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**An analysis of the development of R&D expenditure
at regional level in the light of the 3% target**

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I The Lisbon Strategy and the 3 % target¹

The Lisbon Strategy and the ERA

In its communication "Towards a **European Research Area**" (cf. Commission of the European Communities 2000b), the European Commission presents the vision of a pan-European research zone in which research activities are concentrated and funding is allocated irrespective of national borders according to the needs of the knowledge-based economy, economic growth and employment. This "European Research Area" (ERA) is a central element of the **Lisbon Strategy** for growth and competitiveness agreed upon by the European Council on 23-24 March in 2000 in Lisbon. To increase productivity and to respond to the challenges of globalisation and the knowledge-based society (cf. Commission of the European Communities 2000b: 4/5), the Heads of State define as a strategic goal for the EU in the following decade "*to become the most competitive and dynamic knowledge-based economy in the world capable of sustainable economic growth with more and better jobs and greater social cohesion.*" (European Parliament 2000: 2).

The strategy to achieve this objective is directed towards, first, the knowledge-based economy and society through information society and R&D policies, competitiveness and innovation, and a complete internal market, second, the European social model, and third, the support of a favourable economic development through macro-economic policies (cf. European Parliament 2000: 2). The ERA goals were endorsed by the Heads of State, thereby establishing the ERA concept as a constitutive component of European research policy.

¹ This publication is funded by the European Commission (EC) under the FP6 contract no. PP-CT-M2-2005-002 (Regional Key Figures). This document contains material which may not be reproduced or copied without permission. The information herein does not necessarily reflect the opinion of the EC. The EC is not responsible for any use that might be made of data appearing herein.

The Barcelona 3 % objective

The Barcelona Summit in 2002 emphasised the "competitive economy based on knowledge" (European Council 2002: 18) as a main long-term goal of the European Union and a means to reduce the gap between the Community and its main competitors. It promoted the better integration of Member States into a **European Knowledge Area**, agreed on a European Community Patent, and set the quantitative goal to increase investment in research and development **to 3 % of GDP** by 2010 (from 1.9 % at the time). Two thirds of this investment were envisaged to be contributed by private firms and one third by public sources (cf. Commission of the European Communities 2002: 5).

Implementation through Community Policy

Starting with the 6th Community Framework Programme and its specific programmes, European Research Policy started to integrate, strengthen, and structure the European Research Area. The current 7th Framework Programme pursues the following four objectives: (i) to support co-operation between European universities, industry, research centres and public authorities, as well as with other non-European actors in order to gain leadership in key scientific and technology areas; (ii) to fund 'frontier research' to enhance the creativity and excellence of European research; (iii) to strengthen the European human potential in research by supporting training, mobility, and research careers; and (iv) to enhance the European research and innovation (infrastructure) capacities (cf. Commission of the European Communities 2005a: 5ff.; Commission of the European Communities 2007a: 16).

The achievement of these defined goals should be supported by an 'open method of coordination' (OMC) as an instrument of spreading best practice and implementing the main goals of the European Union. OMC in the field of research policy is supervised by the Scien-

tific and Technical Research Committee (CREST) through a system of yearly cycles. Each cycle focuses on a limited number of policy issues. The monitoring of progress is discussed at annual European Councils, and the whole process is reviewed at High Level Forums and by Expert Groups (cf. European Parliament 2000).²

Assessment and re-orientation in 2005

In 2005, following an analysis of the situation five years after the launch of the Lisbon strategy and the assessment that significant challenges remained on the way towards achieving the Lisbon goals, a major re-launch of the Lisbon strategy was initiated, with a view to re-focusing priorities and simplifying implementation procedures.

It was agreed that "the overall objective of 3 % investment is maintained [as a 'headline target'], with an adequate split between private and public investment [while] specific intermediate levels need to be set out at national level. This objective will be obtained inter alia by tax incentives for private investment, a better leverage effect of public investment and by a modernised management of research institutions and universities." (Council of the European Union 2005). The responsibility to work towards the 3 % objective is assigned to the Member States (Commission of the European Communities 2005c: 20; cf. also Council of the European Union 2007b: 6). In the meantime, all Member States, except Bulgaria, have set national R&D investment targets reflecting their national situation which range from 0.75 % in Malta to 4 % in Finland and Sweden.

However, the strategy also maintained its broader focus on growth and employment, "... knowledge, innovation and the optimisation of human capital" (Council of the European Union 2005: 2) and the vision of a knowledge society on all levels in the EU Member States.

² Cf. also http://ec.europa.eu/invest-in-research/coordination/coordination01_en.htm (22.08.2008). The Commission of the European Communities (2007d: 16-18) gives an overview of ERA-related initiatives.

More national and community resources including Structural Funding are to be allocated to pursue the economic, social and environmental aspects of the Lisbon agenda, and all relevant regional and national stakeholders are to be integrated into the strategy process.

In the 2007 Green Paper, the European Commission formulated the ERA goals along the following six dimensions: (1) Realising a single labour market for researchers; (2) Developing world-class research infrastructures; (3) Strengthening research institutions; (4) Sharing knowledge; (5) Optimising research programmes and priorities; and (6) Opening to the world: international cooperation in S&T (cf. Commission of the European Communities 2007d: 10ff.). The Commission initiated a process of consultation and debate to specify and stimulate the developed orientations and ideas. On this basis, new initiatives to realise the European Research Area were defined.³ In March 2007, the European Council stated: "The renewed Lisbon Strategy for Growth and Jobs is beginning to deliver results. [...] The positive developments in the economic, employment and social sectors are mutually reinforcing." (Council of the European Union 2007b: 2). Priority areas of reform are knowledge and innovation, business environment, employment, and energy and climate change. Further, the European Councils stated that the role of the regional level with respect to growth and jobs should be increased; an objective that is incorporated in the cohesion policy programmes for the period 2007-2013 (cf. Council of the European Union 2007a: 10).

The Ljubljana Process

In 2008, in order to address the fragmentation of European research activities and policies, the Member State research ministers and the Commission agreed on a new partnership ("Ljubljana Process") with the aim of supporting the creation of a European Research Area. This process involves a long-term ERA vision and the improvement

³ Cf. http://ec.europa.eu/research/era/specific-era-initiatives_en.html (02.09.08).

of the political governance of the ERA, i.e. linking research policies to other policy fields such as innovation, cohesion and education policies (cf. Council of the European Union 2008).⁴ In the overall context of the European Partnership for Growth and Jobs, the European Member States conceive reforms adapted to their specific situation and needs. They are specified in National Reform Programmes that refer to the Integrated Guidelines proposed by the Commission and are approved by the European Council. In these plans, research and innovation are identified as engines of sustainable growth (cf. Commission of the European Communities 2007c: 13ff.). Finally, in December 2008, a Council Conclusion was adopted on the "2020 Vision for ERA".⁵

Concluding, even though efforts to create a European Research Area are not new, they can be considered as an important reform of policy-making in the domain of research policy (cf. Edler/Kuhlmann 2005: 59; Larédo 2006: 1).⁶ The implementation of strong European research through networking and bundling of resources as well as efforts for the removal of barriers is related to a new definition of existing governance levels in research. Additionally, the crucial role which is now attributed to research in the broader context of economic growth and industrial competitiveness is a new line of thinking in Europe. While the conviction that science and technology are the key basis for growth and competitiveness has by now been expressed in multiple policy goals, one quantitative indicator has gained particular visibility: the Barcelona 3 % target (cf. Peter 2000: 4; Schibany/Streicher 2008: 1).

⁴ Cf. also <http://www.euractiv.com/en/science/ministers-see-new-vision-european-research-area/article-171660>, http://ec.europa.eu/research/era/specific-era-initiatives_en.html (18.11.2008).

⁵ Cf. http://www.consilium.europa.eu/ueDocs/cms_Data/docs/pressData/en/intm/104497.pdf.

⁶ Cf. André (2006); Banchoff (2003); Caracostas (2003: 43ff); Commission of the European Communities (2007a: 13) for a historical overview of common research efforts at the European level.

II The development of R&D investments in the EU27 1995 – 2005: National level⁷

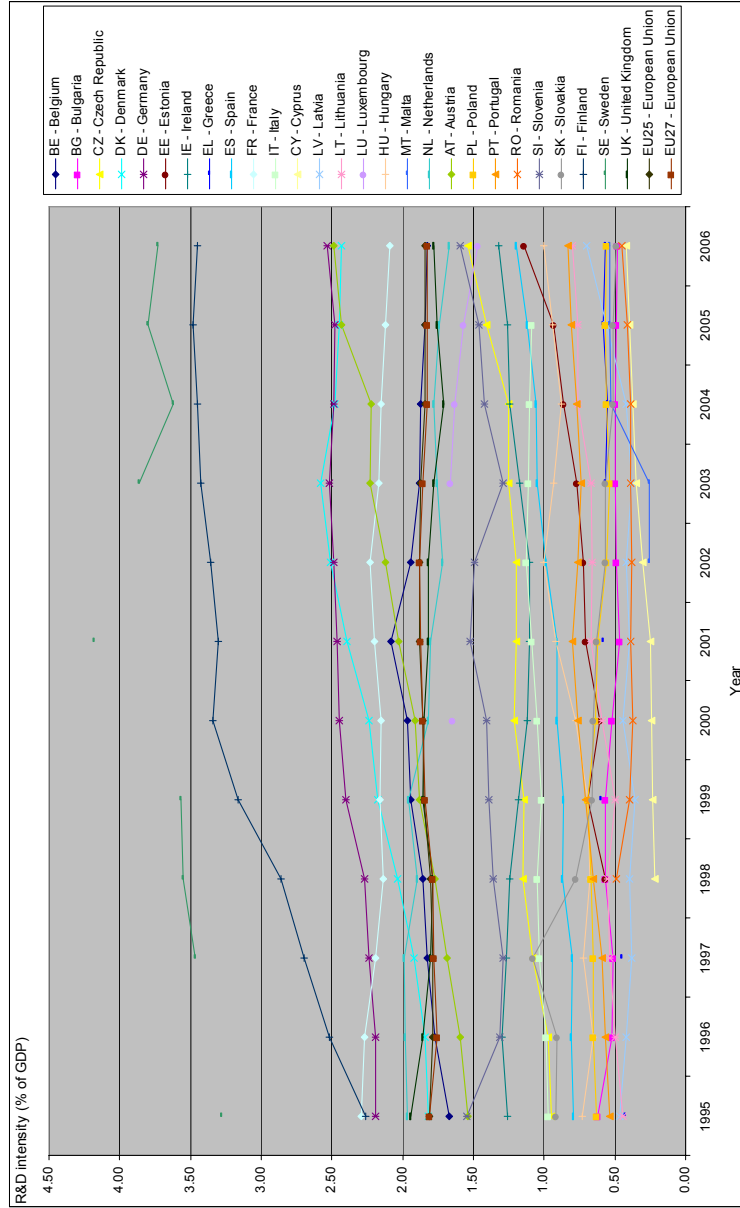
Figure 1 clearly shows that, in 2006, only the two Nordic countries Finland and Sweden exceeded the defined 3 % target of R&D investment in relation to gross domestic product. These two countries stand out since the closest followers, Denmark, Germany and Austria, only have R&D intensities of about 2.5 % of their respective GDP. France invested 2.09 % of its GDP in research and development activities, while all other European Union Member States spent less than 2 % of their GDP on research and development. On the EU27 level, this share was 1.83 %.

Among the "more than 2 % investors", Finland and also Denmark realised strong increases between the mid-1990s and the beginning of the 2000s (Finland), or 2003 (Denmark), respectively. The Finnish share of R&D expenditure increased further until 2005, albeit with slower growth rates, whereas the Danish share decreased slightly between 2003 and 2006. In Germany, the share of R&D investment (slowly) increased until the beginning of the 2000s and has stagnated since. Starting from a slightly higher position than Finland in 1995, the French share of R&D investment in relation to GDP has dropped in recent years. A fairly strong increasing trend during this ten-year period is witnessed by Austria, where R&D intensity was raised from 1.54 % in 1995 to 2.49 % in 2006, now placing this country in the group of Member States which invest between 2% and 2.5 % of their GDP in R&D activities.

⁷ The analysis is based on the RKF database built for comprehensive analyses of the structure and development of the national and regional distribution of research and technological activities in the countries and regions of the European Union. The RKF database is a compilation of different sources with the main source being Eurostat. The database is constructed as part of the RKF project.

3 % Goal in European Regions

Figure 1: The development of national R&D intensities between 1995 and 2006



Source: Regional Key Figures

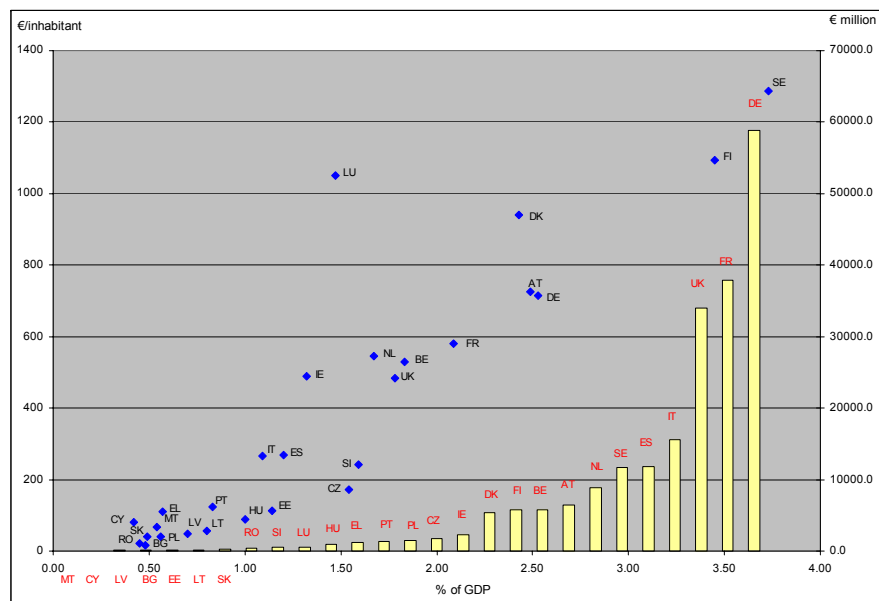
Figure 2 shows the complexity of the relationship between R&D investment and gross domestic product. Besides the R&D investment as a share of the national GDP on the x-axis, figure 2 also shows the investment per capita (R&D expenses per inhabitant) on the left y-axis and the absolute R&D spending (€ million) of the EU Member States (right y-axis; yellow bars) in 2006.

It is apparent that the UK, France and especially Germany make the highest contribution to the overall EU R&D spending. In 2006, these three Member States also had the highest GDP figures within the EU (cf. also Table 1) – although the UK and France switch second and third place. In 2006, these three countries accounted for 60.9 % of EU27 R&D spending, and for 51.9 % of EU27 GDP. However, R&D intensity in these large countries is lower than in the 'small champions' Finland and Sweden. Sweden is home to about 1.8 % of the EU population (2005), but it spends 5.5 % of the EU27 R&D. This relationship also becomes apparent when considering the figures for R&D spending per inhabitant, where Sweden also holds top position, followed by Finland, which is – in terms of its population (1.1 % of the EU population, 2005) – a rather small country, but accounts for 2.7 % of total EU27 R&D spending in 2006. The high Finnish R&D spending in relation to its GDP and also to its population positions it among the top EU Member States in terms of its R&D share to GDP and also in terms of R&D spending per capita.

In absolute terms, however, Finland belongs to the "medium R&D spenders" of the European Union, together with Denmark, Belgium and Austria (cf. figure 2).

3 % Goal in European Regions

Figure 2: R&D investments of the EU Member States 2005: Absolute figures (€ million)*, percentage of GDP** and investments per capita (€/inhabitant)***



Note: *: IT: 2005 data; **: IE, DK, BE, AT, IT, FR: 2005 data; UK: 2003 data; ***: UK: 2003 data
Source: Regional Key Figures

Table 1: R&D investments (gross expenditures for research and development, GERD, € million) and gross domestic product (GDP, € million) of the European Union Member States, the EU25 and the EU27 in 1995, 2000 and 2005

Country	GERD (€ million)			GDP (€ million)				
	1995	2000	2006	1995	2000	2006		
Austria	2820.1	4028.7	6318.6	8.	183220.6	210392.3	257897.2	9.
Belgium	3628.1	4964.0	5967.2	9.	217418.8	251741.0	316622.0	8.
Bulgaria	62.0	71.3	121.2	24.	10018.9	13704.3	25238.2	22.
Cyprus		24.5	62.4	26.	7073.7	10078.7	14630.9	24.
Czech Republic	403.0	744.0	1760.6	13.	42267.8	61495.2	114020.7	16.
Denmark	2530.4	3891.8	5419.5	11.	139129.2	173597.9	220069.4	11.
Estonia		37.0	151.0	23.	2881.8	6103.0	13233.6	26.
Finland	2262.7	4422.6	5761.2	10.	99,901.2	132272.0	167041.0	13.
France	27447.9	30953.6	37909.0	2.	1200918.9	1441372.0	1807462.0	3.
Germany	42234.0	50619.0	58872.3	1.	1929422.0	2062500.0	2322200.0	1.
Greece	437.0		1222.6	16.	100716.6	137929.5	213985.0	12.
Hungary	250.4	405.3	900.5	17.	34118.6	52025.0	90045.1	17.
Ireland	648.0	1175.9	2310.6	12.	51313.3	104620.3	174705.0	15.
Italy	8386.5	12460.3	15598.8*	4.	861117.6	1191057.3	1479981.1	4.
Latvia	17.9	37.5	112.3	25.	3792.5	8495.6	16046.7	25.
Lithuania	22.0	73.0	190.5	22.	4961.1	12360.3	23721.4	23.
Luxembourg		363.9	563.5	18.	15811.2	22000.6	33853.6	20.
Netherlands	6306.9	7626.0	9256.0	7.	320502.2	417960.0	534324.0	6.
Poland	672.7	1196.6	1512.6	15.	106362.8	185713.8	272130.7	10.
Portugal	470.3	926.6	1560.8	14.	87038.4	122270.2	155322.6	14.
Romania	216.8	148.7	444.1	20.		40346.4	97718.4	18.
Slovakia	138.3	142.9	216.6	21.	14960.9	22016.9	44571.4	19.
Slovenia	243.1	297.3	483.8	19.	15729.6	21125.2	30453.9	21.
Spain	3624.0	5719.0	11815.2	5.	456494.7	630263.0	980954.0	5.
Sweden	6324.9		11721.8	6.	193931.7	266422.0	313327.0	7.
United Kingdom	16932.3	29069.7	34037.1	3.	872453.8	1573359.3	1912656.0	2.
Malta			32.9	27.	2754.3	4221.1	5075.1	27.
EU27	126584.7	170488.9	214746.4		7002335.5	9175442.8	11637232.0	

Note: GERD data for Italy is 2005 data
Source: Regional Key Figures

Generally, the four most populous EU Member States - Germany, France, the United Kingdom and Italy - have the highest GDP and R&D spending in 2006 (Italy: GERD data available for 2005 only), but the interrelation between these figures produces comparatively heterogeneous positions in the common presentation in figure 2. Germany, for instance, seems to be quite similar to Austria with respect to its R&D intensity and R&D expenditure per inhabitant, but on a higher scale with a population ten times larger than in Austria, and GDP and R&D investments that are about nine times higher than in Austria. So these countries seem to have similar structures, but on different levels. The Netherlands, Belgium and the United Kingdom seem to have quite comparable structures with respect to the shares of GDP they spend on R&D, as well as their R&D levels per capita. France is situated between this three country group and Austria/Germany, with high absolute R&D investment and GDP and an above-average position in terms of R&D/capita. Ireland has comparable R&D spending per capita to the UK⁸. The position of Denmark and Luxembourg seems to be quite singular: Luxembourg has comparatively low absolute R&D investment, but its low population figure positions it near the top with respect to R&D spending/capita. Since Luxembourg has – compared to its population – high GDP figures, its R&D in relation to GDP is below the EU average. Luxembourg's R&D spending in 2006 was slightly higher than that of Slovenia (cf. Table 1), but its population is the second smallest in the EU after Malta. These relationships produce an outstanding position of this European Country. Denmark belongs to the top five European countries in terms of R&D spending per capita.

Despite higher absolute R&D investments, Italy and Spain have lower R&D intensities than Slovenia and the Czech Republic. The latter achieve this position due to smaller GDP and lower population figures. Finally, there is a group of EU Member States with R&D

shares below 1 % of GDP, and comparatively low R&D spending per capita: Cyprus, Romania, Slovakia, Bulgaria, Latvia, Poland, Malta, Greece, Portugal, and Lithuania. However, a more detailed look at the R&D and GDP figures shows that Poland, for instance, has an only slightly lower R&D investment than the Czech Republic, but its GDP is nearly 2.5 times higher than the Czech one (cf. Table 1), which results in a less favourable R&D intensity.

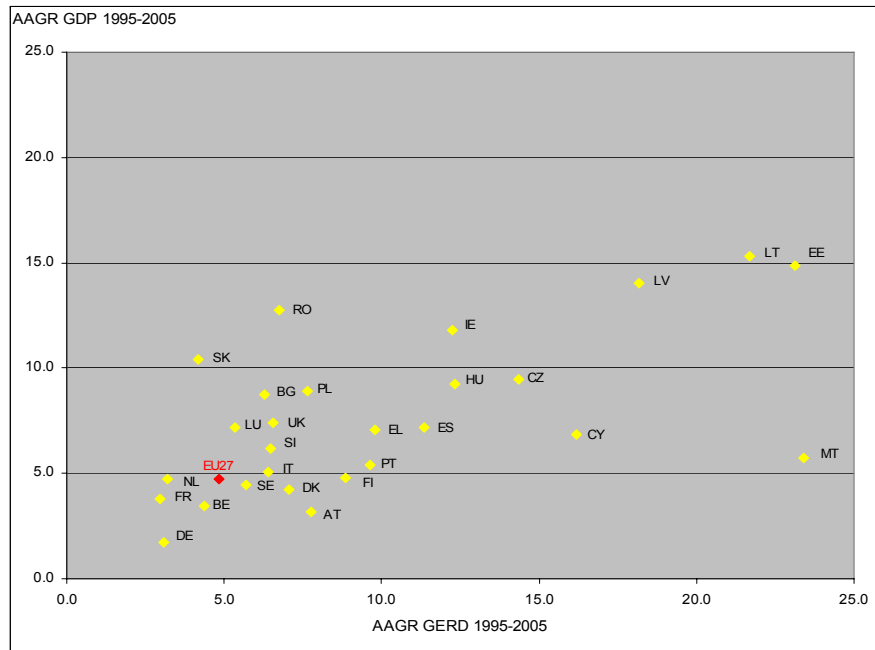
When the growth rates of these indicators are analysed, the picture of Member States' positions changes (cf. figure 3). First of all, the range of variation in the average annual growth rate of R&D expenditure is larger than that of GDP, with the Baltic countries, Cyprus and particularly Malta showing impressive growth rates of R&D expenditure. However, it must be kept in mind here that the Maltese average growth rate of R&D is based on figures for 2002-2006, with a high increase in 2004 (from € 11.5 m in 2003 to € 24.0 m in 2004; break in series). Since the figures for this small nation are generally comparatively modest, even slight changes lead to impressive growth rates. Nevertheless, a tendency of relative lower growth rates for R&D investment in countries with high absolute values (cf. also figure 2) can be observed, whereas the growth rates for France, Germany, the Netherlands and Belgium remain below the EU27 average.

Mainly the group of new Member States have realised impressive growth during the last few years. Particularly the Baltic countries have witnessed above-average growth rates with regard to their R&D expenditures that have surpassed those of their respective gross domestic product. However this has had only a limited impact on overall EU R&D intensity due to the relatively low weight of this group of countries in total EU GDP.

⁸ It has to be kept in mind that the UK figures are from 2003, see also above.

3 % Goal in European Regions

Figure 3: Annual average growth rates (AAGR) of gross domestic product (GDP) and gross domestic expenditure on research and development (GERD) 1995-2005*



Note: *: AAGR based on 1995-2006 period. Exceptions: GERD: EE 1998-2006, IT 1995-2005, CY 1998-2006, LU 2000-2006, MT 2002-2006; GDP: RO 1998-2006.

Source: Regional Key Figures

In summary, different EU Member States show different growth rates and development paths of R&D expenditure in both absolute and relative terms. In recent years, positive trends can also be observed for new Member States such as Estonia, the Czech Republic or Slovenia. Although it has to be considered that, in small states, even small increases in R&D spending over-proportionately influence the relative figures, they do seem to have realised a "take-off" with respect to both absolute spending and R&D intensity which could move them up to the middle of the field in the coming years.

The analysis in this section did not exclusively refer to the 3 % goal, but attempted to give some deeper insights into the relationship of absolute R&D figures, GDP and growth rates. As the most important finding, it becomes obvious that the largest economies with the highest absolute R&D spending do not yet belong to the top performers with regard to R&D intensity. This indicates that countries with large economies (i.e. high GDP figures) have to realise higher total increases of R&D investment in order to enhance their R&D intensity. During the time period considered, some medium-sized countries significantly increased their R&D intensities (e.g. Finland, Denmark and Austria). Larger countries such as France or Germany witnessed either a slow decrease or stagnation. As the large economies dominate with regard to overall GDP, the dynamic medium-sized economies will therefore not be able to substantially influence the overall community average on their own.

III The Lisbon Strategy, the European Research Area and the European Regions

The analysis of regions,⁹ regional research systems and regional developments is gaining increasing importance in the context of the European Research Area and the Lisbon strategy. Since the ERA is conceived of as an "interconnected research space, in which barriers would disappear, collaboration would flourish, and where a functional integration process would take place..." (Commission of the European Communities 2001: 4), the regional level will inevitably play a role as a building block, as it is at the regional level that research capabilities reside. While due to the political structure of the EU, responsibilities for decision-making reside at many levels, among them, the national, regions are the final loci of implementation and, to an increasing degree, relevant political actors in their own right.

Even before the official launch of the Lisbon strategy the European Commission highlighted that "[f]rom a competitiveness and cohesion point of view, there is thus a clear need to formulate 'Integrated RTD and Innovation Strategies' which connect to the economic development process in the regions and which, via the national system of RTD and innovation support, are integrated into a wider European perspective." (Commission of the European Communities 1998: 9). Later, regions were envisaged to assume a "motor role" and emerge as "dynamic players in developing and structuring the European Research Area." (Commission of the European Communities 2001: 7). It was recognised that ERA-related policies needed to be adapted to the specific regional conditions ('research policy territorialisation') to enable the absorption of research results by individual socio-economic actors and ascertain that increased investment in research

and innovation really serves as a means to stimulate socio-economic development (cf. Commission of the European Communities 2001).

While the national level sets the framework and often provides funding, regional authorities have to tailor existing approaches to regional requirements and to mobilise research and innovation. Also, they are the actors best able to closely interact with research policy's addressees through hands-on support for networking, innovation and technology transfer. Furthermore, regions have a co-ordinating role in bundling resources from the local, the national and the European levels, which is most evident in federal states like Germany and Austria, or states with a high degree of devolution of power such as the United Kingdom and Spain (cf. Commission of the European Communities 2000: 7).

Since the mid-1990s, different regional, strategy building programmes have been launched: Regional Technology Plans (RTP) were the starting-point and the underlying concept has been widely applied and broadened. Many European regions have since then participated in RIS, RITTS, RIS+, TRIPS, RISI and further programmes. Networking between these regions is fostered by the Innovating Regions in Europe Network, see the innovating-regions.org platform. The INTERREG initiative of the European Commission that is directed towards cross-border regional co-operation also addresses RTDI activities (cf. Commission of the European Communities 2001: 14-16; Koschatzky 2001: 313ff.).

In many European regions, policies for research, innovation and technological development are designed and implemented at the regional level by regional authorities. In many cases, this could not be realised to the same extent without support by the European Union, as regional authorities may have substantial political competencies, but not necessarily very high budgets for RTDI policy. Such support is, for instance, provided through the Innovation Framework Pro-

⁹ Generally understood as socio-economic entities below the national level and considered according to the NUTS classification.

gramme, the RTD Framework Programme or the Structural Funds (cf. Commission of the European Communities 2001: 6).

It is a central tenet of European research policy that "Innovation is most effectively addressed at regional level, as physical proximity fosters the partnerships between actors in both public and private sectors." (Commission of the European Communities 2007b: 2). It is assumed that geographical proximity and a common cultural context facilitate the building of partnerships and clusters as necessary foundations for networked specialisation in the ERA and ultimately lead to competitive advantage and economic success. Additionally, the integration of local actors enhances the acceptance of political strategies (cf. Commission of the European Communities 2001: 8/9; Commission of the European Communities 2007b: 2; Niessler 2008).

Basically, European regions can benefit directly from three main Community support measures for regional research and innovation activities: the Structural Funds and their priority for knowledge and innovation, the "Regions of Knowledge" and the "Research Potential" initiatives in the 7th Community Framework Programme (cf. Commission of the European Communities 2007b: 3-6). In order to pursue the overall goals set out in the Lisbon Strategy, the EU Commission has taken steps to align and synchronise efforts between research policy, innovation policy and cohesion policy under the different responsibilities of DG RTD, DG Enterprise and DG Regio. From the current programming period 2007-2013 onwards, the objectives of European cohesion policy have been realigned to offer substantial resources for research and technological development (RTD) and innovation both for weaker (Conversion) and in more advanced (Competitiveness and Employment) regions. The regional operational programmes are required to commit 60% or 75% of Structural Funding to "Lisbon-relevant" projects. Additionally, beneficiaries are encouraged to use instruments of research, innovation and cohesion policy in synergy (cf. Committee of the Re-

gions 2007: 9), as well as the practical guide for researchers, research organisations, entrepreneurs, cluster managers and regional policymakers (Commission of the European Communities 2008).

The ERA and the 3 % goal: The view of European regions

Since 2002, the 3 % goal defined at the Barcelona European Summit has been a benchmark of European (public and private) investments for research and development activities. However, in 2006, EU27 R&D intensity had still not been raised above 1.84 % (2007: 1.83 %) and thus remained far below that of the United States (2.61 %) and the 3 % target.¹⁰ On the regional level, more than 100 European regions currently invest less than 1 % of their GDP in R&D. Research investments and activities are concentrated in a few European regions: 8 regions are responsible for 25 % of EU R&D investment, and 31 regions for 50 % (cf. Committee of the Regions 2008: 4; Myllyvirta 2008). However, "[a]n increasing number of European regions are making research and innovation a top priority of their public funding" (Committee of the Regions 2008: 3).

The analysis of research policy measures at the regional level has to take into account some basic aspects:

- techno-economic conditions in the European Union's regions (there are 271 NUTS 2 regions in the EU27) are very heterogeneous, in particular with reference to their research, industrial, knowledge, and their human resource base,
- regions on the corresponding NUTS level have different responsibilities for research policies, but also in terms of budgetary competence and legal powers,

¹⁰ Schibany/Streicher attributes this development mainly to the stagnation of R&D investment in some large European countries. Based on the long-term trend of R&D intensities since 1995, they calculate a share of 1.8 % for the EU27 in 2010 (cf. Schibany/Streicher 2008: 5).

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- successful research policies rely on existing regional strengths and are based on the general guidelines of excellence support and critical mass generation (cf. Dory 2008: 16/17).

Successful research and development activities can be observed in regions with high absorptive capacities, i.e. an economic fabric that can absorb and exploit the generated research results. However, R&D cannot be the only measure to pursue and achieve the Lisbon goals of growth and employment, and it would be an oversimplification to expect that higher investment in R&D automatically leads to growth and the transformation into a knowledge-based regional economy.

However, as demonstrated in the first booklet in this series, different European regions can benefit from increased research and innovation capabilities in different ways, from developing and extending technological leadership to developing absorptive capacities, in order to better benefit from research results produced worldwide (cf. Commission of the European Communities 2003: 7/8; Dory 2008: 3-6).

IV The contribution of R&D activities at a regional level to the 3 % objective

This subsection will address the question of how the development of R&D expenditures in individual regions contributes to the pan-European 3 % target. The starting point of such an analysis is the very uneven distribution of R&D expenditure as well as R&D intensity across the EU27. This not only international, but also intranational differentiation implies that, in the short run, the potential of individual regions to contribute to the 3 % target at the EU27 level differs substantially. It explains why the 3 % target cannot and has not been set as a direct numerical benchmark at the regional level.

With a view to the converging fields of European regional policy and European research policy, the question which regions should be encouraged with priority to contribute to the 3 % European objective (e.g. through the competitiveness and employment objective of the Structural Funds) has become of increasing political interest. In this context, this booklet aims to contribute by discussing empirical evidence and considering the implications of regional disparities for policies supporting research investments at a regional level.

Overall it will contribute to a better understanding of two issues:

- Firstly, the 3 % target is set to be reached by 2010. Until then a major change in the current structure of the system cannot be expected. Thus it is important to know which groups of regions in the ERA currently provide the most leverage for increasing research intensity in the overall system and which groups of regions actually make use of that leverage.
- Secondly, under the heading of "regional attractiveness", European policy looks beyond 2010 and aims to identify ways to build regional R&D capacities that complement the needs of the (local) industrial sector (networked specialisation). This booklet aims to assess if such an approach can bear fruit, irrespective of the current regional R&D intensity.

The starting point: Empirical evidence of spatial disparities

Figure 4 shows the Lorenz curves for gross expenditure on R&D (GERD) in 2000 and 2005. Evidently, the bottom 50 % of NUTS 2 regions in terms of R&D spending contribute little more than 5 % to the total EU27 GERD (6.1 %). Similarly, it demonstrates that the structural situation has not changed much since the first adoption of the Lisbon goals in 2000. This finding is corroborated by Table 2 listing the Gini coefficients of R&D spending for all sectors of performance in both 2000 and 2005. All of them evidence a tendency towards de-concentration, albeit a very slight one. Disparities in the research system remain stronger than disparities in the economic system. However, the decrease of disparities in the research system was somewhat higher than that of disparities in the economic system. Within the research system, they are more pronounced in the business research system than in the public research system.

Table 2: Spatial concentration of R&D expenditure and GDP in the EU27 (Gini coefficients based on NUTS 2 regions¹¹, 2000 and 2005)

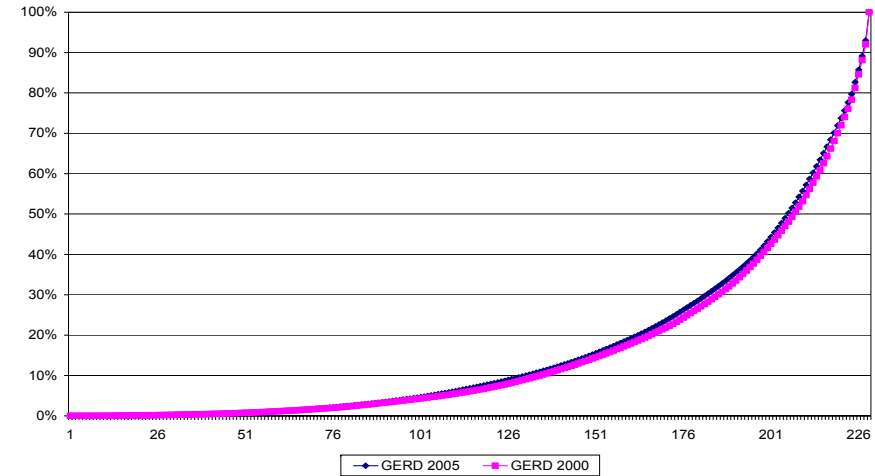
GERD2000	0.6855	GOVHERD2000	0.6231
GERD2005	0.6696	GOVHERD2005	0.6127
BERD2000	0.7282	PPSGDP2000	0.5140
BERD2005	0.7181	PPSGDP2005	0.5077

Note: GERD: Gross Expenditure on R&D; BERD: Business Expenditure on R&D; GOVHERD: Government Research and Higher Education Expenditure on R&D; PPSGDP: GDP in PPS 2000.

Source: Regional Key Figures (see Annex for explanation of Gini coefficient)

¹¹ As in the following tables and figures "NUTS 2" refers to a sample including BE and UK on the NUTS 1 level due to data availability. Likewise, not all recent changes made in the geographical definition of NUTS 2 regions can be accounted for (e.g. for DK & SI, which do not yet provide useful R&D data at the new NUTS 2 level). Consequently, the analysis is generally based on a sample of 229 regions of which 17 are NUTS 1 (BE 3, DK 1, SI 1, UK 12), and 212 regions at NUTS 2 level. FR and AT 2005 data are estimated based on 2002 to 2004 growth. GERD data for the UK are sums of available figures for BERD, GOVERD and HERD. GOVERD estimated for DE21 and DE22.

Figure 4: Spatial concentration of gross expenditure on R&D in the EU 27, 2000 and 2005 (Lorenz curves based on NUTS 2 sample)



Source: Regional Key Figures (for explanation of Lorenz curve, see Annex)

Spatial disparities: Theoretical background

From a theoretical point of view, the inevitability and, to a degree, the socio-economic desirability of regional differentiation in the ERA system is firmly established. There has long been unanimous consensus among regional scientists that some activities develop better in specialised agglomeration than in dispersion. It has been broadly acknowledged in academic discourse that learning is a cumulative process (Gregersen/Johnson 1997), so that knowledge-based activities profit from possibilities for interaction and mutual sourcing which concentration provides to a more than proportional degree. This line of thinking is also reflected in the realignment of European Structural Policy. Consequently, the existing disparities should not be interpreted as a detrimental centre-periphery structure, but as the result of a healthy regional division of labour based on specific regional capabilities and inter-regionally and internationally networked specialisations, which can be built upon.

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In regional science, it is well acknowledged that knowledge-based activities can profit from the proximity of other knowledge-based activities through knowledge spillovers across regional boundaries i.e. transfer of knowledge through local labour markets or informal exchange (Jaffe et al. 1993). While benefits from spatial co-location occur only over relatively short distances (Tappeiner et al. 2008; Breschi/Lissoni 2001), European regions are additionally connected through an interregional network of knowledge exchange. The external influences on regional research systems are therefore not only conditional upon spatial, but also upon the degree of networked closeness to other regional research systems. While the description of this multi-level embeddedness is beyond the scope of this booklet, it has one important implication: Smaller regions can source complementary knowledge from distant nodes of activity. To do so, however, they have to be able to absorb, process and locally recombine external knowledge. When this capability has been achieved, they are better positioned to profit from increased R&D investment. In particular, this would be important for the many regions in the "middle field" (cf. pp. 16-17). In the medium to long term, this process of increasing the R&D capacity of "middle field" regions will be a crucial element in achieving the 3 % objective at the EU27 level.

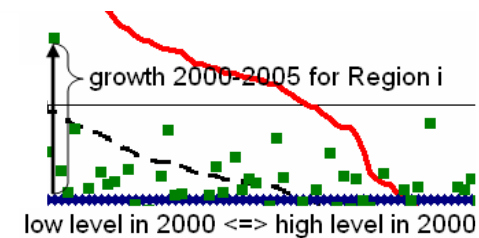
Empirical evidence: Developments by regions

Regarding the developments at the NUTS 2 level with a view to achieving the 3 % objective at the European level, two issues have to be considered: Firstly, how did the individual regions develop relative to their starting point in 2000 when the Lisbon goals were set; and, secondly, to what extent did this have an impact on the overall ERA system?

The following figures for total R&D expenditure and R&D intensity provide the needed information. The green/red/black dots display the development of individual regions' R&D intensity from 2000 to 2005 based on an index setting the level of 2000 as 100.

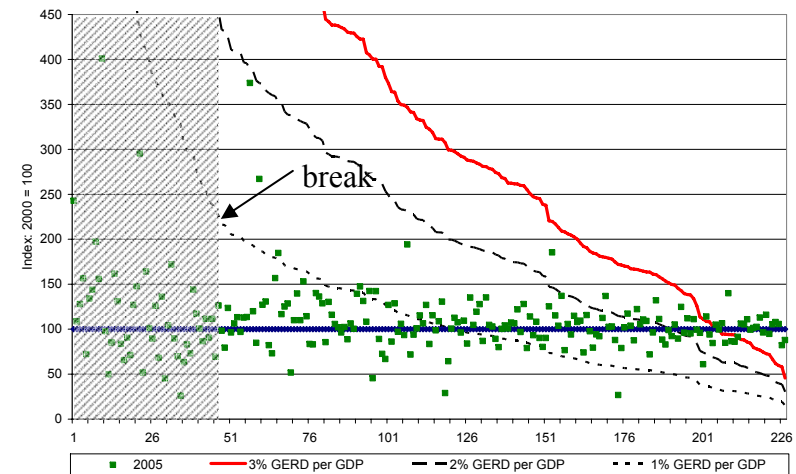
The diagonal lines indicate how far the levels of R&D intensity were above or below the initial level in 2000 (e.g. red line for 3 %). Additionally, regions are ordered by their level of R&D intensity in 2000. A region with a low R&D intensity will thus be found to the left, the leading regions to the right¹².

Figure 5: Explanatory schematic for Figures 6 to 8



Source: own figure

Figure 6: Relative development of R&D intensity in EU27 NUTS2 regions, ordered by initial level of R&D intensity (left: low; right: high)

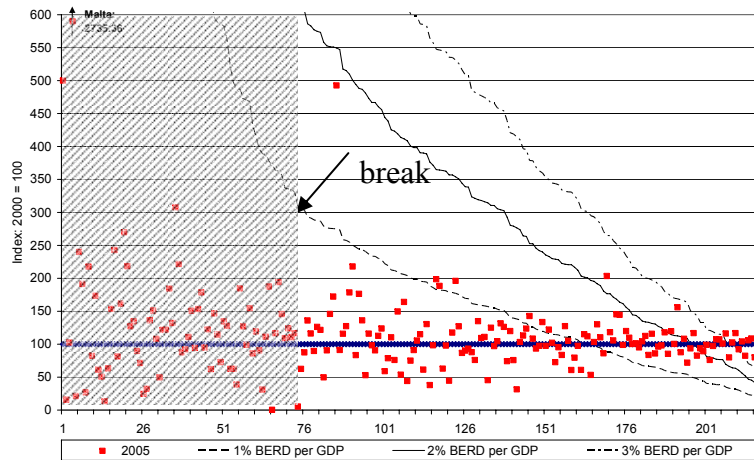


Note: Geometric mean estimation performed for up to three missing years; BE and UK included on NUTS1 basis, SI on NUTS 0 basis due to availability of data. Source: Regional Key Figures

¹² Data based on geometrical imputations where missing, coverage incomplete.

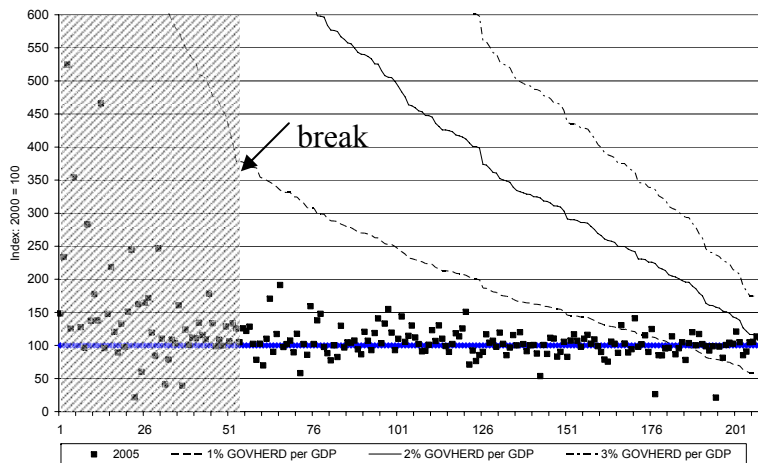
3 % Goal in European Regions

Figure 7: Relative development of business R&D intensity in EU27 NUTS2 regions, ordered by initial level of business R&D intensity



Note: Geometric mean estimation performed for up to three missing years; BE and UK included on NUTS1 basis, SI on NUTS 0 basis due to availability of data; Source: Regional Key Figures

Figure 8: Relative development of public R&D intensity in EU27 NUTS2 regions, ordered by initial level of public R&D intensity



Note: Geometric mean estimation performed for up to three missing years; BE and UK included on NUTS1 basis, SI on NUTS 0 basis due to availability of data; Source: Regional Key Figures

A similar analysis of the relative development of expenditure can be conducted for absolute expenditure on R&D as displayed in the Annex (Figure Annex 11-13). In this case, regions are ordered by the initial level of absolute expenditure in 2000 (ascending from left to right), so that the relative relevance of the observed change for the overall system increases the further right in the figure it is displayed.

Overall, the findings confirm and differentiate the indications found above. In detail:

- About 75 % of NUTS 2 regions spend far less than 3 % of their GDP on R&D, about 50 % of them spend less than 1 %.
- In all sectors of performance there is a noticeable break (see arrows in Figure 6 - Figure 8) indicating a "research periphery" (see scaffolding Figures) of at least 20 % of the regions in which R&D is of relatively minor importance.
- The absolute development of GERD has been positive in most regions while there is no such trend for R&D intensity. If at all, the increase of R&D expenditure seems to be keeping pace with economic growth across the board.
- Developments for GERD, BERD and public expenditure do not differ substantially across the board while they do differ substantially for individual regions. Among them, BERD development appears most idiosyncratic.
- The "research periphery" is slightly larger with regard to business or public R&D intensity considered separately than it is for overall R&D intensity – indicating that R&D efforts in the periphery are quite often dominated by one sector of performance alone. This could be interpreted as evidence of the fact that most research in the periphery, if at all, is networked externally rather than within an integrated regional system.

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In summary, research capacities have undoubtedly grown in the years since the Lisbon accord. Given the fact that knowledge generation is a cumulative process which more than proportionately benefits from the increase of activities, this is good news. On the other hand, at Community level, R&D intensity has not grown as planned.

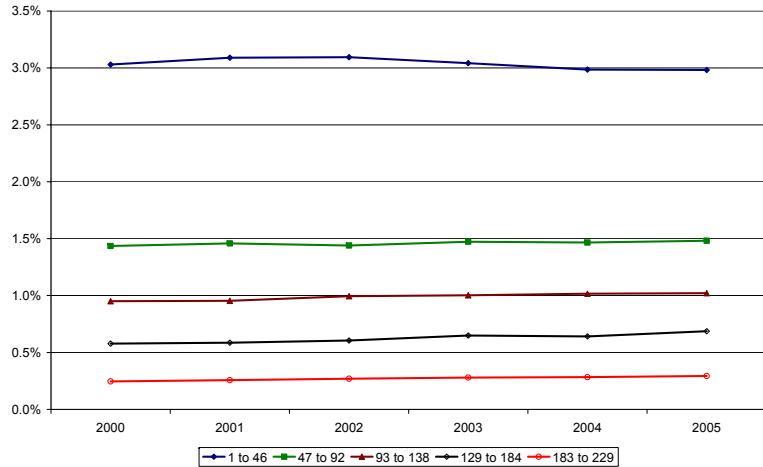
Developments by sections: Leverage foregone?

Even given the caveat of the high degree of idiosyncrasy observed above, it is instructive to investigate how different sections of the ERA system have developed and if the leverage they provide has been used. The development of R&D intensity in groups of regions (sorted 20 % quantiles, weighted average) demonstrates that:

- Only the top 46 regions are above 3 % R&D intensity (sorted by R&D intensity). The next 20 % quantile is already oriented towards a weighted mean of 1.5 %.
 - Research intensity in the upper 20 % of regions, uniting about 50 % of EU27 GERD, has decreased slightly rather than increased. Without an increase in the contribution of these regions, R&D intensity in the ERA system as a whole can hardly be increased in the short run.
 - R&D intensity in the following 40 % quantile has increased by about 5 %. This is a significant development. It demonstrates that R&D potentials in this field (uniting about one third of EU27 GERD) can be leveraged, even though ample room for improvement remains.
 - A significant increase by about 20 % has been realised in the lower 40 % quantile. Growth has been most steady in the lower 20 % quantile. With a view to the "research periphery" identified above, this is good news. The development indicates an increase in absorptive capacities that enables them to make use of knowledge sourced outside these regions.
- When the regions are ordered by private and public R&D intensity, it emerges that the biggest increases by far occurred in the lowest 20 % quantiles respectively. With regard to public research intensity, the second lowest 20 % developed unevenly and even at times negatively, while in private research intensity the development is simply less dynamic. This suggests that, in the last five years, in each field of R&D activity, the weakest regions have on average been able to improve their standing. Against the background of the Commission's aim to promote regionally networked clusters of complementary specialisation, this is good news. However, given the high overall degree of idiosyncrasy of developments among regions illustrated by Figure 6 and Figure 7, the results should not be over-interpreted.
 - If the regions are ordered by absolute expenditure on R&D (see Annex), the result is that the smallest regions in terms of absolute spending have not been able to improve their R&D intensity. While the strong relative growth mentioned accrues to regions in the second lowest 20 % quantile, R&D intensity in the lowest 20 % decreased until 2003 and has only recently reached its 2000 level. The most peripheral regions seem to continue to provide challenges for enabling policies and leave ample room for improvement.
 - Finally, the development of R&D intensity depends on the share of business investment in overall R&D investment (see Annex). The development for the 20 % of regions where the share of business expenditure is highest is stable and positive, while in those regions where activities are strongly dominated by public research, R&D intensity decreased. In the middle field, growth was slow and at times uneven. The results suggest that isolated raises in public R&D spending cannot induce the same effects as complementary efforts in public and private expenditure (cf. Dory 2005).

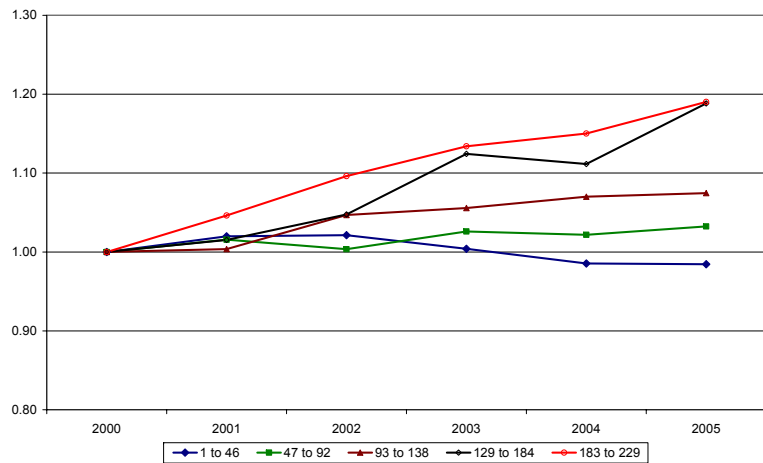
3 % Goal in European Regions

Figure 9: Development of R&D intensity by 20 % quantiles, based on NUTS 2 sample sorted by R&D intensity in 2000



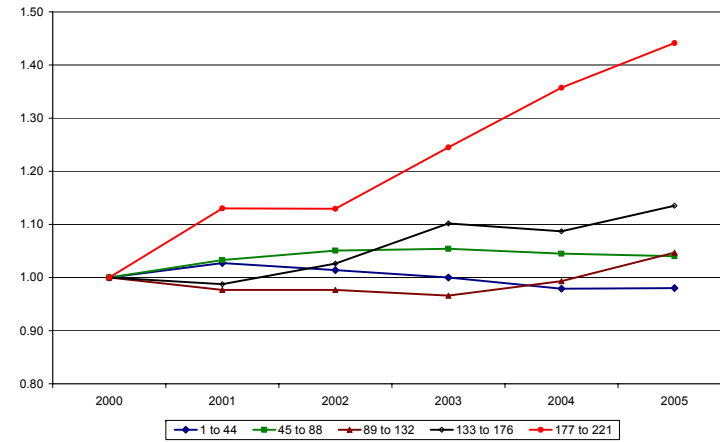
Note: Geometric mean estimation performed for up to three missing years; BE and UK included on NUTS1 basis, SI on NUTS 0 basis due to availability of data; Source: Regional Key Figures

Figure 10: Development of R&D intensity by 20 % quantiles, based on NUTS 2 sample sorted by R&D intensity, as Index (2000=1)



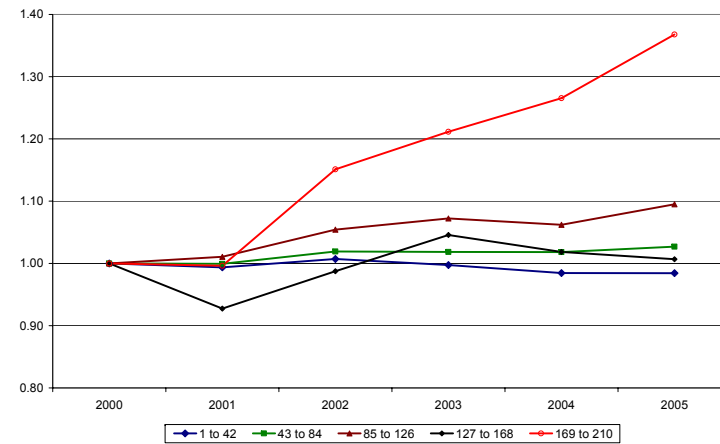
Note: Geometric mean estimation performed for up to three missing years; BE and UK included on NUTS1 basis, SI on NUTS 0 basis due to availability of data; Source: Regional Key Figures

Figure 11: Development of business R&D intensity by 20 % quantiles, based on NUTS 2 sample sorted by business R&D intensity in 2000, as Index (2000=1)



Note: Geometric mean estimation performed for up to three missing years; BE and UK included on NUTS1 basis, SI on NUTS 0 basis due to availability of data; Source: Regional Key Figures

Figure 12: Development of public R&D intensity by 20 % quantiles, based on NUTS 2 sample sorted by public R&D intensity in 2000, as Index (2000=1)



Note: Geometric mean estimation performed for up to three missing years; BE and UK included on NUTS1 basis, SI on NUTS 0 basis due to availability of data; Source: Regional Key Figures

Developments by clusters: The impact of regional structure

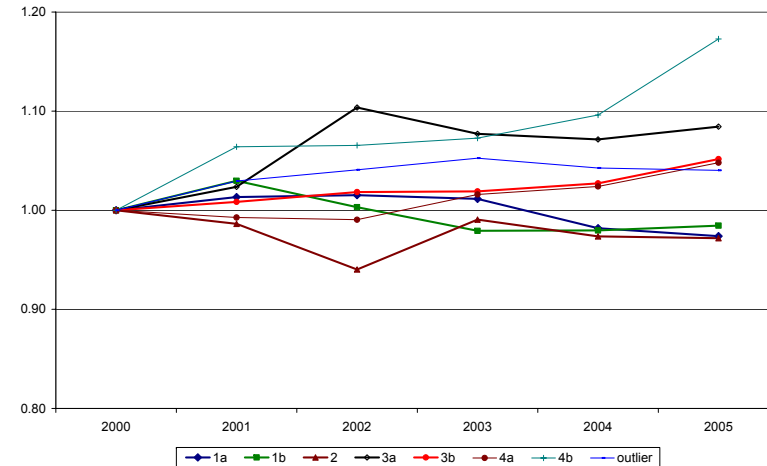
Another way of differentiating the developments of R&D expenditure in the EU 27 is to look at trends by clusters of regional research systems as established in the first booklet of this series (see Annex). Again, the overall level of R&D intensity has not changed much in absolute terms in any of the groups (Figure: Annex 17).

This analysis corroborates the findings of the analysis by quantiles: R&D has grown least in regions with an already high R&D intensity (1a, 1b) with the exception of the best performing outliers. In regions with lower R&D intensity, in contrast, a differentiation emerges that can be attributed to structure. In line with the findings of the first booklet of this series, it demonstrates that, among the weakest regions, a higher increase in R&D intensity has been realised by those that are business-driven (4b). In the middle field, in contrast, growth has been higher in those regions where business research is complemented by public R&D efforts (3a). It has been lowest in regions with an "isolated" capability in public R&D (2).

Overall, this supports the above mentioned policy concept that complementary capacities of the public and the private R&D sector will benefit the development of research intensity. However, it also shows that critical mass will be needed for complementarity to develop its beneficial effects. In some regions with a very low R&D intensity (4a), this does not yet seem to be the case.

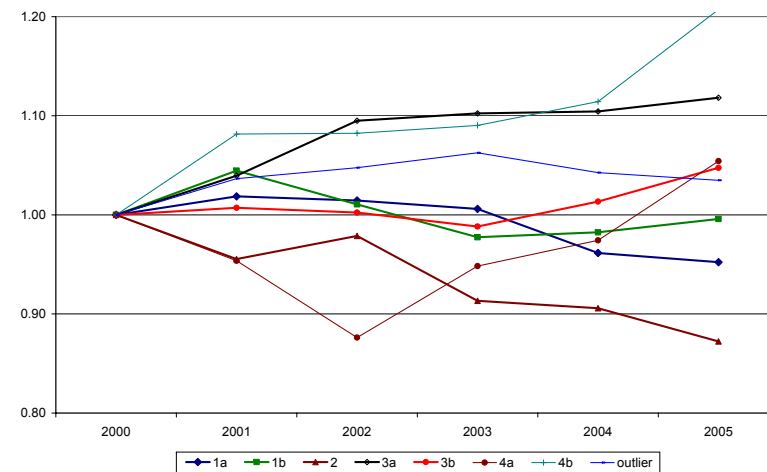
Additionally, the analysis illustrates that the observed differences in trends are apparently not directly driven by public sector investment (cf. Figure Annex 18). Figure 13 and Figure 14 demonstrate that, statistically, the driving force behind the general trends is the business sector. This underlines that the role of public investment seems to be of an indirect nature. While it does not directly cause private R&D intensity to rise, it helps create the preconditions for private investment and, in the long run, may raise the attractiveness of regions.

Figure 13: Development of R&D intensity by clusters, NUTS 2 sample, as Index (2000=1)



Note: Geometric mean estimation performed for up to three missing years; BE and UK included on NUTS1 basis, SI on NUTS 0 basis due to availability of data; Source: Regional Key Figures

Figure 14: Development of business R&D intensity by clusters, NUTS 2 sample, as Index (2000=1)



Note: Geometric mean estimation performed for up to three missing years; BE and UK included on NUTS1 basis, SI on NUTS 0 basis due to availability of data; Source: Regional Key Figures

The regional distribution of R&D expenditure development: The continued importance of national framework conditions

Figure 15 illustrates that nation states continue to play a major role in pre-determining the research intensity of regions in the European Research Area, even though intra-national differentiation plays an important role. On the map, a "V of high R&D intensity" emerges, including the Scandinavian countries, Austria, Germany, northern Italy, southern France, Île-de-France, the United Kingdom and Ireland. Other regions, particularly in the new Member States and the southern periphery, continue to lag behind on a national scale.

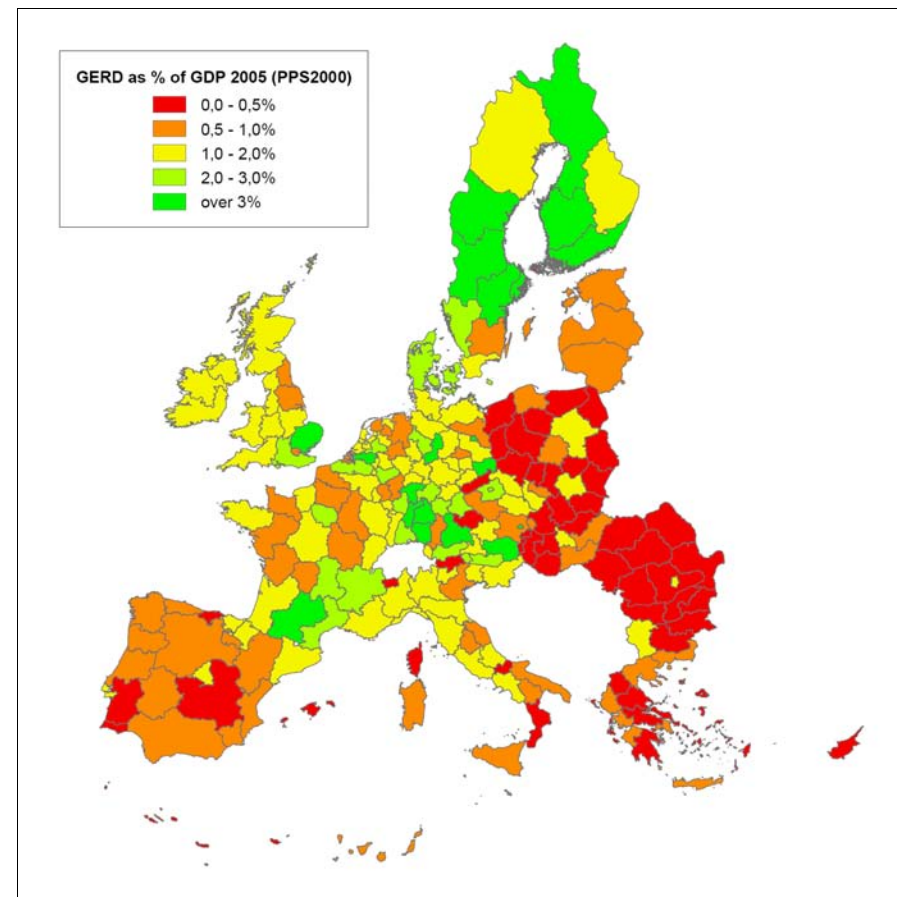
In addition, Figure 16 illustrates that R&D activities in the centre of Europe tend to be dominated by business research. The "V of R&D intensity" can to a degree be superposed by a "V of high share of private R&D expenditures in total GERD". In the southern periphery and the new Member States, in contrast, R&D activities are often dominated by public R&D activities.

Given this importance of geographic location, it is informative to illustrate the relative growth of GERD in European regions.

Over the whole period from 2001 to 2005, dynamics can be identified in the periphery rather than at the centre (Figure Annex 7, 8, 9), mirroring the results of the analysis by quantiles. Few of the leading regions where R&D intensity is already high have been able to further increase it significantly, indicating that such efforts may possibly become more difficult the more advanced a region already is.

While the figures clearly illustrate that the growth of R&D intensity realised from 2000-2005 has not sufficiently contributed to achieve the 3 % target by 2010, it is necessary to bear in mind that the ambitions of the Lisbon strategy go beyond its headline targets. Although this is not yet directly reflected in the regional growth of R&D intensity, the Lisbon strategy may well have started to develop an important impact on efforts to improve regional attractiveness for research.

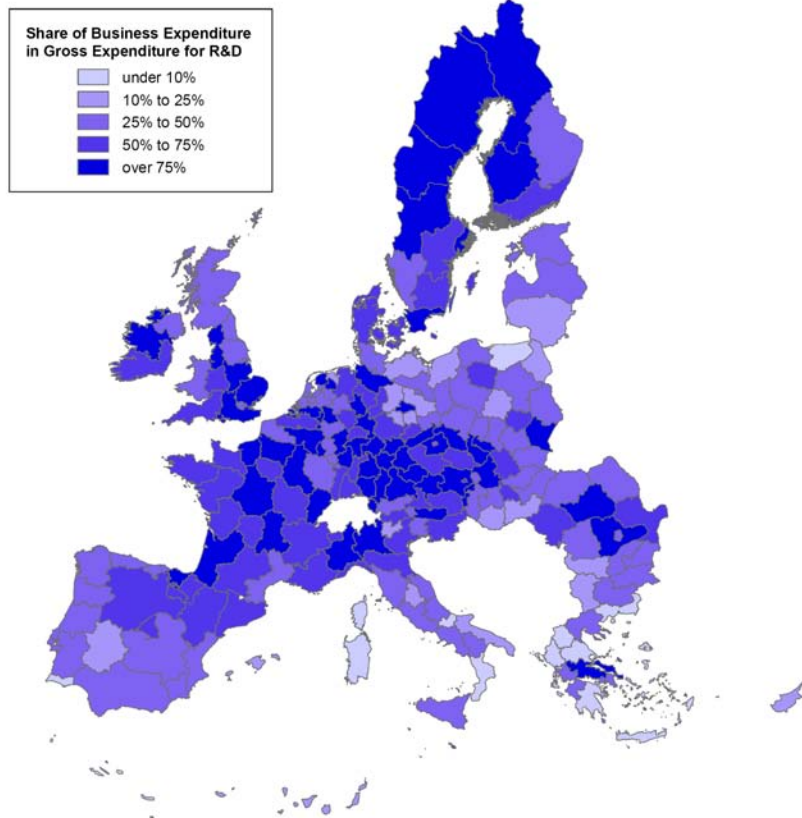
Figure 15: R&D intensity 2005 (PPS 2000)



Source: Regional Key Figures

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Figure 16: Share of business expenditure in total R&D expenditure 2005



Source: Regional Key Figures

To identify direct efforts contributing to the 3 % headline target of the Lisbon strategy, it seems advisable to separate the period 2001-2003 (where efforts can hardly be directly attributed to the just conceived Lisbon agenda) from the period 2003-2005 (where first effects of European policy on national and regional efforts can be assumed to emerge). However, it is always necessary to bear in mind that the years from 2001 to 2003 constitute a time of recession, while the years from 2003 to 2005 constitute a period of relative boom. Consequently, the pick-up of GDP growth in the 2003-2005 period may conceal some of the achieved results with regard to R&D expenditure in absolute terms. It should also be borne in mind that a stagnation of R&D intensity can correspond to an absolute increase in real R&D expenditure, as there may be a parallel growth in the volume of research performed and regional/national GDP.

With regard to R&D intensity growth, the trends between 2001-03 (

Figure 17) and 2003-05 (Figure 18) differ as follows.

- On average, the growth trend gained momentum in Sweden, Germany, Latvia, Lithuania, Poland, Portugal, Slovenia, Slovakia, the Czech Republic and Belgium, while it slowed in Italy and Spain. It remained positive in Estonia, Finland, Cyprus and Ireland.
- In France, the Netherlands, the UK and Greece, the overall trend did not really change, but was driven by different regions. In Greece, however, fluctuation is likely evidence of a low overall level of activity causing even minor changes to result in high growth rates. The same caveat applies to Bulgaria and Romania, where the overall trend is less positive.
- Regions that merit specific policy attention due to an apparent lack of dynamics are large parts of Poland, eastern Germany, and the former industrial areas in Belgium, northern France and Germany as well as parts of rural Sweden, Italy and Romania.

With regard to the development of business R&D (Figure Annex 8), positive trends can be observed in Spain, Portugal, southern France, Italy, Latvia, Lithuania, Estonia and Finland. In contrast, business R&D intensity decreased in parts of France, Germany, Bulgaria, Poland, Romania, Greece and, remarkably, Sweden.

Comparison of the two periods (Figure 19, 2001-2003 vs. Figure 20, 2003-2005), however, results in the finding that the negative trend in the Swedish and the Polish systems could be reversed. In Germany and France, developments have remained stable. Besides Stockholm, Baden-Württemberg is a remarkable example of a leading region where growth actually picked up from the first to the second period. In contrast, trends in Romania and Bulgaria as well as in parts of Italy and Greece (where positive developments in some leading regions may compensate) were negative. It seems that some Mediter-

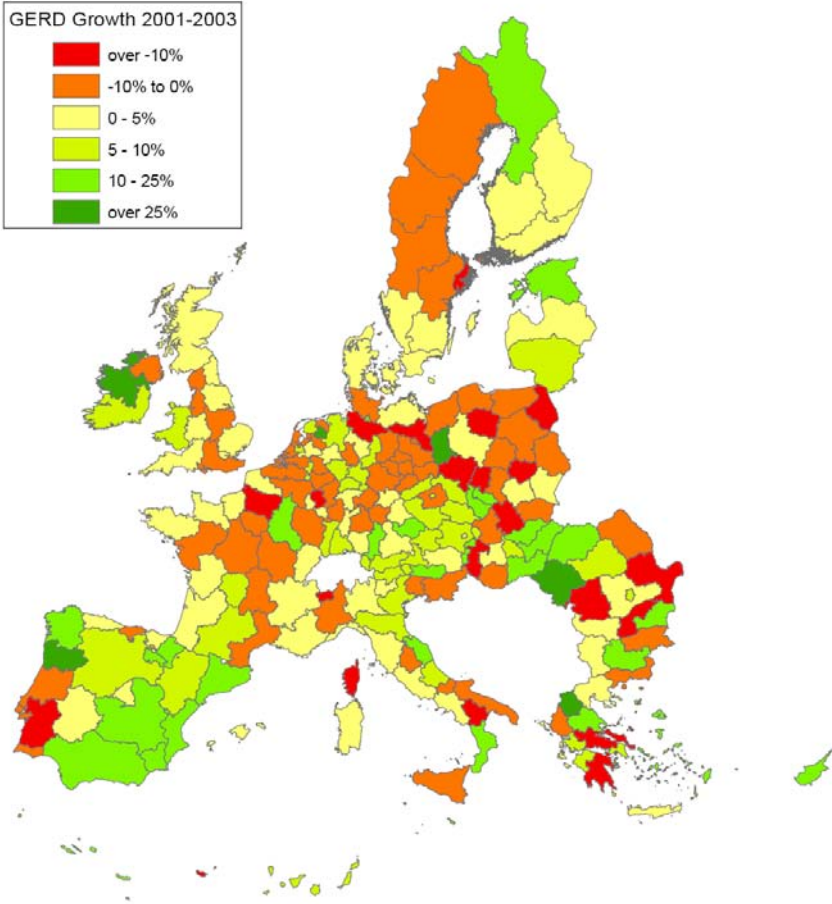
anean and new Member States (e.g. Spain, Portugal, the Baltic States, Hungary) have developed considerable impetus to integrate themselves into the ERA while others are still working towards that aim.

It is thus a positive finding to observe that in the period 2000-2005 (Figure Annex 9), public expenditures were significantly raised outside the centre. Again, the general trend can be read optimistically in terms of the integration of the periphery into the ERA. In contrast, the growth of expenditure on R&D in the leading regions does not sufficiently outpace GDP growth to increase regional R&D intensity. Also, some countries fall short of the task to increase public R&D in both leading and lagging regions. This applies to France, Germany, Italy, western Poland and Portugal. A comparison between the two periods confirms this impression (Figure 21, Figure 22). The trend has deteriorated for many regions in the major economies of Germany, Italy and France, while it has improved in the Czech Republic, Slovakia, Slovenia, Latvia and Romania; which still contribute little to overall EU27 public R&D intensity.

Interestingly, however, with regard to public R&D investment, the leading NUTS 2 regions seem to counter the, at first sight, negative or at best moderately positive trend in R&D spending in the key countries. For example, the trend has improved for Madrid, Paris, Midi-Pyrénées, parts of Sweden and remained steady in London. On the other hand, the development of Italy, large parts of rural France and, remarkably, Stockholm and Bavaria remains a case of concern.

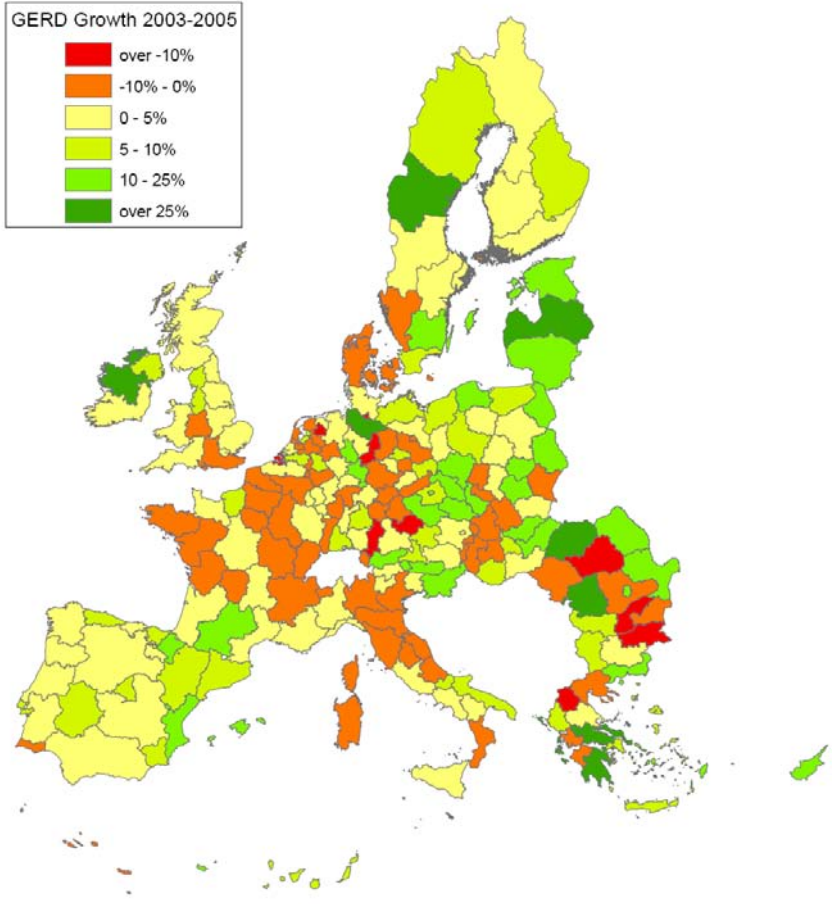
3 % Goal in European Regions

Figure 17: Average annual growth of total expenditure for R&D 2001-2003



Source: Regional Key Figures

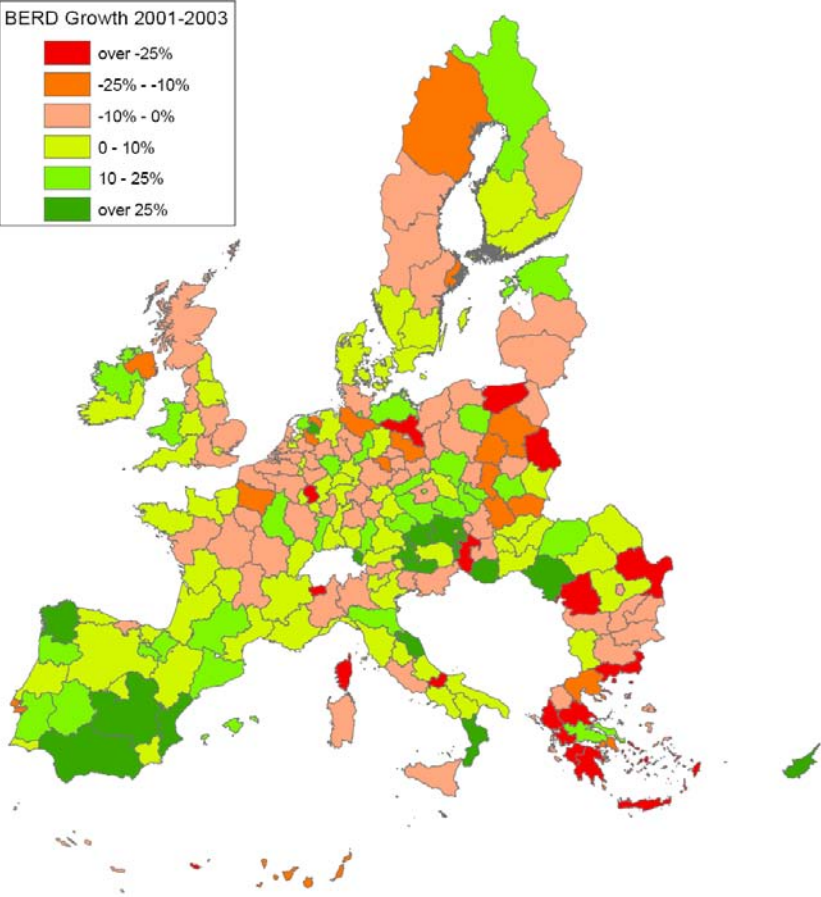
Figure 18: Average annual growth of total expenditure for R&D 2003-2005



Source: Regional Key Figures

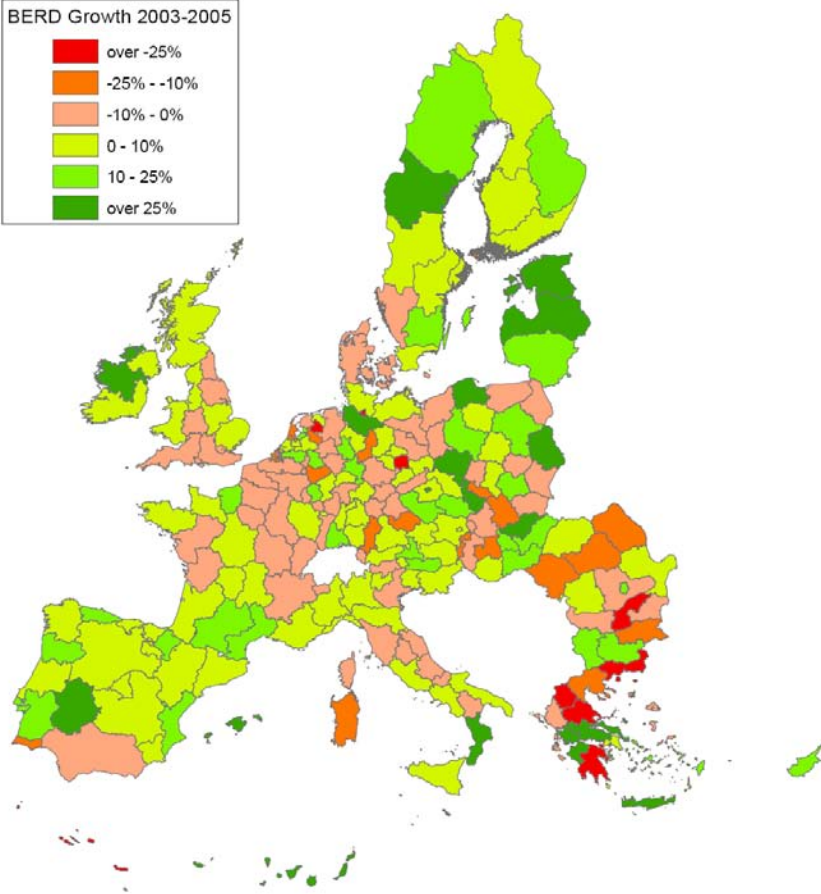
3 % Goal in European Regions

Figure 19: Average annual growth of business expenditure for R&D 2001-2003



Source: Regional Key Figures

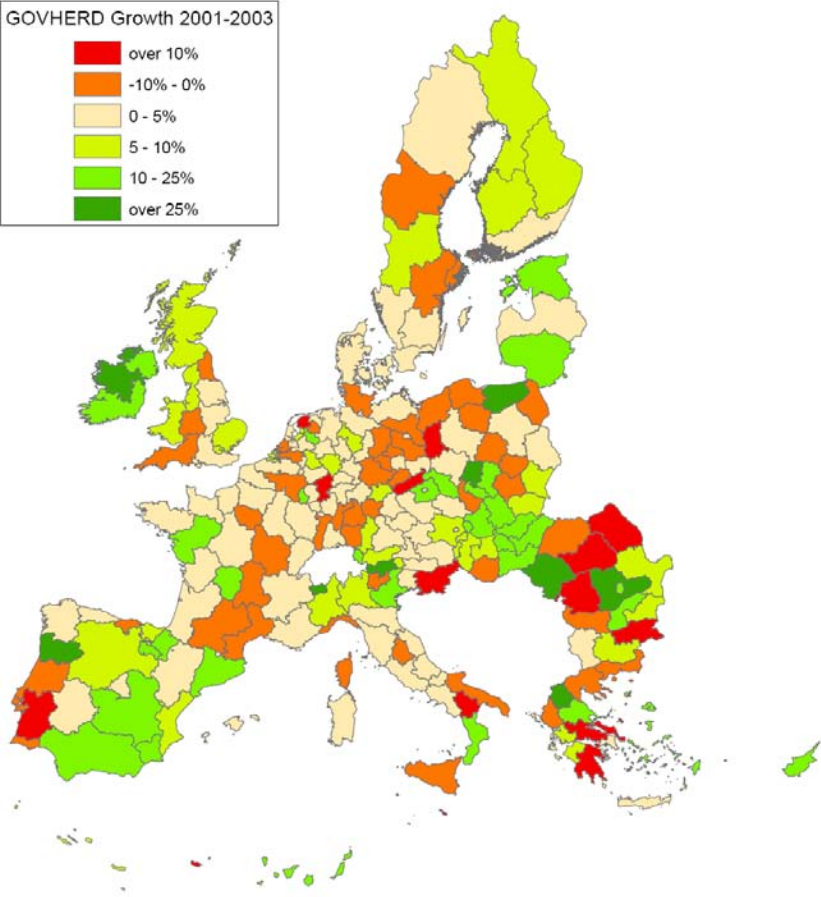
Figure 20: Average annual growth of business expenditure for R&D 2003-2005



Source: Regional Key Figures

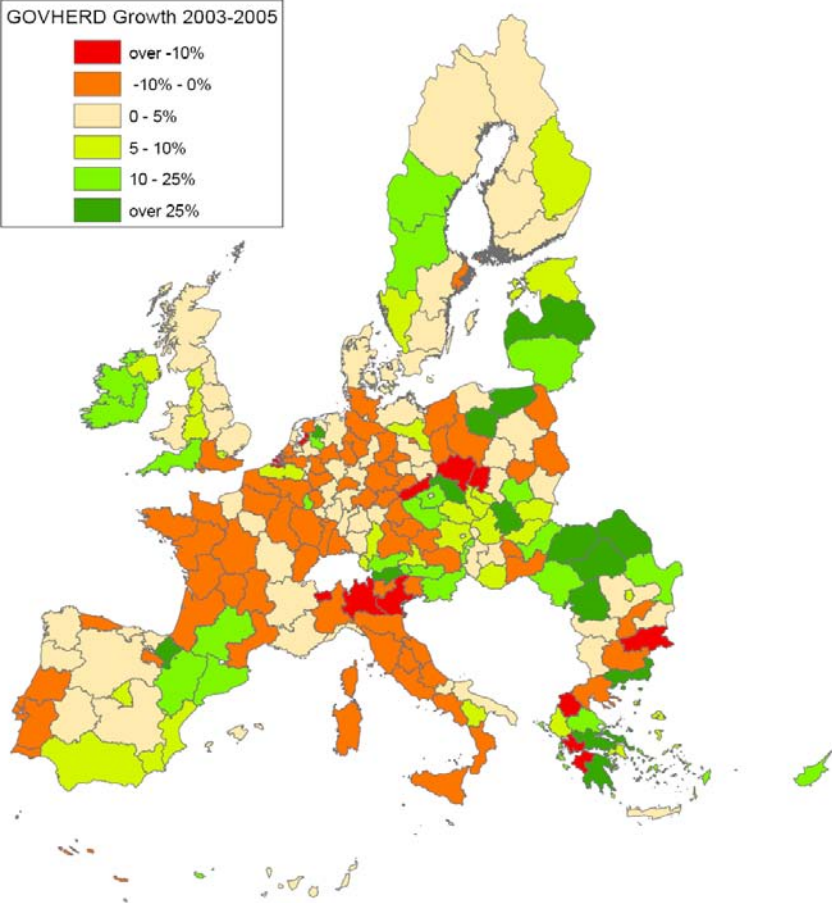
3 % Goal in European Regions

Figure 21: Average annual growth of public expenditure for R&D 2001-2003



Source: Regional Key Figures

Figure 22: Average annual growth of public expenditure for R&D 2003-2005



Source: Regional Key Figures

The regional distribution of R&D expenditure development: Structure of growth by performer

In order to further analyse the structural development of R&D expenditure in European regions, and to avoid the dependency of findings on GDP growth, it is instructive to analyse **absolute growth** in the field of business R&D expenditure and public R&D expenditure as well as the relation between those trends. Figure 23 and 24 show the absolute growth trends using the following categories of regions:¹³

- on average, neither public nor private expenditure changed by more than 2.5 % annually
- private and public expenditure increased by more than 2.5 % annually
- private and public expenditure decreased by more than 2.5 % annually
- private expenditure increased by more than 2.5 % while public expenditure decreased by more than 2.5 % annually
- private expenditure increased by more than 2.5 % while public expenditure remained stable (-2.5%-2.5% AAGR)
- private expenditure decreased by more than 2.5% while public expenditure remained stable (-2.5%-2.5% AAGR)
- public expenditure increased by more than 2.5 % while private expenditure decreased by more than 2.5 % annually
- public expenditure increased by more than 2.5 % while private expenditure remained stable (-2.5%-2.5% AAGR)
- public expenditure decreased by more than 2.5 % while private expenditure remained stable (-2.5%-2.5% AAGR)

¹³ Cluster analysis was investigated as an alternative approach, but did not produce more meaningful results.

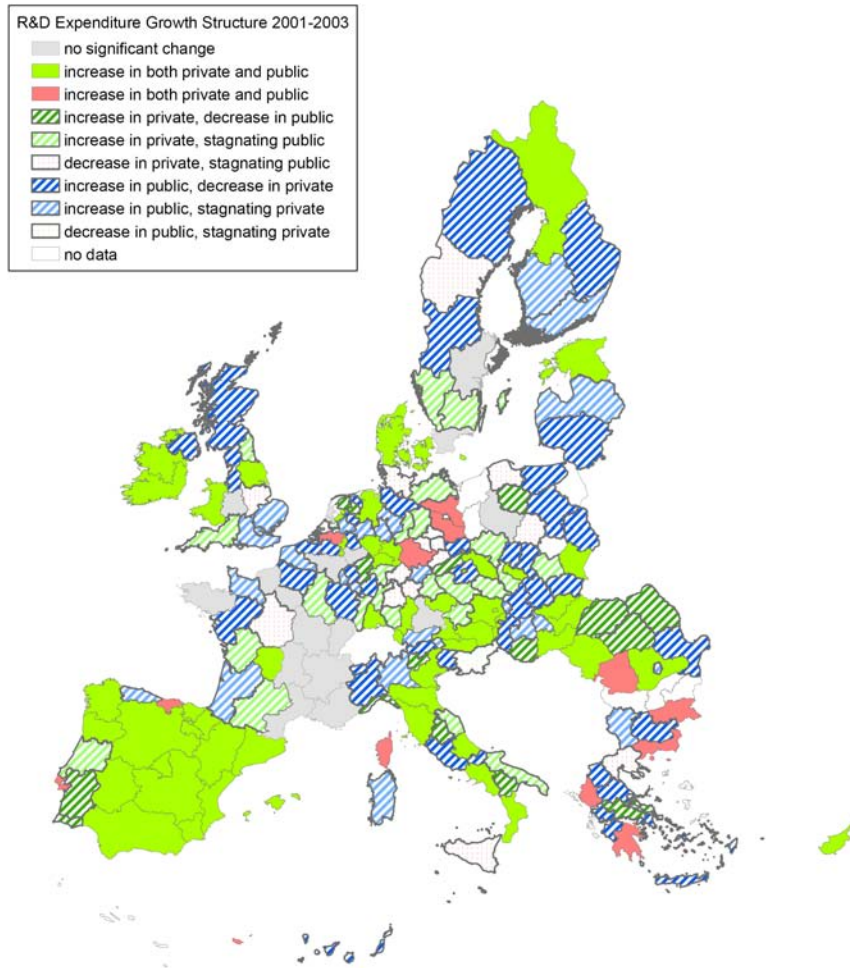
The data demonstrate that from 2001-2005, both public and private expenditure grew in parallel in Spain, Finland, Ireland, Latvia, Estonia, Cyprus and the eastern part of Hungary (Figure Annex 10). A simultaneous decrease of both, in contrast, was rare outside Corse and Sardegna. Similarly, there were few regions where private expenditure grew while public expenditure decreased. Public expenditure, in contrast, increased in some regions of Greece, Romania, Slovakia, and the UK as well as in Denmark and Lithuania, while private expenditure declined or stagnated. Similar developments can be observed in single regions in Belgium, Hungary, Poland, Sweden, and France. In a number of regions in France, Italy, Poland and Germany, the growth in business expenditure was not matched by growth in public investment.

When comparing the two periods 2001-2003 (Figure 23) and 2003-2005 (Figure 24) with regard to the structure of growth, it becomes apparent that increases in public expenditure in parallel with decreases in private expenditures were much more prevalent in the recession period 2001-2003 than in the period 2003-2005. In many regions which could have been a subject of concern in 2003 on this basis, simultaneous growth or at least stability prevailed from 2003 to 2005. Slovakia seems to have a particular problem in that private R&D has continued to decrease, despite increasing investment in public R&D.

In contrast, private expenditure growth accompanied by a decrease in public expenditure in the earlier period did not result in any characteristic outcome. A negative change of the trend in business expenditure growth can be observed in some regions of Romania, Greece and Andalucía. Developments in Greece and Romania, however, provide little substantial information due to the very low level of activity. For some regions, a continued growth in investment in public R&D during times of slack in the business sector may have contributed to the return to the path of growth. The data suggest, however, that this is strongly conditional on framework conditions.

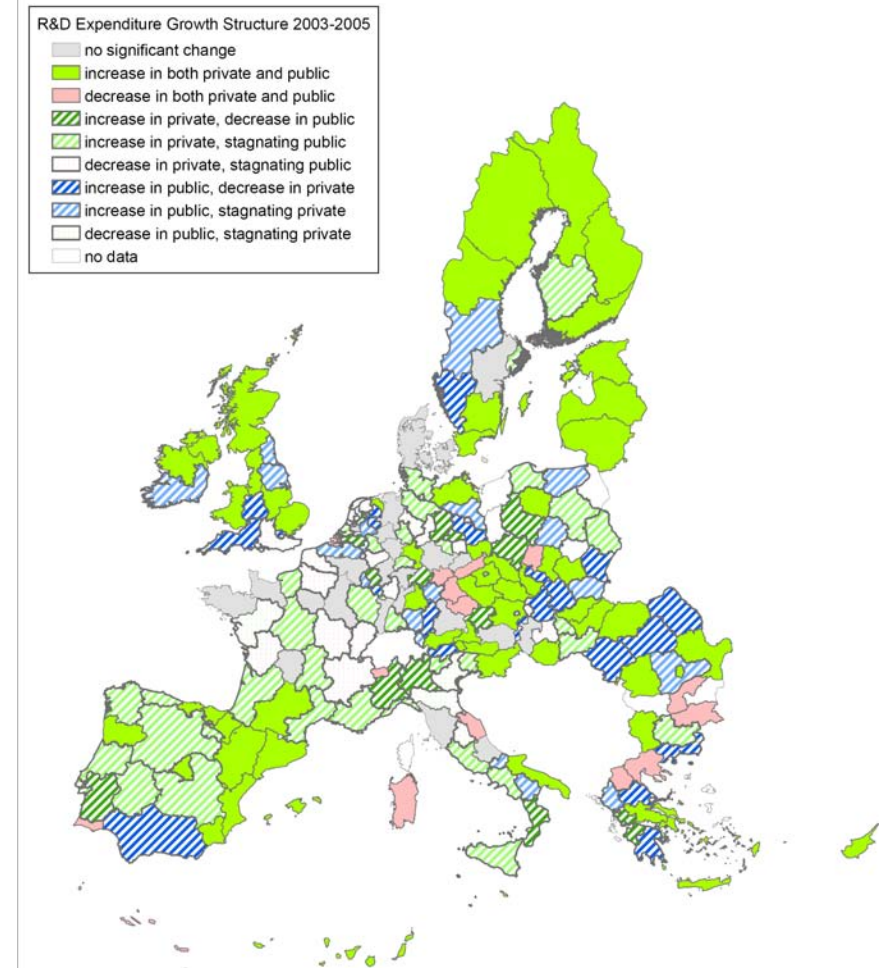
3 % Goal in European Regions

Figure 23: Structure of growth 2001-2003¹⁴



Source: Regional Key Figures

Figure 24: Structure of growth 2003-2005



Source: Regional Key Figures

¹⁴ It should be pointed out that this and the following figures illustrate relative growth. They do not provide information about structural starting conditions.

V The relevance of the 3 % objective for the attractiveness of NUTS 2 regions

The 3 % target is one of two pan-European headline objectives of the renewed Lisbon strategy after 2005. In the context of the Lisbon strategy, the 3 % target is a means to the end of competitiveness and employment, not the end in itself. Acknowledging that a one-size-fits-all numerical benchmark is not suitable for all countries in the short run, the renewed Lisbon strategy requires each Member State to contribute to the broader strategy according to its capabilities as set out by the Member States in their individual National Reform Programmes. All Member States, except Bulgaria, have set national targets reflecting their individual situations. Likewise, the Lisbon strategy does not propose setting specific R&D expenditure targets for individual regions.

The first obvious reason why a numerical target for "the regional level" cannot and has not been set is the extent of spatial disparities in the ERA system. Instead, the relevant question is to what extent R&D investments in some of such regions can be efficient and worthwhile, even if R&D intensity is not yet very high.

The second and more complex reason is that regionally-based actors in research and science interact across the boundaries of their (NUTS 2) regions and are embedded in multi-level knowledge flows, value chains and policy contexts and that, consequently, regional R&D activities do not necessarily feed knowledge into regional economic activity (only).

Recent econometric studies have again confirmed that while "in the US the generation of innovation usually occurs in self-contained geographical areas that rely on their own R&D inputs [the process in Europe] is much more linked not to just having an adequate socio-economic context, but to proximity to other innovative areas and to the capacity to assimilate and transform inter-regional knowledge

spillovers" (Crescenzi et al. 2007)¹⁵. The meaning of overall research intensity is a more complex matter at the regional than at the national level, since it has to take into account a strong set of pre-existing inter-regional hierarchies and interdependencies that cannot be changed in the short run.

Based on this understanding of multi-level embeddedness with regard to knowledge flows, value chains and policy contexts, the EU Commission approaches the question of research policy that takes effect at the regional level through the notions of "attractiveness" and "networked specialisation" (Commission of the European Communities 2005; Directorate-General for Research 2008) which are thought to enable weaker regions and to improve the performance of stronger ones. In more concrete terms, these notions imply that regional R&D investment (irrespective of its source) is worthwhile when it increases the attractiveness of the region for future investment in the research or industrial sector. Firstly, as civil R&D activities do not thrive in isolation, this may relate to the creation of a basic regional potential in the first place. Secondly, in more developed regions, it may relate to the establishment of fruitful complementarity between specialisation in the public and the private sectors.

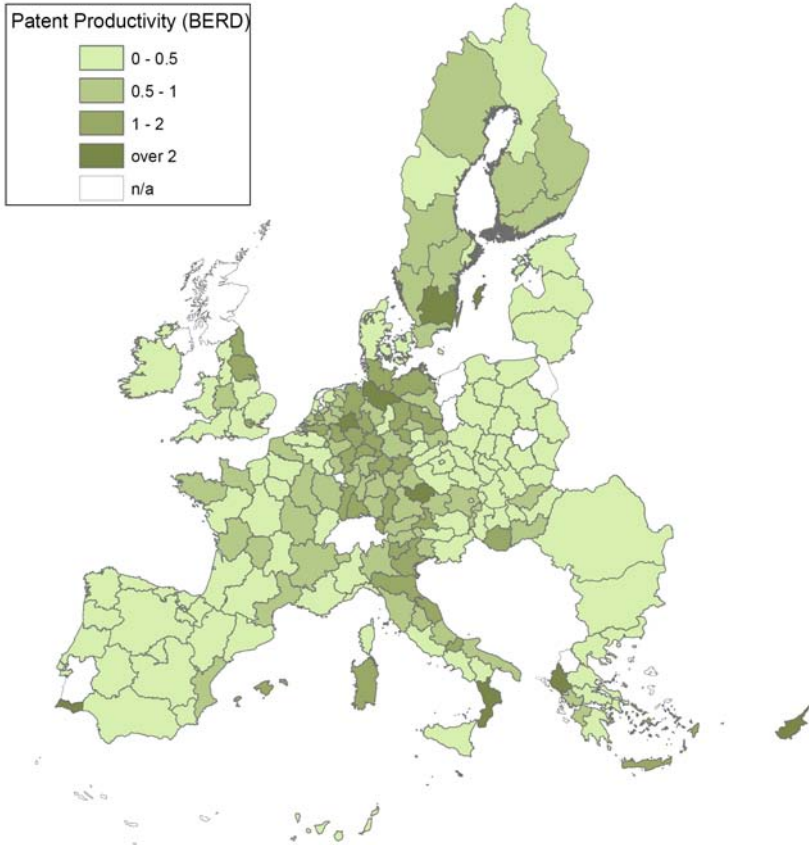
The attractiveness of regions: The issue of efficiency

To make regions more attractive, a research policy as defined above would want to favour and support research activities where input results in a comparatively high amount of output so that the investment increases the regional availability of knowledge and thus the region's attractiveness to future investors.

¹⁵ This finding may be attributed to the higher degree of socio-cultural and regulatory integration as well as the higher mobility of the educated labour force in the US. In the EU27, the distribution of both human capital and R&D activities has, at least for now, to be taken as a given framework condition to a higher degree. In other words, pre-existing regional interdependencies and disparities appear to be more relevant in the EU27 as they are less easily changed.

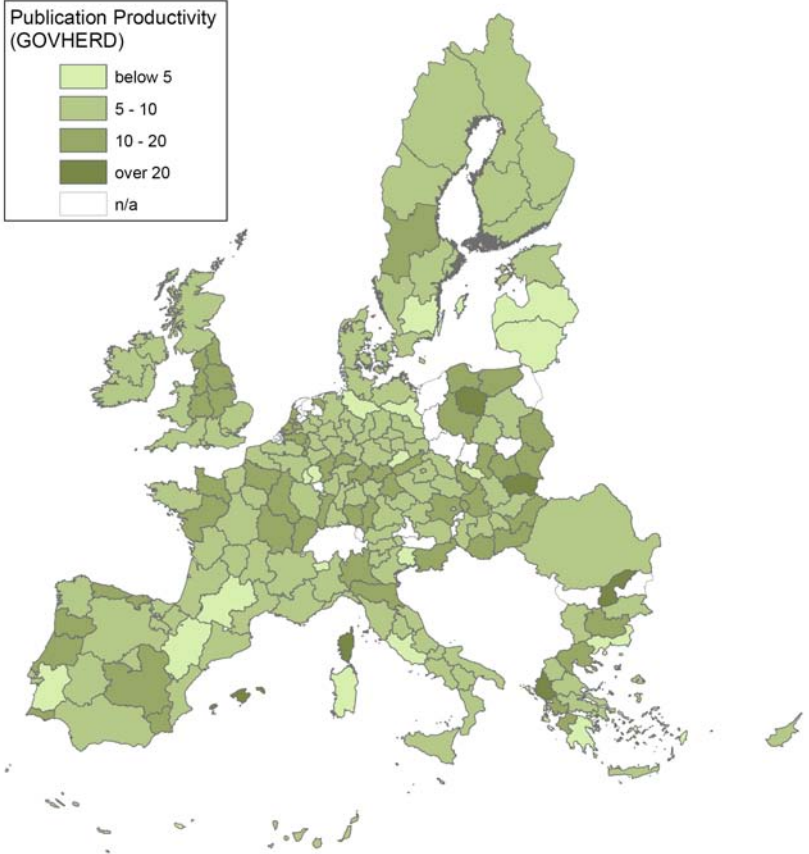
3 % Goal in European Regions

Figure 25: Productivity: Patents per business expenditure on R&D



Source: Regional Key Figures

Figure 26: Productivity: publications per public expenditure on R&D



Source: Thomson ISI / CWTS via Regional Key Figures

3 % Goal in European Regions

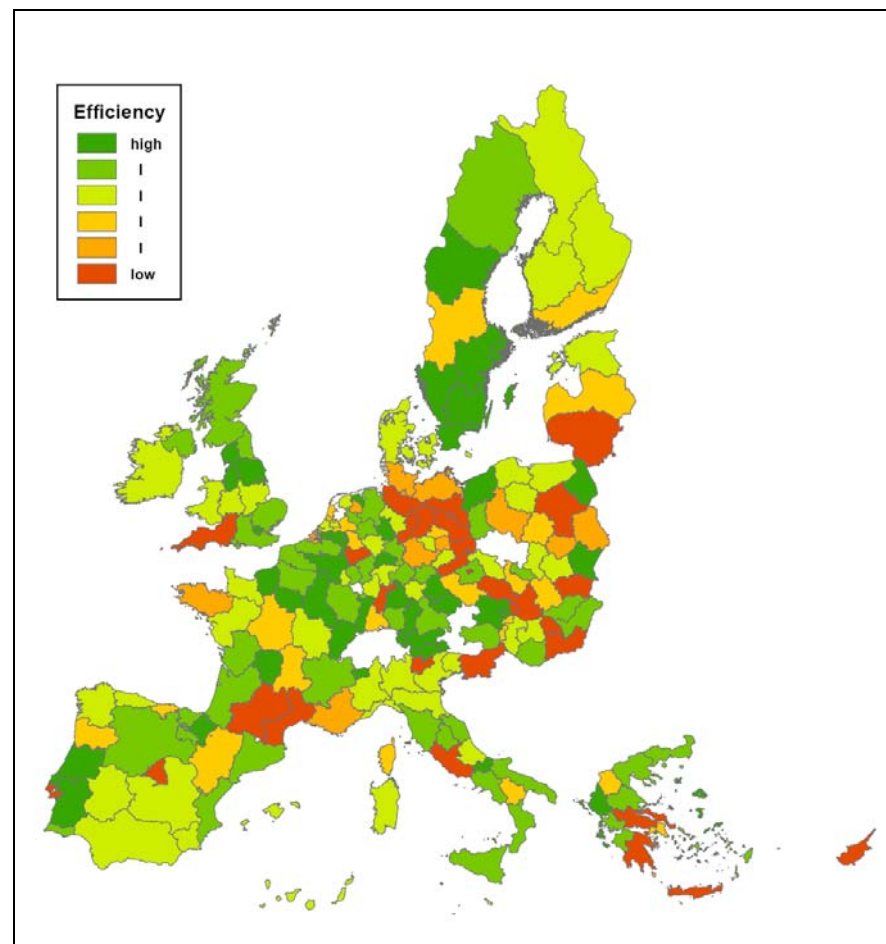
Very often, these issues are approached by analysing patent and publication **productivity**. This information is illustrated in Figure 25 and Figure 26, indicating that high patent productivity is even more spatially concentrated than publication productivity. Sometimes, therefore, this sort of analysis leads to the premature conclusion that business investment in research outside the centre is less worthwhile because it will be less productive. As elaborated above, however, regional framework conditions differ greatly. An analysis should thus not only take into account information about the level of productivity as such, but about the highest possible productivity that the regional research system under consideration could theoretically have achieved. Therefore, a worthwhile target for R&D investment in this context would not be a region with high productivity, but a region which is *performing well according to its capabilities*.

Such regions which perform "productivity **best practice**" in a group with similar framework conditions are, in economic theory, referred to as **efficient**. Information about **efficiency** rather than productivity can be obtained through data envelopment analysis.¹⁶

The model thus reflects to what degree the output of a regional research system matches that of other regional research systems where a similar amount of input is devoted to research.

As an **input**, the model considers **gross expenditure on R&D**, as a **two-dimensional output** it considers **both patents and publications**. Figure 20 below maps the results of the data envelopment analysis, i.e. the distribution of research efficiency across Europe: Clearly, research can also be efficient in peripheral regions

Figure 27: Overall efficiency of research based on DEA estimation



Source: Regional Key Figures

¹⁶ For methodological details, see Annex.

3 % Goal in European Regions

To corroborate this finding, an econometric analysis was conducted to explore whether regional research systems with a higher R&D intensity automatically display a higher efficiency (DEA) than those with a lower R&D intensity (GERD as % of GDP).

The following variables were included to control for other effects that are likely to influence efficiency:

- economic size (absolute GDP in PPS2000),
- structure of regional research system, (relation of business to public research expenditure),
- location in national innovation system (dummy variable).

Based on the analysis of the available RKF data, the result is that a simple relation between research intensity and efficiency cannot be identified and that there is no evident optimum (see model p. 33).

This demonstrates that research in regions with low research intensity can indeed be efficient and thus worthwhile while this will not necessarily be the case for all activities in regions with more than 3 % R&D intensity.

In line with the policy approaches taken by the European Commission, this model supports the notion that there is also a perspective for research in the periphery, even when these regions are starting their efforts from very low levels of R&D intensity.

It shows that research can be efficient and desirable in regions which are currently generating most of their value added in non-research related fields (and hence do not display a high R&D intensity). On the other hand, the model indicates that R&D efficiency seems to remain an issue in some regions with higher R&D intensity.

A second important issue is that the model finds that the structure of the local innovation system matters. Systems seem to become more efficient when a higher share of private sector investment is present.

While this finding does not permit the conclusion that public research would by nature have a detrimental effect on the efficiency of regional research systems, it strongly suggests that it is beneficial for the efficiency of a regional research system for public efforts to be complemented by private efforts. This is in line with the basic tenets of the "networked specialisation" approach.

Finally, the model indicates that there seems to be a tendency for some regions in certain national innovation systems to be more efficient than others. While there are a number of caveats connected to such an analysis and the results should not be over-interpreted, it appears noteworthy that – all other things being equal – higher efficiencies are not only found in regions located in countries such as Finland, Sweden and France, but also in regions in Italy, Spain and Portugal, which may not have been expected.

For policymakers the model thus has the following implications:

Evidently, it is not just R&D intensity but the composition of activities in a regional research system that matters with regard to the efficiency of R&D activities in the regional system. Consequently, the functional division of labour in R&D cannot solely be conceptualised in terms of regional disparities in R&D intensity. The specific regional institutional set-up and its embeddedness in multi-level knowledge flows, sectoral value chains and governance have an important mediating role. While this embeddedness can partially be proxied by national attribution, the analysis does not permit the simple conclusion that the efficiency of regional research systems *predominantly* depends on the national research system in which they are located. As illustrated by Figure 27, a remarkable differentiation of efficiency is to be observed within Member States, most evidently within Germany. In summary, the efficiency of R&D efforts varies across Europe independently of R&D intensity and national attribution, so that, at all political levels, benefits can be expected from mutual learning and best-practice exchange on a European scale.

3 % Goal in European Regions

Figure 28: Regression model I: Efficiency

Dependent Variable: DEA Score

	Coef.	Std. Err.	p-val
GERD (% of GDP)	0.0610	0.0487	0.2120
GDP (PPS 2000)	0.0000	0.0000	0.5660
BERD/GERD	-0.0592 ***	0.0171	0.0010
at	-1.3438 **	0.6348	0.0360
be	-1.4899 **	0.6665	0.0270
cz	-0.6859	0.6100	0.2620
de	-1.0266 *	0.5850	0.0810
dk	-1.3158	0.8199	0.1100
ee	-1.4637 *	0.8082	0.0720
es	-1.3147 **	0.5890	0.0270
fi	-1.4924 **	0.6400	0.0210
fr	-1.2603 **	0.5887	0.0340
gr	-1.0398 *	0.5930	0.0810
hu	-1.0905 *	0.6110	0.0760
ie	-1.2412	0.8136	0.1290
it	-1.3010 **	0.5582	0.0280
lt	-0.4834	0.8082	0.5500
lu	-0.8572	0.8271	0.3010
lv	-1.2063	0.8080	0.1370
mt	-1.4539 *	0.8080	0.0740
nl	-1.1396 *	0.6034	0.0610
pl	-1.1868 **	0.5922	0.0470
pt	-1.3244 **	0.6264	0.0360
se	-1.8072 ***	0.6250	0.0040
sk	0.1803	0.6429	0.7790
si	-0.2415	0.8102	0.7660
uk	-1.3911 **	0.6046	0.0230
cons	2.7362	0.5715	0.0000
/sigma	0.5713	0.0293	
LR chi2(27)	59.41 ***		
Pseudo R2	0.1449		

Note: 2001 data, NL23 excluded as outlier (otherwise no visible country effects)

Efficiency is high when explained variable is low (see Annex).

Source: own calculation

What to do: Options for policy action

Based on the finding that public efforts need to be complemented by private efforts in order to make regional research systems efficient, the question remains: Which sort of policy intervention will help to make regional research systems attractive to private investment?

The question to be answered in this context is whether regional investment in public sector R&D will, possibly with a time lag, automatically trigger investment in private sector R&D.

The policy approach currently taken by the EU Commission supports this general notion, but cautions that private and public sector R&D are performed by two distinct socio-economic systems (the public research and the private business system) that partially follow different internal logics. Interactions between the two systems take place in a multi-level process in which interactive links and the matching of competences do not necessarily take place regionally. Even when co-located, activities in either one of these systems will therefore not automatically be relevant for those in the other *at the regional level*. Without such mutual relevance, however, public R&D investment can hardly trigger complementary private efforts.

To find out about the current situation, panel models were used to investigate whether the direct effects of investment in public R&D (GOVERD+HERD (t)) on business R&D (BERD) have been able to be observed at the regional level in the recent past. The analysis was based on data from the RKF database for the years 2000 to 2005, including data for the preceding five years to build time-lagged variables (GOVERD+HERD (t-x)). To take into account possible effects of economic size, overall wealth, regional spillovers, and economic cycles, the following control variables were included in the model.

- Gross domestic product (GDP): economic size,
- Gross domestic product per capita (GDP per capita): overall wealth,
- Spatially lagged GERD: knowledge spillovers from adjacent regions,
- Dummy indicating if observation from year 200[x]: economic cycles.

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Figure 29: Regression model II: Impact of public investment

Dependent Variable: BERD

	Coef.	Std. Error	p-val.
GOVERD+HERD (t-5)	-0.2023	0.1358	0.1368
GOVERD+HERD (t-4)	0.3472 **	0.1516	0.0223
GOVERD+HERD (t-3)	-0.4509 *	0.2403	0.0611
GOVERD+HERD (t-2)	-0.1817	0.1677	0.2791
GOVERD+HERD (t-1)	-0.0269	0.1187	0.8206
GOVERD+HERD (t)	0.2526	0.2430	0.2990
GDP	0.0095 ***	0.0027	0.0005
log GDP (in 1000) per Capita	-20.2270 *	11.5450	0.0802
GERD (2nd spatial Lag)	-0.0131	0.0096	0.1736
GERD (1nd spatial Lag)	0.0117	0.0083	0.1631
year2001	39.7060 ***	14.4100	0.0060
year2002	72.4870 ***	23.3520	0.0020
year2003	81.7010 ***	30.0720	0.0068
year2004	86.3430 **	36.3670	0.0179
year2005	123.3700 ***	47.6890	0.0099

Source: own calculation

The results demonstrate that a positive effect of public R&D investments on business R&D expenditure can be detected with a four year time lag. There is also, however, a close to significant negative effect with a three year time lag, so that the overall picture remains somewhat ambiguous. Additionally, the result is strongly conditional on the consideration of economic size and time effects, indicating that the effect is prone to be superposed by economic cycles.

Consequently, our findings underwrite the current policy position that R&D intensity cannot be increased by simply raising *any* regional investment in public R&D. To achieve the desired complementarity of public and private efforts at the regional level, a more complex policy approach will be needed that takes into account the effects of the multi-level embeddedness of regions, the internal logic of the private sector and the regional match of competences.

It is possible that the average effect would be stronger if networked specialisation had already become a reality in more regions of the EU27. If networking between the public and the private R&D sector were to be improved at a regional level, public investment in R&D could possibly develop a higher leverage for regional attractiveness.

Results by country and R&D expenditure size groups

In view of these findings it appeared worthwhile to analyse the effects of public investments by groups of regional research systems (see Annex). The results can be summarised as follows:

In the business-driven core countries of the EU27, public R&D investment does not have a directly significant positive impact on business R&D investment. If present at all, effects are negative. In these countries, many firms are internationally networked and apparently more likely to primarily react to shifts in international business requirements than to changes in the regional R&D base. This assumption is supported by the high relevance of time effects which point at the importance of business cycles for private R&D.

For the southern periphery, the results appear unclear, fuzzy and to a degree stochastic. In these regions, business investment in R&D cannot be found to be subject to economic cycles. Public investment in R&D displays a weak tendency to benefit business investment in R&D in the short run, while it has a significantly negative impact in the long run. This suggests that, in the periphery, policy efforts are likely to bear fruit in the short term, but need to be stabilised to last.

In Eastern Europe, in contrast, the effects of public investment in R&D are strongly significant and positive, with a typical time lag of between three and five years. The immediate effect, however, is significantly negative. While the exact causal link is not clear, this remarkable finding seems to indicate that a time-lagged, but in broad terms simultaneous build-up of R&D capacities is taking place in regions in the new Member States.

VI Summary and policy conclusions

In short, the presented analysis of the development of regional R&D expenditure and regional R&D intensity in the light of the 3 % objective can be summarised as follows:

Despite visible catching-up tendencies, the European Research System remains driven by a limited number of leading regions which account for a dominant share of investment (the top 25 regions account for about 50 % of expenditure). Consequently, there is a structural need to support the participation of “middle range” regions in European research efforts and to enhance their capacity for adopting research findings generated elsewhere (absorptive capacity). Evidence suggests, however, that such a process will need time as the spatial distribution of R&D spending in Europe has proven to be quite persistent in the past.

The technical realisation of any quantitative short-term target for R&D intensity (such as those defined for 2010-2012), will therefore most likely be dependent on increases in regions with a potential for increase from an already existing critical mass of R&D activity. The evidence on trends presented in this booklet suggests that the alternative scenario of a substantial increase in the short term of R&D activities in many “middle range” regions is less likely.

Our empirical findings suggest that, so far, neither the key regions nor those in the “middle field” have substantially contributed to a community-wide increase in R&D intensity. Overall, the increases in R&D spending have not been sufficient to reach the Barcelona 3 % target. Instead, R&D intensity has been characterised by stagnation. On the other hand, EU policy does seem to have contributed towards the build-up of R&D capacities in lagging regions, thus increasing the potential for long-term structural change. This trend is particularly evident in the second half of the period from 2001 to 2005 and will possibly gain momentum in the long run.

The study also suggests that the build-up of a public research base is relevant with that long-term aim in mind, since private R&D spending outside the established centres of R&D activity exhibits a strong tendency to be subject to economic cycles. In more peripheral regions and under certain framework conditions, public investment in times of downturn does seem to lay the foundations for a renewed increase in private expenditure once the economy picks up again.

Furthermore, our analysis has shown that, particularly in peripheral regions, the productivity of research seems to depend strongly on the local situation. Likewise, however, it has revealed that peripheral investment can indeed be efficient and worthwhile. The findings thus suggest that, in many cases, peripheral regions have a relevant potential to contribute to the overall Lisbon objective of increasing competitiveness and employment. Moreover, it has been demonstrated that there are differences in efficiency regardless of the current level of R&D expenditure and national attribution. Consequently, learning from European best practices makes sense for both the leading and the lagging regions.

Finally, this booklet has highlighted that regionally co-located activities in public and private research are not a priori interrelated at the regional level. Our analysis has shown that, for now, public investment in R&D in a certain region cannot be found to directly induce the co-location of private R&D activities in the same region. Instead, actors from the public and the private R&D sectors need to be seen as interacting in multi-level systems.

In many cases, apparently, an environment still has to be created which favours the establishment of regional interrelations between public and private activities. It is possible that with greater coordination of the public and private activities at regional level across Europe (as is being targeted under the heading of “networked specialisation”), an analysis of the regional interrelatedness of R&D spending trends would show different results in the future.

References:

- André, M. (2006): L'espace européen de la recherche: histoire d'une idée, *Journal of European Integration History*, 12, 131-150.
- Banchoff, T. (2003): Political Dynamics of the ERA. In: Edler, J./Kuhlmann, S./Behrens, M. (eds.): *Changing Governance of Research and Technology Policy. The European Research Area*. Cheltenham, UK, Northampton, MA; USA: Edward Elgar, 81-97.
- Breschi, S./Lissoni, F. (2001): Knowledge Spillovers and Local Innovation Systems: A Critical Survey, *Industrial and Corporate Change*, 10, 975-1005.
- Caracostas, P. (2003): Shared Governance Through Mutual Policy Learning: Some Implications of the ERA Strategy for the 'Open Co-ordination' of Research Policies in Europe. In: Edler, J./Kuhlmann, S./Behrens, M. (eds.): *Changing Governance of Research and Technology Policy. The European Research Area*. Cheltenham (UK): Edward Elgar Publishing, 33-63.
- Commission of the European Communities (1998): *Reinforcing Cohesion and Competitiveness through Research, Technological Development and Innovation*, Communication from the Commission to the European Parliament, the Council, the Committee of the Regions and the Economic and Social Committee. Brussels.
- Commission of the European Communities (2000a): *Making a reality of The European Research Area: Guidelines for EU research activities (2002-2006)*. Communication from the Commission to the Council, the European Parliament, the Economic and Social Committee and the Committee of the Regions, COM2000 (612) final. Brussels.
- Commission of the European Communities (2000b): *Towards a European Research Area. Communication from the Commission to the Council, the European Parliament, the Economic and Social Committee and the Committee of the Regions*, COM(2000) 6 final. Brussels.
- Commission of the European Communities (2001): *The Regional Dimension of the European Research Area. Communication from the Commission*, COM(2001) 549 final. Brussels.
- Commission of the European Communities (2002): *More Research for Europe. Towards 3% of GDP. Communication from the Commission*, COM(2002) 499 final. Brussels.
- Commission of the European Communities (2003): *Investing in research: an action plan for Europe. Communication from the Commission*, COM(2003) 226 final/2. Brussels.
- Commission of the European Communities (2005a): *Building the ERA of knowledge for growth. Communication from the Commission*, COM(2005) 118 final. Brussels.
- Commission of the European Communities (2005b): COMMUNICATION FROM THE COMMISSION Cohesion Policy in Support of Growth and Jobs: Community Strategic Guidelines, 2007-2013; COM(2005) 0299.
- Commission of the European Communities (2005c): *Working together for growth and jobs. A new start for the Lisbon Strategy. Communication from President Barroso in agreement with Vice-President Verheugen to the Spring European Council*, COM(2005) 24 final. Brussels.
- Commission of the European Communities (2007a): *Commission Staff Working Document Accompanying the Green Paper 'The European Research Area: New Perspectives'*, SEC(2007) 412/2. Brussels.

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- Commission of the European Communities (2007b): *Competitive European Regions Through Research and Innovation. A contribution to more growth and more and better jobs*. Brussels.
- Commission of the European Communities (2007c): *Integrated Guidelines for Growth and Jobs (2008-2010) including a Commission Recommendation on the broad guidelines for the economic policies of the Member States and the Community (under Article 99 of the EC Treaty) and a Proposal for a Council Decision on guidelines for the employment policies of the Member States (under Article 128 of the EC Treaty), presented by the Commission. Communication from the Commission to the Spring European Council, COM(2007) 803 final, Part V*. Brussels.
- Commission of the European Communities (2007d): *The European Research Area: New Perspectives. Green Paper 04.04.2007, COM(2007) 161*. Brussels: European Commission, Directorate-General for Research.
- Commission of the European Communities (2008): *Competitive European Regions through Research and Innovation. Practical Guide to EU Funding Opportunities for Research and Innovation*.
- Committee of the Regions (2007): *Study on structural capacity and motivation of regions and local and regional authorities in R&D. Study performed by Application Européenne de Technologies et de Services (AETS)*.
- Committee of the Regions (2008): Opinion of the Committee of the Regions on 'More efficient support for research and innovation in EU regions', *Official Journal of the European Communities*, 2008/C 105/01, 1-6.
- Council of the European Union (2005): *Presidency Conclusions. European Council Brussels 22 and 23 March 2005*. Brussels.
- Council of the European Union (2007a): *Presidency Conclusions, Brussels European Council 14 December 2007*. Brussels.
- Council of the European Union (2007b): *Presidency Conclusions, Brussels European Council 8/9 March 2007*. Brussels.
- Council of the European Union (2008): *Council Conclusions on the launch of the "Ljubljana Process" - towards full realisation of ERA*. Brussels.
- Crescenzi, R./Rodriguez-Pose, A./Storper, M. (2007): The territorial dynamics of innovation: a Europe-United States comparative analysis, *Journal of Economic Geography*, 7, 673-709.
- Directorate-General for Research, E.C. (2008): **Challenging Europe's Research: Rationales for the European Research Area (ERA)** Report of the ERA Expert Group.
- Dory, T. (2005): Challenges for Regions in the European Research Area. Presentation at the 2nd PRIME PhD Summer School Budapest, 2-9 July 2005. Online: http://www.prime-noe.org/Local/prime/dir/Training%20&%20Education/Budapest%20Summer%20School/Dory_presentation.pdf (accessed: 28.07.2008).
- Dory, T. (2008): *RTD policy approaches in different types of European regions. JRC Scientific and Technical Reports*. Luxembourg: European Commission. Joint Research Centre - Institute for Prospective Technological Studies. Directorate General Research.

3 % Goal in European Regions

- Edler, J./Kuhlmann, S. (2005): Towards One System? The European Research Area Initiative, the Integration of Research Systems and the Changing Leeway of National Policies. *Technikfolgenabschätzung - Theorie und Praxis* Nr.1, 14.Jg., März 2005, 59-68. Online: <http://www.itas.fzk.de/tatup/051/edku05a.pdf> (accessed: 28.07.2008).
- European Council (2002): *Presidency Conclusions. Barcelona European Council 15 and 16 March 2002.*
- European Parliament (2000): Presidency Conclusions, Lisbon European Council 23 and 24 March 2000. Online: http://www.europarl.europa.eu/summits/lis1_en.htm (accessed: 18.07.2008).
- Gregersen, B./Johnson, B. (1997): Learning Economies, Innovations Systems and European Integration, *Regional Studies*, 31, 479-490.
- Jaffe, A./Trajtenberg, M./Henderson, R. (1993): Geographic Localization of Knowledge Spillovers as Evidenced by Patent Citations, *The Quarterly Journal of Economics*, 108, 577-598.
- Koschatzky, K. (2001): *Räumliche Aspekte im Innovationsprozess. Ein Beitrag zur neuen Wirtschaftsgeographie aus Sicht der regionalen Innovationsforschung*, Reihe Wirtschaftsgeographie. Münster: LIT Verlag.
- Larédo, P. (2006): A tentative foresight of the European Research Area. Contribution to the preparation of the seventh Framework Programme. Background paper to the international seminar on "myths and realities of innovation in the European Union", Madrid, April 21-25, 2006. Online: <http://www.prime-noe.org/Local/prime/dir/Laredo%20Publications/Madrid%20Background%20PL%202006.pdf> (accessed: 19.06.2008).
- Myllyvirta, J. (2008): The Impact of Research Infrastructures on the Regional Dimension of the ERA. Presentation at the Conference "Research Infrastructures and their Structuring Dimension Within the European Research Area" 5-6 March 2008 Brdo, Slovenia. Online: http://www.riera.si/1_Myllyvirta.ppt (accessed: 05.08.2008).
- Niessler, R. (2008): Research Infrastructures in Europe - the Role of the European Union. Presentation at the Conference 'Research Infrastructures and their Structuring Dimension within the European Research Area' , Brdo, Slovenia, 5-6 March 2008. Online: http://www.riera.si/3_niessler.ppt#10 (accessed: 01.08.2008).
- Peter, V. (2000): The European Research Area. A new vision for Europe's future. Paper presented at the 4th International Conference on Technology Policy and Innovation 28-31/08/2000, Curitiba, Brazil. Online: ftp://ftp.cordis.europa.eu/pub/indicators/docs/ind_wp_vp1.pdf (accessed: 14.07.2008).
- Schibany, A./Streicher, G. (2008): Aiming high – revisited. An updated assessment of the 3%-target. Joanneum Research, Institute of Technology and Regional Policy, *InTeReg Working Paper No.50-2008.*
- Tappeiner, G./Hauser, C./Walde, A. (2008): Regional knowledge spillovers: Fact or artifact, *Research Policy*, 37, 861-874.

Annex

Lorenz Curve

The Lorenz curve is a graphical representation of a distribution function; it is a graph showing the proportion of the distribution assumed by the bottom $y\%$ of the values. It was originally developed by Max O. Lorenz in 1905 to represent income distribution, whereas in this booklet it is used to illustrate the distribution of R&D expenditure across European Regions. It illustrates what percentage $y\%$ of the total R&D expenditure is spent in the bottom $x\%$ of regions. The percentage of regions is plotted on the x-axis, while the percentage of R&D expenditure is plotted on the y-axis.

For a population of size n , with a sequence of values y_i , $i = 1$ to n that are indexed in non-decreasing order ($y_i \leq y_{i+1}$), the Lorenz curve is the continuous piecewise linear function connecting the points (F_i, L_i) , $i = 0$ to n , where $F_0 = 0$, $L_0 = 0$, and for $i = 1$ to n .

$$F_i = i/n$$

$$S_i = \sum_{j=1}^i y_j$$

$$L_i = S_i/S_n$$

Gini Coefficient

The Gini coefficient is a measure of statistical dispersion, commonly used as a measure of the inequality of income distribution or the inequality of wealth distribution.

It is defined as a ratio with values between 0 and 1: A low Gini coefficient indicates more equal, while a high Gini coefficient indicates more unequal distribution. 0 corresponds to perfect equality (e.g. each region spends exactly the same amount on R&D) and 1 corresponds to perfect inequality (e.g. all expenditure is concentrated in one region, while there is none in all the others).

The Gini index is defined as a ratio of the areas on the Lorenz curve diagram. If the area between the line of perfect equality and Lorenz curve is A , and the area under the Lorenz curve is B , then the Gini index is $A/(A+B)$. Since $A+B = 0.5$, the Gini index, $G = A/(0.5) = 2A = 1-2B$. If the Lorenz curve is represented by the function $Y = L(X)$, the value of B can be found with integration.

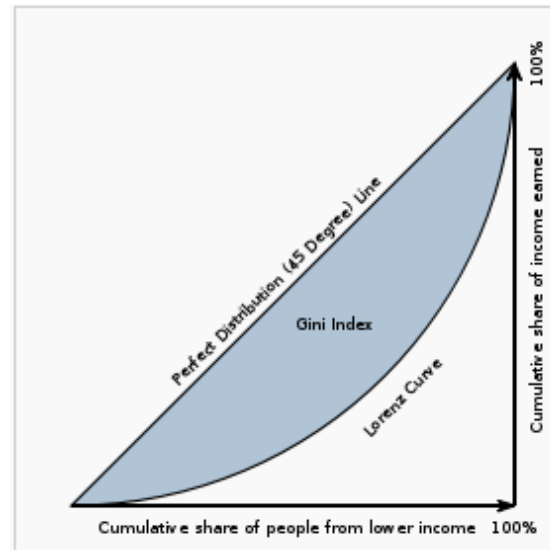
$$G = 1 - 2 \int_0^1 L(X) dX.$$

If the Lorenz curve is approximated at each interval as a line between consecutive points, then the area B can be approximated with trapezoids and:

$$G_1 = 1 - \sum_{k=1}^n (X_k - X_{k-1})(Y_k + Y_{k-1})$$

is the resulting approximation for G .

Figure Annex 1: Lorenz Curve and Gini Coefficient



Data envelopment analysis

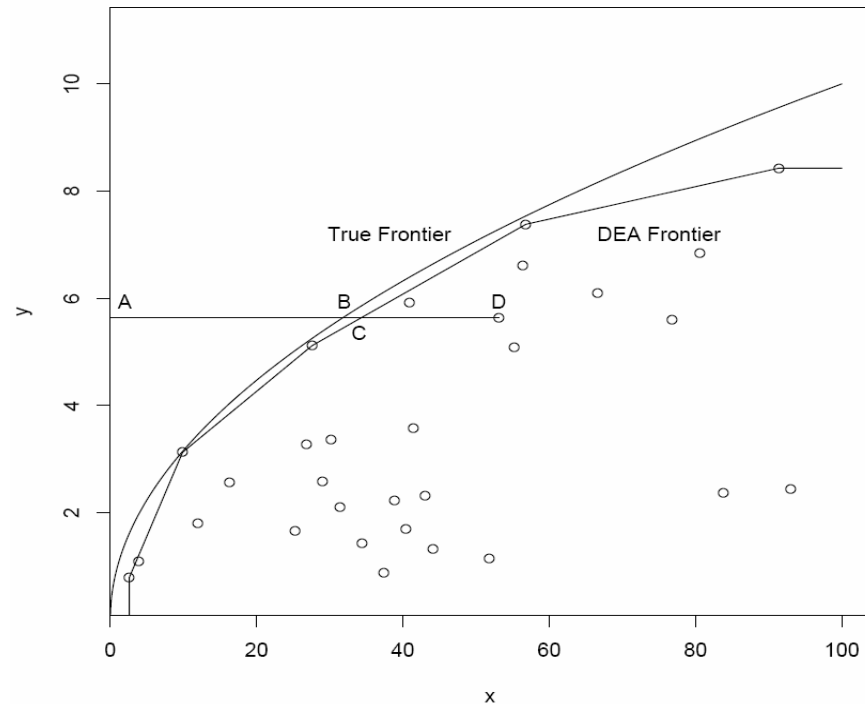
Data envelopment analysis, DEA, is one of many procedures used in non-parametric efficiency estimation. The idea of efficiency analysis is that a so-called decision-making unit (firms, persons, regions) commands a set of inputs to produce certain outputs. The efficiency model assumes that, given a certain amount of input, there is a technological limit to the production of outputs, i.e. a unit cannot produce more than this output. The union of all these maximum points which correspond to a specific input amount is called the theoretical frontier. Units falling short of this theoretical frontier are inefficient. Inefficiency is usually quantified by radial measures. If the theoretical frontier is observed, the estimation of inefficiency would be a trivial task. However, this is usually not the case. Instead only a given number of units are observed for which we have sample values of inputs and outputs. Using these data points, DEA is one way of estimating the theoretical frontier from the observed data.

In particular, DEA constructs the estimated frontier as the smallest convex hull "enveloping" all data points in the sample.

To exemplify this notion, consider the one-input-one-output-case depicted in the figure below, where the true frontier is given as $y = \sqrt{x}$. x is taken to be non-random, and inefficiency is generated by $y^{obs} = y \cdot \exp(-|u|)$ with $u \sim N(0,1)$. The small circles give observed sample coordinates for the units. The smallest convex hull which envelops all the data points is the DEA frontier. Obviously, the DEA frontier does not coincide with the theoretical frontier, but if more and more units are observed, the DEA frontier will converge to it (Kneip et. al, 1998). Using this estimated frontier, it is easy to define a measure of inefficiency. In the input-direction this is simply the used input divided by the input needed to provide this output level. Looking at the figure given below, and focussing on the inefficient point D , this is given by the ratio of the length of line segment AD divided by the length of the line segment AC , whereas

the true but unobserved inefficiency measure is $|AD|/|AC|$. Two things are important to note. Firstly, this input-inefficiency measure may take values of 1 and above, because $|AC| \leq |AD|$.

Figure Annex 2: DEA estimation



Secondly, a value of 1 indicates that the unit is efficient, because then the unit is on the frontier. Any value greater than 1 indicates inefficiency. Thus low values are desirable. Also note that DEA also works for the multiple-input-multiple-output case. The interpretation of the measures remains the same.

Explaining DEA measures

It is often the case that not only the mere inefficiency measure is of interest, but also why it takes a certain value. This corresponds to the task of explaining why a unit is inefficient. One way to answer this question is by employing the two-step methodology proposed by Simar and Wilson (2007), where inefficiency measures are calculated by DEA and then regressed on a set of additional explanatory variables. Both authors propose a complicated algorithm, which corrects several statistical problems. In this booklet, we use a closely related, but much simpler methodology and in our one-input-two-outputs case used for the DEA estimations asymptotically equivalent. We simply calculate DEA scores in the first step, and regress them on a set of explanatory variables using the Tobit-regression (see Figure 28) in the second. Tobit-regression is a maximum-likelihood approach which takes into account that the dependent variable (here the DEA score) only has limited support. As explained above, the input-inefficiency measure is limited to the interval $[1, \infty[$. A detailed explanation of the Tobit model can be found in many references, among them Wooldridge (2002, Ch. 16).

Panel data modelling

The objective of using panel data in regression analysis is primarily that it is possible to account for unobserved heterogeneity. Econometricians call unobserved heterogeneity any time-constant characteristic of the sample units (in our case the NUTS 3 regions) which cannot be observed and thus does not enter regression. This unobserved heterogeneity, which potentially consists of a multitude of factors, leads to a loss of precision if it is uncorrelated with the explanatory variables. It even leads to inconsistency of the regression if it is correlated with them. In Figure 29 and Figure Annex 3 - Figure Annex 5 we have tested whether such unobserved heteroge-

neity exists and also whether it is uncorrelated with our explanatory variables. There is strong evidence of its existence. Additionally, it seems to be correlated with the observed variables. Therefore, we have chosen the within-estimator for panel data to correct for endogenous unobserved heterogeneity. The within-estimator, described in detail in Wooldridge (2002, Ch. 10), demeans all variables by their time averages before running the regression. Since the unobserved heterogeneity (endogenous or not) is assumed to be time-constant, it simply drops out.

Figure Annex 3: Regression model II: Impact of public investment

Dependent Variable: BERD, Core Europe de+fr+uk+nl+be

	Coef.	Std. Error	p-val.
GOVERD+HERD (t-5)	-0.1696	0.1207	0.1608
GOVERD+HERD (t-4)	0.3138	0.2016	0.1204
GOVERD+HERD (t-3)	-0.6526 **	0.2648	0.0141
GOVERD+HERD (t-2)	-0.3602 *	0.2081	0.0842
GOVERD+HERD (t-1)	-0.0008	0.1530	0.9959
GOVERD+HERD (t)	0.2032	0.2998	0.4982
GDP	0.0119 **	0.0052	0.2364
log GDP (in 1000) per Capita	-31.9070 *	18.0400	0.0777
GERD (2nd spatial Lag)	-0.0190 *	0.0112	0.0907
GERD (1nd spatial Lag)	0.0182 **	0.0093	0.0495
year2001	60.3530 ***	21.8580	0.0060
year2002	103.7500 ***	33.5460	0.0021
year2003	125.7900 ***	42.2570	0.0031
year2004	130.7200 **	50.9850	0.0107
year2005	191.7400 ***	69.3330	0.0059

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Figure Annex 4: Regression model II: Impact of public investment

Dependent Variable: BERD, Southern Europe gr+es+it+pt+cy

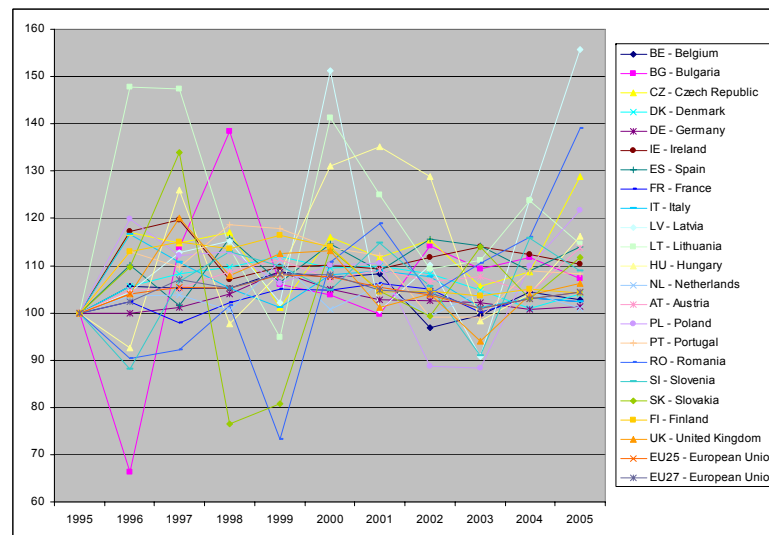
	Coef.	Std. Error	p-val.
GOVERD+HERD (t-5)	-0.6930 **	0.2991	0.0214
GOVERD+HERD (t-4)	0.3436	0.3357	0.3072
GOVERD+HERD (t-3)	0.0798	0.3577	0.8236
GOVERD+HERD (t-2)	0.1453 *	0.0857	0.0912
GOVERD+HERD (t-1)	-0.0547	0.1092	0.6171
GOVERD+HERD (t)	0.0638	0.1728	0.7122
GDP	0.0085 ***	0.0022	0.0002
log GDP (in 1000) per Capita	-3.3392	11.9580	0.7803
GERD (2nd spatial Lag)	0.0172 **	0.0085	0.0439
GERD (1nd spatial Lag)	-0.0087	0.0099	0.3815
year2001	-13.3640	8.9715	0.1377
year2002	-4.7438	16.7860	0.7777
year2003	-26.0240	23.9530	0.2784
year2004	-29.1980	30.4880	0.3393
year2005	-39.6100	36.0110	0.2726

Figure Annex 5: Regression model II: impact of public investment

Dependent Variable: BERD, Eastern Europe cz+ee+lv+lt+hu+si+sk

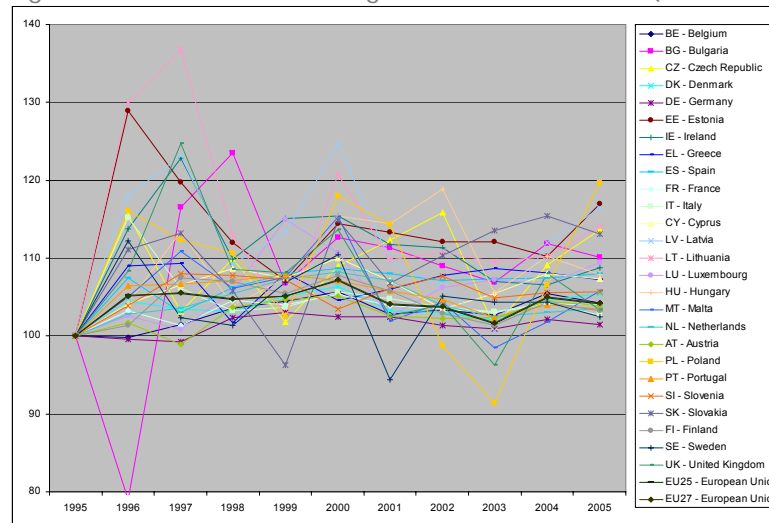
	Coef.	Std. Error	p-val.
GOVERD+HERD (t-5)	0.7765 ***	0.1870	0.0008
GOVERD+HERD (t-4)	0.7350 **	0.2696	0.0156
GOVERD+HERD (t-3)	1.7194 ***	0.3567	0.0002
GOVERD+HERD (t-2)	-0.6983	0.5051	0.1871
GOVERD+HERD (t-1)	-1.2035 ***	0.2036	0.0000
GOVERD+HERD (t)	-0.0566	0.1133	0.6248
GDP	0.0080 ***	0.0013	0.0000
log GDP (in 1000) per Capita	5.4682	10.9510	0.6248
GERD (2nd spatial Lag)	0.0157 **	0.0060	0.0196
GERD (1nd spatial Lag)	-0.0059	0.0036	0.1277
year2001	-26.3480	6.0290	0.0005
year2002	-36.9200	10.4070	0.0029
year2003	-59.4460	6.3028	0.0000
year2004	-79.2880	8.1814	0.0000
year2005	-104.0200	14.4860	0.0000

Figure Annex 6: Line chart on growth GERD 1995-2005 (1995=100)



Source: Regional Key Figures

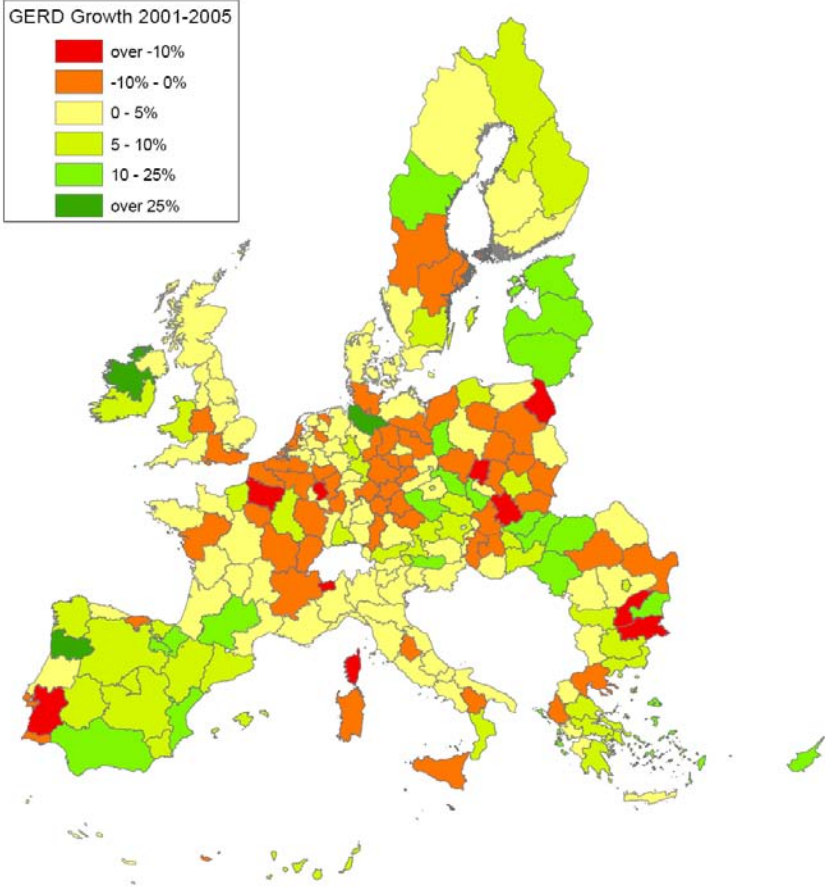
Figure Annex 7: Line chart on growth GDP 1995-2005 (1995=100)



Source: Regional Key Figures; Note: Romania excluded due to incomplete data

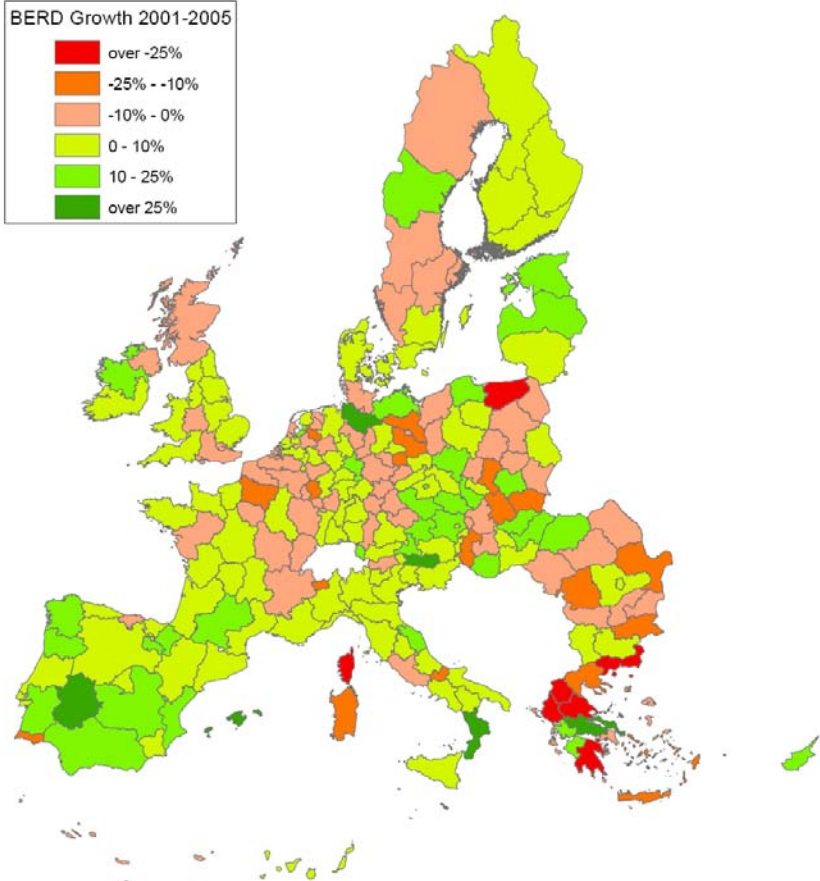
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Figure Annex 8: Average annual growth of total expenditure for R&D 2001-2005



Source: Regional Key Figures

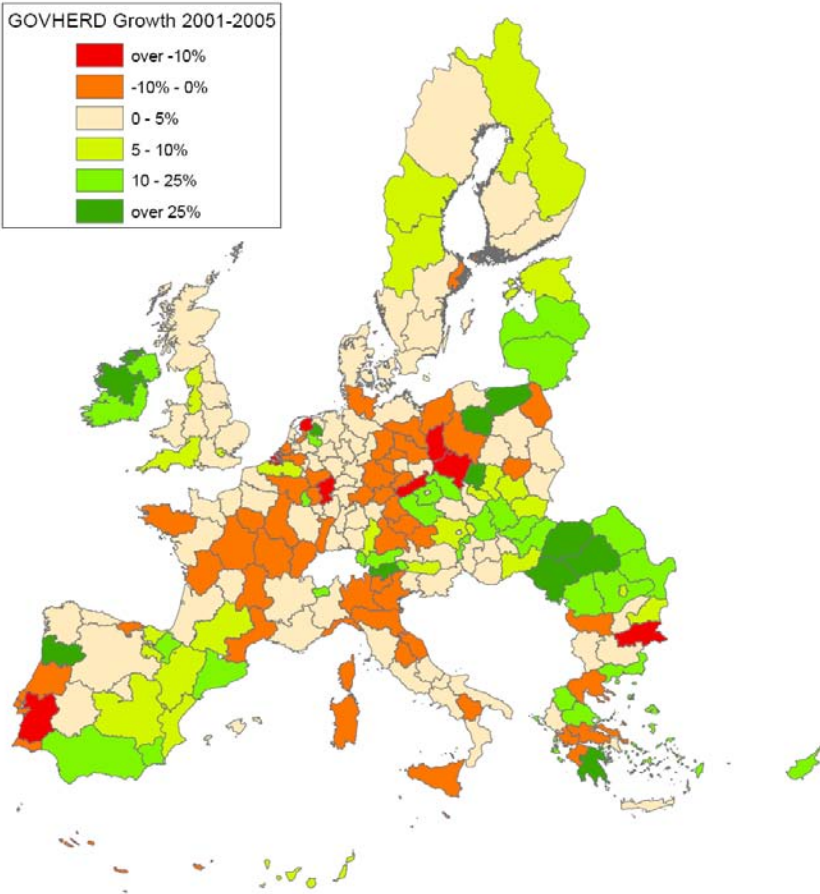
Figure Annex 9: Average annual growth of business expenditure for R&D 2001-2005



Source: Regional Key Figures

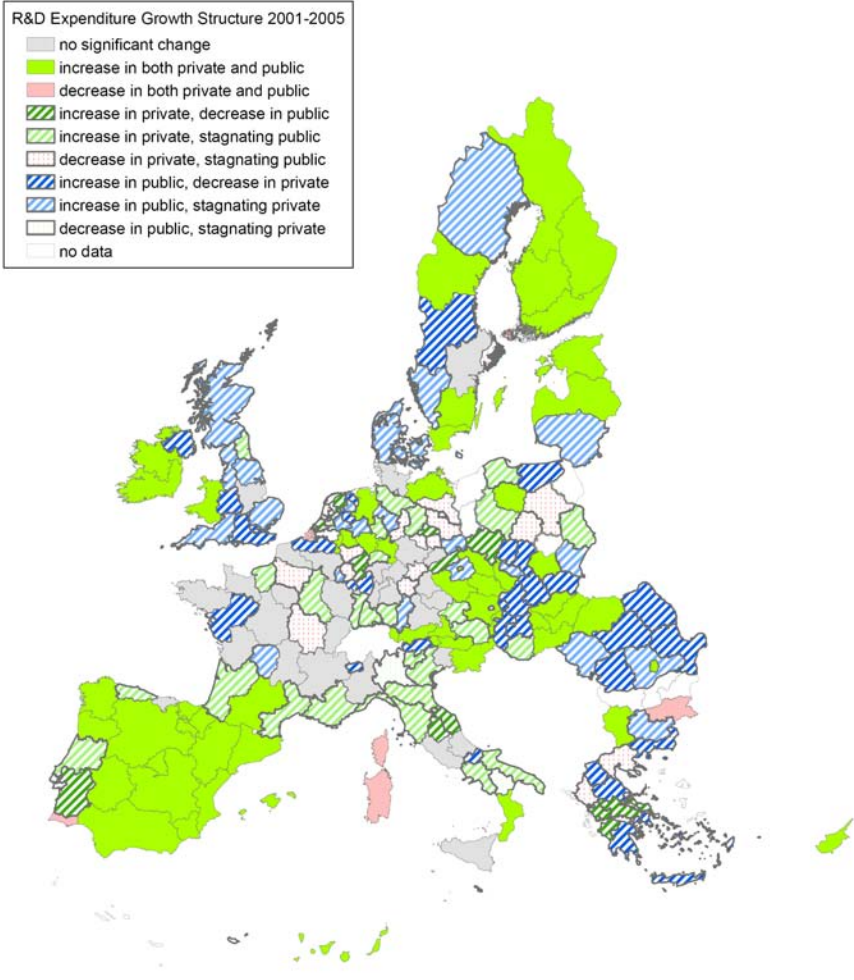
3 % Goal in European Regions

Figure Annex 10: Average annual growth of public expenditure for R&D 2001-2005



Source: Regional Key Figures

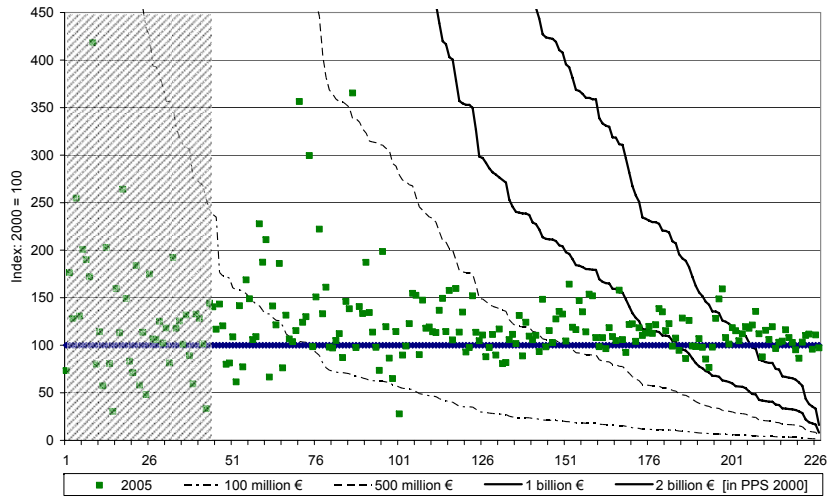
Figure Annex 11: Structure of growth 2001-2005



Source: Regional Key Figures

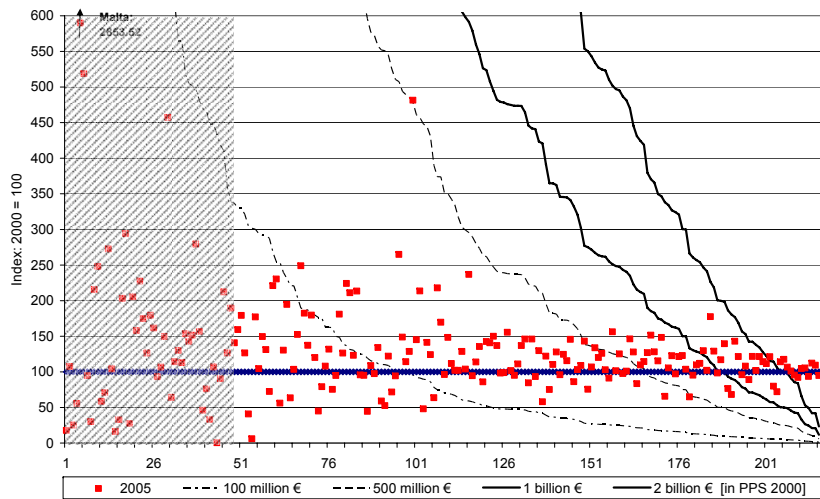
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Figure Annex 12: Relative development of R&D expenditure in EU27 NUTS2 regions, ordered by initial level of R&D expenditure



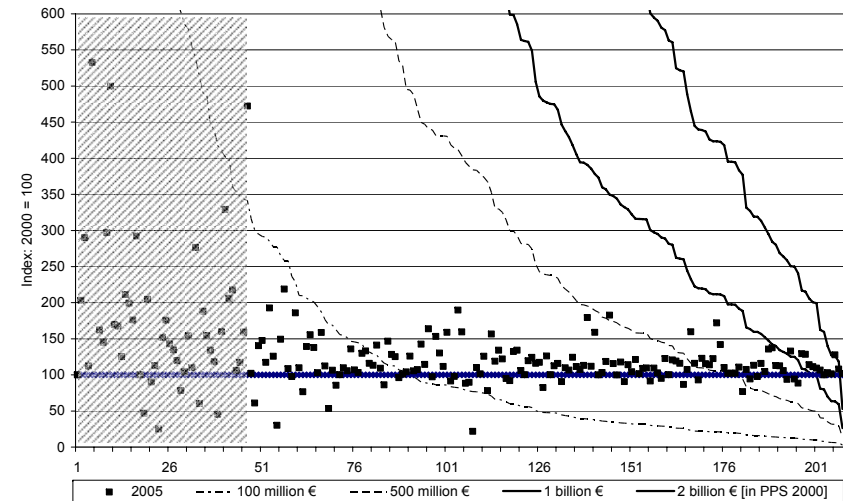
Note: Geometric mean estimation performed for up to three missing years; BE and UK included on NUTS1 basis, SI on NUTS 0 basis due to availability of data; Source: Regional Key Figures

Figure Annex 13: Relative development of business R&D expenditure in EU27 NUTS2 regions, ordered by initial level of business R&D expenditure



Note: Geometric mean estimation performed for up to three missing years; BE and UK included on NUTS1 basis, SI on NUTS 0 basis due to availability of data; Source: Regional Key Figures

Figure Annex 14: Relative development of public R&D expenditure in EU27 NUTS2 regions, ordered by initial level of public R&D expenditure



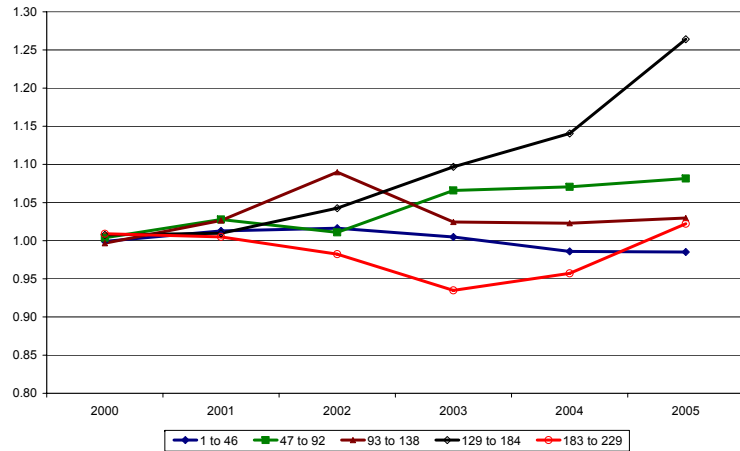
Legend: Diagonal lines refer to absolute amounts of expenditure (from left to right): 100 million euro, 500 million euro, 1 billion euro, 2 billion euro

Note: Geometric mean estimation performed for up to three missing years; BE and UK included on NUTS1 basis, SI on NUTS 0 basis due to availability of data

Source: Regional Key Figures

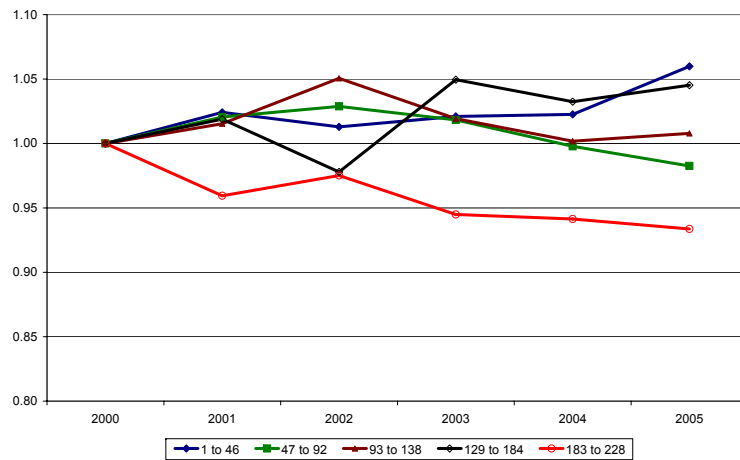
3 % Goal in European Regions

Figure Annex 15: Development of R&D intensity by 20% quantiles, based on NUTS 2 sample sorted by absolute R&D expenditure in 2000, as Index (2000=1)



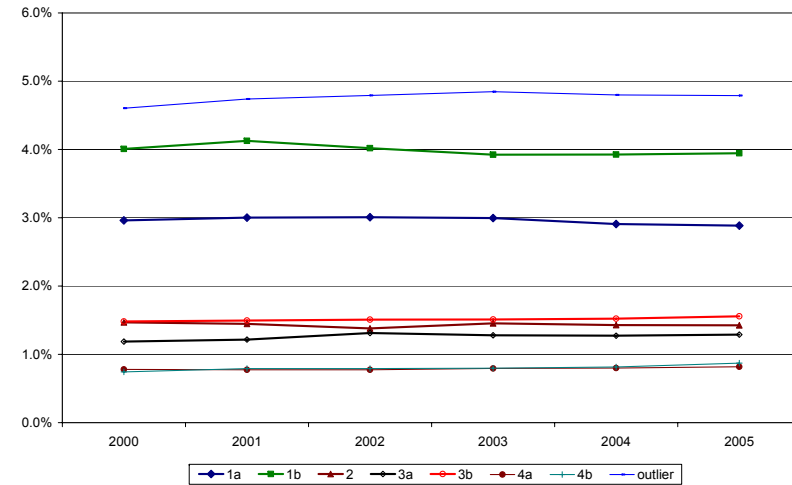
Note: Geometric mean estimation performed for up to three missing years; BE and UK included on NUTS1 basis, SI on NUTS 0 basis due to availability of data; Source: Regional Key Figures

Figure Annex 16: Development of R&D intensity by 20% quantiles, based on NUTS 2 sample sorted by share of business R&D expenditure in 2000, as Index (2000=1)



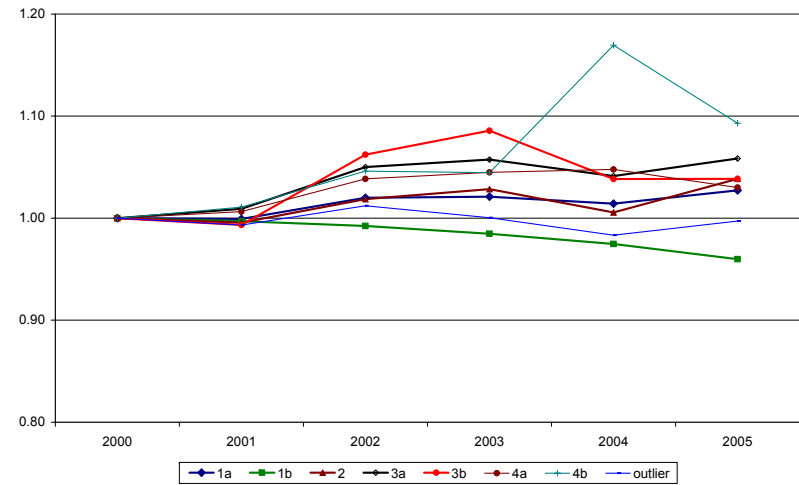
Note: Geometric mean estimation performed for up to three missing years; BE and UK included on NUTS1 basis, SI on NUTS 0 basis due to availability of data; Source: Regional Key Figures

Figure: Annex 17: Development of R&D intensity by clusters, NUTS 2 sample



Note: Geometric mean estimation performed for up to three missing years; BE and UK included on NUTS1 basis, SI on NUTS 0 basis due to availability of data; Source: Regional Key Figures

Figure Annex 18: Development of public R&D intensity by clusters, NUTS 2 sample, as Index (2000=1)



Note: Geometric mean estimation performed for up to three missing years; BE and UK included on NUTS1 basis, SI on NUTS 0 basis due to availability of data; Source: Regional Key Figures

Clusters of Regional Research Systems

direct quote from the first publication under the FP6 contract no. PP-CT-M2-2005-002 (Regional Key Figures)

Type 1 Regions are **R&D-driven regions** characterised by a high publishing and a very high patenting intensity. In these regions the business sector contributes an above average share to regional GERD. In Type 1 Regions, the average R&D intensity in terms of GERD as % of GDP exceeds the cross-type average by more than 100%.

Type 1 Regions can be differentiated into two main sub-groups:

Type 1a Regions are **broadly based R&D-driven regions** with a moderately high publishing intensity and a high patenting intensity. Among them are the German city states, the capital regions of Ile-de-France and Wien, the UK regions bordering London, the state of Denmark and a number of prosperous urban regions in Germany and France (e.g. Rhône-Alpes, Midi-Pyrénées, Köln, Dresden).

Type 1b Regions are **business-oriented, R&D-driven regions** with a very high publishing and patenting intensity. Among them are the German regions of Karlsruhe and Tübingen, the capital regions of Stockholm and Southern Finland and two other Swedish regions. Although they have a somewhat stronger focus on industrial R&D input than Type 1b regions, they have a similar focus on R&D output which is a rather even combination of basic and applied results.

Type 2 Regions are **public-sector-centred, R&D-supported regions**, with a very high publishing intensity in contrast to an only slightly above average patenting intensity (average excluding outliers). The gross expenditures for R&D per GDP are slightly above average in these regions and mostly accounted for by either universities or public research institutions. The contribution of the business sector is clearly below average. Among the Type 2 regions are the capital regions of Brussels, Prague, Bratislava, London and Northern Holland as well as some industrially less developed regions with noteworthy university towns in Germany, the Netherlands, Austria, Sweden and the UK.

Type 3 Regions are **broadly based, R&D-supported regions**, with an average publishing and patenting intensity. Unlike Type 1 or Type 2 regions, they are not home to outstanding centres of excellence in either public sector or business research. This group includes a significant share of all NUTS 2 regions for which data is available (close to one third). Type 3 regions can be differentiated into two main sub-groups:

Type 3a Regions are comparatively **public-sector-oriented**, resulting in a slightly higher publishing and a somewhat lower patenting intensity than other Type 3 regions. Among the Type 3a regions are regions in the Czech Republic, Germany, Spain, France, Italy, the Netherlands, Austria, Sweden and the UK. Additionally, the states of Slovenia and Ireland as well as the capital regions of Madrid and Budapest (Közép-Magyarország) are counted among this type of regions.

Type 3b Regions are comparatively **business-oriented**, resulting in a lower publishing intensity and a moderately higher patenting intensity than in other Type 3 regions. Among the Type 3b regions are the Grand Duchy of Luxembourg as well as regions from the Czech Republic, Germany, France, the Netherlands, Austria, Sweden and the UK.

The group of **Type 4 Regions** comprises the remaining regions in which R&D plays a less than central role and which, for that reason, have lagged behind in performance with a far below average publishing intensity, a very low patenting intensity and an amount of investment in **R&D** that can only be described as **complementary** to the region's main drivers of growth. While R&D is an important input for economic processes in the region, it does not yet determine the logic of thinking of many socio-economic actors. In the case of Type 4 regions it is questionable whether all of the concerned "research systems" deserve to be designated as "systems", because activities are more often than not singular and isolated, resulting in a high volatility of figures at a low level. For these reasons it is not possible to unambiguously distinguish between Type 3 and Type 4 regions. While some of them can be clearly assigned to one group, others are closer to the line of separation and may switch types depending on the extent of activities of the few main regional players in the year in question. An inter-temporal aggregation, however, did not seem advisable. The most recent available data are already comparatively old and an aggregation would have had to include even older information and would thus have compromised the topicality of the analysis. Based on the analysis, Type 4 regions can be further sub-divided into:

Type 4a Regions which are **public-sector-oriented** and lack a significant basis for business sector R&D, resulting in the near absence of patenting activities, particularly with a view to high-tech patents. In contrast, they harbour some noteworthy activities in public research, which result in limited publishing activity. Type 4a regions are present in Germany, Greece, Spain, France, Italy, Hungary, Poland, Portugal, Slovakia and Finland. Additionally, the states of Estonia, Cyprus, Latvia, Lithuania and Malta display characteristics of Type 4a regions.

Type 4b Regions, on the contrary, are **business-oriented** and do not commit any sizeable resources to public research efforts resulting in a very low publishing intensity. While much of the regional expenditure on R&D is accounted for by business enterprises it is so low on an absolute level that no significant patenting activities result. In fact, the average patenting intensity in Type 4b regions is lower than that in public-sector-oriented medium performing regions (Type 3a).

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