BAK
Basel Economics

Top Technology Region (TTR) Benchmarking Report 2008

Report

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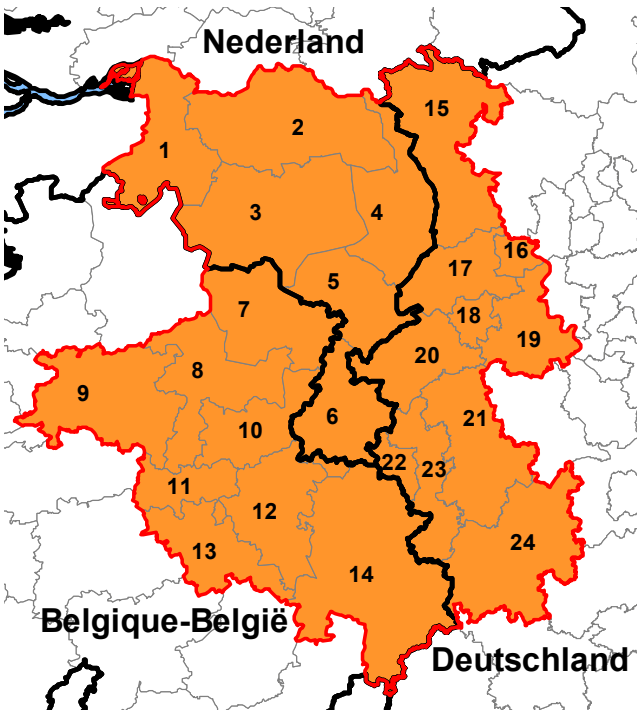
1 *Introduction*: TTR and competitiveness

Following a meeting initiated by Minister Vrehen of the Province of Limburg on April 10th 2008, the secretaries of State of North Rhine-Westphalia responsible for Economy (Dr. Baganz) and for Innovation (Dr. Stückradt), the Ministers responsible for Economy and Innovation of Dutch North-Brabant (Mrs. Moons), Belgian-Limburg (Mr. Vandeput), Dutch-Limburg (Mr. Vrehen), Liège (Mr. Mestrez) and Flemish Brabant (Mr. Olbrechts), commissioned BAK Basel Economics to conduct a benchmarking analysis of the Top Technology Region (TTR) that aims to become a successful technology region. This report summarises the results of this analysis for the TTR, the region defined in Fig. 1.

Fig. 1: The Top Technology Region (TTR)



1 Midden-Noord-Brabant
2 Noordoost-Noord-Brabant
3 Zuidoost-Noord-Brabant
4 Noord-Limburg
5 Midden-Limburg
6 Zuid-Limburg
7 Arr. Maaseik
8 Arr. Hasselt
9 Arr. Leuven
10 Arr. Tongeren
11 Arr. Waremme
12 Arr. Liège
13 Arr. Huy
14 Arr. Verviers
15 Kreis Kleve
16 Kreisfreie Stadt Krefeld
17 Kreis Viersen
18 Kreisfreie Stadt Mönchengladbach
19 Rhein-Kreis Neuss
20 Kreis Heinsberg
21 Kreis Düren
22 Kreisfreie Stadt Aachen
23 Kreis Aachen
24 Kreis Euskirchen

Source: BAK Basel Economics

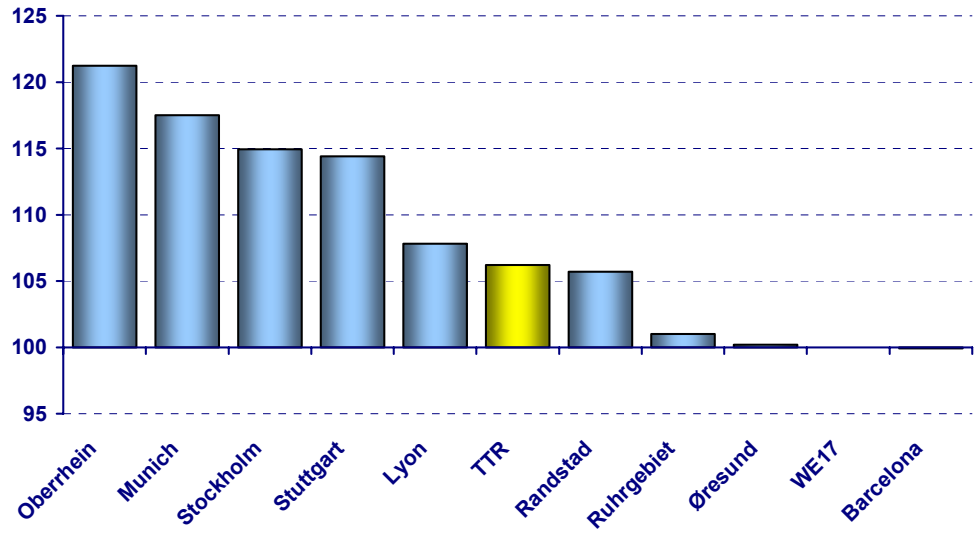
What are the characteristics of a successful technology region and how is it possible to measure it in an international context? The aim in this economical analysis is first, to define a concept for measuring the importance of the technological driven sectors, and second to compare the TTR with most successful European technology regions. Additionally, this benchmarking report gives a deeper insight of the Technology Sector within TTR[1].

[1] See Annex for the definition of the Technology Sector and the industries included.

As a first step, BAK Basel Economics has calculated a Technological Competitiveness Index (TCI)[2], including four different indicators. Besides growth and value added share of technology driven sectors also innovation in terms of patents and scientific publications are part of this BAK TCI. The Top Technology Region reaches an Index-Value of 106, substantially higher than the Western European average (of 100)[3]. Furthermore, TTR ranks in the middle of the selected benchmarking sample with ten well known and highly successful European technology regions such as Oberrhein, Munich or Stuttgart[4]. Fig. 2 presents the results of the Technological Competitiveness Index.

Fig. 2: BAK Technological Competitiveness Index (TCI)

Standardized, WE17 = 100



Note: The benchmarking region Oxford&Cambridge is not included in the figure due to missing data.
Source: BAK Basel Economics

[2] See Annex for detailed information about TCI.

[3] The Western European average consists of the 15 'old' EU countries, Norway and Switzerland. WE17 is used as a shortcut for this average respectively aggregate.

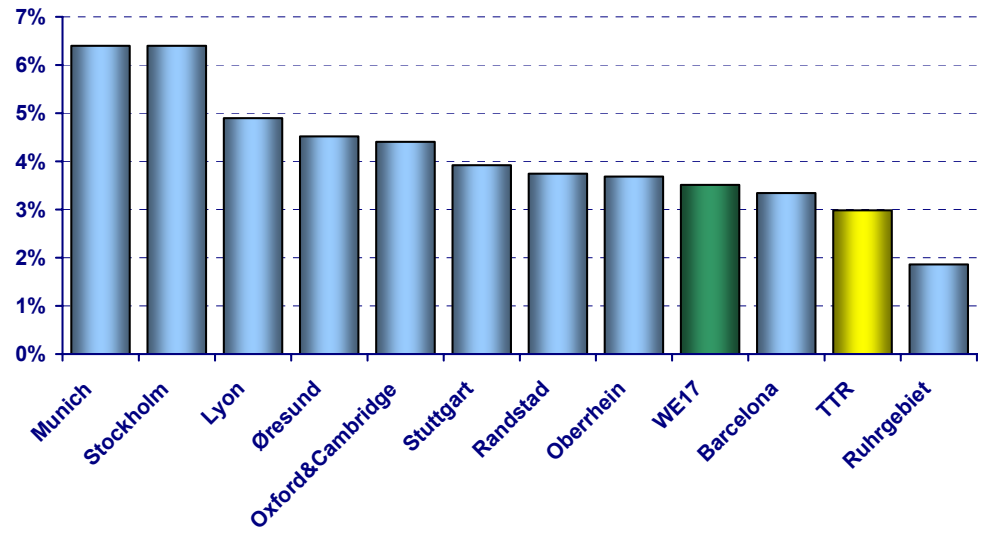
[4] See Annex for the definition of these regions. For one of these regions, Oxford&Cambridge in the UK, some of the necessary data is not available. Therefore, the TCI for example can not be built for this region. If the data is not available, Oxford&Cambridge is dropped from the figures.

2 Technology and innovation: TTR's focus

The size of the Technology Sector of TTR is above the Western European average. Between 1996 and 2006 gross value added (GVA) of the Technology Sector grew by 3.0 percent per year in TTR. This was more than the economy as a whole (2.2%). As Fig. 3 shows the Technology Sector in other European regions realized clearly higher growth rates in the past. Munich and Stockholm (both 6.4% p.a.) stand on the top of the growth ranking. However, the TTR's growth gap to other distinct technology regions such as Stuttgart or Oberrhein is only one percentage point.

Fig. 3: GVA growth in Technology Sector

In % p.a. (based on 2000 prices and 97 PPP), 1996-2006



Source: BAK Basel Economics

What could be the reasons for the finding that several regions' growth in the Technology Sector was higher over the last ten years than in TTR? One reason could be location factors in this three nations' region. Another factor could be the innovation potential in terms of research and development activities, an issue particularly important for the success of the Technology Sector. In this report, we examine the innovation potential in TTR compared to the other technology regions in more details. As indicators for the regional innovation power, patents and scientific publications are used.

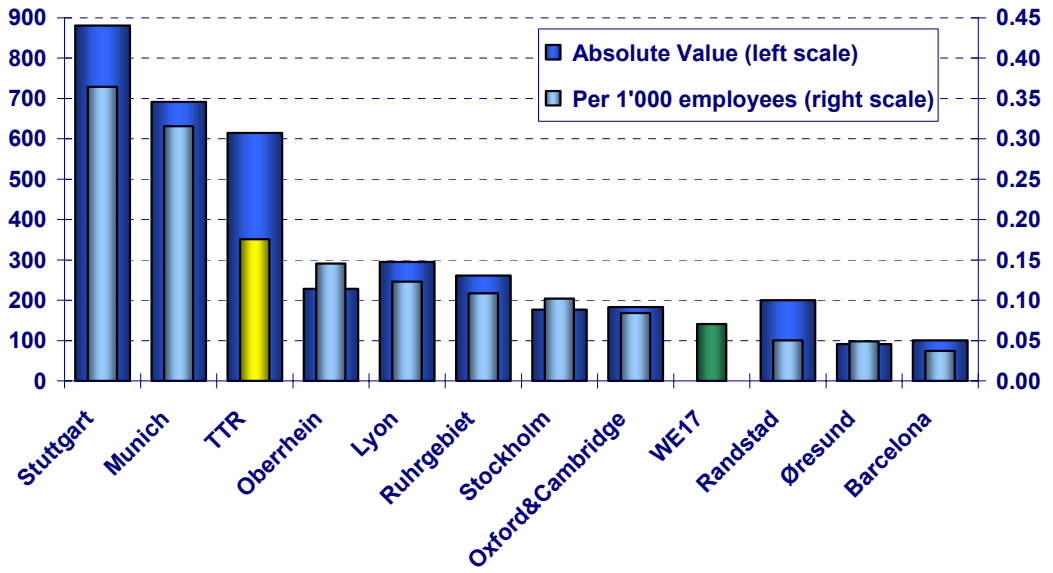
Fig. 4 presents the average number of patents (2000-2004) and the number of patents per 1'000 employees[5]. In both measures, TTR ranks on the third position in the bench-

[5] BAK uses a person concept of employment. Therefore, employee is the number of persons in employment, not the number of jobs provided.

marking sample. Only Stuttgart and Munich, both regions specialised in the Automotive Industry, have a higher level of patents than TTR. This is a very positive finding for TTR and is a sign of substantial innovation potential in TTR.

Fig. 4: Patents

Average 2000-2004, absolute value and per 1'000 employees [6]



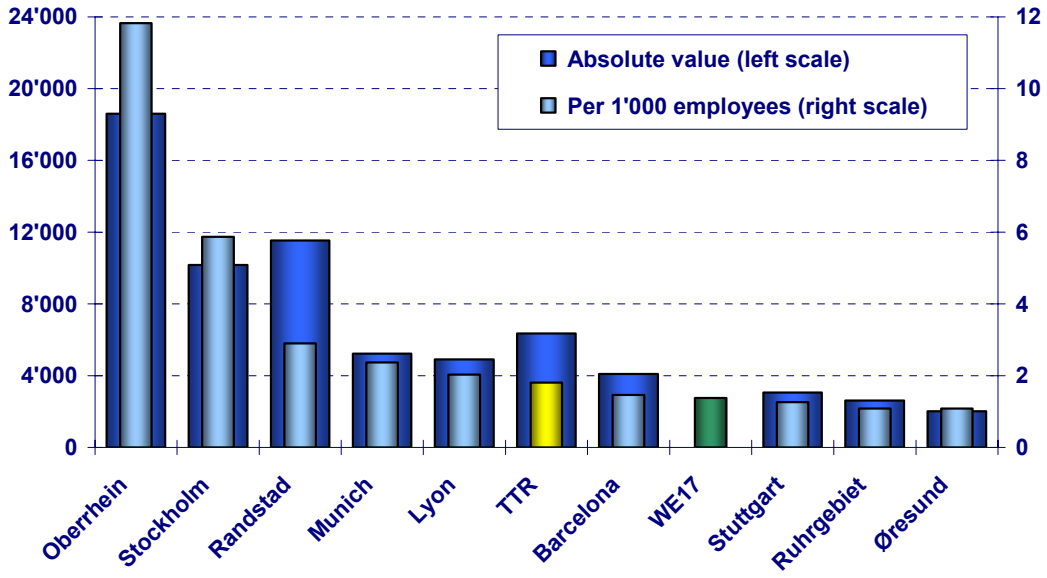
Source: BAK Basel Economics

The scientific publications in technology fields are the second indicator for the regional knowledge base and the innovation capacities. Fig. 5 pictures publications again in total numbers as well as relatively to the number of persons in employment. In contrast to patents TTR does not hold a top position in the sample, but does not perform particularly bad either: the region ranks in relative terms above the Western European average and above well known technology region such as Stuttgart. In total numbers of publications TTR takes the fourth position, behind Oberrhein, Stockholm and Randstad.

[6] In Fig. 4 and in Fig. 5 the number of persons in employment in the aggregate economy is used.

Fig. 5: Publications

Average 2000-2006 absolute value and per 1'000 employees



Note: The benchmarking region Oxford&Cambridge is not included in the figure due to missing data.
Source: BAK Basel Economics

Summing up, the TTR holds a high innovation potential, which is comparable with Europe's most distinct technology regions. It seems that TTR has a problem with the adoption of scientific capacities and knowledge to the broader production and the creation of corresponding value added in this production. There is some gap between the innovation potential and the economic development of the Technology Sector in the recent years. The cooperation between science (Universities, technical colleges) and companies in the Technology Sector seems more pronounced in other distinct technology regions as Stuttgart, Munich or Stockholm.

3 TTR's most promising technology industries

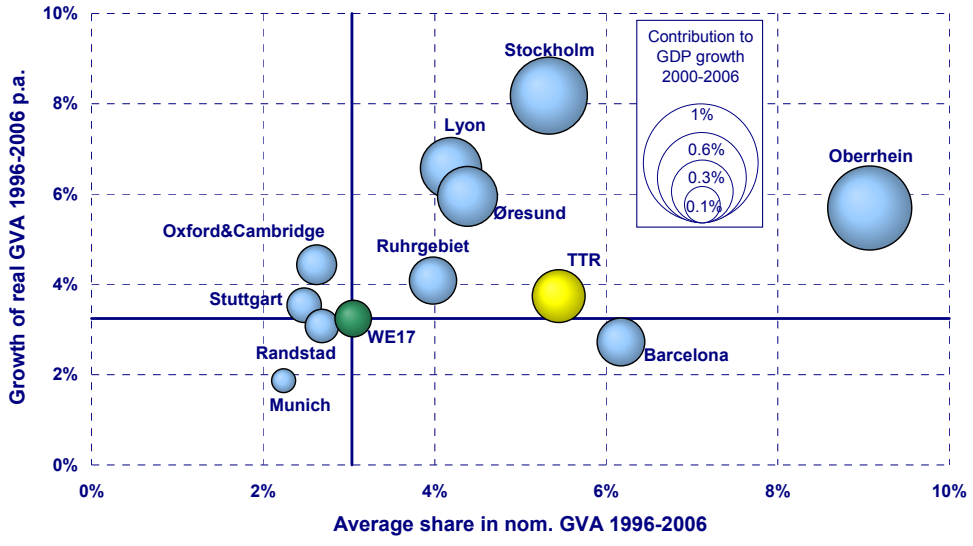
In this chapter, we focus on three fields of technology which proved to be of special interest: Chemicals & Advanced Materials, Health Sciences and High Tech Systems[7]. The choice is based on present economic importance in TTR, the existing innovation potential and on growth potential in the future. The selected industries do have the potential to foster the future success in the TTR.

3.1 Chemicals & Advanced Materials: Close to Europe's best

Chemicals & Advanced Materials features a high importance for TTR's economy. From 1996 to 2006 the average nominal GVA share was 5.4 percent. Only Oberrhein and Barcelona hold higher shares. Within TTR especially the Dutch regions Midden-Noord-Brabant and Zuid-Limburg and the German region around Neuss are distinct production location in Chemicals & Advanced Materials. Fig. 6 shows the average annual GVA growth over the last ten years. TTR's growth was above Western European average, but lower than in other well known Chemical Industry locations like Oberrhein, Stockholm or Lyon.

Fig. 6: Growth contribution of Chemicals & Advanced Materials

Average share in nominal GVA and real GVA growth (based on 2000 prices and 97 PPP) p.a., 96-06



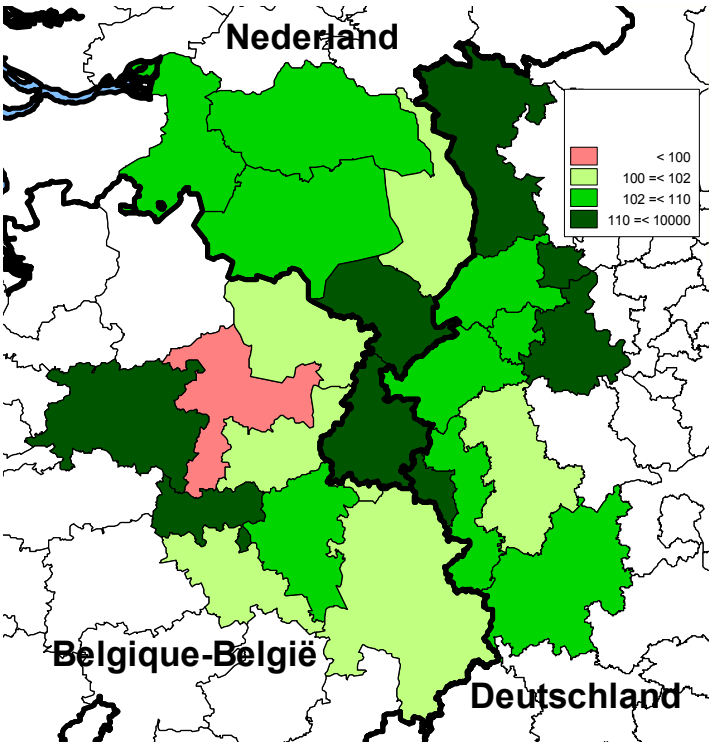
Source: BAK Basel Economics

[7] See Annex for the definitions of these three industry aggregates.

Furthermore, the innovation activity in the field of Chemicals & Advanced Materials is high within TTR. The number of patents and scientific publications per employee in the Chemicals & Advanced Materials sector achieve in several sub regions of the TTR an above-average level in international comparison. To a large extend the universities and technical colleges are responsible for this high level of research. Therefore, the TTR as a whole has a high potential in the sector of Chemicals & Advanced Materials.

Fig. 7: BAK Chemicals & Advanced Materials Competitiveness Index within TTR

Standardized, WE17 = 100



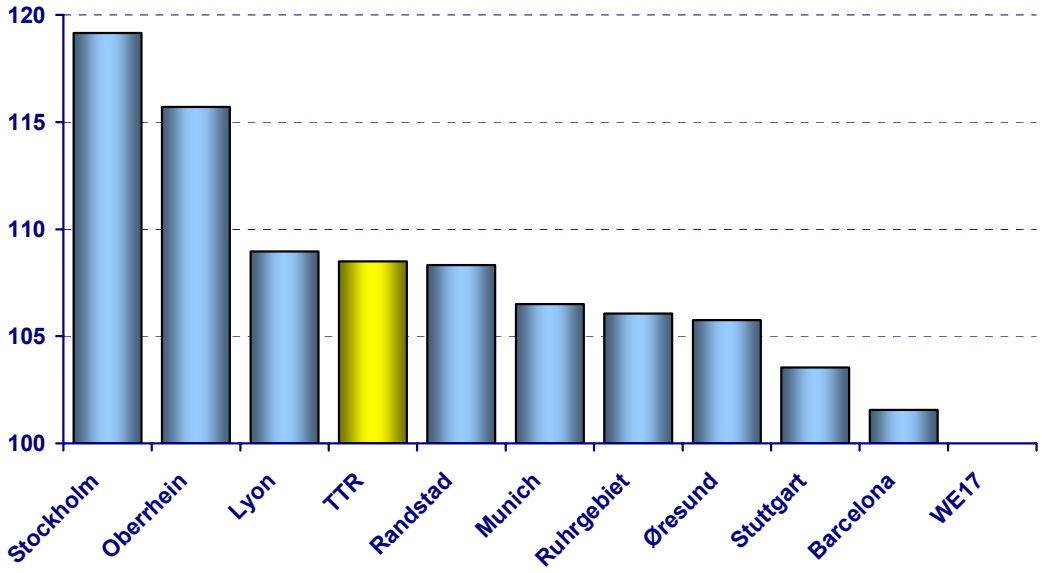
Source: BAK Basel Economics

As Fig. 7 impressively shows, almost all sub regions within TTR rank in the Chemicals & Advanced Materials Competitiveness Index[8] above the Western European average. An index value above 110 holds Midden- and Zuid-Limburg, Arr. Leuven and Waremme as well as Kreis Kleve and Rhein-Kreis Neuss. In the international comparison, the TTR as a region holds a fourth place in the Chemicals & Advanced Materials Competitiveness Index among the sample of technology oriented benchmarking regions (see Fig. 8).

[8] All the industry specific Competitiveness Indices are constructed similar to the TCI but with indicators limited to the specific industry. See Annex for details on the TCI construction.

Fig. 8: BAK Chemicals & Advanced Materials Competitiveness Index

Standardized, WE17 = 100



Note: The benchmarking region Oxford&Cambridge is not included in the figure due to missing data.
Source: BAK Basel Economics

In the future, strengthening the Chemicals & Advanced Materials cluster leads to more innovation power and economies of scale in the production process. Particularly, the regions should gain from more jobs and value added in this cluster by using its innovative strength. An increased cooperation between companies and research institutions, particularly across the national borders within the region, could facilitate such a process.

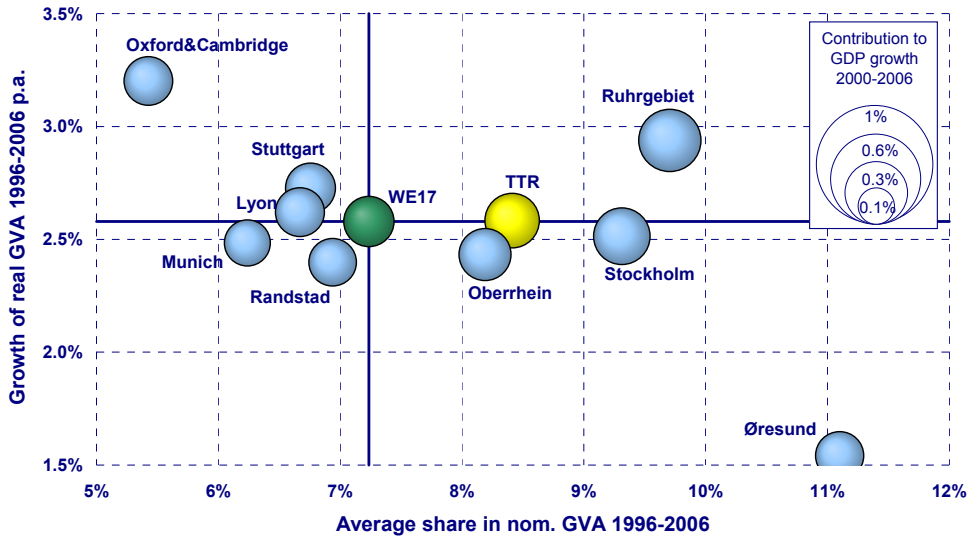
3.2 Health Sciences: Future potential

Growth in the Health Sciences sector did not differ a lot in the observed regions. In recent years TTR's average annual growth rate was 2.6 percent, exactly the Western European average growth (see Fig. 9). In contrast, the importance of Health Sciences is clearly higher in TTR than in the Western European average and in many other regions. From 1996 to 2006 the average growth contribution of Health Sciences to TTR's domestic product was 0.22 percent.

Health Sciences is one of the sectors with an expected high growth potential for the future. Due to the high share TTR is in a good position for an ongoing strong development of Health Sciences. In contrast to Chemicals & Advanced Materials the number of publications in the field of Health Sciences is slightly below the Western European average. Only the University cities of Leuven and Aachen denote a particularly high density of scientific publications within TTR.

Fig. 9: Growth contribution of Health Sciences

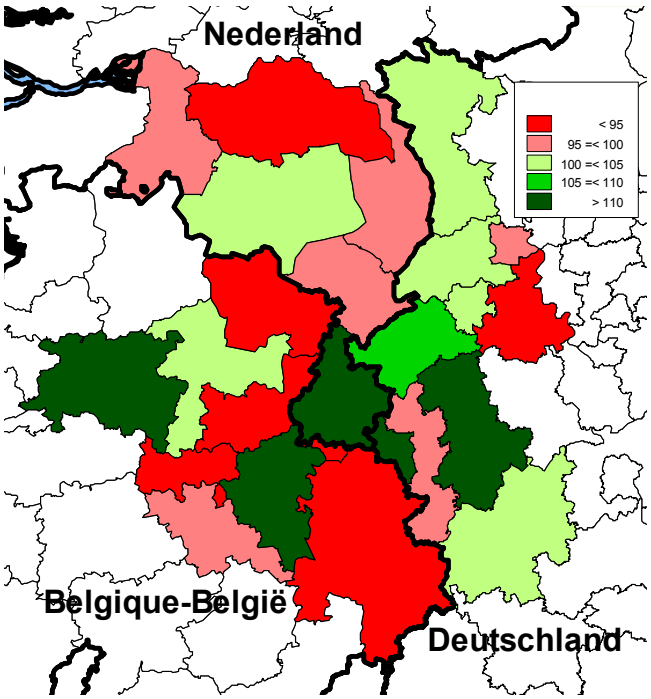
Average share in nominal GVA and real GVA growth (based on 2000 prices and 97 PPP) p.a., 96-06



Source: BAK Basel Economics

Fig. 10: BAK Health Sciences Competitiveness Index within TTR

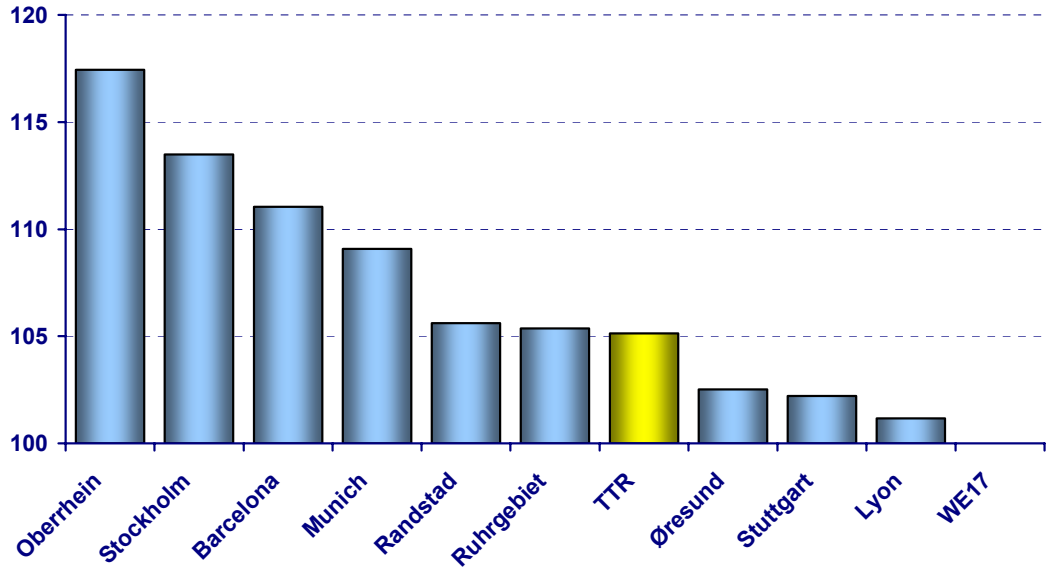
Standardized, WE17 = 100



Source: BAK Basel Economics

Fig. 11: BAK Health Sciences Competitiveness Index

Standardized, WE17 = 100



Note: The benchmarking region Oxford&Cambridge is not included in the figure due to missing data.
Source: BAK Basel Economics

Therefore it does not surprise that on the sub regional level Arr. Leuven and the Kreisfreie Stadt Aachen reach the highest value of the Health Sciences Competitiveness Index (see Fig. 10[9]), whilst other sub regions clearly rank below the Western European level of 100. Compared with the other regions in the benchmarking sample, TTR with an index value of 105 is in the middle of the ranking (see Fig. 11). However, there is potential in the Health Sciences and there is a chance for a booming sector in the future.

3.3 High Tech Systems: Good innovation

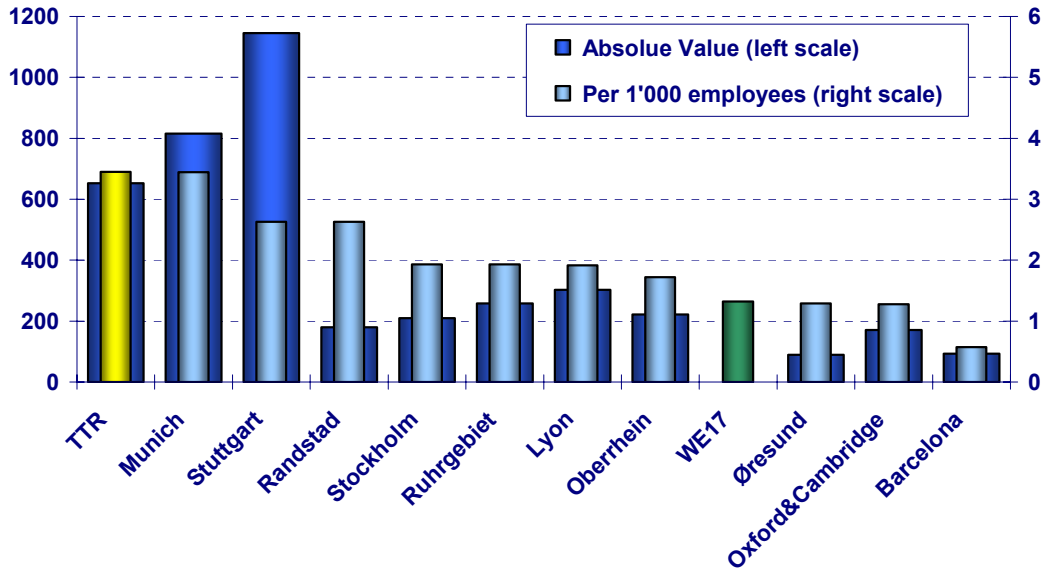
The sector High Tech Systems includes some of the most technologically driven parts of the economy. Therefore, innovation is an essential and critical element for a successful regional development of these industries. With respect to the innovation potential TTR is very well positioned. In the chosen benchmarking sample TTR has the highest number of patents per employee in the High Tech Systems sector (see Fig. 12). The two automotive orientated regions Munich and Stuttgart achieve more patents in total, since they have a larger High Tech Systems sector. For scientific publications, a quite similar picture emerges: TTR is on the first position in total numbers of publications and at fourth position in relative terms, just behind Randstad, Stockholm and Lyon. As in the field of

[9] Note that due to index limit of 110 this is not obvious in the map (Fig. 10). Arr. Leuven and Kreisfreie Stadt Aachen reach 146 and 135 respectively, while the other dark green sub-regions do not surpass 114.

Chemicals & Advanced Materials, TTR is a regional economy with a strong level of innovation activities in the field of High Tech Systems as well.

Fig. 12: Patents in High Tech Systems

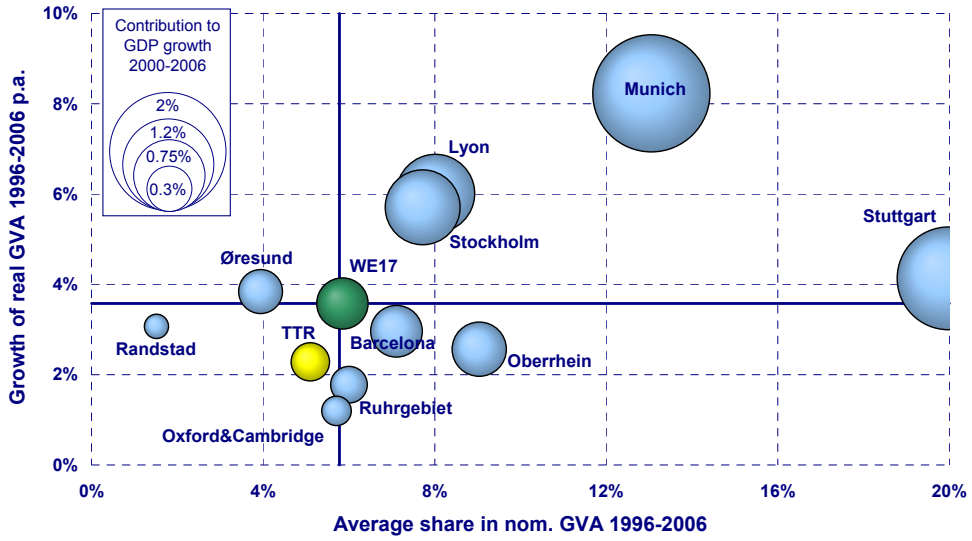
Average 2000-2004, absolute value and per 1'000 employees in High Tech Systems sector



Source: BAK Basel Economics

Fig. 13: Growth contribution of High Tech Systems

Average share in nominal GVA and real GVA growth (based on 2000 prices and 97 PPP) p.a., 96-06



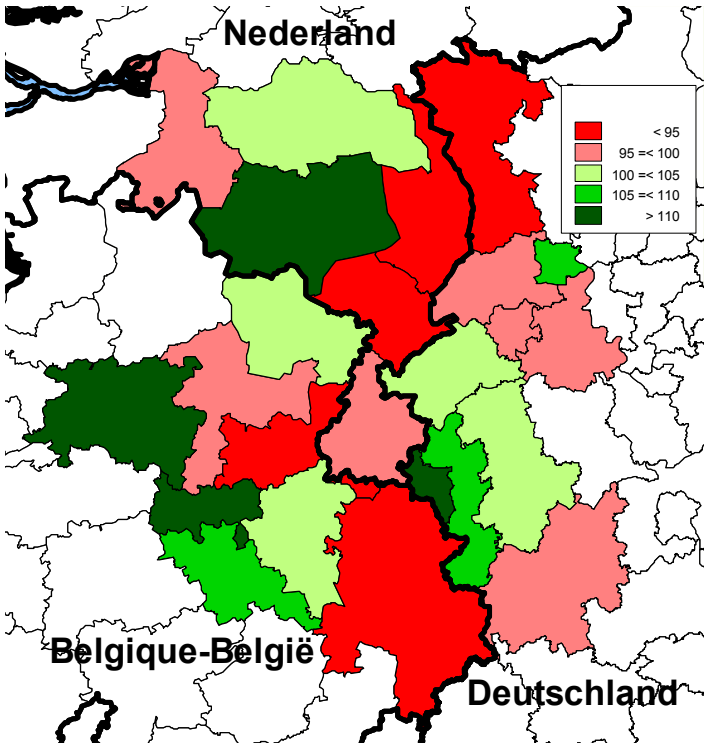
Source: BAK Basel Economics

The strong innovation potential within the TTR should lead to a strong performance of the corresponding industries in the TTR as well. However, the performance data tell another story than expected. Fig. 13 shows that TTR's High Tech Systems sector has developed rather weak in comparison to the Western European average. From 1996 to 2006 the average annual growth rate of real GVA was 2.3 percent, only slightly above TTR's economy as a whole (2.2%). The top European regions like Munich, Lyon and Stockholm have grown three to four times faster. Furthermore, the share of the sector in the economy is not particularly large. Actually it is even below the Western European average. TTR is not gaining as much from the High Tech Systems sector as would be expected given the innovation capacities in the corresponding knowledge fields within the region.

Within TTR there are a few sub-regions with a high High Tech Systems Competitiveness Index (see Fig. 14). Especially Zuidoost-Noord-Brabant, Arr. Leuven and Waremme and Kreis Aachen as well as Kreisfreie Stadt Aachen show a combination of good growth performances of the industries and high innovation potentials. In contrast, High Tech Systems does not play such a significant role in other parts of the TTR.

Fig. 14: BAK High Tech Systems Competitiveness Index within TTR

Standardized, WE17 = 100



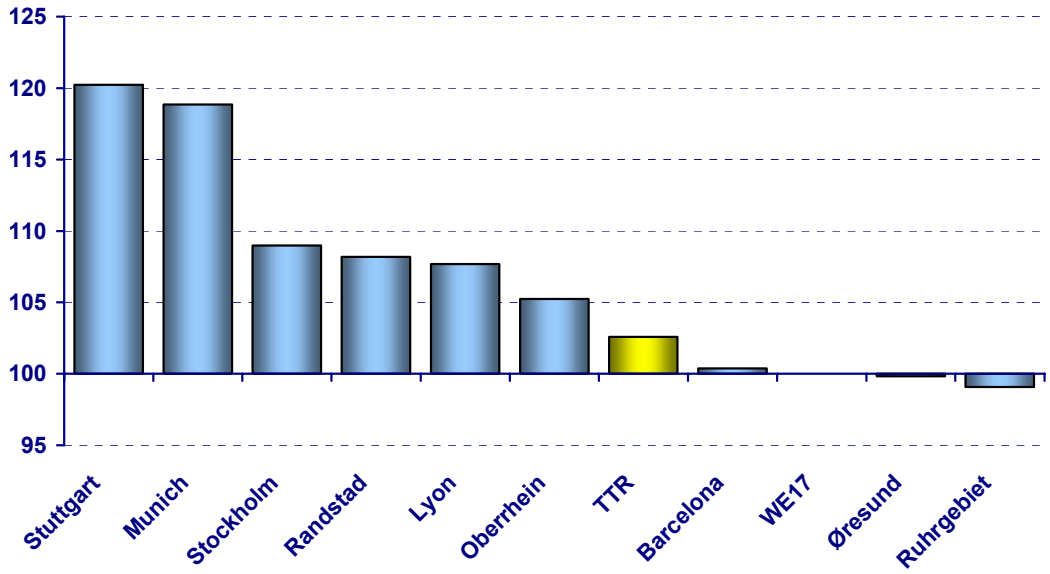
Source: BAK Basel Economics

In Fig. 15 TTR is positioned in the middle of the ranking of the High Tech Systems Competitiveness Index. Although above the Western European average, the difference is not

large. The position of TTR in the index reflects the combination of strong innovation potential and a less advantageous position with respect to the production of the corresponding industries.

Fig. 15: BAK High Tech Systems Competitiveness Index

Standardized, WE17 = 100



Note: The benchmarking region Oxford&Cambridge is not included in the figure due to missing data.
Source: BAK Basel Economics

A discrepancy between scientific innovation and production level is present in TTR's High Tech Systems sector. The regional «production» of knowledge does hardly influence the regional value added or jobs provided. It seems that in TTR the link between research, development and production does not function as well as it could. Other technology regions like Munich, Lyon, Stockholm or Stuttgart do have more efficient connections between these elements of a complete production cycle in High Tech Systems: they are economically more successful in transferring R&D activities into production in their region. In other words, the value added chain in TTR between the research part and the production part seems not to be optimally integrated.

4 *Conclusion*: Diversity as a chance

The empirical analysis shows both strengths and weaknesses of TTR's Technology Sectors. As seen above, TTR is very successful in Chemicals & Advanced Materials. In the performance part as well as with respect to innovation potential, TTR is close to the most distinct European technology regions. There is a good regional balance between research (patents/publications) and production in Chemicals & Advanced Materials. The success of good cooperation in these technologically driven sectors could be a valuable example for other industrial parts of the Technology Sector.

As for High Tech Systems and partially for Health Sciences, the potential is high as well. However, the performance is not yet at the top. This indicates an insufficient link between innovation and production. The data show clearly that there is a divergence of the regional distribution of strong innovation spots (Universities, technical colleges) and places where value added is produced. This gives a picture of geographical complementarities in the field of High Tech Systems and Health Sciences. A future challenge is to generate more value added from the high innovation potential in TTR. More intra-industry and interregional cooperation is necessary to exploit economies of scale and positive external effects, thus raising value added and employment in TTR's Technology Sector.

A better cooperation between the different sub-regions will not only raise GDP but also the attractiveness of TTR as a distinct European technology region. At the moment, other regions like Oberrhein, Munich, Stockholm or Stuttgart are better positioned than TTR. On the one hand, their advantage is a strategy of focusing on only one strong Technology Sector: Chemicals and chemical products in the case of Oberrhein and Stockholm, High Tech Systems for Munich and Stuttgart. In recent years, this strategy has raised welfare of these regions. On the other hand, there is a high cluster risk for these regions. For TTR a strategy of geographical complementarities should be more promising, combined with a concentration on more than just one technology industry: Chemicals & Advanced Materials, High Tech Systems and Health Sciences can be strong elements in such a strategy.

TTR's location factors (market and product regulations, company and manpower taxation, accessibility) are mostly good in international comparison[10]. In addition, there is a high innovation potential. However, TTR is not a region in terms of a single unique functional economic area. Furthermore, TTR is not focused on just one Technology Sector. Turning this position into strength, the double diversity is a big chance for the region: The get-together of different strengths from different parts of TTR is the key for more success in terms of higher value added and more employment. The focus on several outstanding sectors gives stability on the way to sustainable growth.

[10] See the extended Charts and Maps Annex (separate document) for more information.

5 Annex

Definition of BAK Technological Competitiveness Index (TCI)

It is an equal weighted index of the nominal GVA share of the Technology Sector (1996-2006), the real GVA growth (1996-2006), the number of patents (2000-2004) and the number of publications (2000-2006). There is an index for the Technology Sector as a whole, for Chemical & Advances Materials, High Tech Systems and Health Sciences.

Definition of Technology Sector

It is a weighted aggregate of technology intensive industries:

- 100% of
  - Chemical and chemical products (NOGA 24)
  - Mechanical Engineering (NOGA 29)
  - Computer, Elec. Engineering, Precision Instrument (NOGA 30 to 33)
  - Motor Vehicles and Parts, Other Means of Transport (NOGA 34 and 35
- 50% of
  - Coke, Refined Petroleum Products (NOGA 23)
  - Rubber and Plastic Products (NOGA 25)
  - Metals and Metal Products (NOGA 27 and 28)
  - IT Services (NOGA 72)
- 25% of
  - Telecommunication and Postal Services (NOGA 64)
  - Health and Social Services (NOGA 85)

Classification of Chemicals & Advanced Materials

It is an aggregate of NOGA 2-digit industries:

- Chemical and Chemical Products (NOGA 24)
- Rubber and Plastic Products (NOGA 25)

Classification of High Tech Systems

It is an aggregate of NOGA 2-digit industries:

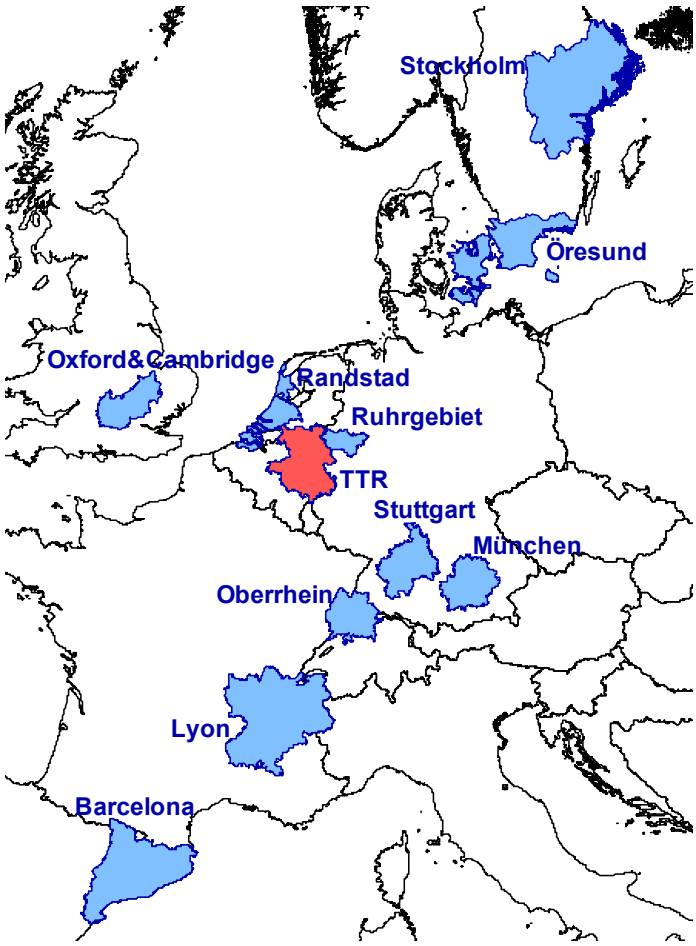
- Mechanical Engineering (NOGA 29)
- Computers, Elect. Engineering, Precision Equipment (NOGA 30 to 33)
- Motor Vehicles and Parts, Other Means of Transport (NOGA 34 and 35)

Classification of Health Science

It is the NOGA 2-digit Health and Social Services (NOGA 85).

Definition of the selected Benchmarking Regions

Fig. 16: Benchmarking regions



Source: BAK Basel Economics

- **Randstad**:
  Aggregate of Nuts2 regions NL31, NL32, NL33, NL23

- **Barcelona**:
  Nuts2 region ES51 (Cataluña)

- **Lyon**:
  Nuts2 region FK71 (Rhône-Alpes)

- **Ruhrgebiet**:
  Aggregate of Nuts3 regions DEA51, DEA31, DEA52, DEA12, DEA56, DEA13, DEA32, DEA53, DEA54, DEA55, DEA16, DEA17, DEA36, DEA56, DEA1F, DEA5C

- **Stuttgart**:
  Aggregate of Nuts3 regions DE111, DE112, DE113, DE114, DE115, DE116, DE117, DE118, DE141, DE142, DE12A, DE12B, DE129, DE11D, DE143, DE11C, DE11A, DE119, DE11B

- **Oxford&Cambridge**:
  Aggregate of Nuts2 and Nuts3 regions UKH12,UKJ1,UKH2

- **Munich**:
  Aggregate of Nuts3 regions DE211, DE219, DE21I, DE21J, DE212, DE217, DE218, DE21C, DE21H, DE21L, DE21A, DE21B, DE276, DE271, DE275, DE21E, DE226, DE227, DE221

- **Øresund**:
  Aggregate of Nuts1 and Nuts2 regions DKC, DKI (all Denmark), SE04 (Sweden)

- **Stockholm**:
  Aggregate of Nuts1 regions SE01, SE02

- **Oberrhein**:
  Aggregate of Nuts2 and Nuts3 regions BS, BLKL, AG, JU, SO (all Switzerland), SB, DA651, BW01, SP (all Germany), FK42 (France)