develop such linkages. But such policies are not without pitfalls: Linkages between regional clusters are not a substitute for the inherent strength of a regional cluster. And effective linkages might require geographical proximity within at least a group of neighbouring countries, not the entire EU. Scanbalt, a network of regional clusters in biopharmaceuticals in the Baltic Sea Region, is an example of what might be useful.

In addition to these five broad activities, it might

in some exceptional cases also be beneficial to give limited direct support to cluster initiatives and cluster organizations.^{xxvi} The challenge is to make resources available where they are the only barrier that inhibits a cluster initiative from getting off the ground, while avoiding the growth of cluster initiatives that do not have a solid base in a healthy regional cluster.

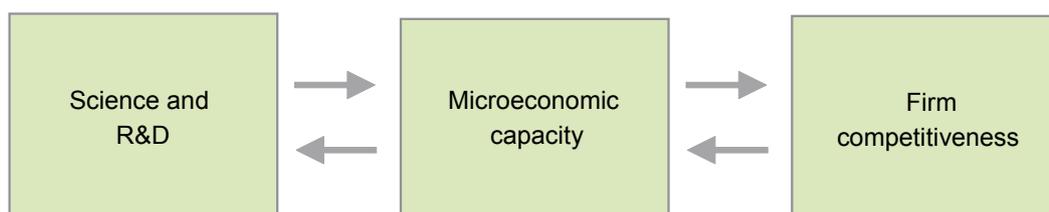
Cluster initiatives are not a panacea and they are not a substitute for efforts to remove weaknesses in the general business environment or the overall context. But if they are part of an integrated strategy for competitiveness upgrading, they can be powerful tools to reach an impact that cross-cutting policies alone will be hard stretched to have. And they can provide very powerful bottom up input to refine cross-cutting horizontal policies at the regional, national, and European level. In this spirit, the European Commission should support the use of cluster initiatives as an additional policy tool alongside sound overall economic policies.

Improve the effectiveness of EU competitiveness policies

The European Union has developed many policies that are designed to directly improve different aspects of microeconomic competitiveness in the EU member countries and their regions: Regional policies, science and innovation policies, competition policies, enterprise and SME policies, sectoral policies, etc. But despite all these efforts, the performance gap to global peers, the United States in particular, has remained or is even growing.

The policy debate in Europe around innovation and competitiveness is a good example to analyze how the debate can be informed and policies can be improved if the existence and role of regional clusters is taken into account.

Figure 14: The innovation – competitiveness nexus



The innovation debate tends to be centred on traditional input measures, such as scientific research and R&D spending. A linear relationship is often assumed where more R&D and investments in the science community lead to more economic growth and enhanced competitiveness of firms. The evidence, however, supports a more sceptical view. More and more resources in a badly functioning microeconomic system will only lead to waste. The innovation process is extremely complex, involving many different types of actors: individual entrepreneurs and start-ups, large firms, capital providers, research organizations, public authorities and so on. Dense clusters tend to act as hotbeds for innovation and are often much more critical than additional resources.

Linkages between the three boxes of figure 14 are not unidirectional but interactive. The quality of the microeconomic environment depends on what actors are present, which incentive systems drive behaviour of different actors, the climate of competition and cooperation, and quality of infrastructure, sophistication of demand etc. Furthermore, the microeconomic business environment is complemented by the macro and micro policy environment. Micro policies in turn can be more general in nature – “horizontal” – or more focused on sectors or clusters.

A good example of how misled the discussion is in Europe is the debate about R&D spending levels. The U.S. has an overall level of 2.6% of GDP, whereas the EU average is 1.9%, with a goal of 3%. So what would happen if Europe would surpass the U.S. and reach the goal of 3%? Most probably it would lead to a lot of waste and to new scientific breakthroughs. However, due to weaknesses in Europe’s microeconomic capacity, the production of new science (publications, patents etc.) would most certainly be commercialized elsewhere, especially in the U.S.

The EU Commission has a number of policy tools that could leverage clusters to increase their impact on European competitiveness. Structural funds and framework programs now cover an impressive range of programs and initiatives related to clusters, innovation and competitiveness.

Innovation policies again are a good example for what should be the objective: policies should enhance linkages between the scientific community (left box), i.e. universities and research organizations, and private industry (right box) by improving the microeconomic capacity of the nations and regions of Europe. The role of universities in the innovation process typically involve five areas: spin-out of research projects leading to the formation of new firms, licensing technology to established firms, university-industry collaboration programs (e.g. joint funding of research), publishing of research making it generally available, and through the continuous flow of graduated students and PhDs with new skills and knowledge. There is a tendency to focus the policy debate on spin-out of research creating new firms. However, university linkages with established firms often lead to higher growth which points to the fact that established clusters are critical to the university-industry linkage in the innovation process.

C. Research recommendations

The research objective of this project was to test the value of cluster mapping data in the context of the ten new EU member countries given the limitations of current data availability. As we have argued above, the results of this research do in our view present solid support for cluster mapping as a tool that should be more broadly used in Europe. Our research recommendations are thus focused on how we can remove current data limitations and then extend our research in three directions:

- *Geographic scope*; while the EU-10 countries are particularly interesting because of they high level of structural change they have gone through in recent years, they are together a relatively biased sample of countries to benchmark individual regions against; the comparison to the available data from the United States and Sweden has made that clear. We therefore suggest extending the cluster mapping work to the other European countries. Over time, we also suggest to work with the OECD and other relevant organization to include more countries from, for example, Asia into the comparison.
- *Breadth of data*; our analysis was to a very large degree based on employment data. We have discussed

the limitations of using this dimension in the methodology section. We suggest including data around at least three additional areas:

- additional indicators of economic activity, like number of establishments, value added, etc.
 - indicators of economic performance, like exports, FDI inflows, productivity, innovation, etc.
 - indicators of business environment quality, like skill levels, available policy programs, etc.
- *Depth of data*; in our analysis we had to make some compromises because of data coming from different sources over time (Poland) or data only being available at the three digit industry level. We suggest initiating a joint effort of the EU's statistical agencies to develop a consistent data set of cluster-based data over time covering the EU member countries.

With this additional data, we could push the analysis significantly forward. The first objective would be to analyse in more detail the relationship between cluster presence and economic performance. We have made some initial steps in this report in that direction but would like to go much further.

Second, we would be able to better understand the evolution of clusters, their emergence and decline over time. The profile of a regional cluster today depends much on its profile in the past, and understanding these dynamic relationships is critical to devise policies that can change a regional cluster's trajectory in a sustained, positive way.

Third, we would analyze in more detail the relationship between specific business environment conditions and economic policies on the one hand and the strength and evolution of regional clusters on the other hand. Understanding these linkages in more detail is critical to set appropriate cluster-based economic policies.

Appendix

1. Members of the Panel Group of Experts

- Martin Bruncko, Slovakia
- Mateja Dermastia, Slovenia
- Lars Eklund, Sweden
- Krzysztof Gulda, Poland
- Tomas Ilves, Estonia
- Charles Kovac, Hungary
- Ralf Moons, Belgium
- Antoni Subira, Spain

2. Regional clusters with two or three stars, by country, 2004

Cyprus	Hospitality and Tourism	***
Cyprus	Financial Services	**
Liberec, CZ	Automotive	***
Liberec, CZ	Textiles	***
Ostrava, CZ	Metal Manufacturing	***
Praha City, CZ	Education and Knowledge Creation	***
Praha City, CZ	Entertainment	***
Praha City, CZ	Financial Services	***
Praha Region, CZ	Automotive	***
Brno, CZ	Processed Food	**
Brno, CZ	Heavy Construction Services	**
Liberec, CZ	Processed Food	**
Liberec, CZ	Heavy Construction Services	**
Olomouc, CZ	Building Fixtures, Equipment and Services	**
Olomouc, CZ	Processed Food	**
Olomouc, CZ	Heavy Construction Services	**
Olomouc, CZ	Metal Manufacturing	**
Ostrava, CZ	Heavy Construction Services	**
Plzén, CZ	Processed Food	**
Plzén, CZ	Heavy Construction Services	**
Plzén, CZ	Metal Manufacturing	**
Praha City, CZ	Heavy Construction Services	**
Praha City, CZ	Hospitality and Tourism	**
Praha City, CZ	Transportation and Logistics	**
Praha Region, CZ	Processed Food	**
Praha Region, CZ	Heavy Construction Services	**
Praha Region, CZ	Transportation and Logistics	**
Ústí nad Labem, CZ	Processed Food	**
Ústí nad Labem, CZ	Heavy Construction Services	**

Estonia	Heavy Construction Services	**
Estonia	Transportation and Logistics	**
Győr, HU	Automotive	***
Szeged, HU	Processed Food	***
Székestehevár, HU	Information Technology	***
Budapest, HU	Business Services	**
Budapest, HU	Education and Knowledge Creation	**
Budapest, HU	Entertainment	**
Budapest, HU	Financial Services	**
Budapest, HU	Heavy Construction Services	**
Budapest, HU	Information Technology	**
Budapest, HU	Publishing and Printing	**
Budapest, HU	Transportation and Logistics	**
Debrecen, HU	Processed Food	**
Debrecen, HU	Heavy Construction Services	**
Győr, HU	Processed Food	**
Győr, HU	Information Technology	**
Miskolc, HU	Metal Manufacturing	**
Székestehevár, HU	Processed Food	**
Székestehevár, HU	Heavy Construction Services	**
Székestehevár, HU	Metal Manufacturing	**
Lithuania	Apparel	***
Lithuania	Processed Food	**
Lithuania	Education and Knowledge Creation	**
Lithuania	Heavy Construction Services	**
Lithuania	Textiles	**
Lithuania	Transportation and Logistics	**
Latvia	Entertainment	***
Latvia	Processed Food	**
Latvia	Transportation and Logistics	**
Malta	Hospitality and Tourism	**
Malta	Information Technology	**
Malta	Transportation and Logistics	**
Gdańsk, PL	Transportation and Logistics	***
Katowice, PL	Automotive	***
Łódź, PL	Apparel	***
Warszawa, PL	Financial Services	***
Wrocław, PL	Automotive	***
Białystok, PL	Processed Food	**
Bydgoszcz, PL	Building Fixtures, Equipment and Services	**

Appendix

Bydgoszcz, PL	Processed Food	**
Bydgoszcz, PL	Financial Services	**
Gdansk, PL	Financial Services	**
Gdansk, PL	Hospitality and Tourism	**
Katońice, PL	Processed Food	**
Katońice, PL	Education and Knowledge Creation	**
Katowice, PL	Heavy Construction Services	**
Katowice, PL	Metal Manufacturing	**
Kielce, PL	Processed Food	**
Kraków, PL	Processed Food	**
Kraków, PL	Education and Knowledge Creation	**
Kraków, PL	Heavy Construction Services	**
Kraków, PL	Metal Manufacturing	**
Łódz, PL	Processed Food	**
Łódz, PL	Financial Services	**
Łódź, PL	Textiles	**
Łódź, PL	Transportation and Logistics	**
Lublin, PL	Processed Food	**
Lublin, PL	Financial Services	**
Lublin, PL	Heavy Construction Services	**
Lublin, PL	Transportation and Logistics	**
Olsztyn, PL	Building Fixtures, Equipment and Services	**
Olsztyn, PL	Processed Food	**
Olsztyn, PL	Forest Products	**
Poznan, PL	Building Fixtures, Equipment and Services	**
Poznan, PL	Processed Food	**
Rzeszów, PL	Building Fixtures, Equipment and Services	**
Rzeszów, PL	Processed Food	**
Rzeszów, PL	Heavy Construction Services	**
Szczecin, PL	Processed Food	**
Szczecin, PL	Hospitality and Tourism	**
Szczecin, PL	Transportation and Logistics	**
Warszawa, PL	Processed Food	**
Warszawa, PL	Education and Knowledge Creation	**
Warszawa, PL	Biopharmaceuticals	**
Warszawa, PL	Transportation and Logistics	**
Wrocław, PL	Processed Food	**
Wrocław, PL	Financial Services	**
Wrocław, PL	Heavy Construction Services	**
Slovenia	Heavy Construction Services	**
Slovenia	Metal Manufacturing	**
Slovenia	Transportation and Logistics	**
Bratislava, SK	Financial Services	***
Košice, SK	Apparel	***

Košice, SK	Metal Manufacturing	***
Bratislava, SK	Automotive	**
Bratislava, SK	Education and Knowledge Creation	**
Košice, SK	Heavy Construction Services	**
Nitra, SK	Automotive	**
Nitra, SK	Communications Equipment	**
Nitra, SK	Processed Food	**
Nitra, SK	Heavy Construction Services	**
Žilina, SK	Heavy Construction Services	**
Žilina, SK	Metal Manufacturing	**

3. Employment by cluster category and country, 2004

Cluster	Cyprus	Czech Republic	Estonia	Hungary	Latvia	Lithuania	Malta	Poland	Slovakia	Slovenia
Aerospace	0	7 509	0	2 060	25	1 343	0	11 138	0	107
Analytical Instruments	4	4 256	1 137	7 028	934	251	0	11 541	1 472	4 640
Apparel	2 764	33 631	9 430	59 038	14 433	39 103	1 614	204 086	48 025	11 726
Automotive	487	118 438	3 213	51 209	1 345	1 094	304	153 920	40 731	9 519
Building Fixtures, Equipment and Services	3 910	112 652	12 359	58 105	17 458	24 237	2 328	262 379	38 631	17 545
Business Services	1 907	35 508	2 712	39 889	2 312	8 040	916	68 183	11 282	7 297
Chemical Products	832	33 762	2 777	20 063	1 629	4 842	411	62 302	11 386	6 334
Communications Equipment	32	31 980	9 629	25 344	1 718	3 030	0	39 309	25 035	4 950
Processed Food	9 521	158 961	15 467	136 538	25 082	36 820	2 798	523 652	56 602	23 217
Agricultural Products	1 778	21 392	3 341	20 735	4 558	5 694	1 099	62 899	10 392	2 830
Distribution Services	3 633	31 214	3 921	21 563	10 933	14 283	1 400	99 500	11 386	4 605
Education and Knowledge Creation	2 577	78 860	17 906	79 915	18 663	32 887	1 872	282 051	31 813	17 139
Entertainment	3 774	65 112	10 308	54 465	1 575	11 657	1 423	106 332	19 509	8 096
Heavy Machinery	136	34 140	669	21 068	5 107	2 524	0	75 503	12 598	6 460
Financial Services	14 287	102 224	8 908	91 732	1 299	15 573	5 108	317 873	48 507	21 795
Fishing and Fishing Products	318	3 715	6 989	4 199	9 051	4 756	592	28 723	2 631	496
Footwear	711	5 855	2 266	13 073	356	684	447	28 982	18 972	2 959
Forest Products	3 206	70 132	8 033	30 960	5 615	14 714	348	144 917	19 605	13 429
Furniture	1 374	35 108	6 159	21 423	9 712	13 095	1 352	109 122	19 719	7 573
Heavy Construction Services	9 561	174 510	24 180	118 031	18 407	47 876	3 658	296 100	74 673	24 925
Hospitality and Tourism	19 277	116 710	17 851	87 505	10 163	27 011	9 987	243 981	39 720	18 416
Information Technology	1 898	53 242	1 240	82 430	436	9 959	5 939	46 422	24 646	8 001
Jewellery and Precious Metals	915	18 481	426	7 409	781	776	356	29 874	3 182	2 772
Leather Products	204	6 513	1 034	7 081	341	2 730	63	14 539	1 592	2 970
Lighting and Electrical Equipment	389	16 476	1 554	26 082	1 452	1 597	601	19 138	10 219	3 270
Construction Materials	632	16 091	1 270	12 191	1 414	2 119	389	36 672	7 719	1 612
Medical Devices	152	7 087	565	9 202	605	1 958	1 027	17 986	2 472	1 375
Metal Manufacturing	1 378	163 122	2 809	75 399	7 133	7 445	1 523	215 424	70 179	31 938
Oil and Gas Products and Services	148	2 898	5 655	6 979	420	3 693	198	18 585	6 014	93

Biopharmaceuticals	907	13 150	88	21 236	2 269	537	631	48 532	4 576	5 424
Plastics	535	18 625	873	13 821	1 598	4 215	299	50 370	5 327	4 412
Power Generation and Transmission	106	18 576	1 595	10 250	907	964	63	21 942	7 671	5 071
Production Technology	476	65 833	1 094	29 404	4 389	4 113	178	83 963	23 158	8 705
Publishing and Printing	2 223	42 489	6 258	34 852	6 620	6 511	1 300	84 538	13 897	9 895
Sporting, Recreational and Children's Goods	15	8 287	660	6 365	941	554	1 199	15 633	1 292	1 699
Textiles	1 166	74 162	13 719	41 861	9 385	28 662	832	137 567	41 196	14 084
Tobacco	282	845	0	2 067	325	734	53	5 205	241	0
Transportation and Logistics	10 917	132 951	29 772	117 028	33 830	38 754	9 148	327 985	43 658	26 789
Sum	102 432	1 934 493	235 867	1 467 602	233 219	424 833	59 455	4 306 868	809 728	342 168

Source: Compiled by authors

4. Regional clusters gaining/losing stars, 2000-2004

Wroclaw, PL	Automotive	****
Székestehevár, HU	Processed Food	***
Székestehevár, HU	Heavy Construction Services	***
Székestehevár, HU	Metal Manufacturing	***
Debrecen, HU	Heavy Construction Services	***
Malta	Hospitality and Tourism	***
Malta	Transportation and Logistics	***
Lódz, PL	Transportation and Logistics	***
Katowice, PL	Automotive	***
Lublin, PL	Transportation and Logistics	***
Rzeszów, PL	Building Fixtures, Equipment and Services	***
Bydgoszcz, PL	Financial Services	***
Olsztyn, PL	Forest Products	***
Bratislava, SK	Automotive	***
Nitra, SK	Communications Equipment	***
Košice, SK	Apparel	***
Cyprus	Tobacco	**
Praha City, CZ	Aerospace Vehicles and Defense; Engines	+
Praha City, CZ	Publishing and Printing	+
Praha Region, CZ	Construction Materials	+
Praha Region, CZ	Oil and Gas Products and Services	+
Praha Region, CZ	Tobacco	+
Plzén, CZ	Automotive	+
Plzén, CZ	Building Fixtures, Equipment and Services	+
Plzén, CZ	Communications Equipment	+
Plzén, CZ	Production Technology	+
Ústí nad Labem, CZ	Hospitality and Tourism	+
Liberec, CZ	Automotive	+
Liberec, CZ	Communications Equipment	+

Liberec, CZ	Hospitality and Tourism	++
Brno, CZ	Hospitality and Tourism	++
Olomouc, CZ	Production Technology	++
Estonia	Analytical Instruments	++
Estonia	Heavy Construction Services	++
Estonia	Hospitality and Tourism	++
Estonia	Transportation and Logistics	++
Budapest, HU	Aerospace Vehicles and Defence; Engines	++
Budapest, HU	Analytical Instruments	++
Budapest, HU	Heavy Construction Services	++
Budapest, HU	Lighting and Electrical Equipment	++
Budapest, HU	Metal Manufacturing	++
Győr, HU	Footwear	++
Győr, HU	Heavy Construction Services	++
Győr, HU	Information Technology	++
Pécs	Communications Equipment	++
Pécs	Hospitality and Tourism	++
Pécs	Sporting, Recreational and Children's Goods	++
Miskolc, HU	Chemical Products	++
Miskolc, HU	Construction Materials	++
Miskolc, HU	Medical Devices	++
Miskolc, HU	Metal Manufacturing	++
Miskolc, HU	Plastics	++
Debrecen, HU	Tobacco	++
Szeged, HU	Agricultural Products	++
Szeged, HU	Construction Materials	++
Szeged, HU	Oil and Gas Products and Services	++
Szeged, HU	Tobacco	++
Lithuania	Financial Services	++
Lithuania	Textiles	++
Lithuania	Tobacco	++
Latvia	Building Fixtures, Equipment and Services	++
Latvia	Heavy Construction Services	++
Malta	Medical Devices	++
Malta	Sporting, Recreational and Children's Goods	++
Lódz, PL	Building Fixtures, Equipment and Services	++
Lódz, PL	Financial Services	++
Lódz, PL	Heavy Construction Services	++
Lódz, PL	Hospitality and Tourism	++
Lódz, PL	Medical Devices	++
Warszawa, PL	Aerospace Vehicles and Defence; Engines	++
Warszawa, PL	Business Services	++
Warszawa, PL	Distribution Services	++
Warszawa, PL	Information Technology	++
Warszawa, PL	Metal Manufacturing	++

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Warszawa, PL	Biopharmaceuticals	++
Kraków, PL	Building Fixtures, Equipment and Services	++
Kraków, PL	Footwear	++
Kraków, PL	Hospitality and Tourism	++
Kraków, PL	Leather Products	++
Kraków, PL	Oil and Gas Products and Services	++
Kraków, PL	Biopharmaceuticals	++
Kraków, PL	Sporting, Recreational and Children's Goods	++
Kraków, PL	Transportation and Logistics	++
Katowice, PL	Apparel	++
Katowice, PL	Education and Knowledge Creation	++
Katowice, PL	Entertainment	++
Katowice, PL	Hospitality and Tourism	++
Katowice, PL	Publishing and Printing	++
Katowice, PL	Sporting, Recreational and Children's Goods	++
Lublin, PL	Financial Services	++
Lublin, PL	Heavy Construction Services	++
Lublin, PL	Tobacco	++
Rzeszów, PL	Furniture	++
Rzeszów, PL	Heavy Construction Services	++
Rzeszów, PL	Oil and Gas Products and Services	++
Rzeszów, PL	Plastics	++
Kielce, PL	Processed Food	++
Kielce, PL	Transportation and Logistics	++
Białystok, PL	Distribution Services	++
Białystok, PL	Furniture	++
Białystok, PL	Hospitality and Tourism	++
Poznań, PL	Automotive	++
Poznań, PL	Agricultural Products	++
Poznań, PL	Forest Products	++
Poznań, PL	Hospitality and Tourism	++
Poznań, PL	Metal Manufacturing	++
Szczecin, PL	Processed Food	++
Szczecin, PL	Furniture	++
Szczecin, PL	Construction Materials	++
Szczecin, PL	Medical Devices	++
Gorzów Wielkopolski, PL	Communications Equipment	++
Gorzów Wielkopolski, PL	Construction Materials	++
Gorzów Wielkopolski, PL	Metal Manufacturing	++
Gorzów Wielkopolski, PL	Oil and Gas Products and Services	++
Gorzów Wielkopolski, PL	Transportation and Logistics	++
Wrocław, PL	Building Fixtures, Equipment and Services	++
Wrocław, PL	Hospitality and Tourism	++
Wrocław, PL	Leather Products	++
Wrocław, PL	Transportation and Logistics	++

Opole, PL	Heavy Machinery	++
Opole, PL	Transportation and Logistics	++
Bydgoszcz, PL	Heavy Construction Services	++
Bydgoszcz, PL	Jewelry and Precious Metals	++
Bydgoszcz, PL	Metal Manufacturing	++
Bydgoszcz, PL	Textiles	++
Bydgoszcz, PL	Transportation and Logistics	++
Olsztyn, PL	Building Fixtures, Equipment and Services	++
Olsztyn, PL	Education and Knowledge Creation	++
Olsztyn, PL	Fishing and Fishing Products	++
Gdansk, PL	Footwear	++
Gdansk, PL	Heavy Construction Services	++
Gdansk, PL	Construction Materials	++
Slovenia	Power Generation and Transmission	++
Bratislava, SK	Financial Services	++
Bratislava, SK	Information Technology	++
Nitra, SK	Apparel	++
Nitra, SK	Automotive	++
Nitra, SK	Building Fixtures, Equipment and Services	++
Žilina, SK	Footwear	++
Žilina, SK	Information Technology	++
Žilina, SK	Construction Materials	++
Žilina, SK	Power Generation and Transmission	++
Košice, SK	Footwear	++
Košice, SK	Construction Materials	++
Košice, SK	Textiles	++
Cyprus	Distribution Services	--
Praha City, CZ	Hospitality and Tourism	--
Praha Region, CZ	Business Services	--
Praha Region, CZ	Sporting, Recreational and Children's Goods	--
Plzén, CZ	Heavy Machinery	--
Plzén, CZ	Construction Materials	--
Plzén, CZ	Medical Devices	--
Ústí nad Labem, CZ	Construction Materials	--
Ústí nad Labem, CZ	Medical Devices	--
Ústí nad Labem, CZ	Metal Manufacturing	--
Ústí nad Labem, CZ	Transportation and Logistics	--
Liberec, CZ	Information Technology	--
Brno, CZ	Analytical Instruments	--
Brno, CZ	Jewelry and Precious Metals	--
Estonia	Apparel	--
Estonia	Business Services	--
Estonia	Distribution Services	--
Budapest, HU	Hospitality and Tourism	--

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Székestehevár, HU	Chemical Products	--*
Székestehevár, HU	Plastics	--*
Győr, HU	Apparel	--*
Győr, HU	Communications Equipment	--*
Győr, HU	Heavy Machinery	--*
Győr, HU	Oil and Gas Products and Services	--*
Pécs	Apparel	--*
Miskolc, HU	Processed Food	--*
Miskolc, HU	Heavy Construction Services	--*
Debrecen, HU	Leather Products	--*
Debrecen, HU	Oil and Gas Products and Services	--*
Debrecen, HU	Transportation and Logistics	--*
Szeged, HU	Footwear	--*
Lithuania	Agricultural Products	--*
Lithuania	Entertainment	--*
Latvia	Business Services	--*
Latvia	Education and Knowledge Creation	--*
Latvia	Furniture	--*
Malta	Financial Services	--*
Malta	Tobacco	--*
Lódz, PL	Education and Knowledge Creation	--*
Lódz, PL	Construction Materials	--*
Lódz, PL	Biopharmaceuticals	--*
Lódz, PL	Textiles	--*
Lódz, PL	Tobacco	--*
Warszawa, PL	Apparel	--*
Warszawa, PL	Education and Knowledge Creation	--*
Warszawa, PL	Entertainment	--*
Warszawa, PL	Heavy Construction Services	--*
Warszawa, PL	Publishing and Printing	--*
Kraków, PL	Chemical Products	--*
Kraków, PL	Education and Knowledge Creation	--*
Kraków, PL	Financial Services	--*
Katowice, PL	Metal Manufacturing	--*
Katowice, PL	Production Technology	--*
Kielce, PL	Building Fixtures, Equipment and Services	--*
Kielce, PL	Financial Services	--*
Kielce, PL	Construction Materials	--*
Białystok, PL	Education and Knowledge Creation	--*
Białystok, PL	Transportation and Logistics	--*
Poznan, PL	Aerospace Vehicles and Defense; Engines	--*
Poznan, PL	Lighting and Electrical Equipment	--*
Poznan, PL	Tobacco	--*
Szczecin, PL	Education and Knowledge Creation	--*
Szczecin, PL	Financial Services	--*

Szczecin, PL	Transportation and Logistics	-*
Gorzów Wielkopolski, PL	Heavy Machinery	-*
Gorzów Wielkopolski, PL	Financial Services	-*
Gorzów Wielkopolski, PL	Leather Products	-*
Wroclaw, PL	Analytical Instruments	-*
Wroclaw, PL	Education and Knowledge Creation	-*
Opole, PL	Building Fixtures, Equipment and Services	-*
Opole, PL	Power Generation and Transmission	-*
Opole, PL	Production Technology	-*
Olsztyn, PL	Financial Services	-*
Olsztyn, PL	Heavy Construction Services	-*
Olsztyn, PL	Leather Products	-*
Gdansk, PL	Processed Food	-*
Gdansk, PL	Education and Knowledge Creation	-*
Gdansk, PL	Hospitality and Tourism	-*
Gdansk, PL	Biopharmaceuticals	-*
Slovenia	Apparel	-*
Slovenia	Jewelry and Precious Metals	-*
Slovenia	Textiles	-*
Bratislava, SK	Education and Knowledge Creation	-*
Bratislava, SK	Entertainment	-*
Nitra, SK	Agricultural Products	-*
Nitra, SK	Medical Devices	-*
Nitra, SK	Production Technology	-*
Žilina, SK	Processed Food	-*
Žilina, SK	Forest Products	-*
Žilina, SK	Leather Products	-*
Praha Region, CZ	Metal Manufacturing	***
Székestehevár, HU	Automotive	***
Székestehevár, HU	Communications Equipment	***
Lithuania	Distribution Services	***
Malta	Communications Equipment	***
Malta	Fishing and Fishing Products	***
Lublin, PL	Education and Knowledge Creation	***
Rzeszów, PL	Automotive	***
Gorzów Wielkopolski, PL	Textiles	***
Debrecen, HU	Apparel	****

5. Regional clusters with two and three stars, by cluster category, 2004

Apparel	Košice, SK	***
Apparel	Lithuania	***
Apparel	Łódź, PL	***

Automotive	Győr, HU	***
Automotive	Katowice, PL	***
Automotive	Liberec, CZ	***
Automotive	Praha Region, CZ	***
Automotive	Wrocław, PL	***
Automotive	Bratislava, SK	**
Automotive	Nitra, SK	**
Biopharmaceuticals	Warszawa, PL	***
Building Fixtures, Equipment and Services	Bydgoszcz, PL	**
Building Fixtures, Equipment and Services	Olomouc, CZ	**
Building Fixtures, Equipment and Services	Olsztyn, PL	**
Building Fixtures, Equipment and Services	Poznań, PL	**
Building Fixtures, Equipment and Services	Rzeszów, PL	**
Business Services	Budapest, HU	**
Communications Equipment	Nitra, SK	**
Education and Knowledge Creation	Praha City, CZ	***
Education and Knowledge Creation	Bratislava, SK	**
Education and Knowledge Creation	Budapest, HU	**
Education and Knowledge Creation	Katowice, PL	**
Education and Knowledge Creation	Kraków, PL	**
Education and Knowledge Creation	Lithuania	**
Education and Knowledge Creation	Warszawa, PL	**
Entertainment	Latvia	***
Entertainment	Praha City, CZ	***
Entertainment	Budapest, HU	**
Financial Services	Bratislava, SK	***
Financial Services	Praha City, CZ	***
Financial Services	Warszawa, PL	***
Financial Services	Budapest, HU	**
Financial Services	Bydgoszcz, PL	**
Financial Services	Cyprus	**
Financial Services	Gdańsk, PL	**
Financial Services	Łódź, PL	**
Financial Services	Lublin, PL	**
Financial Services	Wrocław, PL	**
Forest Products	Olsztyn, PL	**

Heavy Construction Services	Brno, CZ	**
Heavy Construction Services	Budapest, HU	**
Heavy Construction Services	Debrecen, HU	**
Heavy Construction Services	Estonia	**
Heavy Construction Services	Katowice, PL	**
Heavy Construction Services	Košice, SK	**
Heavy Construction Services	Kraków, PL	**
Heavy Construction Services	Liberec, CZ	**
Heavy Construction Services	Lithuania	**
Heavy Construction Services	Lublin, PL	**
Heavy Construction Services	Nitra, SK	**
Heavy Construction Services	Olomouc, CZ	**
Heavy Construction Services	Ostrava, CZ	**
Heavy Construction Services	Plzén, CZ	**
Heavy Construction Services	Praha City, CZ	**
Heavy Construction Services	Praha Region, CZ	**
Heavy Construction Services	Rzeszów, PL	**
Heavy Construction Services	Slovenia	**
Heavy Construction Services	Székestehevár, HU	**
Heavy Construction Services	Ústí nad Labem, CZ	**
Heavy Construction Services	Wrocław, PL	**
Heavy Construction Services	Žilina, SK	**
Hospitality and Tourism	Cyprus	***
Hospitality and Tourism	Gdańsk, PL	**
Hospitality and Tourism	Malta	**
Hospitality and Tourism	Praha City, CZ	**
Hospitality and Tourism	Szczecin, PL	**
Information Technology	Székestehevár, HU	***
Information Technology	Budapest, HU	**
Information Technology	Győr, HU	**
Information Technology	Malta	**
Metal Manufacturing	Košice, SK	***
Metal Manufacturing	Ostrava, CZ	***
Metal Manufacturing	Katowice, PL	**
Metal Manufacturing	Kraków, PL	**
Metal Manufacturing	Miskolc, HU	**
Metal Manufacturing	Olomouc, CZ	**
Metal Manufacturing	Plzén, CZ	**
Metal Manufacturing	Slovenia	**
Metal Manufacturing	Székestehevár, HU	**
Metal Manufacturing	Žilina, SK	**

Processed Food	Szeged, HU	***
Processed Food	Białystok, PL	**
Processed Food	Brno, CZ	**
Processed Food	Bydgoszcz, PL	**
Processed Food	Debrecen, HU	**
Processed Food	Győr, HU	**
Processed Food	Katowice, PL	**
Processed Food	Kielce, PL	**
Processed Food	Kraków, PL	**
Processed Food	Latvia	**
Processed Food	Liberec, CZ	**
Processed Food	Lithuania	**
Processed Food	Łódź, PL	**
Processed Food	Lublin, PL	**
Processed Food	Nitra, SK	**
Processed Food	Olomouc, CZ	**
Processed Food	Olsztyn, PL	**
Processed Food	Plzén, CZ	**
Processed Food	Poznań, PL	**
Processed Food	Praha Region, CZ	**
Processed Food	Rzeszów, PL	**
Processed Food	Szczecin, PL	**
Processed Food	Székestehérvár, HU	**
Processed Food	Ústí nad Labem, CZ	**
Processed Food	Warszawa, PL	**
Processed Food	Wrocław, PL	**
Publishing and Printing	Budapest, HU	**
Textiles	Liberec, CZ	***
Textiles	Lithuania	**
Textiles	Łódź, PL	**
Transportation and Logistics	Gdańsk, PL	***
Transportation and Logistics	Budapest, HU	**
Transportation and Logistics	Estonia	**
Transportation and Logistics	Latvia	**
Transportation and Logistics	Lithuania	**
Transportation and Logistics	Łódź, PL	**
Transportation and Logistics	Lublin, PL	**
Transportation and Logistics	Malta	**
Transportation and Logistics	Praha City, CZ	**
Transportation and Logistics	Praha Region, CZ	**
Transportation and Logistics	Slovenia	**
Transportation and Logistics	Szczecin, PL	**
Transportation and Logistics	Warszawa, PL	**

ENDNOTES

- i Henry W. Chesbrough (2004), *Open Innovation: The New Imperative for Creating and Profiting from Technology*, Harvard Business School Press: Cambridge, MA.
- ii Christian Ketels (2003), *The Development of the Cluster Concept – present experiences and recent developments*, Prepared for the NRW Department of Economics Workshop at the Institute for Industry and Technology, Duisburg.
- iii Michael E. Porter (1998), *On Competition*, Harvard Business School Press.
- iv Solvell, Lindqvist, Ketels (2003), *The Cluster Initiative Greenbook*, Ivory Tower: Stockholm
- v For an example of another cluster mapping effort see: Department of Industry and Trade (2002), *Business Clusters in the UK: A first assessment*, London.
- vi See www.isc.hbs.edu and Michael Porter, The Economic Performance of Regions, *Regional Studies*, Volume 37, Numbers 6-7 / August-October 2003.
- vii This work was conducted by Lindqvist, Malmberg and Sölvell (2002)
- viii The exact formula for calculating the Specialization Quotient (SQ) is given by:

$$SQ_{r,s} = \frac{e_{r,s} / E_s}{E_r / E}$$

where

- $SQ_{r,s}$ = the specialization quotient for region r and cluster sector s
- $e_{r,s}$ = the number of employees for region r and cluster sector s
- E_s = the total number of employees in all regions for sector s
- E_r = the total number of employees in all cluster sectors for region r
- E = the total number of employees in all regions and all cluster sectors

- ix The exact formula for dominance (D) is given by:

$$D_{r,s} = e_{r,s} / E_r$$

where

- $D_{r,s}$ = the dominance for region r and cluster sector s
- $e_{r,s}$ = the number of employees for region r and cluster sector s
- E_r = the total number of employees in all cluster sectors for region r

- x Note, however, that the level of exports can also be affected by exchange rate devaluations or falling relative wage costs (real exchange rate); both helpful to raise exports but a sign of weak rather than strong competitiveness. The focus of our the change of macroeconomic variables that hit all sectors of the economy.
- xi Michael E. Porter (2005), *Business Competitiveness Index*, in: World Economic Forum, *The Global Competitiveness Report 2005/06*.
- xii Michael E. Porter (1990), *The Competitive Advantage of Nations*, Free Press.
- xiii Michael E. Porter (2003), The Economic Performance of Regions, *Regional Studies*, Volume 37, Numbers 6-7 / August-October 2003.
- xiv See the data available on the website of the Institute for Competitiveness and Prosperity, Toronto, Canada at www.competeproper.ca
- xv This typology has been developed in Porter (2003)
- xvi Data from NUTEK and Lindqvist, Malmberg and Sölvell (2002); quoted in Christian Ketels (2006), *The competitiveness of the Stockholm region*, background report for the OECD.
- xvii Michael E. Porter (2003), The Economic Performance of Regions, *Regional Studies*, Volume 37, Numbers 6-7 / August-October 2003.
- xviii Ostrava has a dominating metal manufacturing cluster that accounts for close to 25% of all cluster sector employment in the region.
- xix World Economic Forum (2005), *The Global Competitiveness Report 2005/06*, Palgrave Macmillan.
- xx Michael E. Porter (2005), *Business Competitiveness Index*, in: World Economic Forum, *The Global Competitiveness Report 2005/06*, Palgrave Macmillan.
- xxi <http://data.isc.hbs.edu/iccp/index.jsp>
- xxii Örjan Sölvell, Christian Ketels, Göran Lindqvist (2003), *The Cluster Initiative Greenbook*, Ivory Tower and new unpublished research.

Endnotes

^{xxiii} Foundation Clusters and Competitiveness (www.clustercompetitiveness.org)

^{xxiv} A possible partner is The Competitiveness Institute TCI (www.competitiveness.org)

^{xxv} An example is the course “Microeconomic of Competitiveness” developed at Harvard Business School and now taught at more than 60 universities worldwide (including a number in Europe). For more information see www.isc.hbs.edu/moc.htm

^{xxvi} Michael E. Porter and Willis Emmons have coined the term “institutions for collaboration” to describe them: *Institutions for Collaboration: Overview*, HBS Case 9-703-436, Harvard Business School Press.