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**MORE RESEARCH FOR EUROPE
Towards 3% of GDP**

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EXECUTIVE SUMMARY

In March 2000, at the Lisbon European Council, Heads of State and Government set the Union the goal of becoming "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" by 2010. Two years later at the Barcelona European Council, which reviewed progress towards the Lisbon goal, they agreed that research and technological development (R&D) investment in the EU must be increased with the aim of approaching 3 % of GDP by 2010, up from 1.9 % in 2000. They also called for an increase of the level of business funding, which should rise from its current level of 56 % to two-thirds of total R&D investment, a proportion already achieved in the US and in some European countries. This twin objective is ambitious but realistic: today, several European countries are close to or beyond these levels. The 2002 Broad Economic Policy Guidelines of the Member States and the Community acknowledge the importance of this goal and recommend to improve incentives for firms to invest in R&D while preserving sound fiscal policies.

These R&D investment objectives set at Barcelona arise from the recognition that strengthening our R&D and innovation systems is essential in realising the Lisbon strategic goal. Its achievement is put at risk by the large and growing gap in R&D investment between the EU and the US. This gap reached more than €120 billion in 2000, 80 % of which was due to lower R&D investment by business in Europe.

The role of R&D as a driving force for a competitive and dynamic knowledge-based economy is linked to the economy's capacity to turn new knowledge into technological innovation¹. Although many enterprises recognise the increased importance of investing in R&D, they will do so only to the extent that they can exploit results effectively and expect sufficient returns to balance the risk inherent in such investment.

The present Communication aims at launching a debate on the ways and means of reaching the objectives for R&D investment. It identifies the wide range of policy areas which must be mobilised in a coherent manner. It sets out in each area the main objectives to be pursued either by intensifying actions already underway in the context of the Lisbon strategy and the European Knowledge Area or by undertaking new initiatives. Even where action has been launched and agreed at European level, more needs to be done to ensure that it is delivering results at national and local levels. At the same time, it is recognised that the diversity of situations in Member States and Candidate Countries must allow for a differentiated policy response.

More attractive framework conditions are essential if Europe is to achieve the R&D investment objectives it has set. Among the most important in this regard are a sufficient supply of highly qualified human resources, a strong public research base, a dynamic entrepreneurship culture, adequate systems of intellectual property rights, a competitive environment with research and innovation-friendly regulations and

¹ Hereafter referred to in the text as "innovation".

competition rules, supportive financial markets, macro-economic stability and favourable fiscal conditions.

There is also a case for a more effective and focused use of public financial incentives to private R&D and technology-based innovation, within the context of State aid rules and of the Stability and Growth Pact, which imply that efforts to enhance public support for R&D must to a large extent come through restructuring of public expenditure. In this regard, public authorities have a range of financing instruments at their disposal, in particular direct support measures, fiscal incentives, guarantee schemes and public support for risk capital. A mix of these instruments is required, as no single instrument is able to provide the full range of incentives.

Lastly, the place of R&D in the overall business strategy of companies as well as the effectiveness and efficiency of their R&D activities are important factors to consider.

The commitment of all actors at Member State and European levels is required to create a joint upward momentum for R&D investment throughout Europe.

On the basis of the debate initiated by this Communication, the Commission will consider proposing a focused set of prioritised actions in Spring 2003.

1. INTRODUCTION: PUTTING EUROPE IN THE LEAD

In March 2000, at the Lisbon European Council, Heads of State and Government set an ambitious goal for the Union: 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" by 2010.

Creating a European Area of Research and Innovation within the European Knowledge Area is one of the key steps in the Union's path towards achieving that objective². Scientific and technological progress is crucial to sustainable growth and quality employment in today's knowledge-based economy.

Considerable progress has been made in the past two years to establish the policy basis for more effective and integrated research and innovation systems in Europe. While these efforts need to be sustained, attention should be paid to the R&D under-investment in Europe, in particular the massive and growing gap of R&D investment between the European Union and its major competitors, first and foremost the United States. The yearly gap between the Union and the US was in excess of €120 billion in 2000³. This is reflected in the relatively weak performance of the European economy. It is such an analysis⁴ that led the Barcelona European Council in March 2002 to set a new objective to help reach

² European Commission, *Towards a European Research Area*, COM(2000)6, 18.01.2000

³ OECD and Eurostat data / Commission services estimates, current euro.

⁴ See the Commission services working paper annexed to the present communication for a more detailed factual analysis. Moreover, a recent report on R&D, prepared by Member States and submitted to the ECOFIN Council, analysed how R&D can contribute to achieving the Lisbon strategic goal and stressed the need to improve R&D and innovation in the EU.

the Lisbon goal. On the recommendation of the European Commission⁵, Heads of State and Government agreed that R&D investments in the EU should be increased, with the aim of approaching 3 % of GDP by 2010, up from 1.9 % in 2000. Several recommendations to set such an objective had been put forward in recent years, notably by the European Parliament⁶ and the Economic and Social Committee⁷. It is also supported by quantitative objectives to increase R&D investment that have recently been set in several Member States⁸. The 2002 Broad Economic Policy Guidelines of the Member States and the Community acknowledge the importance of this goal and recommend to improve incentives for firms to invest in R&D while preserving sound fiscal policies.

Approaching 3 % of GDP for R&D expenditure is an objective for the European Union as a whole. Current and future Member States cannot all be expected to meet this target individually by 2010 but they should all contribute to the effort. They should co-ordinate their efforts to create a joint dynamic for the growth of R&D investments throughout the Union.

The resources and policies that need to be mobilised encompass much more than government R&D spending. Indeed, more than 80 % of the R&D investment gap with the United States lies with the funding levels of the business sector. This is why the Barcelona European Council called for an increase in the level of private sector funding, which should rise from its current level of 56 % to two-thirds of total R&D investment, a proportion already achieved in the US and in some European countries.

The main challenge for inducing higher private investment in R&D is thus to make R&D investment more attractive and profitable to business in the European Research Area. This calls for coherent mobilisation of a wide range of policies to reinforce a virtuous circle whereby increased investment in knowledge and technology is transformed in new products and services, and leads to improved competitiveness growth and employment.

The twin objective defined at the European Council in Barcelona is ambitious but necessary. The objective is also achievable. Sweden and Finland already meet the 3 % target and R&D spending in Germany is above 2.5 %. Moreover, the business sector already provides at least two-thirds of investment in R&D in Belgium, Germany, Finland and Sweden and Ireland is close to this level. The present Communication is intended to launch a debate on the ways and means to promote R&D investment and innovation in Europe⁹. In doing so, it recognises that success depends both on Member States ensuring that the policies already put in place deliver results across the EU as a whole, and on shaping new action which can take the Union further towards its goal. What is at stake is not only success in

⁵ Communication from the Commission to the Spring European Council in Barcelona, *The Lisbon Strategy - Making Change Happen*, COM(2002)14, 15.01.2002

⁶ "Report on the communication from the Commission *Towards a European Research Area*", *Session document*, European Parliament, A5-0131/2000, 9 May 2000

⁷ J.O. C 204, 18 July 2000, p. 70

⁸ In Austria, Denmark, Finland, Greece, Ireland, Luxembourg.

⁹ In this context, reference should also be made to COM(2002) 262 of 21.05.2002 "Productivity: the key to competitiveness of European economies and enterprises" and to further Communications which the Commission intends to present on the European Research Area, the role of universities and the competitive position of innovative firms.

reaching the 3 % target, but, in so doing, realising the Lisbon commitment to high levels of growth, employment and social cohesion.

2. EUROPE'S DEFICIT IN R&D INVESTMENT

2.1. A massive, growing investment gap...

Comparison of R&D expenditure in the EU and in the US shows a massive and rapidly growing gap, both in value and as a share of GDP. The gap reached 124 billion current euro in 2000 and it has doubled at constant prices since 1994. R&D intensity in the EU, measured as the percentage of GDP accounted for by total investment in R&D, stagnated at around 1.9% over the last ten years, while in the US it grew continuously from 2.4 % in 1994 to 2.7 % in 2000.

The bulk of the R&D gap (more than 80 %), and most of its increase in recent years, is due to lower funding by the EU business sector. In addition, the US government devotes almost a third of its R&D funding to support business R&D, compared to only half that share (16 %) provided by public funding in the EU. The leverage effect of this substantial and sustained government support in the US is one of the factors contributing to the rise of business-funded R&D in the second half of the 1990s.

There is an even wider gap between the EU and Japan in terms of R&D intensity, as Japan devotes 3 % of its GDP to R&D. Moreover, the business sector accounts for 72 % of R&D expenditure in Japan, compared to 56 % in Europe and 67 % in the US. However, there are significant limitations to a comparison with Japan because of the differences in the roles of the public and private sectors, and the problems of the Japanese financial system, which have weakened Japan's economic performance and obscured the benefits of its high R&D intensity.

2.2. ...and lagging high tech performance

Output indicators suggest that Europe is under-performing in innovation. Labour productivity gains, which are partly driven by innovation, have slowed down in the EU during the second half of the 1990s, while they accelerated in the US during the same period¹⁰. Furthermore, trends in international trade of high-tech products point to European weaknesses in the competitiveness of some technology-based segments of the economy. Indeed, the EU's world market share of high-tech products still lags far behind the share of the US at 18 % (excluding intra-European trade) compared to 22 % for the US.

EU and national policies to reverse the trend should be based on a thorough analysis of the causes of the investment gap and take into account differences between industrial structures and sectors and between Member States.

¹⁰ European Commission, *Productivity: The Key to Competitiveness of European Economies and Enterprises*, COM(2002)240, 14.05.2002

2.3. Industrial structure and sectors

The structure of industry in the US is considerably more specialised in high-tech and research intensive sectors than is the case in the EU¹¹. This situation explains part of the investment gap. A large part of the difference between the US and the EU is coming from the defence industry and from the information & communication technologies sector (ICTs). However, structural effects cannot explain fully the difference in R&D investment between the US and the EU. In most sectors, including medium and low-tech manufacturing as well as the services sector, European firms invest less in R&D as a proportion of sales than their American counterparts. This means that EU enterprises tend to specialise in less technology-intensive products and services. They therefore risk losing competitiveness to more innovation-intensive rivals, even in non-high-tech sectors which constitute the bulk of the EU economy.

Therefore, the EU needs to promote a shift towards R&D intensive sectors with high growth potential and, perhaps more importantly, also towards higher R&D efforts in all sectors if it is to attain the objective set at the Lisbon European Council.

Multinational companies account for the greater share of business R&D expenditure. Increasingly, they tend to invest on the basis of a global analysis of possible locations¹². A worrying trend in this respect is the growing concentration of transnational R&D expenditure in the US, suggesting a decline in the global attractiveness of the EU as a location for R&D as compared to the US¹³. At the same time, a growing proportion of SMEs and larger national companies are faced with international competition on their home markets, compelling them to raise their innovation capacity through either in-house or outsourced R&D. Data suggest that smaller companies in the EU invest relatively less in R&D than is the case in the US¹⁴.

This is due to a range of barriers related for example to human resources, access to external sources of finance and appropriate local infrastructures, diffusion of knowledge within the EU, and creation and expansion of technology-based firms.

2.4. Diversity of national and regional situations

EU countries and regions¹⁵ are starting from very different levels of R&D intensity, from around 1 % of GDP or less in Southern Member States, to 3.4% in Finland and 3.8 % in Sweden. Differences are even greater between regions within countries. Trends of R&D intensity also vary, with rapid growth in the Nordic countries, Ireland and Austria, while the share of R&D investment in GDP decreased in France and the UK. Particular attention needs to be given to inter-

¹¹ See also Commission Staff Working Document, *European Competitiveness Report 2001*, 2001

¹² "Assessing the Impact of Technology and Globalisation. The Effects of Growth and Employment", *European Commission research project*, 5th Framework Program (IHP), AITEG, 2000-2002

¹³ In 1991, both the US and the three larger EU countries (France, Germany and the UK) attracted around 45% of all cross-country business R&D investment in the OECD area. In 1998, those three European countries attracted only 35% of cross-country investments whereas the US share had soared to 55% (OECD, *Measuring globalisation - The Role of Multinationals in OECD Economies*, 2001)

¹⁴ European Commission, *Third report on S&T indicators*, to be published, 2002

¹⁵ Here "regions" refers to sub-national entities.

regional evolutions as trends at regional level appear to have diverged in recent years.

The relative weights of government and business funding also vary widely between EU countries, with business R&D above or close to two thirds of total expenditure in Finland, Sweden, Germany, Belgium and Ireland, while it is less than 30% in Greece and Portugal.

Overall, candidate countries' performance in R&D is now progressing. They have an average R&D intensity of 0.7 % of GDP, similar to the levels of Greece and Portugal, with the Czech Republic reaching 1.25 % and Slovenia 1.5 % of GDP. However, the share of business funding remains very low in most candidate countries and its progress may require specific support.

The diversity of situations in Europe calls for differentiated but co-ordinated policies to establish a common upwards momentum to reach the 3 % objective.

3. REVERSING THE TREND: AREAS FOR CONCERTED ACTION

A wide array of policy areas must be brought into play to reinforce the attractiveness and profitability of R&D investment. They relate to the framework conditions for R&D in Europe and to governments' financial support to business R&D. Attractive framework conditions are a prerequisite for increasing the R&D and innovation performance of the EU. In addition, more effective government support can have a considerable leverage effect on business R&D investment. Many initiatives are already underway both at European level and in the Member States in these areas. However, their individual and combined effectiveness needs to be assessed in the light of the new goal for R&D investment, with particular attention to identifying areas where new or reinforced measures should be considered. The following sections identify the main policy areas and objectives on which a focused debate must be conducted with all stakeholders in order to carry out such an assessment.

3.1. More attractive framework conditions

Firms will invest more in R&D to the extent that they can exploit results effectively and expect to reach sufficient returns to balance the risk inherent in such activities. Increased investment in R&D requires more favourable framework conditions. Business must have access to a sufficient supply of quality human resources and to a strong public research base. Other framework conditions such as the entrepreneurship culture, adequate intellectual property rights systems, a competitive environment with research and innovation-friendly regulations and competition rules, supportive financial markets, a favourable fiscal environment and macro-economic stability are also essential.

3.1.1. *Sufficient and high quality human resources*

Community policies already recognise the importance of having sufficient numbers of research scientists and engineers with appropriate qualifications. R&D is particularly labour intensive and available data show that lack of human resources is a major constraint on the EU's capacity to deliver on the 3 % objective.

This requires urgent consideration as the European labour market for researchers is already showing signs of tension in some areas. Although the proportion of people attaining a tertiary education qualification has increased in all countries, globally, human resources in S&T are close to full employment. Even at current R&D levels, the recruitment of new researchers to replace those retiring will be difficult in some EU countries due to their relatively older S&T workforce, especially considering the worrying decline in the attractiveness of some natural sciences, engineering and technology curricula among students¹⁶. The problem will be aggravated if the demand for researchers outside Europe also grows and the net outflow of S&T human resources from Europe to the United States primarily¹⁷ continues. At their Joint Informal Meeting in Uppsala in March 2001, Ministers of Research and Education stated that this situation was cause for "grave concern" for some countries.

Numerous initiatives have been taken recently aimed at improving the availability, mobility and quality of human resources for R&D. The Commission has presented a strategy to create a favourable environment for the mobility of researchers and has set out a series of actions to build up R&D competence and excellence, while taking into account the specific situation of the regions lagging behind¹⁸. These actions have also been taken forward in the Commission's Action Plan for skills and mobility¹⁹. At Council level, the detailed work programme on the follow-up of the objectives for education and training systems in Europe has identified a number of actions in relation to recruitment to scientific and technical studies²⁰.

The objective of increasing investment in R&D so that it approaches 3 % of GDP is not only a challenge but also an opportunity to raise the profile of careers in S&T. It is a powerful incentive for change in education, training and mobility conditions in Europe.

Objectives to be pursued that require intensified effort or further initiatives include:

- | |
|---|
| <ul style="list-style-type: none"> – Assessing and raising awareness of employment / skills needs and future career opportunities in different S&T areas; assessing the capacity of the educational and training system to respond to those needs, in close co-operation with private and public sector employers and suppliers of trained scientists and engineers. – Encouraging further women to enter S&T careers²¹. |
|---|

¹⁶ See European Commission's "Action Plan on Skills and Mobility in Europe" COM(2002)72 of 13 February 2002 and the STRATA-ETAN expert working group, op. cit.

¹⁷ Although this will require further study, European students are known to represent 36% of foreign students in the US, 60% of whom are still present in the US five years after they moved. For a study of trends in the late 1990s see S. Mahroum, "Europe and the challenge of the brain drain", *IPTS Report* n°29, Nov. 1998.

¹⁸ COM(2001) 331 of 20.06.2001

¹⁹ COM(2002) 72 of 13.02.2002

²⁰ Official Journal C142 of 14.06.2002

²¹ According to the STRATA-ETAN expert working group, *Benchmarking National R&D Policies - Human Resources in RTD*, May 2002, women currently only represent between a quarter and third of researchers in EU countries

- Encouraging further the development and visibility of poles and networks of excellence for higher education and R&D, competitive with non-European alternatives.
- Encouraging the development and visibility of S&T careers in Europe, both in enterprises and in the public sector, by paying greater attention to financial conditions, career paths for young scientists, research equipment and availability of funds for research.
- Facilitating life-long learning, transfer of knowledge and career development through the mobility of researchers within Europe as well as the entry of third country researchers, primarily by removing national obstacles and providing adequate information and assistance at all levels.

3.1.2. *A strong public research base with improved industry links*

The excellence and scale of Europe's science base, including long-term research, are critical for the dynamics of the knowledge-based economy. Poles of scientific excellence around public research institutions tend to have a powerful leverage effect on R&D investment by all kinds of enterprises in the area, including enterprises which would otherwise not invest in R&D. However, there is evidence of higher intensity of science-industry relations in the US than in Europe and of wide variations between European countries. This raises the question of the effectiveness of public R&D in providing a strong science base for business in Europe.

Public policies have an important role to play in facilitating the development of poles and networks of excellence. Regional authorities are playing an increasing role, for example in attracting R&D related investment from abroad. As a consequence, R&D investment exceeds the 3 % threshold in some regions which have put a strong emphasis on research and innovation and achieved an effective mix of public and private partnerships. At Community level, the Structural Funds contribute substantially to the development of R&D infrastructures, capabilities and training at regional level, helping to reduce existing imbalances.

Policies should aim at encouraging the networking of public and private research regardless of location. With a budget of €17.5 billion, the Community Framework Programme for R&D 2002-2006 will be a powerful instrument to support public-private partnerships in trans-European networks of excellence and integrated projects. However, its effect will be maximised only if its actions are relayed and supported through a stronger co-ordination between European and national R&D programmes, as well as among national programmes, which still represent about 80 %²² of civil public R&D budgets in the EU.

Facilitating mobility of researchers between public research and the private sector is also an important means of improving networking between public and private R&D in the EU.

²²

Community or intergovernmental scientific cooperation does not exceed 17% of the total civil public expenditure in the EU. The EU framework programme for research accounts for only 5.4% of the total public effort. "Towards the European research Area", COM(2000)6 Final, 18 January 2000.

Objectives to be pursued that require intensified effort or further initiatives include²³:

- Establishing clearer and more consistent priorities for public R&D, with more systematic participation of industry to their definition in relevant industrial or technological sectors.
- Encouraging further the development of public-private R&D partnerships and clusters leading to knowledge transfer and commercialisation of R&D results²⁴.
- Encouraging further initiatives to strengthen the public research base and its links with industry in the context of EU regional and cohesion policies and of the financial instruments targeted at candidate countries.
- Opening national R&D programmes more to transnational collaborations.
- Removing obstacles to university-industry researcher mobility, addressing notably the transferability of pension rights and the recognition of mobility as a positive element in career progression.

3.1.3. *Entrepreneurship for, and through, R&D*

Increased investment in R&D will be achieved through increased investment by existing R&D performers, but also through a growing number of firms, in particular SMEs, investing in R&D (in-house or outsourced), and through the creation of new innovative R&D-based companies, provided that such enterprise creation is supported by an appropriate culture of entrepreneurship.

Entrepreneurship is extremely important in creating high-growth companies that create value from R&D investment and that are also new R&D performers. Spin-off companies in particular have been a key route for exploiting and furthering R&D both in the public and private sectors.

However, Europeans are much more reserved than Americans when it comes to creating new businesses²⁵. The Commission is preparing a Green Paper on entrepreneurship²⁶ in order to address this shortcoming.

The successful promotion of spin-offs comes through a combination of many factors, some related to the endowments of specific regions and institutions and some to management practices and regulatory situations.

Public collaborative R&D programmes are reported as having a major influence on the launch of spin-off companies and on their early growth by facilitating the

²³ These areas for action should also be considered in relation to public financing of private R&D (see 3.2.1.)

²⁴ Recent examples of large public-private R&D partnerships include the joint undertaking for the European satellite navigation system Galileo. Examples of regional R&D clusters include, among many others, a cluster in electronics and other fields developed around Oulu University in Finland, biotechnology clusters in the three German "BioRegios", and several clusters in the transports sector in Andalusia.

²⁵ See European Commission *Flash Eurobarometers* n° 107, November 2001, and n° 81, October 2000

²⁶ This will consider aspects such as the simplification of company registration procedures, regulations covering bankruptcy and the promotion of business education

establishment of strategic links²⁷. Spin-offs from public research are being increasingly encouraged at regional, national and EU levels, by supporting training activities²⁸ in addition to science and technology parks and business incubators. Large corporations also increasingly encourage spin-offs to exploit research competence and results with long-term growth potential. There are still, however, few success stories in European attempts to replicate the achievements of Silicon Valley.

On the demand side, R&D-based entrepreneurship is favoured by a high level of scientific and technological literacy and a culture of trust and understanding in the relations between science and society. The implementation of the Commission's Science and Society Action Plan²⁹ will contribute in this regard.

Objectives to be pursued that require intensified effort or further initiatives include:

- Promoting high technology ventures linked to public sector research through close co-operation with the risk finance community and development of management skills (especially in relation to intellectual property rights and technology transfer).
- Exploring appropriate measures to support spin-offs from larger firms.

3.1.4. *Effective adaptation and use of intellectual property rights systems*

Intellectual property rights (IPRs) – in particular patents, copyright, trade secrets, design - are an increasingly important factor in defining rules of the game in research collaborations and technology transfer among firms and between industry and public research organisations. They are also important in scientific and technological co-operation agreements between countries and in international trade agreements.

Firms in many sectors would not invest in R&D nor be able to generate wealth if their intellectual property could be freely copied. The increasing importance of intellectual property to firms can be seen in the growth of patenting activity and earnings gained from the licensing of technology. IPR systems are complex and are evolving rapidly in response to the need to adapt protection to new technological areas and to demand by intellectual property owners for legally safer, stronger, more harmonised and better enforced international standards of protection. Improving IPR systems and their use requires a coherent approach across research and innovation, internal market, international trade and competition policies.

EU legislation: A range of measures have been adopted or proposed to establish a more effective and unified IPR framework in the EU. These include an affordable and legally certain Community patent, patent protection of biotechnology and computer-implemented inventions, copyright for the digital age, protection of

²⁷ Pietro Moncada, Alexander Tübke, Jeremy Howells and Maria Carbone: "The Impact of Corporate Spin-Offs on Competitiveness and Employment in the EU", *IPTS-Report*, n° 44, May 2000; Martin Meyer, "Start-up support and company growth", *IPTS-Report*, n° 51, February 2001.

²⁸ Such as those supported under the European Social Fund

²⁹ COM(2001)714 of 4 December 2001

databases and of designs. Any delay in the adoption or implementation of these measures would be detrimental to the competitiveness of European industry.

International harmonisation and enforcement: The costs and legal uncertainties in the field of IP protection can be an impediment to investment in R&D and innovation. Harmonisation of IPR legislation at European level must be pursued. On the international level, the protection and enforcement of IPR through the implementation of the WTO TRIPS³⁰ agreement and the WIPO³¹ conventions are critical to the development of trade, international R&D collaboration and technology transfer.

Technology transfer from public institutions and public/private R&D collaborations: National rules governing the ownership and management of IPRs arising from publicly funded R&D and IPR arrangements and related financial aspects in university-industry collaborations vary considerably across Europe and within countries. These differences are an impediment to the effective development of trans-national public/private collaborations and technology transfer.

Awareness, training and support services: Effective protection, exploitation and transfer of knowledge depend not only on having appropriate legal and enforcement tools but also on the capacity of knowledge producers to use them. This is not yet fully the case, in particular in SMEs, universities and other public research organisations.

Objectives to be pursued that require intensified effort or further initiatives include:

- Improving further the EU IPR legal framework where necessary in order to deal with the evolution of technology and the world-wide harmonisation process, based on timely evaluation of the effects of existing legislation and of new IPR issues arising in particular from technological advances.
- Pursuing actively progress in international harmonisation and enforcement of IPR systems, and helping least developed and developing countries build their own capability and promoting mutually beneficial R&D collaboration in areas of common interest.
- Promoting the use of good practices regarding IPR aspects in publicly funded R&D and in industry-university collaborations.
- Promoting more effective management of IPRs by producers and users of knowledge (awareness, training of scientists and engineers, development and professionalisation of innovation support services).

3.1.5. *Research- and innovation-friendly regulations*

The sectoral regulation of markets has a bearing on R&D activities, both directly and indirectly through the ability to market innovative products and services. Two

³⁰ Trade Related Intellectual Property Agreement under the World Trade Organisation, which establishes minimum standards for the protection and enforcement of IPRs

³¹ World Intellectual Property Organisation

horizontal types of regulation also have a direct and considerable influence, namely the rules and practice of standardisation and of public procurement.

The regulation of product and service markets should aim to favour competition and business development while securing a high level of protection for consumers and for the environment, as well as a level playing field for enterprises (see section 3.1.6.). These objectives may be convergent and even mutually beneficial. There are numerous cases where the imposition of safety or environmental constraints has created new market opportunities for high-tech products or processes, with long-term positive effects on growth and productivity which prove far more important than the short-term negative effects of the new constraints.

In other cases, however, inadequate or overly restrictive regulations prove harmful to business and R&D development. A striking example is the slower development of agro-biotechnologies in Europe due to stringent limitations imposed on R&D, while the sector was thriving elsewhere due to less restrictive regulation. There are also examples where regulations make it difficult for newcomers (e.g. technology-based start-ups) to enter a market.

An interesting example of balanced regulation is the special treatment of orphan drugs in both US and EU law. This provided incentives for spin-off firms to develop drugs for these small niche markets. The R&D stimulated by this legislation has also led to significant technology spillovers in other areas of the biotechnology sector.

The existence of a formal standards policy and timely adoption of standards play a critical role in the commercialisation of new technologies, as demonstrated in the case of mobile telephony. Under such a policy, industry can determine its own technical solutions for standardisation which can often be used to underpin legislation at European level.

Public procurement related to public infrastructure is an important funding source for some industries in areas such as transport, communications and defence. However, EU governments tendency to request established technologies in their tendering procedures discourages innovation. Moreover, continuing fragmentation of EU procurement markets in some areas reduces rewards for innovative risk-takers in the EU vis-à-vis those in the US.

Changes in these areas could have a substantial impact on increasing private R&D investment in the industries concerned and they should be explored in detail with the European institutions, Member States and industry.

Objectives to be pursued that require intensified effort or further initiatives include:

- Exploring the possibilities offered by European and national regulation of product and service markets to encourage R&D and innovation, and paying particular attention to the effects of regulation on R&D and innovation both directly and through the ability to market new products and services. There may be a case for focused regulatory reviews in this respect.
- Where appropriate, and in close co-operation with industry, encouraging more systematic development and use of common European standards. This could

notably be promoted in the context of the creation of technological platforms bringing together the various stakeholders interested in the development, testing and use of new technologies³².

- Evolving towards more innovation-friendly public procurement rules and practices, improving opportunities for the participation of SMEs, notably through the adoption and implementation of the legislative proposals modernizing EU public procurement law. This could provide European companies with a large user group for their newest technologies and enable them to quickly achieve the market penetration needed for global commercial success.

3.1.6. *A competitive environment and supportive competition rules*

A sufficient degree of competition is fundamental for the economy to achieve the optimum allocation of resources and the highest possible welfare. Competition in product markets is essential to ensure that companies innovate to differentiate and keep abreast of competitors.

Community competition policy has evolved from a formal approach to a more economic and effects-based approach. It now takes into account the dynamic nature of markets and the specific characteristics of R&D and innovation. Three elements of Community competition policy have a more direct bearing on firms' R&D and innovation activities. They relate to R&D co-operation agreements, technology transfer agreements and R&D State aids.

R&D co-operation between firms is increasingly necessary to take advantage of economies of scale, sharing of knowledge and complementary technologies. Most co-operation agreements are not problematic for competition and benefit from exemptions under article 81 (3) of the Treaty relating to efficiency considerations. The new Block Exemption Regulation 2659/2000 on R&D agreements³³ reduces the regulatory burden for companies and gives them greater contractual freedom.

With regard to technology licensing agreements, the current Block Exemption Regulation³⁴ will also be revised, following the same approach as for other Block Exemptions. The aim is a simpler and possibly wider block exemption for technology licensing agreements, limiting competition policy scrutiny of licensing agreements to situations where it is necessary, and providing greater legal certainty.

As for state aids to R&D, the Commission recognises their legitimacy in addressing market failures and their important role in the knowledge economy. In line with the requests of the European Councils of Lisbon and Stockholm, the Commission is also committed to encouraging the redirection of state aids towards horizontal objectives, including R&D. In the light of the Barcelona 3% objective, it has considered that the current Community Framework for State Aid for Research and

³² Recent examples at European level include the proposal for the European and Developing Countries Clinical Trial Partnership, bringing together governments and industry for the development and testing of new medicines and vaccines against HIV/AIDS, malaria and tuberculosis. This initiative is based for the first time on article 169 of the EC Treaty.

³³ OJ L 304 of 5.12.2000

³⁴ Commission Regulation 240/96, OJ L 031, 9.12.1996.

Development, which allows for supportive R&D intensities, should be prolonged until 2005³⁵. In the context of the next revision of the Block Exemption Regulation for SMEs, the Commission will consider extending it to state aids for R&D.

In competition decisions, a permanent challenge is to understand changes in industrial R&D and innovation processes and to assess their effects on future market dynamics and competitive conditions, in particular in highly innovative industries. A dynamic view going beyond a static appraisal and extrapolation of past behaviour is necessary, in particular in assessing market power.

Objectives to be pursued that require intensified effort or further initiatives include:

- In the context of competition decisions, taking due account of market dynamics and competitive conditions in assessing R&D and innovation activities, in particular in highly innovative industries.
- Monitoring the reorientation of State aid to R&D and its leveraging effect on investment and pursuing studies on possible adaptation of the Community Framework in the context of its next revision in 2005.

3.1.7. Supportive financial markets covering the various stages of development of high-tech and other innovative companies

Many innovative companies require access to equity and/or debt financial markets for investment in R&D and innovation activities. High growth, high technology companies are critically dependent on access to equity financing at different stages of their development: risk capital in early (seed and start-up) and development stages, and secondary markets³⁶ for the financing of Initial Public Offerings and subsequent expansion phases.

Full implementation of the Financial Services Action Plan (FSAP) and the Risk Capital Action Plan (RCAP) is therefore important to create more efficient and integrated financial markets in Europe, thereby improving access to and reducing the cost of external finance. This is even more necessary given the severe downturn in market conditions since 2000. Confidence in these markets needs to be restored in parallel with the pursuit of their rationalisation. Large firms are making growing use of European Investment Bank (EIB) loans to finance R&D and innovation activities. This is an indication that properly designed debt instruments, such as bonds and securitised loans, could become a significant source of finance for mid-size firms and other organisations investing in R&D and innovation.

Objectives to be pursued that require intensified effort or further initiatives include:

- In the context of the implementation and possible follow-up of the RCAP and the FSAP, identifying measures that would help foster debt and equity market

³⁵ Community Framework for State Aid for Research and Development, OJ 45, 17.2.1996.

³⁶ Such as the German Neuer Markt, the French Nouveau Marché, the high tech segment of Euronext and NASDAQ-Europe (formerly EASDAQ)

financing of R&D and innovation in companies at different stages of their development.

- In the context of the follow up of the EIB's "Innovation 2000 Initiative", putting in place financial instruments contributing better to this objective.

3.1.8. *Macro-economic stability and favourable fiscal conditions*

Public policies in support of R&D should be considered in the context of the Stability and Growth Pact, including its requirements to maintain a budgetary position "close to balance or in surplus" over the economic cycle. Fiscal discipline contributes to macro-economic stability and to the creation of a supportive environment for R&D and innovation.

Sound public finances are beneficial to R&D investment in several ways. Low real interest rates reduce the cost of long-term investments, including R&D. Price stability reduces uncertainty as to the rate of return for investors. This is especially helpful for R&D, where returns often only materialise in the medium to long run. A more binding budget constraint with clear restrictions on deficit financing underlines the need for prudent public expenditure policies. Shifting public spending towards areas such as R&D and technological innovation has positive spill-over effects on private investment. However, governments need to ensure that public R&D spending does not crowd-out more productive private sector investment.

Efforts to redirect public expenditure should also be made in a framework of sound fiscal policies. Therefore, efforts to enhance capital accumulation, including public support for R&D, must to a large extent come through restructuring of public expenditure³⁷. A sound tax environment has positive effects on R&D and innovation. For enterprises operating across borders within the internal market, there is a need to create the appropriate direct tax environment so that decisions on investment in R&D are not distorted by purely tax-driven decisions. The Commission's objective³⁸ of providing companies with a consolidated corporate tax base for their EU-wide activities would remove obstacles to the efficient allocation of investments, including business investment in R&D.

Furthermore, certain taxes, such as VAT and some local taxes³⁹, are payable regardless of the final outcome of activities. Such forms of taxation may particularly discourage activities such as R&D that have uncertain or more long-term returns to investment.

Objectives to be pursued that require intensified effort or further initiatives include:

³⁷ Report from the Commission and the (ECOFIN) Council to the European Council (Stockholm, 23-24 March 2001), "The contribution of public finances to growth and employment: improving quality and sustainability", Doc. 6997/01

³⁸ Put forward in the Commission Communication "Towards an Internal Market without tax obstacles", COM(2001)582, 23.10.2001

³⁹ For example, some VAT paid when assets are acquired for business purposes may not be deductible from the VAT charged to final customers and some local taxes are often charged simply because a business activity is being undertaken. Taxes on labour (such as payroll taxes) may also be significant for entities carrying on R&D activities, since these can involve an above-average proportion of highly-skilled employees.

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| <ul style="list-style-type: none">– Exploring ways that Member States could reform their tax systems to reduce existing disincentives to investment in R&D and innovation. |
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3.2. More effective use of public financing for business R&D

In the context of the 3% objective and in accordance with State aid rules, public support mechanisms to stimulate private investment in R&D are justified if the private return is lower than the social return or to address systemic failures⁴⁰. In this regard, public authorities have a range of financing instruments at their disposal, in particular direct support measures, fiscal incentives, guarantee schemes and public support for venture capital. Each instrument has its own characteristics and merit which may vary depending on sectors and countries. More effective design and implementation of these instruments, individually and in combination, can act as a stimulus to increased private investment and contribute to the achievement of the 3% objective.

3.2.1. *Direct support measures*

Direct support measures are particularly appropriate where governments want to retain control over the type of research carried out and orient research efforts towards public policy and long-term objectives. They are the predominant mechanism for promoting private investment in research in most countries.

They should appropriately be directed to areas in which the private sector faces significant obstacles to investment. In this regard, public-private partnerships can play an important role in boosting private investment by reducing the risk associated with the investment.

There is a wide range of direct support programmes in operation across the Member States aimed at collaboration between knowledge producers and users⁴¹ in specific technological sectors, creating and developing science and technology parks and stimulating networking of private and public research units. Instruments include subsidies, competitive grants, procurement, grants repayable in case of successful commercial exploitation and block funding of public institutions. Many countries implement several types of scheme simultaneously.

3.2.2. *Fiscal incentives*

Appropriately designed fiscal incentives encourage a flexible and responsive market allocation of R&D investment between competing technologies and sectors and entail less interference in the market. They allow faster reallocation of resources between technologies in response to the increasing pace of technological change and market developments. They also reduce uncertainty: enterprises know in advance the level of incentive available.

On the other hand, fiscal incentives are more likely to lead to unintended windfalls by rewarding investment that would have taken place without the incentive. Their

⁴⁰ For example to enhance interactions between different parts of the research and innovation system.

⁴¹ This concerns also the growing number of firms which have little or no R&D capability but outsource their R&D needs.

final cost and impact are more difficult to predict because of the wide range of variables involved.

Fiscal incentives for R&D of various types are increasingly used, with 18 OECD countries now employing them as against twelve in the mid-1990s⁴². Tax credits for R&D expenditures are becoming more popular than tax allowances. A number of countries either target R&D tax incentives to smaller firms or provide more generous provisions to these firms than to large enterprises. Also, a number of tax schemes are focused on wage costs and others are aimed at encouraging collaboration between industry and public research organisations.

Appropriate design of fiscal measures strongly influences their effectiveness in stimulating increased R&D investment. Member States should co-ordinate their initiatives in this respect to avoid harmful tax practices within the EU.

3.2.3. *Guarantee mechanisms*

Inadequate access to external finance (debt or equity) at reasonable cost is a common problem for SMEs and notably for small and newly-established high technology companies. The problem is even more acute for R&D financing because of the risk involved. Given this situation, guarantee mechanisms for both equity and loans can be attractive means of increasing the availability of capital and reducing access costs. Equity guarantees are typically directed to prospective investors in R&D. Loan guarantees provide a direct incentive to firms to raise their R&D efforts. Guarantees provide a means of sharing risk, thus reducing the exposure of borrowers/investors and companies. In general and when applied appropriately, they can potentially exert leverage on private investment in R&D for a lower cost than direct or fiscal measures.

Guarantee mechanisms vary depending on the type of company concerned. For high technology start-ups, equity guarantees can stimulate investment by reducing the level of risk involved and increasing the rate of return. Loan guarantees are generally more appropriate for SMEs in traditional sectors because of their preference for debt financing. They can also be attractive for young high technology firms once these are sufficiently mature to generate stable revenue streams.

A variety of loan guarantee schemes are currently operated at Member State and European levels but these are not generally designed specifically for R&D. Equity guarantee schemes have only recently been introduced.

3.2.4. *Public support for risk capital*

As the number of high technology companies grows, risk capital, which is their major source of capital in the early (seed and start-up) and development stages, contributes increasingly to the financing of R&D. However, these firms often have difficulty raising finance in the early stages because of the risk involved and the small scale of investment required. Despite recent growth in the supply of

⁴² European countries are Austria, Belgium, Denmark, France, Italy, Netherlands, Portugal, Spain, United Kingdom and Hungary. While a few countries have discontinued or are considering phasing out their tax incentives for R&D, more have enhanced them in recent years or are studying ways to do so.

early stage funding (until the 2000-2001 crisis), risk capital is still not playing as full a role in Europe as in the US. In seeking to close this gap, the public sector is playing a growing role at regional, national and European levels, not only through guarantee mechanisms and fiscal incentives, but also through reimbursable grants, subsidised loans and direct equity investments in risk capital funds.

Recently, a variety of schemes have been put in place in a number of Member States to stimulate private investment in funds associated to incubators and science parks or dedicated to funding R&D in high technology start-ups.

3.2.5. *Improving the overall mix of instruments*

A mix of instruments is needed, as no single instrument is able to provide the full range of incentives. It is important to ensure that different instruments are cost-effective and avoid possible crowding out effects, both in their individual features and in their interactions.

The optimal mix of instruments will necessarily differ across countries and regions and may evolve over time. Financing needs vary across industry segments and each segment contribute differently to the overall private investment in R&D. Furthermore, the optimal level of public spending on R&D and its allocation between industry and public research institutions also depends on the characteristics of a country's R&D system. In some cases, this may imply changing the allocation between public and private R&D sectors and/or increasing overall public spending.

The use of consistent criteria for the design and impact evaluation of individual instruments and of the mix of instruments would facilitate policy making and mutual learning across countries.

At Community level, several programmes and initiatives contribute to stimulate private investment in R&D through a variety of financial instruments (grants, loans, equity, and guarantees)⁴³. Increased complementarity and synergy between these instruments is being sought to ensure maximum overall impact⁴⁴. These Community instruments constitute a European learning platform to test new instruments and facilitate exchanges of experience between the various national financial institutions involved in the implementation of some of them.

Objectives to be pursued that require intensified effort or further initiatives include:

- In the context of the benchmarking of research policies, and taking into account differences in national contexts, identifying good practices and innovative

⁴³ In addition to the Community Framework Programme for R&D, these include the “Innovation 2000 Initiative” of the EIB Group and the Structural Funds (normal programmes and the Innovative Actions). The guarantee and equity facilities of the Multiannual Programme for Enterprise and Entrepreneurship can also be used to finance R&D and innovation activities

⁴⁴ The co-operation agreement between the Commission and the EIB in the field of R&D is aimed in particular at facilitating the complementary use of various instruments and taking better into account the specificities of R&D in the design of EIB instruments. The establishment of a EIB loan facility for the financing of European strategic R&D projects, which is being considered to facilitate the financing of multi-partner projects, would also contribute to the development of synergies between the Framework Programme and EUREKA.

schemes to enhance the leverage effect of the various public support instruments on private investment in R&D.

- Making more effective use at regional, national and EU levels of these instruments, considered individually and in combination, to enhance their overall impact

3.3. R&D and innovation in corporate strategies and management

A firm's decision to invest in R&D is not only influenced by framework conditions and the availability of public support. The place of R&D in its overall business strategy and the efficiency of its R&D management are important factors that merit greater attention.

There are a number of examples showing that firms which have integrated R&D and innovation in their business strategy tend to perform better and to invest more in R&D. Many firms, however, have not integrated R&D into their corporate strategy and are not making full use of productivity-enhancing R&D management methods and tools⁴⁵. This concerns not only high-tech sectors, but also medium and low-tech sectors which are becoming more knowledge-intensive as firms in these sectors increasingly need also to develop their capacity to acquire and absorb new technologies.

Another aspect relevant in this context is the recognition of the growing importance of intellectual capital as a key asset of enterprises. In their annual reports, many firms refer to their R&D activities merely as a footnote to their accounts, reducing significantly their visibility to investors.

Objectives to be pursued that require intensified effort or further initiatives include:

- Exploring the role that industrial associations at national and European levels could play in promoting awareness and the use of good R&D management practices.
- Encouraging a more thorough analysis and reporting of R&D and intellectual property assets, which would help both firm managers and the investment community to make better estimates of opportunities and risks.

4. CONCLUSION: TOWARDS A CONCERTED EUROPEAN WAY

The analyses contained in this communication confirm that it is necessary not only to improve the effectiveness of the European R&D and innovation system, but also to address the EU's under-investment in R&D. The current trends in R&D investment must be reversed urgently in order to approach 3 % of GDP by 2010, with an increased share of business funding that should reach two thirds of total R&D expenditure. Such a change is essential to reach the Lisbon objective of

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It is expected that changes in industrial R&D processes and management will accelerate in the coming years, increasing the scope for improving R&D productivity through more extensive use of information and communication technologies (e.g. intelligence gathering, knowledge management, simulation and prototyping, assessment of users' needs).

making Europe the leading knowledge economy in the world. It will require joint efforts involving the European institutions, all Member States and the Candidate Countries, as well as the enterprise sector.

A wide array of public policies must be mobilised in a coherent way to address both framework conditions and the public financing mechanisms for R&D and innovation.

As a first step, the Commission will engage in discussions on the basis of the present Communication with European institutions, Member States, regions and interested parties, including notably industry. These discussions will be conducted with a view to identify actions that should be introduced or strengthened at the various levels to encourage in more effective, systematic and coherent ways R&D investment in Europe. Inputs from these discussions will allow the Commission to propose orientations in the context of its synthesis report to the 2003 Spring European Council. After the European Council and depending on its results, the Commission will consider proposing a focused set of prioritised actions supported by a process of open co-ordination.