UNITED NATIONS ECONOMIC COMMISSION FOR EUROPE

Fostering Innovative Entrepreneurship

Challenges and Policy Options

UNITED NATIONS

United Nations Economic Commission for Europe

Fostering Innovative Entrepreneurship

CHALLENGES AND POLICY OPTIONS

UNITED NATIONS
New York and Geneva, 2012

NOTE

The designations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area, or of its authorities, or concerning the delimitation of its frontiers or boundaries. This volume is issued in English and Russian only.

ACKNOWLEDGEMENTS

A substantive contribution to this publication by Mr. Igor Yegorov, Head of Department, Centre for S&T Potential Studies and Science History Studies, Academy of Sciences, Ukraine, is gratefully acknowledged.

The secretariat would also like to thank Ms. Radoslava Sentova and Messrs. Guillaume Chatein, Thomas Nicolas de Lamballerie and Alexandre van Meeuwen, interns with the secretariat, for their contribution to this publication.

ECE/CECI/13

Printed at United Nations, Geneva (Switzerland)

UNITED NATIONS PUBLICATIONS
Sales No. 12.II.E.3
ISBN: 978-92-1-117056-6
eISBN: 978-92-1-055307-0

FOREWORD

In both developed and developing parts of the world, knowledge-based development is recognized as a vehicle securing the stability and dynamics of the economy. Decision makers in countries with economies in transition (or emerging market economies) increasingly explore ways and means of modernizing and diversifying their economic structures through fostering research and development, and strengthening its impact on various sectors of life.

The development of enterprises, which base their competitive strength on the application of Research and Development (R&D) outputs is a pillar of knowledge-based economy. Such enterprises, often spun off from research institutions and closely linked to academia, vehicle the innovative outputs towards the commercial applications. The uninterrupted cycle of innovation and successful commercialization of its results is largely determined by the intensive collaboration of major stakeholders, that is institutions of applied research, private innovative companies and government agencies establishing framework conditions for this process.

Emerging market economies of the region often lag behind their more developed counterparts in terms of the efficiency of commercialization of R&D outputs and the scope of innovation-based enterprises' activities. It is noted in the literature that the lack of private investment in research as well as insufficient industry-science links are the major obstacles to this type of entrepreneurship. At the United Nations Economic Commission for Europe (UNECE), we identify and examine good practices in reducing barriers to innovative enterprise development in both developed and emerging market economies. By providing a platform for sharing the accumulated country experience we are also advising member Governments on policy options.

This publication puts together good practices of fostering innovative enterprises in the region and highlights some policy actions that may be required to this end in emerging market economies of the region. It also summarizes the recommendations developed by the 2010 UNECE International Conference “From Applied Research to Entrepreneurship: Promoting Innovation-driven Start-ups and Academic Spin-offs."

I hope that this publication will meet with the interest of policymakers and other stakeholders working practically to foster the innovative entrepreneurship and competitiveness of their economies.

Andrey Vasilyev
Officer-in-Charge
United Nations Economic Commission for Europe

CONTENTS

ANNEXES

LIST OF BOXES AND FIGURES

BOXES

TABLES

Overview

In the emerging market economies (countries in transition) of the UNECE region,[1] the sustained economic growth based on the use of innovation has come forward as the major objective of government policy. In countries rich in resources, decision makers have increasingly realized that economic development based on their exports is hardly sustainable given the volatility of external market demand and prices. In other countries, poor in natural resources, there has been no alternative to innovation-based development since the start of transition.

In the market economy, the commercialization of Research and Development (R&D) results is at the heart of the continuous innovation process. This can be defined as the process of turning an invention into a product or service, which can be sold on the market providing returns to the investment by the commercializing company. Continued commercialization nurtures the process of innovation, which is pivotal to sustained economic growth.

In broad terms, the innovation potential is influenced by the scope of R&D, which determines the stock of inventions and innovations to be commercialized; the quantity and quality of human resources available for R&D, which depend on the number of universities and research institutions, and quality of education; regulatory and institutional environment conducive to innovation, including stable property rights; independence of the judiciary; transparent and simple rules, and low costs governing the registration and operation of enterprises; and the wide use of information and communication technologies. These factors influence the business climate in which the innovation-based enterprises operate, and thus determine the demand for innovation.

The data presented in this publication suggest a certain gap between the innovation potential of most of the emerging market economies (EMEs) and that of developed market economies. Despite a good tradition of higher education in natural sciences, advanced positions in certain research areas as well as a strong corps of well-trained scientists, former centrally planned economies lag behind the OECD countries in terms of the number of researchers, enrolment in tertiary education and levels of R&D expenditures per inhabitant. This gap, other conditions being equal, limits the stock of innovations to be commercialized.

At the same time, differences between these two groups of economies go beyond the indicators measuring such inputs in the innovation process. Emerging market economies also lag behind in the efficiency of the conversion of these inputs into commercialized innovations.

---

[1] The term "emerging market economies" is used to define the group of 10 new EU member States (Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia), countries of South-East Europe (Albania, Bosnia and Herzegovina, Croatia, Montenegro, Serbia and the former Yugoslav Republic of Macedonia), as well as the countries of Eastern Europe, Caucasus and Central Asia (EECCA) – that is, Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, the Russian Federation, Tajikistan, Turkmenistan, Ukraine and Uzbekistan.

The general business environment, which is often characterized by a heavy administrative burden on enterprises, violations of property rights and corruption, creates poor incentives for entrepreneurship and the commercialization of research.

A major obstacle to innovation and commercialization seems to be the insufficient communication and collaboration between the scientific community and industry. The absence of closer links between science and industry is a significant shortcoming since, in modern economies, the linear model of innovation has become ineffective and interaction between innovation stakeholders is a key to success. In addition, weak links between industry and science, regulatory hurdles and unclear property rights restrain private investment in R&D and result in disproportionately low patenting of inventions by universities and research institutions. Linkages between industry and science need to be strengthened to ensure that research activity anticipates and takes advantage of market needs.

Fostering technology transfer (through licensing or sale of intellectual property (IP) rights) from universities to private companies would facilitate the collaboration between the scientific community and business operators. The establishment of technology transfer offices in universities could contribute to this endeavour. Not less important could be measures encouraging academic entrepreneurship. To foster spin-offs, universities should have coherent policies regarding the ownership of patents, which provide financial incentives for successful researchers. These incentives could be incorporated in an agreement between the research institution and the inventor to share revenues generated by the patented invention.

To ensure a more effective commercialization and foster the innovation-based entrepreneurship, stakeholders in emerging market economies need to encourage industry-science linkages. The ways and means of achieving this include developing cooperation in R&D through open innovation projects or research joint ventures. The business community should be more actively involved in advising on university curricula, and on available and future job opportunities. At the same time, curricula in scientific subjects should include courses on entrepreneurship training. The mobility of personnel between research institutions and private companies could also contribute to their productive cooperation.

The financing needs of innovation-based small and medium-sized enterprises (SMEs) and spin-offs can be met through a variety of sources, which reflect the changing needs of innovative companies at different stages of development. Specialized financial intermediaries, such as business angels and venture capital firms, have emerged in developed market economies to address the specific financing challenges of innovative companies. However, these forms of financing are not yet well developed in emerging market economies and should benefit from public support.

Governments should facilitate the development of national business angel networks and their links with research institutions and universities. Regulations should encourage also the involvement of venture capital companies in early-stage financing, including through hybrid public-private funds. Governments should facilitate closer collaboration between different types of investors to ensure the continuity of financing, which would match the needs of start-ups at different stages of their life cycle. Corporate venture capital investment should also be promoted, as it can help to bridge the financing gap caused by the lack of development in financial markets. Public grants should be used as seed capital, especially in emerging markets, where alternative sources of private financing may be particularly scarce.

The international experience shows that high-technology SMEs grow and mature faster when effective innovation support institutions are in place. Business incubators and science parks, which are pivotal at the early stage of SME development, should be established with due regard to the peculiarities of the local economy. In particular, science parks, having the advantage of proximity to universities, enable the local economies to reap the synergic effect of clustering small innovation-based enterprises, public research institutions and larger companies.

Encouraging innovation and commercialization of R&D results should be an important part of the Government policy in the areas of science, education, intellectual property and entrepreneurship. This effort can be instrumental in fostering the competitive market economy of the twenty-first century.

Introduction

The purpose of this publication is to identify and examine the major drivers and obstacles to the development of innovative entrepreneurship in the UNECE region with a special emphasis on emerging market (transition) economies. The presented good practices and policy options are expected to assist the decision makers, particularly in EMEs of the region, in developing policies conducive to the commercialization of R&D outputs, produced by universities and other research institutions, and innovative entrepreneurship. This publication also draws on the major findings of a series of capacity-building events organized by UNECE during 2008-2011, including the conclusions and recommendations to governments by the International Conference "From Applied Research to Entrepreneurship: Promoting Innovation-driven Start-ups and Academic Spin-offs".[2]

The dynamic enterprise sector, in particular innovation-driven companies, are recognized as a driving force of modern economy, which increasingly relies on R&D and commercialization of its results. The objective of creating legal, regulatory and institutional conditions conducive to innovative entrepreneurship is particularly challenging for the former centrally-planned economies of the region which have had to re-establish the setup for a market economy anew.

This publication addresses primarily issues specific to the development of innovation-based enterprises in the EMEs of the ECE region. Commercialization of R&D is the heart of the innovation process and its crucial factor is the multi-faceted collaboration between research institutions and producers of products and services. Therefore issues related to the commercialization of innovation and the role of new innovative enterprises in this process are the focus of this publication. It also explores how the innovative potential of these countries compares with that of developed market economies, identifies problems encountered by universities and other research institutions when commercializing the results of their R&D activities, highlights the role of patenting and problems related to early-stage financing of new enterprises, and discusses the major components of institutional setup, which fosters the collaboration of academia with the business sector and is conducive to the development of innovation-driven start-ups and academic spin-offs.

It is important to note that general obstacles to enterprise development in EMEs, that is those non-specific to innovation-based enterprises, remain at least as important a barrier to start-ups as obstacles specific to the innovation sector. Throughout the region, new and operational enterprises face difficulties related to the inefficiency of governance, complicated tax administration, heavy reporting requirements, government inspections, product certification, labour regulations, export licensing and procedures, etc. Although these general hurdles to enterprise development are beyond the scope of the

[2] This series of events includes the Applied Policy Seminar "Early-Stage Financing and Investment Readiness of Innovative Enterprises", Moscow, Russian Federation, 23 May 2008; International Conference on "Ways and Means of Attracting External Finance for New Innovative Enterprises", Astana, Kazakhstan, 21-22 May 2009; International Conference "From Applied Research to Entrepreneurship: Promoting Innovation-driven Start-ups and Academic Spin-offs", Kiev, Ukraine, 9-11 November 2010; and International Conference "Knowledge-based Development and Innovative Entrepreneurship", Baku, Azerbaijan, 24-25 November 2011.

present publication, these should not be discounted when assessing the overall climate for entrepreneurship in individual countries of the region.[3]

Chapter I highlights the importance of innovation and innovative entrepreneurship in the modern economy. Chapter II explores major factors influencing the national potential for innovation. Chapter III analyses the major indicators of science and technology in emerging market economies and compares them with those of developed market economies. Chapter IV examines the role of patenting in the innovation process, while chapter V highlights issues related to early-stage financing of start-ups. Chapter VI explores methods of commercializing the R&D outputs while Chapter VII analyses various types of industry-science linkages conducive to commercialization and establishment of innovation-based enterprises. Finally, Chapter VIII covers good practices related to the institutional support to start-ups and academic spin-offs.

Annex I reproduces the conclusions and recommendations to central and local governments developed by the International Conference "From Applied Research to Entrepreneurship: Promoting Innovation-driven Start-ups and Academic Spin-offs". Annex II presents the methodologies used by the European Union to assess the scope of national innovation activities. Annex III highlights the procedures related to the disclosure of inventions and Annex IV itemizes major channels and forms of industry-science collaboration. Finally, Annex V contains a glossary of terminology used in the publication.

[3] Barriers to enterprise development in emerging market economies of the region and government action aimed at alleviating them are addressed in the UNECE publication, *Developing Entrepreneurship in the UNECE Region: Country experiences in reducing barriers to enterprise development* (United Nations publication, Sales No. E.08.II.E.18).

I. Innovative entrepreneurship as a key factor of modern economic development

In recent decades, innovation has become the focus of economic research as a key long-term factor of economic development. Usually, the start of in-depth innovation studies is associated with the work of Joseph Schumpeter, one of the most influential economists of the twentieth century.[4] A real explosion of interest by social scientists from different schools of thought to the issues of innovation and its role in economic development occurred after the Second World War and has continued through the beginning of the 2000s.[5] The results of innovation studies have increasingly emphasized the link between innovation, underlying research and entrepreneurial effort aimed at commercializing the results of R&D. In many instances innovation is a precondition for an enterprise acquiring a competitive advantage. At the same time, start-ups and academic spin-offs, which bring the R&D results to the market are argued to have become a major driver of continuous and sustainable economic growth.

Schumpeterian perspective tends to emphasize innovation as the market experiment likely to bring about sweeping changes that fundamentally restructure industries and markets. At the same time, in the view of neoclassical economics, innovation is an aspect of business strategy, or part of the set of investment decisions to create capacity for product development or improved efficiency. Recent studies have focused on the idea of "sunk costs", irrecoverable commitments of resources to enter new markets or to create competitive advantages by repositioning production or output in the value chain.[6]

According to the OECD, innovation is the implementation of a new or significantly improved product (good or service) or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations of a company.[7] In other words, innovation takes place not only when technologies are developed but also in business practice, workplace organization and companies' external relations. Innovation may originate in the R&D sector within or outside of company research centres.

The major features include that innovation:

(i) is associated with uncertainty over the outcome of innovation activities. It is not known beforehand what the result of these activities will be, e.g. whether R&D will result in the successful development of a marketable product or how much time and resources will be needed to implement a new production process, marketing or organizational method, and how successful these will be.

(ii) involves investment. Innovation-related investment can include acquisition of fixed and intangible assets as well as other investment expenditures (such as salaries, or purchase of material or services) that may yield potential returns in the future.

---

4 J. Schumpeter, Business Cycles: A Theoretical, Historical and Statistical Analysis of the Capitalist Process (Harvard University Press), 1939.

5 C. Freeman, *Systems of Innovation* (New York, Edward Elgar), 2008.

6 OECD, *Oslo Manual* (Paris), 2005, p. 30.

7 Ibid, chap. 1.

(iii) is subject to spill-overs. The benefits of creative innovation are rarely fully appropriated by the inventing firm. Companies that innovate by adopting the innovation can benefit from knowledge spill-overs as well as from the use of the original innovation. For some innovation activities, imitation costs are substantially lower than development costs, so that an effective appropriation mechanism to provide an incentive to innovate may be required.

(iv) involves the utilization of new knowledge, or a new use or a combination of existing knowledge. New knowledge may either be generated by the innovating firm in the course of its innovation activities (i.e. through intramural R&D) or acquired externally through various channels (e.g. purchase of new technology). The use of new knowledge or the combination of existing knowledge requires innovative efforts that can be distinguished from standardized routines.

(v) aims at improving the firm's performance by gaining a competitive advantage (or simply maintaining competitiveness) by shifting the demand curve for the firm's products (e.g. through increasing product quality, offering new products or opening up new markets or groups of customers) or the firm's cost curve (e.g. through reducing unit costs of production, purchasing, distribution or transaction); or by improving the firm's ability to innovate (e.g. increasing the ability to develop new products or processes, or to gain and create new knowledge).

While a broad definition encompasses a wide range of innovation types, in narrower terms innovation can be related to one or more of its forms, for instance product and process innovations.

The development of new and improved products is a well-directed search and learning process, which involves technical as well as economic uncertainties. Generally speaking, innovation is the result of combining the firm-specific determinants (R&D activities, firm size, etc.) and external influences (technological opportunities, R&D spill-overs, etc.). Moreover, both factor groups are to be interpreted within the context of industry-specific conditions (sectoral technology levels, market dynamics, etc.).

Continuous innovation implies an accompanying flow of decision-making on strategy, organization, finance, marketing and location of operations, alongside that related to research, design and operations.[8]

The innovative status of a company also can be defined in several ways. The basic definition of an innovative firm relates to an enterprise that has implemented at least one innovation, while a product or process innovator is defined as a firm that has implemented either a product or a process innovation.[9] The product, process, marketing method or organizational method must be new to the firm or should be viewed as significantly improved as compared with the existing products, processes and methods. This definition includes, on the one hand, products, processes and methods that firms are the first to develop, and, on the other, those that have been acquired from other firms or organizations. Three other criteria referring to the novelty of innovations, which are used in innovation surveys, categorize innovations as "new to the market", "new to the world" and "disruptive innovation", which is opening the way for radical changes in the modes of production.[10]

It is crucial to know why firms innovate. As was already mentioned, its ultimate objective is to improve the performance of firms, for example by increasing demand for its outputs or reducing costs. In particular, demand for a new product can create a market advantage for the innovator. In the case of productivity-enhancing process innovations, the firm gains a cost advantage over its competitors,

---

8 D. Teece, "Explicating dynamic capabilities: the nature and microfoundations of sustainable enterprise performance", *Strategic Management Journal*, Vol. 28, No. 7, 2007, pp. 501-528.

9 OECD, *Oslo* ..., op. cit., p. 58. See Annex V for definitions of "start-ups" and "spin offs".

10 OECD, *Oslo* ..., op. cit., chap. 3.

allowing a higher mark-up at the prevailing market price or, depending on the elasticity of demand, using a combination of lower price and higher mark-up to increase its market share and profits.

Firms compete successfully when they offer new, better, and/or cheaper products and services, which their customers can use to their advantage, and which their competitors can not emulate. Competitive advantage therefore derives from the ability to produce better products or services and/or to produce them more cheaply than the competitors ("relative dimension" of competitive advantage), or to make and produce new things (an "absolute dimension").[11]

A well functioning market hosts a number of operators of different sizes, where a collaboration between large, medium-sized and small companies takes a variety of forms. It may be a joint venture, established by two or more partners as a separate company with shared equity investments. It can also take the form of a partnership, in which the participating companies continuously commit to shared business or technological objectives without equity sharing, often known as strategic alliances. The collaboration among business operators may also take the form of R&D contracts or technology exchange agreements, whereby firms' shared objectives involve an exchange of research findings or technological know-how.

Firms collaborate among themselves but also increasingly collaborate with universities, research institutions and other external producers of knowledge in a variety of formal and informal organizational forms (R&D consortia, research and technology programs, technology platforms, innovation forums, etc.).

In the context of the innovation process, the roles of small and large firms often differ. Small firms have to be innovative because that is the only way they can penetrate the market or stay thereon. While small firms may cause technological turmoil by bringing completely new ideas to the marketplace, it often is one of the large established firms that eventually ends the turmoil by introducing a product that becomes a dominant design in the market. As an example, in the early 1980s several start-up companies introduced to the market small (personal) computers, but it was IBM that developed a model which incorporated the main features of what is now known as the Personal Computer or PC. Customers have learned to trust large companies and are more willing to try new products of known brands rather than those belonging to unknown start-ups.

Although the names of many large firms are often associated with new products and processes, research has shown that even in global industries, such as those based on information and communication technologies (ICT), production of automobiles or of pharmaceuticals, small and medium-sized companies are often the source of new ideas that are integrated into other products or brought to the market in their own right by large firms.[12] This is also supported by the data on R&D spending. In the United States, for example, in 1981 SMEs (companies with less than 1000 employees) accounted for 4 per cent of US industry spending on R&D. By 2007 their share had risen to 24 per cent. At the same time, the share of large firms with more than 25,000 employees declined from 71 to 32 per cent.[13] This proves that SMEs recently have strengthened their potential for innovation and growth.

In the past, governments tended to underestimate the role of SMEs in innovation. Recently, they have increasingly rebalanced their priorities and have significantly strengthened support schemes for small

[11] M. Dodgson, D. Gann and A. Salter, *The Management of Technological Innovation* (2nd edition), (Oxford, Oxford University Press), 2007.

[12] OECD, OECD Science, Technology and Industry Outlook (Paris), 2010.

[13] National Science Board, *Science and Engineering Indicators 2010* (Arlington), 2010, http://www.nsf.gov/statistics/seind10/append/c4/at04-12.pdf.

firms, introducing some additional benefits for SMEs within their programmes of innovation support.[14] Traditional means of innovation support include Government grants and loans encouraging R&D in companies, research institutions and universities. These instruments are often called "technology push" instruments of innovation policy. At the same time, over the recent years, more and more emphasis has been put on various kinds of demand-based policy instruments. The demand-based innovation policy instruments are expected to encourage innovation through public procurement policies and development of norms and standards, as well as other market development measures (such as living lab user platforms, etc).

Economic research indicates that while some of the public funding used to encourage business R&D largely replaces private expenditures, there are significant net benefits for innovation as well.[15] In many cases innovation originates in R&D, financed both by the Government and the private sector. Related to that, provision of business services to innovators is an important component of national or regional small business policies, which seek to meet the needs of firms at various stages of the innovation process. Proximity helps to bind these various dimensions together, and support of innovation-based entrepreneurship is often the result of policy initiatives by local or regional governments, which have a better knowledge of local conditions and the capacity of innovators in the area.

The heart of the continuous innovation process is the commercialization of R&D results. This can be defined as the process of turning an invention into a product or service, which could be sold on the market providing returns to the investment of the commercializing company. Continued commercialization nurtures the process of innovation, which is pivotal to sustained economic growth.

It is important to note that in order to implement externally generated knowledge and not to lose their competitiveness, innovative firms have to invest in the maintenance and enhancement of their absorptive capacity. They have to anticipate the relevant technological trends in order to make use of them for their own, firm-specific objectives. The investment in firms' own R&D as well as in innovation management, facilitates the comprehension of the results of externally performed R&D on the one hand, and implementation of the resulting technological opportunities, on the other.[16] Fostering the commercialization of R&D results has become an especially important issue in many emerging market economies of the ECE region. The stakeholders of the innovation process – research institutions and producers, as well as regulatory government agencies – have to establish links and collaborate, enabling the process of innovation and commercialization function.

---

[14] A. Pyka, U. Cantner, A. Greiner and T. Kuhn (eds.), *Recent Advances in Neo-Schumpeterian Economics* (New York, Edward Elgar), 2009.

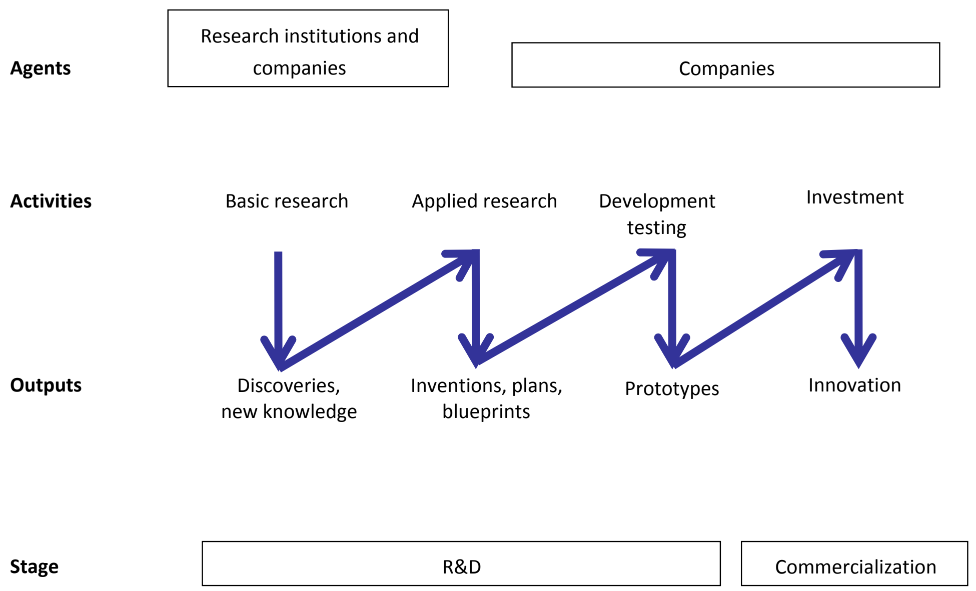
[15] J. Fagerberg, D. Mowery and R. Nelson (eds.), *Oxford Handbook of Innovation* (Oxford, Oxford University Press), 2005.

[16] W. Cohen, R. Nelson and J. Walsh, "Links and impacts: the influence of public research on industrial R&D, *Management Science*, 48(1), 2002, pp. 1-23.

II. Factors influencing the commercialization of R&D results and innovation

The process of innovation goes through a number of stages starting from the laboratory inventions and ending with the new products and processes appearing on the market. This process involves several stakeholders, which enable the commercialization of innovation to occur. The major stages and actors involved in the innovation process are presented schematically in Box 1 and Box 2. While Box 1 illustrates a traditional ("linear") model of innovation and commercialization, Box 2 highlights an interactive or "feedback" approach to these processes.

Box 1. Innovation process: stages and actors involved



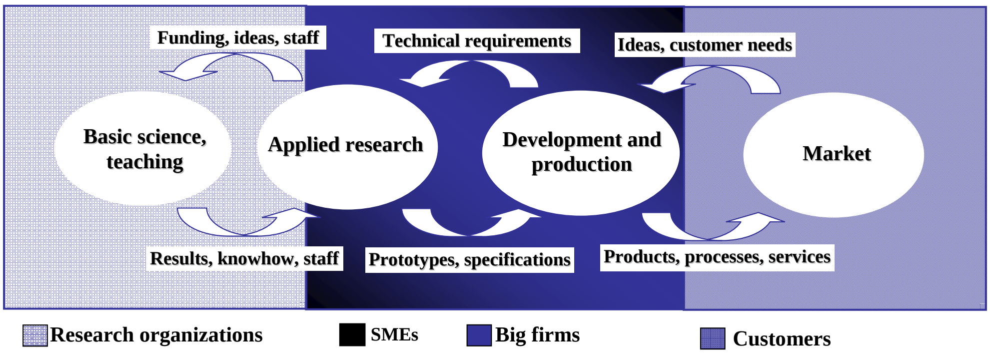
Source: Based on C. Greenhalgh and M. Rogers, *Innovation, Intellectual Property and Economic Growth* (Princeton University Press, 2010), p. 97.

The process of the commercialization of R&D results involves various stakeholders, the roles of which are summarized in Box 3.

The main drivers of commercialization include factors such as:

(a) The **scope of Research and Development**, which determines the stock of inventions and innovations to be commercialized. Among other factors, the scope of R&D depends on the number of universities and research institutions in the country, the number and qualifications of research workers in public research organizations and the corporate sector, investment in R&D from public and private sources and its effectiveness (indicators being the number of scientific articles published and their citation index). The scope and effectiveness of R&D also depends on how well domestic research organizations and companies are connected internationally, how easy it is for them to draw on results generated abroad, and to cooperate with foreign partners in order to leverage domestic resources and capabilities.

Box 2. Innovative process: interaction of major actors and processes



Source: UNECE secretariat.

(b) **Human resources** available for R&D. The availability of highly qualified personnel depends on the quality of education, in particular higher (university) education. The latter is determined by the funds allocated to education by the state, enrolment rates in universities and the quality of education and training therein. Efficient health services and lower revenue inequalities are also important for sustaining a motivated and efficient workforce.

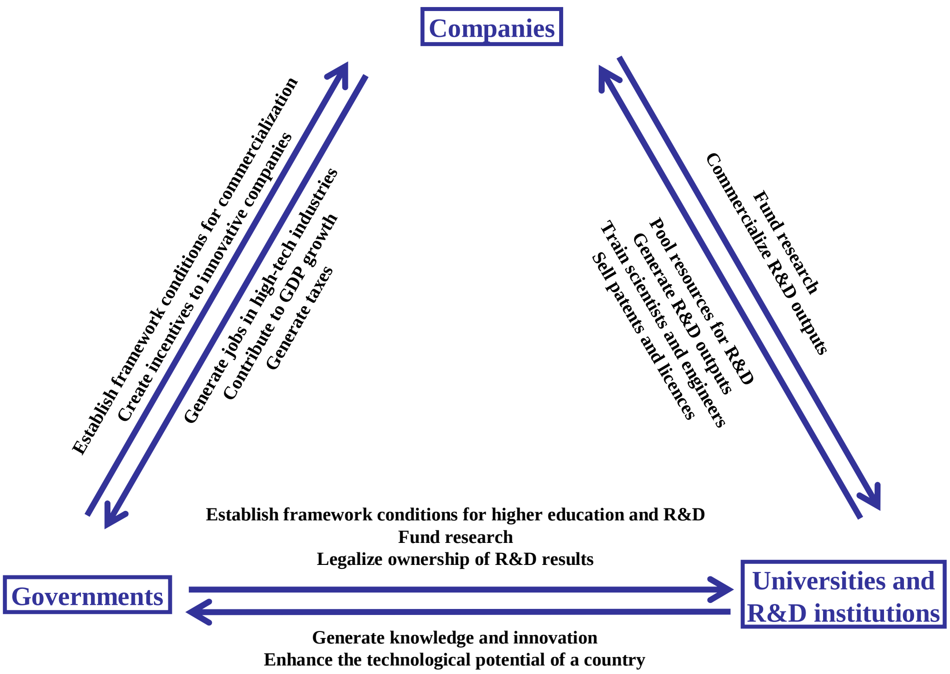
(c) **Regulatory and institutional environment** conducive to innovation, which implies transparency and accountability in public spending and investment, stable property rights including intellectual property rights, independence of the judiciary, transparent and stable rules, low costs and simple procedures governing the registration and operation of enterprises, hiring of workers and the registration of intellectual property, transparent tax administration and reasonable taxation rates, and ease of access to finance at various stages of enterprise development, as well as a level playing field for foreign enterprises potentially interested in investing in the country, including in R&D. These factors influence the business climate in which the innovation-based enterprises operate, and thus determine the demand for innovation.

(d) The **intensity of linkages** between the various actors involved in innovation. These links are provided by public, private or public-private organizations that support entrepreneurs in establishing spin-off companies, commercializing their innovations, bringing them to the market and finding financial solutions (see below).

(e) As emphasized at the International Conference "From Applied Research to Entrepreneurship: Promoting Innovation-driven Start-ups and Academic Spin-offs" **openness to foreign technologies** and to cross-border cooperation in innovation. Research and development is increasingly carried out across national borders and the national capacity to absorb and adapt technologies developed worldwide is one of the key drivers of innovation. By participating in international R&D networks and technology transfer, countries can also tap into the knowledge accumulated abroad as well as foreign sources of innovation finance and investment, and can increase the pace and quality of their own innovation.

(f) **Wide use of information and communication technology** (ICT) as evidenced by international experience. The latter shows that well developed internet and mobile phone networks both provide support for enterprises and render the business environment more conducive to entrepreneurship. Moreover, they are important for enabling domestic research organizations and firms to tap into knowledge generated abroad and to cooperate internationally in R&D and commercialization.

Box 3. Roles of major stakeholders in innovation



Source: UNECE secretariat.

The *Innovation for Development Report*, recently prepared by the European Business School in collaboration with the World Bank, uses a number of indicators to position countries with respect to the conditions created therein for innovation.[17] The report ranks Sweden as the leading country in innovation, and Box 4 highlights the major strengths of this country in innovation and commercialization of R&D results.

The example of Sweden shows the pivotal role of Governments in innovation and commercialization of R&D results, which determine the operational environment through regulations, education policy, public services, infrastructure development and direct funding of R&D.

In the second half of the twentieth century, the evolving structure of R&D funding has been a particularly important factor in the commercialization of innovation. States in Western Europe and North America have progressively abandoned the idea of all results of publicly-financed scientific research automatically entering the public domain, and have awarded universities with more liberty to manage their own intellectual property policies. Universities have responded to this policy change by increasingly patenting the results of their research, licensing patents to industries and/or establishing new companies to commercialize the R&D results. In turn, the prospect of being able to obtain exclusive intellectual property rights to research results has made it more attractive for private companies to fund university research. In the United States, for example, the non-government funding

[17] A. Lopez-Claros, *The Innovation for Development Report 2010-2011: Innovation as a driver of productivity and economic growth* (Palgrave Macmillan), 2010.

of university research in 2000 constant US dollars increased from about 0.5 million in 1972 to over 17.2 million in 2008, that is by 34 times. In relative terms, over the same period the share of non-government financing of university research increased from 21.5 to 33.3 per cent.[18]

Box 4. Sweden, the leader in innovation and commercialization of R&D results

Sweden holds the first place in terms of transparency of governance, low levels of corruption, developed e-administration and favourable "doing business" indicators. It also has a rank of two with respect to the number of scientific and technical journal articles per capita, and levels of R&D expenditure in relation to GDP (public and private). In addition, Sweden is a leader in the number of patent registrations per million inhabitants and is one of the top countries with respect to rates of university enrolment.

Having enjoyed budget surpluses for a number of years, the Government of Sweden has used them to deal with long-term issues. Among those one notes considerable investments in knowledge and training of the labour force to raise labour productivity and foster the R&D effort. Relatively high taxation rates have not discouraged entrepreneurship and innovation, because public revenues have been consistently and transparently invested in education, infrastructure building, R&D and public health, improving the business climate and benefiting the private sector.

Swedish universities and entrepreneurs have established and sustained multiple links, conducive to the commercialization of R&D results. Along the same lines, collaboration in research (revenue sharing contracts) between public and private institutions is encouraged.

Source: A. Lopez-Claros, *The Innovation for Development Report 2010-2011: Innovation as a driver of productivity and economic growth* (Palgrave Macmillan, 2010).

The evolution of innovation policies in industrialized countries has led to the emergence of a complex infrastructure of business support mechanisms. These range from the allocation of risk-free facilities, in which an entrepreneur can test a business idea, to technology transfer networks, subsidized operating premises and venture capital funding. Most of such business support structures rely on public funding, but increasingly private for-profit and non-profit services have also become available.

In particular, private funding plays a key role in the financing of innovation and commercialization of R&D.

Typically private innovation financing comes from the following sources:

- Own financing by companies, individuals and private organizations (in the forms of equity, loans, credits or other in-kind having a monetary equivalent, such as expert work contribution, rights to use premises, equipment or patents);
- Commercial bank loans/credits, guarantees and collaterals;
- Venture financing (various kinds of equity-based financing);
- Stock exchange.

At various stages of the innovation life cycle, inventors and companies use a variety of public and private funding sources.

Given their long and uncertain payback period, R&D projects are known to be inherently more risky than other investment projects. The likelihood of financial constraints is especially high for (potential)

18 National Science Board, *Science and Engineering Indicators 2010* (Arlington), 2010.

new entrants into the R&D and innovation process, since they have no history of successful R&D and innovation and only very limited means of internal finance.

Traditionally, governments have tried to help loosen these bottlenecks in a variety of ways. Financial support mechanisms such as direct funding, tax incentives, subsidies and loans are the main instruments that have been used to encourage private R&D. Economic research indicates that while some of the public funds used to fuel business R&D replace private expenditures, there are significant net benefits as well. In a recent study carried out in Spain it was found that in the mid-2000s public financing produced stronger positive effects on R&D in small firms than in large ones. At the same time, the results were better in low-technology industries (such as timber or light industry) than in high technology sectors. The study argues that public financing induces SMEs to perform research that would not have been carried out in the absence of such funding.[19]

The Government support of research and development in companies, research institutions and universities through grants and loans is often referred to as "technology push" instruments for innovation policy. During the past years, in parallel with the more traditional "push" measures, more and more emphasis has been put on the development and utilization of various kinds of demand-based policy instruments. The most common demand-based innovation policy instruments are public procurement, development and implementation of norms and standards, as well as other market development measures (such as living lab user platforms, etc).

In developed market economies, public procurement, in particular, has become an important tool of fostering R&D and facilitating the commercialization of its results. In the leading countries of the European Union (e.g. Germany, Italy, Netherlands, Norway, Sweden and United Kingdom), public procurement has emerged as a powerful instrument of driving research and innovation by providing to companies "lead markets" for new technologies. While guaranteeing the sales revenues for innovative products that an informed customer is waiting for, Governments reduce the risk of investing in R&D. At the same time, public purchase of R&D results opens up opportunities of improving the quality and productivity of public services through the deployment of innovative goods and services. Technologies launched in this way may then move on to further use in private sector markets. The volume of public procurement accounts for some 16-19 per cent of GDP in most EU countries, being roughly 10 times bigger than the respective volume of public and private R&D investments.

Utilization of public procurement can raise R&D intensity in industry and stimulate the development of research and innovation-intensive products and services. This is a catalytic action different from the "usual" supply of research and development services through grants or contracts.[20] It should be emphasized that the private participation in public procurement paves the way for stable and long-term cooperation between the public sector and companies. For start-ups this creates opportunities to "mature" at relatively favourable conditions of guaranteed markets. This enables companies to focus

---

[19] X. González and C. Pazó, "Do public subsidies stimulate private R&D spending?", *Research Policy*, 37, 2008, pp. 371-389.

[20] European Commission, *Public Procurement for Research and Innovation*, European Commission Expert Group Report, 2006.

on the development of new products and processes, bringing them strategic advantages over the competitors.

III. Emerging market economies: potential for innovation

In the 2000s, the drivers of innovation in emerging market economies of the UNECE region were generally less advanced than those in developed market economies. Many EMEs have relatively well-educated labour forces and a good tradition of scientific research. In particular, important investments in education, and science and technology at the time of the Soviet Union have credited its successor States with a solid scientific background and a high academic research potential. The Russian Federation, for example, has several Nobel Prize winners in natural sciences, and hosts one of the leading schools of mathematicians. However, in the second half of the 2000s, in relative terms the number of scientists in EMEs was generally lower than that in developed market economies.

During 2006-2008, in the new EU member States and selected successor states of the Soviet Union, the number of researchers per million inhabitants tended to increase (see Table 1). The available data for 2008 being incomplete, in the new EU member States, this number was equivalent to 54 per cent of the OECD average in 2006 and 65 per cent in 2007. In selected countries of the former USSR in both years the number of researchers per million inhabitants made up about 53-54 per cent of the indicated average. Finally, in countries of South-East Europe, in both years this indicator was significantly lower than in the above-mentioned groups of economies (less than 20 per cent and about 30 per cent of the OECD average in 2006 and 2007, respectively). It should also be noted that the number of researchers per million inhabitants, as a percentage of the OECD average, varied widely across countries. While in the Russian Federation and Slovenia the number of researchers was as high as 95-110 per cent and 85-103 per cent of the OECD average in 2006 and 2007, in Moldova and Bosnia and Herzegovina, in the same years the corresponding figures did not exceed, respectively, about 20-24 and 6-7 per cent of this average.

During 2008-2009, in absolute terms the number of researchers in several new EU member States (e.g. Poland and Romania) is reported to have marginally declined while the drop was more important in Russia and Ukraine (2 and 3.5 per cent decline respectively).[21]

In the second half of the 2000s, R&D expenditures as a percentage of GDP in the emerging market economies of the region were significantly lower than the OECD average (see Table 2). In 2006-2008, in the new EU member States, they made up 37-39 per cent of the OECD indicator. While the available data for 2008 are incomplete, during 2006-2007, in countries of South-East Europe these expenditures as a percentage of GDP did not exceed 17-18 per cent and in the EECCA countries, 35-37 per cent of the OECD average. In 2008, the average indicator for the latter group of countries (for which the data are available) amounted to about 42 per cent of the OECD average.

[21] OECD, *Main S&T Indicators* No. 1, (Paris), 2011, p. 30; *Science and Innovation Activities in Ukraine*, State Committee of Statistics of Ukraine (Kiev), 2011, p. 32 (in Ukrainian).

Table 1. Number of researchers per million inhabitants in selected emerging market economies, 2006-2008

Country group / country		2006	2007	2008
New EU member States (selected countries)	Bulgaria	1344	1466	1499
	Czech Republic	2569	2715	2886
	Estonia	2613	2748	2966
	Hungary	1745	1733	…
	Latvia	1765	1861	1935
	Lithuania	2371	2529	2546
	Poland	1561	1610	1623
	Romania	952	877	908
	Slovakia	2185	2290	2331
	Slovenia	2921	3109	3490
	Average (countries above)	**1868**	**1947**	**1869**
South-East Europe (selected countries)	Bosnia and Herzegovina	177	197	…
	Croatia	1303	1384	1514
	The former Yugoslav Republic of Macedonia	521	…	…
	Serbia	…	1195	…
	Average (countries above)	**667**	**925**	**1514**
Eastern Europe Caucasus and Central Asia (selected countries)	Belarus	1904	1961	…
	Moldova	698	724	726
	Russian Federation	3258	3305	3191
	Ukraine	1476	1458	…
	Average (countries above)	**1834**	**1862**	**1959**
Memo item:	OECD average	3442	3012	…

Source: World Bank Databank.

It is noted in the literature, that the overall business environment in most of the successor states of the Soviet Union is not sufficiently conducive to innovation and commercialization of R&D results. Violations of property rights, including IPRs, protracted procedures of patent registration, heavy bureaucracy and corruption, lack of judiciary independence – all these factors remain major obstacles to innovation.[22] For instance, according to the World Bank in 2010, in Ukraine the property registration required as many as 10 procedures and an average of 117 days. In the same year, to register property ownership in OECD countries required about 5 procedures and took on average 33 days.[23]

---

[22] UNECE, *Developing Entrepreneurship in the UNECE Region...*, op. cit., chap. 2.

[23] At the same time, a number of countries of Eastern Europe and Central Asia have recently witnessed remarkable progress in creating enabling environments for entrepreneurship. In particular, in many of them the procedures for property registration have undergone a complete overhaul. Today, six countries of the region – Armenia, Azerbaijan, Belarus, Georgia, Lithuania and Slovakia – belong to the 10 top-ranking

Table 2. Research and development expenditure in selected emerging market economies as a percentage of GDP, 2006-2008

Country group / country		2006	2007	2008
New EU member States (selected countries)	Bulgaria	0.48	0.48	0.49
	Czech Republic	1.55	1.54	1.47
	Estonia	1.14	1.11	1.29
	Hungary	1.00	0.96	…
	Latvia	0.70	0.59	0.61
	Lithuania	0.79	0.82	0.8
	Poland	0.56	0.57	0.61
	Romania	0.45	0.53	0.59
	Slovakia	0.49	0.46	0.47
	Slovenia	1.56	1.45	1.66
	Average (countries above)	**0.87**	**0.85**	**0.89**
South-East Europe (selected countries)	Bosnia and Herzegovina	0.02	0.03	…
	Croatia	0.76	0.81	0.9
	The former Yugoslav Republic of Macedonia	0.21	…	…
	Serbia	0.47	0.35	…
	Average (countries above)	**0.37**	**0.40**	**…**
Eastern Europe Caucasus and Central Asia (selected countries)	Belarus	0.66	0.96	0.9
	Moldova	0.41	0.45	…
	Russian Federation	1.07	1.12	1.03
	Ukraine	0.95	0.85	0.97
	Average (countries above)	**0.77**	**0.85**	**0.97**
Memo item:	OECD average	2.23	2.28	2.33

Source: World Bank Databank.

Another major obstacle to the commercialization of R&D results in emerging market economies is the lack of communication and collaboration between the scientific community and manufacturers on the one hand, and the lack of private investment in R&D, on the other. The latter is in part a consequence of the poor business environment, which generally weakens the incentives to invest, and this disincentive effect is particularly strong when the risks are high, i.e. when investing in innovation. It should be emphasized that close collaboration between higher education institutions and the private

economies in terms of the ease of registering property (the other four being New Zealand, Norway, Saudi Arabia and United Arab Emirates). Transferring property in those countries is reported to take on average six procedures and cost 2.4 per cent of the property value, as compared with five procedures and 4.4 per cent of the property value for OECD countries. World Bank and International Finance Corporation, *Doing Business 2011*, http://www.doingbusiness.org/~/media/FPDKM/Doing%20Business/Documents/Annual-Reports/English/DB11FullReport.pdf.

sector coupled with the substantive private financing of R&D was a key growth factor of innovation-based start-ups in the 1990s-early 2000s, especially in the United States. Partly, the lack of investment in R&D in emerging market economies can be explained by weak funding as a result of competing demands for public resources during the transition. However, it is the low level of financing from private sources that is the major cause of insufficient funding for R&D in most of these countries.

In 2007, in the 16 countries of the Euro zone[24] the private R&D spending made up 56.8 per cent of the total spending, 34 per cent coming from Governments and 0.9 per cent from universities (see Table 3). In the same year, in the United States the percentage share of private R&D funding was as high as 66.4. In contrast, the share of R&D investment coming from the private sector did not exceed 40 per cent in the new EU member States and was as low as 30 per cent in selected countries of EECCA. According to Eurostat, in 2007-2009, in the new EU member States this percentage fluctuated between 36 and 39, while in the Russian Federation it tended to decline from about 29 to less than 27 per cent, the public sector providing a stable two thirds of funds for R&D.[25] According to some national sources, this proportion was even higher for several other countries of EECCA, in 2008 the share of public funding of research and development was 80 per cent in Azerbaijan and almost 100 per cent in Armenia and Tajikistan.[26]

As a result, on the one hand, the resource potential of academia is used less productively and less knowledge is generated. On the other hand, industry does not make efficient use of the theoretical knowledge generated through academic research and does not translate it into as many patented inventions and industrial innovations as would have been possible.

In 2007, the level of private R&D expenditure per inhabitant in the new EU member States made up the equivalent of EUR 26.5 and in the countries of EECCA, EUR 15.8. These figures are equivalent to only 9 per cent and 5 per cent, respectively, of private R&D expenditure in the countries of the Euro zone (EUR 293.6 par inhabitant) and less than 5 per cent and 3 per cent, respectively, of similar figures in the United States (the equivalent of EUR 576.9 par inhabitant). Even in more advanced new EU member States such as the Czech Republic and Slovenia the spending of enterprises on R&D per inhabitant constituted in 2007 only 35 and 49 per cent of the Euro zone average, and in Croatia, the Russian Federation and Turkey the corresponding ratio was less than 10 per cent.

In economies where the private financing of R&D is low, often the highest profitability can be obtained in the extraction of natural resources and the low-technology sector. The benefits of alternative investment strategies, namely innovation-based activities, are not obvious, and most manufacturers focus instead on adapting imported technologies and know-how. At the same time, the international experience shows that even in such countries enhanced R&D can enable development of more advanced export products. For instance, a dual strategy has proved to be efficient in Brazil and Israel. While taking advantage of their strength in traditional export sectors, companies also develop high-technology products and industries. Moreover, they seek to strengthen the competitiveness of their primary sectors by applying advanced science-based production methods.

---

[24] The Euro zone countries include Austria, Belgium, Cyprus, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Malta, Netherlands, Portugal, Slovakia, Slovenia and Spain.

[25] http://epp.eurostat.ec.europa.eu/portal/page/portal/science_technology_innovation/data.

[26] Indicators of Science, *Statistical Yearbook*, Federal State Statistics Service, Higher School of Economics (Russian Federation), 2010 (in Russian), p. 326.

Table 3. R&D expenditure in selected emerging market economies by origin of funds, 2007

Country group / country		Unit of measurement	Total	Enter-prises	Govern-ments	Universi-ties	Other sources
New EU member States (selected countries)	Czech Republic	Euro per inhabitant	188.1	101.5	77.5	1.5	7.7
		Per cent	100.0	54.0	41.2	0.8	4.1
	Estonia	Euro per inhabitant	132.8	55.3	60.6	1.1	15.7
		Per cent	100.0	41.6	45.6	0.9	11.9
	Hungary	Euro per inhabitant	98.6	43.2	43.8	…	…
		Per cent	100.0	43.9	44.4	…	…
	Latvia	Euro per inhabitant	56.0	20.3	30.9	0.5	4.2
		Per cent	100.0	36.4	55.2	0.9	7.5
	Lithuania	Euro per inhabitant	65.3	16.0	31.3	4.9	13.1
		Per cent	100.0	24.5	47.9	7.5	20.1
	Poland	Euro per inhabitant	45.9	15.7	26.9	0.1	3.2
		Per cent	100.0	34.3	58.6	0.2	6.9
	Romania	Euro per inhabitant	29.3	7.9	19.7	0.4	1.3
		Per cent	100.0	26.9	67.1	1.4	4.6
	Slovakia	Euro per inhabitant	46.2	16.4	24.9	0.1	4.8
		Per cent	100.0	35.6	53.9	0.2	10.3
	Slovenia	Euro per inhabitant	140.0	81.6	49.9	0.5	8.1
		Per cent	100.0	58.3	35.6	0.4	5.8
	Average (countries above)	Euro per inhabitant	67.1	26.5	32.5	0.5	7.6
		Per cent	100.0	39.4	48.5	0.8	11.4
SEE (selected countries)	Croatia	Euro per inhabitant	78.5	27.9	39.5	2.4	8.7
		Per cent	100.0	35.5	50.4	3.0	11.1
EECCA (selected countries)	Armenia	Euro per inhabitant	4.4	…	2.2	…	…
		Per cent	100.0	…	50.3	…	…
	Azerbaijan	Euro per inhabitant	4.4	0.9	3.3	…	…
		Per cent	100.0	20.8	76.5	…	…
	Belarus	Euro per inhabitant	31.8	14.4	15.7	0.1	1.7
		Per cent	100.0	45.1	49.2	0.3	5.3
	Kazakhstan	Euro per inhabitant	9.9	4.4	3.7	1.5	0.3
		Per cent	100.0	44.5	37.4	15.3	2.7
	Russian Federation	Euro per inhabitant	74.7	22.0	46.8	0.5	5.5
		Per cent	100.0	29.4	62.6	0.6	7.3
	Ukraine	Euro per inhabitant	19.5	5.9	10.2	0.0	3.4
		Per cent	100.0	30.2	52.2	0.2	17.3
	Average (countries above)	Euro per inhabitant	52.5	15.8	32.1	0.4	4.2
		Per cent	100.0	30.0	61.2	0.8	8.0
Turkey		Euro per inhabitant	47.0	22.8	22.1	0.0	2.1
		Per cent	100.0	48.4	47.1	0.0	4.5
Memo item: United States of America		Euro per inhabitant	868.4	576.9	240.8	23.2	27.4
		Per cent	100.0	66.4	27.7	2.7	3.2
Memo item: Euro zone		Euro per inhabitant	516.9	293.6	176	4.6	42.7
		Per cent	100.0	56.8	34.0	0.9	8.3

Note: Averages for groups of countries are weighted by the share of each country's population in total.

Source: UNESCO data centre.

It is argued that to render the commercialization and technology transfer more effective, the private sector in EMEs has to invest and be involved in this process on a considerably more massive scale.[27]

Skilled human resources and high education standards, especially those of higher education, are central to making innovation and commercialization sustainable. Table 4 shows that in 2006-2007, public spending on education as a percentage of GDP was lower than the OECD average by about 0.5 percentage points in the selected new EU countries and by 0.75-1.1 percentage points in the selected countries of Eastern Europe, Caucasus and Central Asia.

Most emerging market economies seem to face important future efforts in terms of tertiary education enrolment: in 2006-2008, only Belarus, Latvia, Lithuania, Russia, Slovenia and Ukraine had levels of tertiary enrolment higher or close to OECD average (about 70 per cent), whereas the corresponding figures for most other countries were below 50 per cent of the OECD average (see Table 5).

Table 4. Public spending on education in selected emerging market economies as a percentage of GDP, 2006-2007

Country group / country		2006	2007
New EU member States (selected countries)	Bulgaria	4.2	4.1
	Czech Republic	4.6	4.2
	Estonia	…	4.8
	Hungary	5.4	5.2
	Latvia	5.1	5.0
	Lithuania	4.8	4.7
	Poland	5.2	4.9
	Romania	…	4.3
	Slovakia	3.8	3.6
	Slovenia	5.7	…
	Average (countries above)	4.9	4.5
Eastern Europe Caucasus and Central Asia (selected countries)	Armenia	2.7	3.0
	Azerbaijan	2.0	1.7
	Belarus	6.0	5.1
	Georgia	3.0	2.7
	Kazakhstan	2.6	2.8
	Kyrgyzstan	5.5	6.5
	Moldova	7.5	8.3
	Russian Federation	3.9	…
	Tajikistan	3.4	3.4
	Ukraine	6.2	5.3
	Average (countries above)	4.3	4.3
Memo item : OECD average		5.4	5.05

Source: World Bank Databank.

[27] According to the European Commission: “The private sector must provide the lion's share of research funding if cutting-edge technologies are to be developed and widely exploited by industry.” See also I. Semenova, "Current issues in the process of technopark establishment in the Russian Federation", *St. Petersburg University Journal*, Geographical section, No. 3, 2009 (in Russian), pp. 132-138.

Table 5. Enrolment and expenditure per student in tertiary (higher) education in selected emerging market economies as a percentage of GDP, 2006-2008

Country group / country		Enrolment in tertiary education (gross enrolment, per cent)			Expenditure per student enrolled in tertiary (higher) education as a percentage of GDP		
		2006	2007	2008	2006	2007	2008
New EU member States (selected countries)	Bulgaria	45.7	49.3	51.0	23.1	20.1	...
	Czech Republic	50.0	54.3	58.3	37.3	30.5	...
	Hungary	66.8	67.2	65.0	23.8	23.8	...
	Latvia	73.6	71.3	69.2	15.8	16.3	...
	Lithuania	76.4	75.9	77.3	17.0	17.1	...
	Poland	65.6	66.9	69.4	17.1	16.6	...
	Romania	52.2	58.3	65.6	...	26.2	...
	Slovakia	44.8	50.1	53.6	24.5	19.5	...
	Slovenia	83.0	85.5	86.7	21.6	...	...
	Average (countries above)	62.0	64.3	66.2	20.0	18.9	...
South-East Europe (selected countries)	Bosnia and Herzegovina	...	33.5	...	...	...	...
	Croatia	45.1	47.0	49.3	26.4	25.6	26.2
	Macedonia, FYR	29.3	35.5	40.4	...	...	...
	Serbia	...	48.0	48.7	...	...	40.0
	Average (countries above)	37.2	41.0	46.1	26.4	25.6	33.1
Eastern Europe Caucasus and Central Asia (selected countries)	Armenia	31.8	34.2	47.7	...	...	6.9
	Azerbaijan	14.3	14.4	15.0	8.9	7.5	9.3
	Belarus	65.8	68.4	72.8	29.0	18.1	...
	Georgia	38.0	37.0	34.3	...	...	11.2
	Kazakhstan	52.7	51.1	46.9	8.4	7.9	...
	Kyrgyzstan	42.7	42.8	52.0	22.2	22.5	17.3
	Moldova	39.4	41.2	40.0	37.6	40.0	38.9
	Russian Federation	72.8	75.0	77.2	13.2	...	...
	Tajikistan	18.6	19.8	20.1	11.1	11.8	21.8
	Ukraine	72.8	76.4	79.4	31.2	25.1	...
	Uzbekistan	9.9	9.9	10.0	...	...	...
	Average (countries above)	41.7	42.7	45.0	20.2	19.0	17.6
Turkey		35.2	37.1	38.4	...	...	...
Memo item: OECD average		69.2	69.6	70.4	26.4	25.6	...

Note: Gross enrolment ratio is the ratio of total enrolment, regardless of age, to the population of the age group that officially corresponds to the level of education shown.

Source: World Bank Databank.

The data presented in Table 5 also show that in 2006-2007, in new EU member States, the expenditure per student enrolled in higher education, as a percentage of GDP per capita, amounted to roughly 74-75 per cent of the OECD average, and in the Czech Republic it was significantly higher than that average (by 5-10 percentage points). While the data for most of South-East European countries are missing, in the EECCA countries in the same years this indicator made up roughly three quarters of the OECD average. Within this region, Moldova and Ukraine had the expenses on tertiary education as a percentage of GDP at the OECD level or even higher, while in the other members of that group (Azerbaijan, Kazakhstan, the Russian Federation and Tajikistan) it did not exceed 46 per cent of the OECD level.

In the case of EECCA countries, one should take into account significantly lower GDP per capita values as compared with developed market economies and the fact that even relatively high indicators of expenditures on higher education as a percentage of GDP in absolute terms (per capita) in the former are much lower than similar indicators in the latter.

Insufficient development of telecommunications and information technology is also characteristic of the business environment in many emerging market economies. Table 6 shows that in 2008-2009, in the new EU member States, the number of internet users and telephones lines per 100 inhabitants represented, respectively. 86-88 per cent and 66-67 per cent of the OECD average. In countries of South-East Europe, they were equivalent to 62-70 per cent and 79-81 per cent of the respective OECD averages. Finally, in the same years, they made up between 25 and 32 per cent and between 45 and 47 per cent of the OECD averages in the emerging EECCA countries.

Table 6. Rates of information and communication technology (ICT) penetration in selected emerging market economies, 2008-2009

Country group / country		Internet users (per 100 inhabitants)		Telephones lines (per 100 inhabitants)	
		2008	2009	2008	2009
New EU member States (selected countries)	Bulgaria	39.5	44.8	28.7	28.5
	Czech Republic	62.3	63.7	21.7	19.9
	Hungary	60.8	61.6	30.8	30.6
	Latvia	63.2	66.7	28.4	28.6
	Lithuania	54.6	58.8	23.4	22.4
	Poland	53.1	58.8	25.5	25.0
	Romania	32.2	36.2	24.2	24.7
	Slovakia	71.2	75.0	20.3	18.9
	Slovenia	57.5	63.5	50.0	50.6
	Average (countries above)	54.9	58.8	28.1	27.7
South-East Europe (selected countries)	Albania	23.8	41.2	10.9	11.5
	Bosnia and Herzegovina	34.5	37.7	27.3	26.5
	Croatia	44.1	50.4	42.4	41.9
	Macedonia, FYR	46.0	51.8	22.4	21.6
	Montenegro	41.0	44.8	58.1	58.7
	Serbia	49.8	56.1	42.0	42.4
	Average (countries above)	39.9	47.0	33.8	33.8
Eastern Europe Caucasus and Central Asia (selected countries)	Armenia	6.2	15.3	20.3	20.4
	Azerbaijan	28.2	42.0	15.1	15.9
	Belarus	23.0	27.0	38.4	41.0
	Georgia	10.1	20.7	14.3	14.5
	Kazakhstan	10.9	18.2	22.0	23.7
	Kyrgyzstan	15.7	...	9.4	9.4
	Moldova	23.4	35.9	30.7	31.6
	Russian Federation	27.0	29.0	31.6	31.6
	Tajikistan	8.8	10.0	4.2	4.2
	Turkmenistan	18.0	2.0	9.5	9.4
	Ukraine	10.1	15.6	28.5	28.3
	Uzbekistan	9.0	16.9	6.8	6.7
	Average (countries above)	15.9	21.1	19.2	19.7
OECD average		64.2	66.8	42.8	41.6

Source: World Bank Databank.

Weak ICT infrastructure handicaps the commercialization of R&D results in general, and the development of innovative start-ups, in particular.

Thus the available data show that in the second half of the 2000s, the EMEs of the region lagged behind the OECD countries in terms of public and private investment in research and development, public expenditure on education and enrolment into higher education as well as the development of information and communication technologies. This has widened the gap between the resources invested in R&D and its commercial outputs, one of its measures being the number of patents registered. At the same time, the lack of direct involvement of private companies in the process of applied research has limited the demand for commercialized products of research, since it discourages its orientation towards commercial needs.

The alternative data set compiled by the European Commission tends to confirm this conclusion. The estimates of the European Innovation Index (EII) made for a number of successor states of the USSR for 2008-2010 were 3 or 4 times lower than those for the leading EU members (see the description of this indicator in Annex II). At the same time, the experts mentioned the relative strength of this group of emerging market economies in human resources to be used in the innovation process.[28]

[28] www.inco-bruit.eu; www.inco-ripka.eu.

IV. The role of patenting in innovation-based entrepreneurship

By definition, a patent is an exclusive right granted by the Government to the patent holder for an invention (a new product or a process), that represents a new technical solution or a new way of doing something.[29]

Patents are a means of protecting inventions developed by firms, institutions or individuals, and as such they may be interpreted as indicators of invention. Patent indicators convey information on the output and processes of inventive activities, in particular, on the technological content of the invention (notably its technical field) and the geographical location of the inventive process. While disclosing information on owners and inventors, and when matched with complementary data (e.g. alliances between firms or between firms and public research organizations, participating multinational companies and small firms, size and composition of research teams, etc.). patent applications can reveal the modalities of the underlying research process. Patents can also provide information about inventors' mobility and networks, and they make possible tracking the diffusion of knowledge (the influence of particular inventions on other, subsequent inventions).[30]

The economic rationale for patenting is to obtain temporary monopoly power over the use of an invention and to increase the profits of the patent holder through its commercialization thereby recompensing the patent holder for the investment made. Owners may also file patents for defensive reasons deterring competitors from using the invention. Once the patent expires, the protected invention becomes part of the public domain, so that the owner no longer holds exclusive rights to it, and it becomes available for commercial exploitation, free of charge, by others. Research has shown that, while this varies across countries and industries and over time, when the proper controls over the information contained in patent applications are applied,[31] there is a positive relationship between patent counts and other indicators related to economic performance (productivity, market share, etc.).

---

29 See http://www.wipo.int/patentscope/en/patents_faq.html#patent, http://www.uspto.gov/patents/index.jsp. Thus acquired patent protection means that the invention cannot be used, distributed or sold on a commercial scale without the patent owner's consent. The protection is granted for a limited period of usually 20 years as stipulated by the TRIPS agreements (http://www.wto.org/english/docs_e/legal_e/legal_e.htm#TRIPs). Patents are always national, i.e. a separate patent is needed for each country in which the inventor seeks legal protection, and the decision whether or not to grant a patent for the invention in question is made by national patent offices based on national law. However, the process of applying for patent protection can be done country by country (the so called "national route"), regionally (the so-called "regional route" applicable to the contracting parties to the European Patent Convention (http://www.epo.org/patents/Grant-procedure/Filing-an-application.html), or internationally through the Patent Cooperation Treaty of the World Intellectual Property Organization (http://www.wipo.int/pct/en/treaty/about.html). European patents granted by the European Patent Office may be extended to some non-member States of the European Patent Convention, such as Albania, Bosnia and Herzegovina, Montenegro and Serbia.

30 OECD Patent Statistics Manual, OECD (Paris), 2009.

31 The problem of proper control over the quality of patenting information remains important, especially for emerging market economies. Sometimes, countries introduce "simplified" procedures for patent registration due to the lack of resources for proper checking of patent information. For instance, in Ukraine until 2003 so-called "declarative" patents were filed. The patents granted were thus based on declarations of the applicants only, and were not compatible with patents granted according to the internationally agreed procedures.

Patents reinforce inventiveness in different ways.[32.] Revealing new knowledge through the disclosure of inventions, they diffuse information that might otherwise be kept secret, thereby encouraging other inventors to develop new inventions. By diffusing information on patented and thus protected inventions, the patent system also deters needless duplication of R&D efforts, encouraging researchers to focus on new areas of research. In addition, as patents are legal titles, they can be traded. Market exchange of patent rights thus facilitates the development of technology markets and eventually improves the allocation of resources in the economy.

As was already mentioned, patents grant their owner a set of exclusive rights over an invention (a product or process that is new, involves an inventive step and is susceptible of industrial application). The legal protection conferred by a patent gives its owner the right to exclude others from making, using, selling, offering for sale or importing the patented invention for the term of the patent, which is usually 20 years from the filing date, and in the country or countries covered by the protection (see Box 5). This set of rights provides the patentee with a competitive advantage in commercially using the invention. Patents can be licensed or commercially used through a spin-off company (see below). It is therefore possible to derive value from the patent rights even if the owner does not have manufacturing capability (which is the case for example of universities).[33]

As a general trend, compared with members of the Euro zone, in the 2000s the EMEs had rather low resident patent applications per million inhabitants (see table 7). In new EU member States this ratio was about 33-42 per cent of the Euro zone average, in selected countries of South-East Europe between 25 and 46 per cent and in the former Soviet Union Republics between 35 and 57 per cent. One also notes that during the period under review in some countries the number of resident patent filings per million inhabitants was significantly higher than for country groups on average. This applies to Slovenia and the Russian Federation where in certain years the number of filings was higher than in the countries of the Euro zone. On the other hand, such countries as Bosnia and Herzegovina, Kyrgyzstan, Lithuania, Tajikistan and the former Yugoslav Republic of Macedonia had levels of patent filings which were much lower than the averages for their country groups.

It is noted in the literature that given the existing stock of inventions, major reasons for low patenting, inter alia, relate to protracted procedures and the high cost of patenting.[34] Generally, the entire procedure from patent application to granting will take over 12 months and may frequently take more than 18 months, depending on legal regulations in a country.[35] In the United States, the process typically takes 24-36 months.[36]

Eventually, the Ukrainian Government had to abolish "declarative' patents" and strengthen control over the patent granting procedures so as to avoid the degradation of the patent system.

32 D. Guellec and B. van Pottelsberghe, *The Economics of the European Patent System* (Oxford, Oxford University Press), 2007.

33 Z. Griliches, "Patent statistics as economic indicators: A survey", *Journal of Economic Literature*, Vol. 28, 1990, pp. 1661-1707.

34 However, lengthy procedures can also be a result of inadequate resources of patent offices relative to the volume of applications, and this problem in turn can be the result of excessively low patenting fees.

35 http://www.wipo.int/sme/en/faq/pat_faqs_q4.html.

36 The patent search typically takes 3-6 weeks, an application preparation about 6-8 weeks, the so-called prosecution phase takes 18-24 months, and the patent issuance typically 3-9 months; http://pw1.netcom.com/~patents2/What per cent20Does per cent20It per cent20Cost per cent20Patent.htm; http://www.gordonrees.com/pubs/pdf/bmhm_11.pdf.

Box 5. Modalities of patent protection

In order to obtain a patent, the inventor has to file an application at a patent office which checks whether the invention complies with the criterion of novelty, and grants or rejects it accordingly. There are different alternative "routes" for protection available to inventors, who will choose one or another depending on their national or worldwide business strategy.

- **National route.** When an inventor (an individual, company, public body, university or non-profit organization) decides to protect an invention, the first step is to file an application with a national patent office (generally the national office of the applicant's country). The first application filed worldwide (in any patent office) for a given invention is known as the *priority application*, associated with a *priority date*. The patent office then begins "searching and examining" the application in order to learn whether or not a patent can be granted, i.e. whether the invention refers to a patentable subject matter, is novel, inventive ("non-obvious to persons skilled in the art") and can be applied in industry. The application is generally published 18 months after it is filed (*publication date*). The time lag between filing and grant or refusal of patents is not fixed; it ranges from two to eight years, with significant differences across national patent offices.
- **International route.** Since 1883, when procedures were standardized under the Paris Convention (about 170 signatory countries in 2006), applicants who wish to protect their invention in more than one country have 12 months from the priority date to file applications in other Convention countries, and if they do so, the protection will apply from the priority date onwards *in the countries concerned*. Alternatively, inventors can use the Patent Cooperation Treaty (PCT) procedure, which has been in force since 1978 and is administered by the World Intellectual Property Organization (WIPO). The PCT procedure allows the claiming of first priority internationally, while keeping the right to file actual patent applications in member countries later. Applicants therefore have more time to fulfil national requirements (since novelty descriptions vary from country to country), and better evaluate chances of obtaining patents and of commercializing the invention.[37]
- **Regional routes.** Applicants can also submit a patent application to a regional office (e.g. Eurasian Patent Office or African Regional Intellectual Property Organization). For instance, the EPO (European Patent Office) is a regional office enjoying the membership of 32 countries, which examines patent applications on behalf of European countries. EPO grants "European patents", which are valid in all its member States in which the holder has validated his rights. Validation requires translation into the national language and payment of national fees.

National patent laws have to comply with international standards, laid down in the TRIPS (Trade-related Aspects of Intellectual Property Rights) agreement, an international treaty which is part of the WTO (World Trade Organization) package of treaties signed in 1994. TRIPS agreement imposes strict conditions on the WTO member States in terms of patentability of inventions in all fields of technology, minimal term of patents of 20 years, limitations of compulsory licensing, etc. After it is issued by the patent granting authority, a patent can still be challenged by third parties. They can do so through the legal system, requesting that a patent be revoked or deemed invalid. In such cases, the patent holder must go to a national court in order to enforce the disputed patent, alleging a third-party *infringement*. However, in Europe, the centralized European patent opposition procedure as well as the centralized European patent appeal procedure may lead to the revocation of a European patent as an alternative to legal action.

Source: OECD Patent Statistics Manual, OECD (Paris), 2009.

[37] *USPTO Performance and Accountability Report 2009*, USPTO (Washington, D.C.), 2010.

Table 7. Resident patent filings per million inhabitants in selected emerging market economies, 2001-2007

Country group / country		2001	2002	2003	2004	2005	2006	2007
New EU member States	Bulgaria	35.8	36.7	35.5	33.8	33.7	31.6	27.6
	Latvia	49.6	64.2	39.1	46.7	48.7	49.8	...
	Lithuania	19.5	24.5	18.5	20.4	19.9	19.2	18.4
	Poland	57.6	60.5	59.4	62.4	53.1	56.6	62.8
	Romania	51.0	67.8	40.5	43.2	42.3	37.7	38.4
	Slovakia	45.7	48.2	39.0	39.9	28.8	35.8	44.3
	Slovenia	151.1	150.5	155.3	171.3	172.0	143.0	164.0
	Average (countries above)	58.6	64.6	55.4	59.7	56.9	53.4	59.2
SEE	Bosnia and Herzegovina	14.0	…	8.5	13.3	17.5	14.6	…
	Croatia	81.5	73.9	87.2	86.7	81.7	71.4	77.6
	Serbia	…	…	…	…	…	…	53.5
	The former Yugoslav Republic of Macedonia	32.7	20.8	22.7	18.2	…	…	…
	Average (countries above)	42.8	47.3	39.5	39.4	49.6	43.0	65.5
EECCA	Azerbaijan	…	…	…	…	33.5	…	…
	Belarus	93.3	90.2	109.6	108.4	119.3	122.1	…
	Kazakhstan	108.2	…	113.8	…	100.6	93.6	…
	Kyrgyzstan	17.0	24.6	35.5	…	…	…	29.6
	Moldova	106.9	59.3	73.7	75.7	97.3	79.1	87.6
	Russian Federation	169.8	163.2	172.7	159.8	165.2	195.7	193.6
	Tajikistan	13.3	6.2	4.7	5.0	4.6	3.9	…
	Ukraine	148.1	33.2	34.2	86.2	75.1	74.3	…
	Uzbekistan	32.2	28.3	36.4	10.6	10.1	12.2	12.1
	Average (countries above)	86.1	57.8	72.6	74.3	75.7	83.0	80.7
Turkey		4.9	6.0	6.9	9.6	12.9	14.7	24.5
Memo item: United States of America		622.6	640.0	650.5	646.5	702.5	742.4	800.2
Memo item: Euro zone		176.7	168.1	158.6	161.0	159.9	169.1	140.9

Note: Patenting rates are not fully comparable across countries due to differences in laws and regulations which affect the breadth of patents. In some countries, the rules favour the filing of relatively fewer broad patents with many claims, in other countries the rules favour the filing of a larger number of narrower patents with few claims.
Source: WIPO Statistics Database and World Bank (World Development Indicators).

This being said, the cost of intellectual property (IP) protection (especially, for patents) can be high, and, therefore, may not be easily affordable for SMEs or public research organizations. The cost of patent protection comprises several fees and depends on the route of the patent protection chosen (national, European Patent or Patent Cooperation Treaty system). Even when the initial costs for a national patent are manageable, they can rise rapidly if protection is sought outside of the country. For example, in the United States issuing a US patent costs about USD 10,000. However, an additional USD 20,000 has to be paid for each country where the invention needs to be protected.[38] The bulk of costs, however, arise from renewal fees (which are increasing over time) and from the need to enforce the patent against infringers (see Box 6).

[38] http://www.uspto.gov/inventors/patents.jsp#heading-7; http://www.bpmlegal.com/ptofeepat.html.

Box 6. Costs and fees related to patent registration and protection

The total cost of patenting is composed of the following types of costs:

Information search costs: these are related to the assessment of the patentability of the invention (novelty criterion) and of potential infringements, and its commercial prospects;

Application fees (e.g. professional charges paid to the patent attorneys or agents for the preparation of the patent application);

If applicable, costs of international patenting, including translation costs;

Fees for maintaining registered patents. These fees are paid to the patent office every year or every five years;

Prosecution fees (e.g. the fees paid to the patent representative/attorney to argue a patent case).

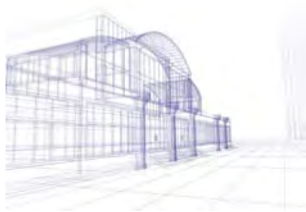
Source: WIPO website; http://www.wipo.int/export/sites/www/sme/en/documents/pdf/managing_patent_costs.pdf; http://www.wipo.int/pct/en/texts/articles/atoc.htm.

SMEs willing to apply for patent protection in various countries can benefit from a WIPO-administered PCT system, which can considerably simplify procedures and reduce costs of patenting (see Box 5).[39]

Because of the potentially significant costs of patenting, SMEs and research organizations need to carefully consider whether patenting is the best available strategy to exploit their intellectual property.

---

[39] This system does not provide "an international patent", but, as was mentioned in Box 5, simplifies the process of filing patent applications, delays the expenses associated with applying for patent protection in foreign countries, and allows the inventor more time to assess the invention’s commercial viability. Under the PCT, an inventor can file a single international patent application in one language with one patent office in order to simultaneously seek protection for an invention in the PCT member countries. The registration becomes valid internationally, and there is no need to apply for patent registration at the National Patent Offices of each country where companies seek IP protection (http://www.wipo.int/pct/en/).



V. Financing early stages of innovation-based SMEs

The access to finance is considered one of the most important factors influencing the development of entrepreneurship in general and of innovative enterprises in particular. According to the EBRD survey conducted in 2009, as much as 47 per cent of South-East European companies considered limited access to finance a significant obstacle to their growth and development.[40] In the same way, according to the World Bank in 2008 access to finance was one of the major enterprise concerns in each of the Central Asian economies.[41] The existence of financial constraints reduces the likelihood that a firm will undertake innovative projects.[42] This concerns, in the first place, small and medium-sized enterprises, which refer to the financing and related problems more often than larger ones.[43]

Several stages in the financing requirements of a start-up are usually distinguished:

a) The seed stage covers the initial research and development of a commercial idea or business concept, focused on determining its technical feasibility, market potential and economic viability;
b) The start-up stage covers the development of a product prototype, initial market research and market-reach activities, and the establishment of a formal business organization;
c) The early-growth stage pertains to small-scale commercialization and growth as well as to laying down the basis for future growth;
d) The expansion stage refers to the stage of substantial growth in the scale and market impact of the company.[44]

For purposes of the current publication, we consider here only the first two stages of enterprise financing, which are particularly pertinent for new innovative firms.

Many of the traditional sources of early-stage finance are not immediately or sufficiently available for innovative enterprises. Indeed, innovation-based projects feature higher risks, which complicate the relationships of entrepreneurs with external investors. While the personal funds of the founders and their close collaborators and friends are often insufficient to cover the needs of start-ups, the uncertainty of outcomes, the intangible nature of assets of innovative enterprises (lack of collateral), the volatility of their cash-flows and the lack of track records often make them unsuitable for bank loans. In emerging market economies, the problem of early-stage financing is aggravated by the underdevelopment of the financial services market.

Given these hurdles, a diversified range of capital providers and specialized financial intermediaries is required to fill the financing gap. We can distinguish here three typical finance providers:

---

[40] EBRD, Business Environment and Enterprise Performance Survey, 2009.
[41] World Bank, *World Bank Enterprise Survey* (Washington, D.C.), 2008.
[42] F. Savignac, "The impact of financial constraints on innovation: evidence from French manufacturing firms", CNRS (Paris), 2006.
[43] B.H. Hall (2010), "The financing of innovative firms", *Review of Economics and Institutions*, Vol. 1, No. 1, Spring 2010, Article 4. Retrieved from http://www.rei.unipg.it/rei/article/view/4. p. 22.
[44] UNECE, *Policy Options and Instruments for Financing Innovation: A Practical Guide to Early-Stage Financing* (United Nations publication, Sales No. E.09.II.E.3), pp. 2-3.

microfinance institutions (MFI) offering microcredits, governments providing grants, and suppliers of external funding, such as business angels or venture capital funds.

In certain cases, **microcredits** can serve as seed financing for innovation-based entrepreneurs.[45] In particular, these can be instrumental for start-ups built around new methods and discoveries in areas such as biotechnology, IT and environmental services. Micro-credits can be used to purchase equipment, technical support and computer services such as databases and web design tools. These instruments might also financially assist new enterprises in protecting intellectual property and obtaining business services, such as preparing business plans and scanning the competitive environment. Subsequently, however, the implementation of innovation projects requires larger amounts of finance limiting the scope of microcredit use by start-ups and academic spin-offs.[46]

Microfinancing is a relatively new instrument for business development in industrialized countries. In 2010, the EU established the European Microfinancing Facility which will offer about 45,000 loans of up to EUR 25,000 to microenterprises or unemployed persons who want to set up their own businesses[47.] Companies having access to microcredits also benefit from training programmes for management and staff. One of the goals of such programmes consists of enhancing awareness of managers regarding the potential of innovation. Among the new EU member States, Romania has recognized that in less developed regions microenterprises had difficulties in accessing finance, which impedes their technological capabilities. As part of its Regional Operational Programme, with EU assistance Romania is developing regional business support structures for microenterprises and other SMEs.[48]

While loans offered though microcredits in most cases do not exceed EUR 25,000 and often can not satisfy the requirements of start-ups, in certain cases they can substitute for the financing by the founders at initial stages of the enterprise life cycle.

Grant programmes provided by government agencies are another source of financing for innovative companies at early stages of development. Under these programmes, start-ups usually receive funds unconditionally, i.e. they don't have to be repaid if the project is not successful. Such programmes enable the seeding and early germination of innovative ideas and provide a certain guarantee for private investors. Yet, to be efficient, several conditions must be respected. The criteria used by public agencies to select high potential firms should be precise and transparent, and in line with those of private investors. The experience shows also that successful public grant programmes are usually decentralized thus better matching the needs of applicants and creating the basis for the future long-term financing of the innovation company. To the same end, in some cases, governments outsource the management of the budget of grant programmes and the selection of companies and projects to a private sector agent.

In recent years, a number of public grant programmes have been implemented in Central and East European countries. Some of the new EU member States have programmes providing direct financing to SMEs.[49] For instance, the Progres programme and the Zaruka programme in the Czech Republic,

---

[45] According to the European Commission Recommendation of May 2003, microcredits are loans below EUR 25,000 assisting microentreprises, i.e. enterprises with fewer than 10 employees, and with turnovers (or balance sheet totals) that are less than EUR 2 million.

[46] Pro Inno Europe, *Global Review of Innovation Intelligence and Policy Studies*, Mini Study 06 – Microfinance & Innovation, February 2009.

[47] Official Journal of the European Union (2010), http://euroalert.net/en/ueprogrammes.aspx?idp=648.

[48] http://www.proinno-europe.eu/page/innovation-and-innovation-policy-romania.

[49] UNECE, *Financing Innovative Development: Comparative Review of the Experiences of UNECE Countries in Early-Stage Financing* (United Nations publication, Sales No. E.08.II.E.2), pp. 74-76.

launched in 2005, offer loans to SMEs in selected sectors to assist them with implementing their business plans and increasing their competitiveness. Along the same lines, since 2003, the Hungarian National Development Bank has been providing direct equity financings to SMEs in Hungary, and in Slovenia, the Slovene Enterprise Fund provides equity finance lines, grant lines and credit lines to start-ups in order to facilitate the creation of new innovative companies. An example of such a packaged programme is presented in Box 7.

Box 7. TechnoPartner programme in the Netherlands

The TechnoPartner programme is an example of the so-called packaged programme grouping four instruments: TechnoPartner Knowledge Exploitation Subsidy, TechnoPartner Seed Facility, TechnoPartner Certificate and TechnoPartner Business Angel Programme (BAP).

The TechnoPartner Knowledge Exploitation Subsidy programme encourages entrepreneurial knowledge organizations (research institutes and universities) and private parties to set up knowledge-intensive and innovative companies in the Netherlands. In order to minimize risks and increase the techno starters' chances of success, the programme:

- Supports the screening of research and scouting of entrepreneurs;
- Subsidizes patenting costs;
- Facilitates access to laboratory equipment;
- Coaches managers;
- Provides pre-seed funding.

The TechnoPartner Seed Facility increases the chances for techno starters to get financing. At the same time, issuing the TechnoPartner Certificate to high technology start-ups, the Government decreases the risk for banks, which provide their financing and improves the risk-return ratio for other investors.

Through its Business Angel Programme the Government advises the new entrepreneurs and new informal investors (virgin angels) on the existing opportunities of investment. To this end the programme organizes information sessions "on starting capital" and provides a booklet containing similar information.

As many as 104 start-ups are currently operational as a result of the TechnoPartner programme. Recently, foreign companies have increasingly started establishing high-technology affiliates in the Netherlands in order to benefit from the programme.

Source: http://www.pionieren.nl/wiki/technopartner/foreignvisitors/technopartner.

It is to be noted that Government use of efficient tools to support commercialization do not necessarily imply a significant financial burden for the state budget. As an example, the International Conference "From Applied Research to Entrepreneurship..." noted that innovation vouchers, ranging in value from EUR 500 in Belgium to EUR 25,000 in Portugal, were a public support initiative, which enabled innovative SMEs to buy expert services from knowledge support institutions facilitating them to develop new products, services and processes, and, in some cases, manage their intellectual property. The innovation voucher schemes, which bring immediate results and are simple to operate, could be emulated in emerging market economies forging closer links between the academic science at the regional level and the business sector.[50]

The Russian START Programme was launched in 2004 by the Foundation for Assistance to Small Innovative Enterprises to stimulate spin-off activity from universities and research institutes of the Russian Academy of Sciences. Funds (USD 250,000 in three years) are provided to cover R&D expenditures and inform private investors of the potential of companies. Under the programme, the

[50] ECE/CECI/CONF.9/2, p. 3.

evaluation of applications is highly decentralized involving over a thousand experts from the regions of Russia where applications are made. Final recommendations are made by 35 Councils composed of scientists, Government officials and entrepreneurs.[51]

In Belarus, the financial support to innovators is offered by the Belarusian Innovation Foundation (BIF). Established in 1999, the BIF provides loan funding to about 10 projects per year. Loans range from USD 50,000 to USD 3 million while the average borrowing is around USD 600,000-700,000. One of the successful start-ups financed by BIF is a company named ADANI that has become a leader in the field of digital radiographic scanning for medical and security applications. In 2011, the overall volume of financing for new innovative enterprises by the Fund is planned to reach USD 22 million.[52] In the same way, in Kazakhstan, the National Innovation Fund established in 2003 supports private venture funds with minority stakes, when their investment policy follows the public priorities in the areas of R&D and innovation.

Another way to finance the development of enterprises at early stages is to call on providers of external equity. As was already mentioned, there are three types of providers: business angels, corporate venture capital funds and venture funds. They receive equity stakes in exchange for their investment so they share both potential benefits and losses of innovative companies. In addition to their investments, they also provide valuable expertise and networking opportunities to these enterprises.

Business angels are individuals that make equity investments in ventures with high growth potential and share their time, expertise and network of contacts with the entrepreneurial team. Investing their own savings and capitals, they differ from venture capital funds, which primarily invest funds granted to them by others. Business angels provide finance to SMEs at earlier stages of their life cycle than other external financiers. Typically companies that receive business angel financing are smaller than venture capital-backed companies.

Very often, business angels are former entrepreneurs who have sold their companies, or retired executives from successful companies. The investments of business angels are often a combination of money, business and practical experience, and contact networks. They offer a number of advantages over the other sources of external finance, for example they can make smaller investments as their transaction costs are lower, and often business angel services are geographically dispersed so they can reach out to start-ups in remote areas.

Given the largely informal nature of business angel activities (often referred to as informal or invisible venture funding), their scope is not easily quantifiable. While the estimates vary, it is certain that recently the role of business angels in financing innovative start-ups has been important. In the United Kingdom, for instance, in 2008-2009, there were 25 networks of business angels. Over the indicated period they:

- Evaluated 8,685 business plans;
- Analysed the status of 824 ventures;
- Made 233 investments, with the average investment being as high as EUR 70,000 (most investments were syndicated with venture capital funds, banks, etc), and undertook some follow-up investments.[53]

---

51 UNECE, *Policy Options and Instruments for Financing Innovation*..., op. cit., p. 14.

52 UNECE, *Innovation Performance Review of Belarus* (United Nations publication, Sales No. E.11.II.E.5), pp. 105-106.

53 C. Mason, unpublished paper to the BBAA Winter Workshop, January 2010.

Recently, the early financing market has witnessed an upsurge in online systems providing market information for business angels and other investors. Simultaneously these interactive electronic platforms give visibility to companies seeking external investment. Online systems typically charge a small amount of money (EUR 100-800) from companies to publish on site their business plans, without evaluating the latter, in fact mediating the match-making between financiers and companies. Examples of such new online portals in the United Kingdom are Angels Den, Angelsoft, Angel Investment, See my Pitch, Nature Vents and Venture Giant. It is estimated that the bulk of business angel investments (by number of investments) in the United Kingdom is already channelled through these online portals.

Growing fast in developed market economies, the business angel market develops more sophisticated organizational patterns, including through international cooperation and syndication of funds.

According to the European Business Angel Network (EBAN) in 2009, in Europe the average amount invested by a business angel in enterprises was around EUR 200,000. This amount varies considerably across countries and regions, with individual angel investments ranging from EUR 15,000 to 400,000. On the other hand, seed funds bring promising start-ups to subsequent stages of their life cycle. Their investment ranges from EUR 200,000 to EUR 1 million (EUR 700,000 on average) and is often effected in collaboration with business angels and other informal investors.

EBAN estimates that the number of business angels in Europe is around 75,000, a small number in comparison to the United States, which has an estimated 250,000. To increase the scope of their activities in Europe, governments need to provide additional stimuli to informal investors.[54] Among the key factors that determine the scale and intensity of business angel activity in a country (potential returns, the number of high-quality start-ups seeking financing), one should emphasize the importance of tax conditions. Tax reliefs on private investments are a major incentive tool to invest. Eastern European countries are reported to have the lowest tax rates in Europe, especially with regard to individual tax rates. However, none of these countries have fiscal incentives such as tax rebates, deductions and exemptions specifically targeting venture capital and business angels' operations.[55]

One should also note that in many emerging market economies, especially in the successor states of the Soviet Union, the development of business angel activities is constrained by the entrenched culture of risk aversion. Despite this, the networks of business angels are getting increasingly visible in the region, for example in Kazakhstan and the Russian Federation.[56]

Corporate Venture Capital (CVC) investors also provide funding for commercialization bridging the gap between inventors and industry. The CVC investor is usually a large company (often a well-established multinational company), which brings in capital and managerial support to small innovative companies (often start-ups) selected on the basis of careful screening. Giving the start-up enough independence to preserve its creativity, the large company benefits in its turn from the growth potential of the start-up. CVC companies may intervene at an earlier stage of the start-up life cycle as compared with traditional venture capital investors (see below). The corporate venture capital investors may be also less concerned with financial returns and more with the strategic value that the entrepreneurial firm may eventually bring to the parent organization.

---

[54] EBAN White Paper October 2010, http://www.eban.org/resource-center/news/197-new-eban-white-paper-2010.

[55] EBAN, Tax Outlook in Europe: Business Angels Perspective, 2010. See also IESE Business School, Investing in Venture Capital and Private Equity in Central Eastern Europe: A ranking of the most attractive countries, p. 16, http://insight.iese.edu/casos/DI-677.pdf.

[56] OECD, *Competitiveness and Private Sector Development: Central Asia 2011*, chap. 4: "Improving Access to Financing for Smaller Enterprises" (Paris).

In the United States, during 1995 and 2010 corporate venture capital became a major vehicle for transferring funds from big multinational companies to small innovative start-ups. In the 2000s, CVC deals represented up to 20 per cent of the total number of venture capital deals and between 7-15 per cent of venture capital invested.[57] Since the CVC investment tends to fall during economic recessions stakeholders need to target ways of combining the CVC financing with other sources.

While business angels and corporate venture capitalists focus primarily on seed and start-up stages of enterprise development, venture capital (VC) funds provide capital to enterprises entering into their early-growth stage in exchange for equity stakes. The objective is to eventually sell those stakes in the future at a premium that justifies the investor risk. Serving as intermediaries channelling funds from institutional investors to enterprises, venture capital firms also provide companies with business advisory services and network contacts, and play an active role in the recruitment and training of management. Although the average amount of venture capital financing varies by country, typically it makes up between EUR 1 to 4 million per project.

According to the OECD, the scope of venture capital funds' activities is particularly important in the United States, which in 2008 accounted for 49 per cent of total VC investments in OECD countries. The United Kingdom ranks the second with 10 per cent of the total. In the same year, as a proportion of GDP, the highest VC investments were recorded in 2008 in Finland, where they totaled 0.23 per cent of its value, while in the United States the corresponding figure was 0.12 per cent. The importance of venture capitalists for innovation-based entrepreneurship lies with the fact that they have developed special skills in evaluating the commercial potential of new technologies enabling the funding of risky technological projects. However, the availability of VC is greatly reduced at times of economic uncertainty. The current financial and economic crisis has forced venture capital funds to downsize initial investments in start-ups and retreat to later stages of start-up development. In the United States, in the immediate aftermath of the financial crisis VC investments declined by more than 50 per cent.[58]

While helping new ambitious companies to grow and internationalize their operations, venture capital financing has its limitations. Generally, venture capitalists target companies, the technological potential of which is well documented and proven, while inventions are preferably protected with international patents. This facilitates the national and international commercialization of their intellectual properties and intangible assets, and also renders the venture assessment easier. In contrast, the access to venture capital can be challenging for service-intensive new ventures.

In order to facilitate access and benefit from venture capital financing, it is important for start-ups to understand the opportunities and limitations of venture capital funds and correctly decide whether or not it is an appropriate choice of external funding in their particular situation. In the latter case, new companies have to become "investment ready". This investment readiness implies a good understanding by start-ups of the requirements imposed by external investors making them an attractive investment opportunity. In particular, to make an investment decision most venture capitalists need a business plan more detailed than that initially drafted by start-ups. Government innovation support institutions can help their client companies to raise the quality of information relating to their investment readiness and enhance their visibility to potential investors.

According to the European Venture Capital and Private Equity Association (EVCA), the amount of capital raised for investment purposes by the Venture Capital and Private Equity (VC&PE) funds in

---

[57] PriceWaterHouse Coopers/National Venture Capital Association, *MoneyTree Report*, http://www.nvca.org/index.php?option=com_docman&task=cat_view&gid=99&Itemid=317.

[58] OECD, OECD Factbook 2010, Economic, Environmental and Social Statistics, http://www.oecd-ilibrary.org/sites/factbook-2010-en/.

the Central and Eastern European region has significantly increased during the 2000s. In this region, fundraising for investment increased from EUR 0.31 billion in 2003 to EUR 2.5 billion in 2008 (after having hit the record of EUR 4.3 billion in 2007). Having mentioned that remarkable growth, one should also note that as a percentage of the European Union total, the share of Central and Eastern Europe in the volume of this investment remains small. In 2007, it made up 5.4 per cent of the European VC&PE funds but dropped to 3 per cent in 2008. In these years, the bulk of the capital to be invested in this region was raised outside of Central and Eastern Europe (roughly two thirds in Western Europe and one third overseas). The funds raised were invested mostly in the Czech Republic, Hungary, Poland, Romania and Ukraine. These countries accounted for as much as 86 per cent of the total investment effected in 2008.[59]

Recognizing the problem of the lack of financing for SMEs, including innovative start-ups, the European Union launched in 2005 the JEREMIE-Programme (Joint European Resources for Micro to Medium Enterprises) aimed at facilitating SME access to finance during 2007-2013. The JEREMIE initiative combines resources allocated to programs of the European Regional Development Fund (ERDF) and the European Social Fund (ESF). As part of the EU regional policy, loans, equity products and microcredits support the creation and expansion of micro, small and medium-sized enterprises.[60] The new EU member States benefit from this programme. In 2008, for example, Romania, through a dedicated fund (the JEREMIE Holding Fund), acquired as much as EUR 100 million of which 60-70 per cent was intended to be used to set up credit guarantee facilities, and the remaining 30-40 per cent would support venture capital funds. In the same way, financial resources are available to innovative enterprises at early stages of their life cycle through the Competitiveness and Innovation Framework Programme (CIP).[61]

The initial stages of innovation-based companies' development in west European countries are also jointly financed by national governments and the European Union financial institutions (see Box 8).

The observers note that the financing of new innovative enterprises has both demand and supply-side aspects. On the supply side, an effort of stakeholders is required to increase the number of high quality projects and start-ups. The support of institutions, which facilitate the commercialization of new ideas, as well as broadening the scope of entrepreneurial education, could be instrumental in this endeavour. On the supply side, the fiscal and regulatory environment needs to be further improved to provide incentives for investors. Tax reliefs and deductions, as well as capital gains taxes, should encourage business angels as well as institutional financiers to invest in promising start-ups.

59 J. Karsai, The End of the Golden Age: The Developments of the Venture Capital and Private Equity Industry in Central and Eastern Europe, Institute of Economics, Hungarian Academy of Sciences, 2009.

60 http://ec.europa.eu/regional_policy/funds/2007/jjj/jeremie_en.htm.

61 http://ec.europa.eu/cip/.

Box 8. Venture capital in Europe: national and European Union support

In countries in which venture capital is not sufficiently available, governments have initiated special funding arrangements that complement the VC investment. In Spain, for example, the Neotec scheme started in 2006 intended to foster start-up high technology companies having a good growth potential. Its venture-capital programme is financed through a EUR 180 million fund, the capital for which was provided by the Spanish government, European Investment Fund and a number of large Spanish companies.

Along the same lines, in May 2008, the European Investment Fund invested about EUR 50 million in Inventure Fund Ky, a fund based in southern Finland (Etelä-Suomi) focusing on new innovative technology companies. The first closing was completed at EUR 35.4 million with a final target of EUR 50 million. The fund targets innovation-based companies with global market potential and attractive business models which are active in the software, electronic, semiconductor, industrial production and material technology sectors. The initial target of the fund is to build a portfolio of 15-20 start-up companies, with an average investment of EUR 1-3 million per company. This investment was made under the European Commission Competitiveness and Innovation Framework Programme.

Source: OECD, *OECD Reviews of Regional Innovation: Catalonia, Spain* (Paris), June 2010; Inventure Fund Ky, 2010, www.inventure.fi.

Various consultancy services provided by Government institutions can be instrumental in enhancing the ICT and business skills of start-ups, while government-sponsored collaboration agreements with research institutions and public knowledge organizations, otherwise unaffordable to SMEs, can create new opportunities for innovation. Government funding schemes can help SMEs to enter into collaboration arrangements that would otherwise be too costly for them. Participating in research programmes or other cooperation schemes, start-ups can build networks of contacts with domestic and international corporations and research teams.

Finally, there is a strong agreement in the literature that government co-financing of new innovation-based companies can be a critical policy instrument to get a venture capital industry off the ground. Without government support, the development of venture capital is constrained by the chicken-and-egg problem: in order to raise funding, venture capital funds ideally need a track record of successful past investments, but in order to invest successfully, they need funding. The promotion of this sector should be part of a more general innovation policy, which tries to improve the framework business environment, including the rules of establishment, operation and taxation of enterprises.

The International Conference "From Applied Research to Entrepreneurship..." recommended that governments adopt a proactive approach to facilitating and fostering the financing of innovation-based start-up companies using, among other instruments, merit-based awards and feasibility grants, facilitate the development of national business angel networks and their links with research institutions and universities, and promote partnerships between industry and government. It also recommended putting in place public initiatives to encourage the involvement of venture capital, and corporate venture capital firms in early-stage financing, including through hybrid public-private funds that create more favourable risk-reward ratios for private investors. Closer collaboration between different types of investors should be promoted to ensure the continuity of financing for start-ups at various stages of their life cycle.

VI. The R&D output: methods of commercialization

The main objective of universities and R&D institutions is teaching, training and research, as well as the dissemination of the new knowledge generated. This objective does not necessarily agree with the goal of earning profit from commercialization of inventions. In order to harmonize to the extent possible the conflicting interests of stakeholders in the process of commercialization of R&D results, universities and R&D institutions should address a number of pertinent issues. Government policy supporting commercialization and innovation typically seeks to facilitate this process by targeting issues such as:

- Facilitating the use of R&D outputs generated within the institution in the interest of the public at large through licensing or other forms of commercialization;
- Ensuring compliance of commercialization with existing laws and regulations and enabling a university or R&D institution to secure sponsored research funding;
- Ensuring operational freedom for university researchers by making certain that planned research does not infringe on third party intellectual property and by acquiring the rights to use third party intellectual property, if necessary;
- Ensuring a fair distribution of income stemming from commercial results according to inventors' and other stakeholders' contributions;
- Ensuring that research results remain available in the public domain for use in future research.[62]

A coherent innovation and commercialization policy will facilitate the transfer of academic knowledge produced by public research to the business sector (technology transfer). Methods of technology transfer include the sale or assignment of intellectual property rights, licensing, establishment of spin-offs and start-ups, various types of cooperation between academia and industry, and cooperation of companies with the educational system.

A. Sale or assignment / transfer of IP rights

The sale or assignment/transfer of IP rights involves a change in the ownership of the patent by the owner (or "assignor") to a third party ("assignee"); this transfer is permanent and irrevocable. The advantage of this strategy of commercialization for a patent owner may be an opportunity to quickly raise funding for future research. For example, a biotechnology start-up company can decide to sell its patent through an assignment agreement and thus be able to invest in continued research and development to increase its patent portfolio.

B. Licensing

Licensing of a patented invention represents permission ("license") of the owner of a patented invention ("licensor") granted to a third party ("licensee") to use the invention in specified

[62] http://www.wto.org/english/tratop_e/trips_e/intel1_e.htm.

geographical areas against a fee to be paid to the licensor. By selling a license the patent owner obtains the right for a flow of income over a number of years and reduces the uncertainty related to future income inflow.[63] At the same time, by purchasing a license, an enterprise obtains access to innovations that otherwise would be difficult to obtain, and expects to increase its market share and profit.[64]

In a number of countries, the patent law may require that an instrument of assignment of patent rights or a license contract be presented to the patent office for registration. By the act of registration, the government recognizes the assignee or the licensee as the holder of the rights transferred by the assignment or of those conferred by the license.

C. Establishment of spin-offs and start-ups

Spin-off companies are created by universities or scientists themselves to commercialize the outcomes of their research. They are often located on university campuses or in close proximity to the latter, enjoying access to laboratories, scientific equipment and peers assistance. To help spin-offs, universities may establish research parks or science parks (see below).

The inventor or a spin-off company has no motivation to commercialize the invention unless there is certainty and clear rules regarding its ownership.[65] The ownership rights to inventions are in general determined by national laws and regulations. Having said that, in developed market economies, a university or R&D institution would normally own or co-own the products of research created by a member of staff, student or guest researcher with the use of the institution's resources (including institution-administered funds, facilities and equipment), unless otherwise stipulated by a number of written agreements between the person in question and the institution.[66] Alternatively, if the invention is made without any use of the institution's resources, it belongs to the inventor. In this case, the research institution would ask the inventor to testify that the invention was made without significant use of its resources. If the institution is satisfied with the testimony, it would then give the inventor a written acknowledgement that it has no claim on ownership of the invention in question.[67] The procedure of invention disclosure is presented in Annex III.

In the case where an invention made by an employee of an institution (using institution resources) is patented and commercialized, up to 100 per cent of the revenue can go to the institution until all out-of-pocket expenses[68] associated with protection and exploitation of the patent have been reimbursed.

---

63 Depending on the desired allocation of business risks, the income can be in the form of upfront fees, payments stipulated by the achievement of pre-set milestones, royalties based on the number of units sold, a share of profits, a stake in the company undertaking the commercialization, or a combination of these.

64 http://www.ehow.com/list_6299066_advantages-disadvantages-licensing-agreements.html.

65 C. Greenhalgh and M. Rogers, *Innovation, Intellectual Property and Economic Growth* (Princeton University Press), 2010, p. 97.

66 For example, material transfer agreement, confidentiality agreement, service agreement and similar.

67 In some countries (e.g. the United States), while the university or R&D institution is assigned the rights on intellectual property generated in the course of government-funded research, the government retains the option to claim ownership. In the event that the government does not exercise its option, it does retain a non-exclusive, non-transferable, irrevocable, royalty free, worldwide license on the invention under government sponsorship. Where a university or R&D institution is a joint inventor with one or more individuals from other institutions (or business entities) and where income is shared between the participating entities, the patents are normally jointly owned by the participating institutions. Moreover, the rights to use the invention and the distribution of royalties among the institutions are generally negotiated before the patent application is filed, http://www.bitlaw.com/source/35usc/202.html.

68 Such expenses include fees associated with patent filing and copyright registration or other continuing costs related to the commercialization of intellectual property.

The net income is shared between the inventor and the institution. When the total net revenue increases, the inventor's share may decrease whereas the share of the institution may increase. For example, in the United States, a university may give the inventor as much as 50 per cent for the first USD 100,000 of net revenue, 40 per cent for the next USD 300,000 and 30 per cent for the subsequent USD 600,000.[69]

Patenting costs and the complexities of related procedures may become important factors discouraging academic scientists from commercializing their intellectual property themselves. The alleged infringements of intellectual property rights can undermine or even stop the spin-off operation when they concern the core of its technological advantage.[70]

Apart from the proper regulation of ownership rights, most universities and R&D institutions in EMEs face additional, specific problems related to intellectual property commercialization such as:

- Lack of competent staff and internal expertise in the intellectual property area;
- Lack of financial autonomy in universities which causes them to develop their own policy versus their research workers and IP protection of university's inventions;
- Insufficient resources to bear the costs associated with patent registration, renewal and litigation.

One way to facilitate the establishment of spin-offs by universities and strengthen the technology transfer from laboratories to industry is to improve the institutional environment, making it conducive to commercialization.

69 http://olv.duke.edu/Inventors/PoliciesAndProcedures/policy_on_inventions.pdf.
70 Creating Spin-Off: Designing Entrepreneurship Conducive Universities, by Elco van Burg, http://cms.ieis.tue.nl/ Beta/Files/abstract per cent20Elco per cent20van per cent20Burg.pdf.

VII. Different types of industry-science linkages

In the early 1960s, Nelson and Arrow emphasized the importance of "new scientific knowledge" as a driving force behind innovation, technological and economic progress.[71] Ever since, its role in developing new and improved products has continuously grown.[72] This is related to the rapidity of the technological progress as well as the increasing complexity of the innovation process. "What university research most often does today is to stimulate and enhance the power of the R&D done in industry ...".[73] As a result, "... as scientific knowledge grows, the cost of successfully undertaking any given, science-based invention declines."[74] This leads, *ceteris paribus*, to a rise in the efficiency of the research process and effectiveness of the firms' innovation activities, because fewer trial-and-error and fewer approaches need to be evaluated and pursued to achieve a given technological end. From this perspective, science provides a powerful heuristic guidance to the search process associated with technological change.

As was already mentioned, successful commercialization crucially depends on the effective interaction between the institutions which generate knowledge and those which transform this into commercially viable products. The three major players are governments, universities and research institutions, and companies. Currently, the links between public research organizations and industry in many emerging market economies are rather weak, which creates an additional obstacle to the process of commercialization of R&D results.

While the variety of industry-academia linkages is presented in Annex IV, the most relevant for commercialization include:

- Cooperation in R&D;
- Cooperation in education;
- Mobility of research personnel;
- Cooperation within the innovation support institutions.

A. Cooperation in R&D and open innovation

As a rule, successful innovation requires a combination of inputs from multiple sources: higher education and research institutions and government-sponsored laboratories, as well as inputs from the

---

[71] R.R. Nelson, "The simple economics of basic scientific research", *Journal of Political Economy*, Vol. 67, 1959, pp. 297-306; K.J. Arrow, "Economic welfare and the allocation of resources for invention", in R.R. Nelson (ed.), *The Rate and Direction of Incentive Activity: Economic and Social Factors* (Princeton), 1962, pp. 609-625.

[72] A. Smith, J.-P. Voß and J. Grin (eds.), "Innovation studies and sustainability transitions", *Research Policy,* 39/4, 2010, Special Section on Innovation and Sustainability Transitions.

[73] N. Rosenberg and R.R. Nelson, "American universities and technical advance in industry", *Research Policy*, 23, 1994, pp. 323-348.

[74] Ibid., p. 340.

private sector, in which companies are suppliers, customers and competitors. This implies a collaboration among various stakeholders.

Cooperation in research and development takes place when universities and companies join their resources to create and develop a new product or technology. This can take different forms, for example when a firm's scientists work hand in hand with academic researchers, or when a company finances a research project at a university to have ownership of the results and the right to commercially exploit them. The research joint ventures accelerate the transfer of technology from fundamental and applied research to commercial applications because both parties have a better understanding of the problems to be solved at various stages of this process.

Recently, the concept of "open innovation" has become an increasingly popular tool to foster academia-industry linkages and the commercialization of R&D results (see Box 9).

It should be noted that the collaboration between innovative companies themselves often pursues the objective of commercialization. Results of a recent company survey for example show that after the goal of acquiring an "improved access to the local markets", the motive of "improved commercialization" and the "introduction of new products" were the second-ranking goals of collaboration among innovative firms based in Argentina and Spain. Other reasons for collaboration included the introduction of new technology to the company and improved productive processes (news quality control systems, stock reduction methods, etc.).[75]

To foster the cooperation of research institutions and innovative enterprises in emerging market economies and strengthen their capacity to harness IPR for financing, governments may want to consider integrating IPR promotion into wider SME support policies and to strengthen the coordination and cooperation between IP offices and enterprise support agencies. Additional services to enterprises could include IP audits, clearing-house services matching inventors and investors, as well as development of model licensing agreements.[76]

In Turkey, the Government is instrumental in supporting the commercialization of academic research outputs and fostering new innovative companies. Among other initiatives, this is the focus of the Industrial Thesis Programme initiated by the Government in 2006. During 2006 and the first quarter of 2011, the Programme supported 403 projects, three quarters of the financing coming from Governments (USD 30 million) and one quarter from private companies (USD 10 million). Universities contributed to the establishment of start-ups through in-kind contributions (research workers and laboratory equipment). To promote new innovative companies the Government offers non-repayable grants as well as tax rebates and insurance premium support. It is also worth mentioning that the scale of support is increasing from year to year. The annual budget of the Techno-Entrepreneurship Capital Support Programme, for example, will have risen from USD 5.5 million in 2009-2010 to USD 27.5 million in 2013-2023. By 2011, as many as 452 entrepreneurs had been supported through this programme.[77]

---

75 E. Castro-Martinez, M. Edwards and I. Fernández-de-Lucio, Patterns and Barriers for Innovation and R&D Cooperation between Argentine and Spanish Firms (Ingenio), 2010.

76 ECE/CECI/CONF.4/2, p. 5.

77 B. Karapinar, "R&D and Innovative Entrepreneurship Grant Programs in Turkey", paper presented to the UNECE International Conference "Knowledge-based Development and Innovative Entrepreneurship", Baku, Azerbaijan, 24-25 November, 2011.

Box 9. The Responsible Partnering project: open innovation to foster R&D cooperation in Europe

Responsible Partnering is a project that was launched in 2004 in order to create a code of conduct to foster efficient cooperation between innovative companies and public research in Europe. This code of conduct is the result of collaboration between a number of European universities and research associations.

The objective of the project is to promote research joint ventures between public research organizations and private companies through a new model of "open innovation". As opposed to the traditional model of company-owned applied research, the open innovation approach encourages companies to collaborate in research with external institutions, in particular public organizations. Through this, innovative companies benefit from access to research resources of public institutions and their research workers acquire additional knowledge and skills. The open innovation model encourages patenting and licensing out of research results, including the inventions, which would have remained unused under the traditional model of innovation.

One of the examples of successfully implemented open innovation is the Philips R&D centre and the High Tech Campus Eindhoven (HTCE) situated in Eindhoven (Netherlands). The Philips system of open innovation combines collaboration with public research institutions and the operation of a technopark with incubation and business facilities.

In 2009, the technopark of HTCE housed over 90 innovation-based companies and institutions employing 8,000 people. Philips has created an environment promoting interaction, networking and knowledge-sharing, leading to joint projects and joint ventures among the HTCE-based companies. While there is no formalized agreement to share technology among those companies, the technology exchange occurs naturally, inspired by the synergies benefiting all stakeholders. The open model used by Philips can be schematically summarized as follows: shared facilities and technology help the networking and exchange of ideas among the campus-based companies.

Along the same lines, collaboration with public research institutions plays an important part in the open innovation model fostered by Philips. In 2007, this company was taking part in about 100 projects in European and national R&D programmes involving about 16 per cent of its full-time research staff. At the same time, Philips Research had 900 partnership links with some 550 different partners, 48 per cent of which were public research organizations. The implementation of research projects involved about 35 university professors as part-time research workers and consultants.

According to Jan van den Biesen, Philips' Vice-President and Director of Public R&D Programmes, over the last two decades the open innovation strategy and, in particular, its collaboration with public research institutions, has paved the way to the astonishing growth of Philips innovation potential.

The Responsible Partnering framework is an example of good practice which could be useful to policy makers, in particular in EMEs who seek to foster linkages between academia and industry and to raise the effectiveness of both public and private R&D.

Source: Responsible Partnering, Joining Forces in a World of Open Innovation: Guidelines for Collaborative Research and Knowledge Transfer between Science and Industry, 2009; "Responsible Partnering between Research and Business", special conference, Lisbon, December 2007; http://www.responsible-partnering.org/; http://www.hightechcampus.nl.

Good practice of online support to innovative entrepreneurs in Finland is presented in Box 10.

Box 10. Finland: online support to innovative entrepreneurs

In the first half of the 2000s the decision makers in Finland perceived a gap between the growth rates of SMEs and those of large companies in Finland. Since then the objective of fostering entrepreneurship has received increasing attention in the Government economic policy and has been emphasized in the national innovation strategy. Since 2008, the Ministry of Employment and the Economy has acquired an overall responsibility for structuring, developing and implementing growth business strategy as part of a comprehensive innovation and industrial policy.

As a starting point for the new policy aimed at fostering entrepreneurship a number of Government agencies (e.g. Tekes, Finnvera, TE-Centres, Finnish Industry Investment, Foundation for Finnish Inventions, Finpro, Invest in Finland, and others) have assembled and published on the world wide web the available instruments supporting the efficient commercialization of research outputs and the development of new ventures. The respective web portals contain information on:

- Legal acts, related to IPR and the regulation of research activities;
- Operational public support programmes and available grants;
- Other sources of financial support, including venture funds and business angel's organizations;
- Application forms and information required to establish contacts with national contact points within the European Enterprise Network (EEN);
- Relevant enterprise development programmes of the European Union.

The electronic support to entrepreneurial activities reduces substantially the costs of consultancy services and the time needed to supply information to governmental agencies. Accepting the electronic reporting, Government agencies on their side also have to react to requests from entrepreneurs within limited periods of time. According to estimates, in 2010 about half of Finnish companies used the information from the specialized portals and submitted their reports electronically.

Source: http://www.tekes.fi/en/community/Annual_review/341/Annual review/1289.

B. Cooperation in education

In the modern economy, university and private sector cooperation in education helps to adapt the curriculum to the evolving needs of the economy. To achieve this, a participation of employers in the development and implementation of educational plans as well as the development of the educational and career advisory systems by universities are instrumental. In addition to that, technology transfer is facilitated through training the R&D staff in business management and commercialization. In developed market economies, the enhanced commercialization and promotion of innovative entrepreneurship has become the focus of Government-sponsored cooperation programmes between universities (see Box 11).

Closer collaboration of companies and universities in the framework of integrated incubators and science parks creates beneficial side effects facilitating the students' access to innovative firms and their adaptation to corporate culture, and increasing their chances to obtain a job offer or establish their own company.

Box 11. Cooperation programme between Cambridge University and Massachusetts Institute of Technology

In 2000, the Government of the United Kingdom initiated a programme of cooperation between Cambridge University and the Massachusetts Institute of Technology (CMI or Institute) providing a budget of USD 100 million. The objective of the programme is to promote lasting cooperation between British industry and university educational and research activities. Projects of the Institute primarily target the following areas:

- Education for innovation, i.e. promoting the entrepreneurial culture at degree level of education in ways that enhance the propensity of students to be more innovative as entrepreneurs;
- Integration of new technologies in the economies of communities;
- Deeper involvement of industry into the knowledge exchange, enabling universities to reach far further into the industrial sector.

The programme focuses on sectors that traditionally have not had active interaction with universities, such as ground transportation and construction. It also tries to strengthen the cooperation of research institutions with high-technology companies in aviation, biology, communications, etc. and intends to broaden its outreach into retail trade, leisure and travel, distribution and the food chain.

The process of programme implementation has revealed the following key factors of successfully engaging industry in knowledge exchange:

- Listening to companies through a systematic dialogue to understand their needs, and involving them into developing and fine-tuning the research and educational programmes that address these needs;
- Educating and empowering agents of innovation and knowledge exchange, including students, and those who work at the interface of universities and industry (e.g. technology transfer specialists);
- Creating networks facilitating knowledge exchange.

In the process of its implementation, the CMI has created several such networks, one of the largest of them being the Cambridge University Entrepreneurs: having launched 31 start-ups in 2005-2007, it has become the United Kingdom's most successful student-led undertaking of this kind. In 2009, as many as 20 of the established companies were operational, and their estimated market value exceeded GBP 22 million.

Source: http://www.cmi.cam.ac.uk/downloads/cmi_final_report.pdf; http://www.cmi.cam.ac.uk/downloads/working_in_partnership.pdf.

According to the final report of the Expert Group for the European Commission, "Entrepreneurship in Higher Education Especially within Non-business Studies", delivered in 2008, in the 2000s entrepreneurial education and training was insufficient in many EU countries, in particular, in the new member States of the European Union. The report noted that the engineering and science faculties often lacked qualified personnel and as a rule did not set up training programmes on entrepreneurship.[78]

Recently, however, there has been an increase in the number, scope and level of higher education courses that focus on entrepreneurship both in the old and new EU member States.[79] Inter alia, these programmes aim at facilitating communication between research workers and business managers. The curricula include issues on technology, business management, entrepreneurship and IT, and emphasize practical know-how through established links with private business or university-based commercial

[78] European Commission, "Entrepreneurship in Higher Education Especially within Non-business Studies", Final Report of the Expert Group, March 2008.

[79] UNECE, *Enhancing the Innovative Performance of Firms...*, op. cit., p. 73.

operations. The final objective of training is encouraging students to set up their own ventures. To achieve this, programmes use such tools as mentoring and coaching, and business plan competition. An example of a successful entrepreneurship training programme in the new EU member States is presented in Box 12.

Box 12. Teaching business in Poland for non-business majors

The nation-wide programme aimed at fostering entrepreneurship in non-business higher education institutions was started in Poland in 2004 by the Academy of Entrepreneurship and Management as a pilot project funded by the European Commission and the Ministry of Science and Higher Education. One of the outputs of the project was an adapted textbook and other study materials (including a website containing study cases and background information for lecturers), which appeared in 2006 as a training-for-trainers toolkit. As a result, during the period 2006-2008, as many as 20 academics were trained as lecturers in entrepreneurship, and entrepreneurship classes became a significant part of the curricula in a number of polytechnic institutes, universities and agricultural schools. Over the same period, the entrepreneurship programmes became operational in as many as 30 tertiary education institutions, while over 1,000 students were trained in entrepreneurship.

Source: http://www.kozminski.edu.pl.

In some cases, training in entrepreneurship becomes one of the objectives of business incubators. In Ukraine, for example, the Kharkov Business Incubator, established in 1998, organizes business education seminars for scientists and engineers. During the first 10 years of operation these seminars were attended by more than 2,000 students.[80] Along the same lines, in Armenia the Enterprise Incubator Foundation (EIF) advises the university on the curriculum and organizes management and business classes for EIF clients (including students and postgraduates, managers and technical staff, as well as professionals and other experts with technical background) at the training centre operated jointly with Yerevan State University.[81]

Recently, the role of international cooperation in education as a means of promoting entrepreneurship has considerably increased. In 2011, in the United States the number of international students representing 68 countries enrolling in the business administration courses at Harvard Business School made up 34 per cent of the total number of enrolments for the class graduating from Harvard Business School in 2013.[82]

Research has shown that a considerable proportion of international students do not stay in the country of graduation. A study of the international mobility of over 1,000 students who came to the United States to gain their PhD between 1992 and 2006 found that about 50 per cent of graduates stayed in the country of graduation while the remaining 50 per cent moved to other countries at least once. As many as 33 per cent returned to their home country at least for some time, despite the loss in career opportunities, income and funding.[83] Another study has found that while stay rates of doctorates who

---

80 http://www.novekolo.info/en/, official website of the Ukrainian Business Incubators and Innovation Centre Association (UBICA).

81 http://www.eif-it.com/index.php.

82 See for example http://mitsloan.mit.edu/newsroom/2011-sabanci.php.

83 L. Van Bouwel, "International Mobility Patterns of Researchers and their Determinants. Opening Up Innovation: Strategy, Organization and Technology", paper presented at the Summer Conference, Imperial College London Business School, 16-18 June 2010, http://www2.druid.dk/conferences/viewpaper.php?id=501842&cf=43.

graduated from US universities depended on the country of origin and field of study, as many as 30 per cent of them left the country upon graduation in 2001.[84]

In a globalized higher education, PhD students now compete on an international basis for jobs and teaching positions. Moving to companies they bring with them an intellectual baggage, acquired during the research work that they completed at universities, and apply it to enhance the company's innovative output. This facilitates the innovation cycle, including its commercialization stage.

C. Mobility of research personnel

One of the effective tools of a strengthened private sector-university cooperation is the intensified employment of research workers in industry (the so-called "personnel pooling"). Academic scientists get positions inside the private sector, either as consultants, founders of companies or members of their boards. Facilitating technology transfers, such arrangements have the additional advantage for universities of shifting a part of the financial cost of research (salaries) to the private sector. At the same time, this helps companies reduce their development costs and acquire a certain "scientific legitimacy" versus the results of their R&D that substantiates their demands in financial and investment markets.

Recent research has suggested that mobile university scientists tend to contribute to innovation more than R&D workers hired from other private companies. Although with time their contribution to innovation depreciates fairly rapidly, hiring scientists from universities presents two advantages for innovative companies:

(1) It boosts their innovative activity;
(2) It permits a reduction in R&D costs because the newly hired from academia on average receive lower salaries than their counterparts from private sector firms.[85]

Box 13 summarizes the types of knowledge transferrable from academic workers to innovating companies.

In 2006, the European Commission acknowledged the importance of scientists' intersectoral mobility between academia and industry and developed practical recommendations to foster it. Among the good practices one can note the establishment of "research hotels" for research workers from industry, who enrol in research institutions to refresh their knowledge and get updated on the new developments at universities. At the same time, research institutions encourage outside consultancy work. At the Massachusetts Institute of Technology (MIT) in the United States, the employment contract covers nine months per year, while the rest of the year can be used for outside consultancy. MIT provides incentives to academics, whose activities enable the Institute to obtain considerable income from research contracts: it relieves those who earn more than USD 2 million for the Institute from teaching responsibilities, and those who earn more than USD 4 million from administrative responsibilities.[86]

---

84 National Research Council, *Policy Implications of International Graduate Students and Postdoctoral Scholars in the United States* (Washington, D.C., National Academies Press), 2005, http://www.ncbi.nlm.nih.gov/books/NBK37571/.

85 A.K. Ejsing, U. Kaiser and H.C. Kongsted, Unraveling the Role of Public Researcher Mobility for Industrial Innovation (IZA), 2011.

86 European Commission, Mobility of Researchers between Academia and Industry, 12 Practical Recommendations, 2006.

Box 13. Types of transferable knowledge: fostering innovation

A number of internationally mobile Slovak scientists who obtained their PhDs abroad have been interviewed after their return to Slovakia. They recognize four types of knowledge that can be transferred to a new employer:

- Embrained (theoretical) knowledge, which depends on conceptual skills and cognitive abilities;
- Embodied knowledge, which is the capacity to apply the theoretical knowledge resulting from practical thinking and learning by doing;
- Encultured knowledge, which arises from socialization and acculturation;
- Embedded knowledge, which is generated through contrasting different organizational cultures and work groups.

For the purpose of innovation, embrained, embodied and embedded knowledge seem to be particularly important.

Source: V. Balaz, and A. Williams, "International return mobility, learning and knowledge transfer: A case study of Slovak doctors", *Social Science and Medicine*, Vol. 67, Issue 11, December 2008, pp. 1641-1934; See also http://www.londonmet.ac.uk/library/l22097_3.pdf.

Results of the research suggest that scientists benefit from research collaboration with industry as witnessed by higher productivity and higher annual citation frequencies. Higher quality of scientific output often positively correlates with enhanced patenting.[87]

On the industry side, acknowledging the advantages of such collaboration, some companies encourage the cooperation between their own scientists and academia. For example, the energy company Schlumberger, France, offers between EUR 25,000 and EUR 100,000 to company workers for research and consultancy work outside of the company. These activities are seen to generate closer collaboration with academia and a positive return on investment to the company. A longer-term mobility occurs when universities employ top managers from the private sector to adapt their management to the newest managerial techniques.[88]

---

[87] M. Mejer, Entrepreneurial Scientists and their Publication Performance. An Insight from Belgium, ECORE Discussion Paper 2011/64, ECARES (Brussels), 2011.

[88] Ibid.

VIII. Institutional support to commercialization and new innovation-based companies

Innovation support institutions are public, private or public-private organizations that provide support to entrepreneurs in establishing spin-off companies, commercializing their innovations, bringing them to the market and finding financial solutions.[89] Among such institutions one notes training and consulting centres, technology transfer centres, incubators and pre-incubators, seed capital funds, technology parks and clusters. The services that they usually provide to academic entrepreneurs are coaching and consulting on managerial, legal and administrative matters. The technology transfer offices (TTOs) established within universities focus on finding partners for commercialization and private investors, as well as on licensing of the patents owned.

In the context of the issues addressed in the present publication, business incubators and science or technology parks are particularly relevant.

A. Business incubators

Business incubation is a systematic way to support the establishment and growth of a new company. A business incubator is an institution, be it privately or publicly owned, that provides physical space and a number of services to start-ups, helping them through the earlier stages of their development. In addition to business prospect assessment, due diligence process management and expert pooling, the incubation process may also include coaching and mentoring of managers and advice on financing and marketing issues, as well as facilitation of networking with industry experts. The expected outcome of business incubation is for a start-up to reach a revenue-generating stage, when it is ready to attract external investment for future development. To be efficient, business incubators need to define clear goals in order to monitor and guarantee their sustainability in the long run.

First business incubators were established in the 1960s in the United States, United Kingdom and France, but nowadays they can be found in most industrialized as well as developing countries. Incubators offer start-ups low-cost premises, sometimes make equipment available to them and provide access to services needed by newly established firms. While some incubators are supported by central and local governments, many are sponsored also by for-profit or non-profit private organizations. The number of EU-based business incubators is currently estimated at about 900, hosting thousands of start-ups.[90]

As an example, the European Space Agency (ESA) has set up a network of business incubators to support the commercial application of space technologies and systems in non-space sectors via new start-up companies. Space technologies are used in motor racing, sailing and skiing-related products. The ESA Technology Transfer Programme Office (TTPO) seeks entrepreneurs having good innovative potential for using space technology, applications and services in a non-space environment, and the ESA Business Incubation provides technical expertise and business development support.

---

[89] UNECE, *Enhancing the Innovative Performance of Firms...*, op. cit., pp. 75-79.

[90] European Commission, *A More Research-Intensive and Integrated European Research Area. Science, Technology and Competitiveness Key Figures Report, 2008-2009*, http://ec.europa.eu/research/era/pdf/key-figures-report2008-2009_en.pdf.

Through the business incubation ESA maximizes the return on investment in space research effected by its member States, provides inter-disciplinary opportunities of collaboration for scientists and minimizes the duplication of research efforts between the space and non-space sector.[91]

The effective operation of business incubators in developed market economies attests to the important role of public-private cooperation in early-stage financing of innovative undertakings. In Japan, for example, as much as 60 per cent of financing for techno parks and similar undertakings comes from central and local government. In the context of transition countries, public co-financing is of particular importance at the pilot and trial stages of innovative production.[92]

Some key features of business incubators in Europe are summarized in Box 14, while Box 15 presents a successful incubator in the former Yugoslav Republic of Macedonia.

Box 14. Main characteristics of business incubators in Europe

A survey conducted in 2006 in 25 EU countries identified the following main characteristics of European business incubators:

- Number of full time employees. The average number of employees in an incubator was six and the median number was four. Half of the existing business incubators were run by small staff of one to three employees and 90 per cent of them employed less than 10 people.
- Number of tenant start-up firms. The average number of tenant start-up firms in an incubator was 25 and the median number was 18. A large majority of incubators supported less than 30 tenant firms.
- Sponsorship. As much as 48 per cent of the existing incubators were publicly sponsored, 12 per cent were privately sponsored and 38 per cent had mixed sponsorship. As much as 70 per cent of business incubators were non-profit institutions while 30 per cent work for profit.
- Location. The bulk of incubator tenant firms (76 per cent) were based at the incubator facilities. The rest were located off-site in rented space or in industrial or science parks. The minimum incubator space required for efficient operation was estimated at around 3,000m².
- Business services offered. As much as 70 per cent of the incubators offered all or most of services and business support required to start-ups. As much as 50 per cent of incubators also hired external business service providers. In addition to business services proper, many business incubators assisted tenant firms in raising early stage external finance.
- Public sources of support. Start-ups obtained public support both through the incubator itself and independently. According to the survey, as much as 64 per cent of incubator-based SMEs enjoyed support from the national programs for SMEs, 58-59 per cent from regional development agencies and national programs for innovative firms and 45 per cent of those benefited from the support of local authorities.

[91] http://www.esa.int/esaMI/TTP2/SEM9UNRMTWE_0.html.
[92] ECE/CECI/CONF.4/2, p. 2.

Box 14. Main characteristics of business incubators in Europe *(continued)*

- Entry and exit. Most of incubators (73 per cent) applied standardized entry criteria and procedures. As much as 43 per cent of them used such criteria for exit. It is generally considered that tenant firms should not need more than four years in the incubator to graduate (some firms graduate earlier). The survival rate of firms reared in the incubator environment was estimated at some 80-90 per cent, which was significantly higher than the average survival rate for start-up firms operating in an open market environment.

Source: J.G. Goddard and H. Chouk, *First Findings from the Survey of European Business Incubators,* Working Paper IMRI, University of Paris, 2006; Centre for Strategy and Evaluation Services for the European Commission's Enterprise DG, *Benchmarking of Business Incubators,* 2002.

In emerging market economies, the operation of business incubators and techno parks faces additional problems**.** The participants of the 2009 Astana International Conference "Ways and Means of Attracting External Finance for New Innovative Enterprises" noted that often countries of the region did not have the financial basis and pilot manufacturing facilities to ensure the commercialization of new technologies. On the enterprise side, new entrepreneurs often lacked understanding regarding the available financial sources, objectives of external investors and implications of various modes of funding. As a rule, they overvalue the available assets and extend unrealistic claims on external investors. In the same way, the lack of clarity regarding the ownership of research and development results – inventors and developers versus the related institutions – impedes their adequate valuation. Entrepreneurs often do not have funding for testing of technologies and their benchmarking to the technologies available from competitors.[93]

Box 15. The Youth Entrepreneurial Service Incubator in the Former Yugoslav Republic of Macedonia

The Youth Entrepreneurial Service (YES) Incubator was established in 2007 and has its premises near the Skopje airport, in the vicinity of the highways Skopje-Belgrade and Skopje-Athens. Currently the YES Incubator hosts 16 client companies employing 44 people.

At pre-incubation stage, the incubator consults the would-be entrepreneurs and assists them in compiling business plans.

At incubation stage, the incubator offers to entrepreneurs fully equipped offices at affordable rents, free or low cost business consulting (administrative, financial, marketing and legal), matchmaking with potential customers and suppliers, financial support (credit lines of up to EUR 15,000), and the possibility of obtaining grants (up to EUR 1,500).

Success Story: One of the companies developed within the incubator is Broker Inc. Established in 2008, this company specializes in on-line investment and in 2009 it employed six IT engineers, three marketing experts and two graphic designers. In 2009, Broker Inc. won the national competition part of the World Summit Award for e-business and commerce and will now compete on the global level.

Source: http://www.ecabit.org/ – network of business incubators and technology parks in Eastern Europe and Central Asia; http://www.infodev.org – special programme jointly created by the World Bank to help information sharing among small innovative companies; http://www.idisc.net/en/Incubator.122.html – InfoDev website promoting incubators' actions.

93 Ibid.

B. Science parks

Science parks, research parks or technology parks (technoparks), are organizations whose aim is to increase the wealth of the community by promoting the culture of innovation and the competitiveness of its associated businesses and knowledge-based institutions.[94]

Compared to business incubators, science and technology parks tend to be larger in size, often spanning large territories and housing various entities ranging from corporate, government and university laboratories to private companies. Science parks do not necessarily offer a full range of business support services but some of them may host a business incubator for early stage innovation-based ventures. Typically, however, science and technology parks provide services to companies at post-incubator stages of their life cycle or provide a launch pad for companies that are "spun out" from a university or company. Main features of science parks are summarized in Box 16.

Box 16. Main characteristics of science parks

In 2007 the International Association of Science Parks (IASP) conducted a survey of its members (including parks from all over the world) and identified the following main characteristics of science and technology parks:

- Location. Science and technology parks were situated mostly in urban environments, and 36 per cent of the parks were located on a University campus or adjacent to one.
- Territory occupied by the park. As much as 45 per cent of the parks had relatively small territories (less than 200,000 square metres). On the other hand, 33 per cent of the parks had territories exceeding 600,000 square metres, of which 22 per cent occupied territories of over 1 million square metres.
- Number of resident companies. As much as 58 per cent of parks reported having hosted 100 resident companies or less, and 23 per cent – more than 200 companies. Middle-size parks (101 to 200 companies) represented 19 per cent of the total number.
- Ownership. Publicly-owned science and technology parks prevailed (54 per cent of the total), while 16 per cent of parks were entirely private and 30 per cent reported mixed (public-private) ownership.
- Government support. Most science parks received public financial support of some sort. The most widespread forms of such support were grants (45.4 per cent of parks); subsidies (40.3 per cent of parks); tax incentives (27.3 per cent of parks) and subsidized loans from governments and public administrations of different levels: national, regional and local (20.8 per cent of parks).

Source: International Association of Science Parks, http://www.iasp.ws/; statistics available at http://www.iasp.ws/.

In the University-based science parks (business incubators) up to 40 per cent of tenant companies are spin-offs or start-ups, while a significant number of academics participate in tenant business operations as directors, partners or mentors. The science park generates income for the university and at the same time benefits the local economy though the use of its inputs.[95] An example of a university-based incubator that is operational in Serbia is presented in Box 17.

---

[94] See the full definition of science parks suggested by the International Association of Science Parks in the glossary.

[95] J. Allen, *Third Generation Science Parks* (Manchester Science), 2007.

In the context of science parks, the enhanced industry-science linkages take the form of:

- Establishment of joint research laboratories;
- Opening of park facilities to outside users from industry;
- Development or joint development of pilot plants or demonstration laboratories, open to industry;
- Liaison with university technology transfer offices;
- Professional development and training for practitioners from the industry, including training based on advanced technologies;
- Internship programmes and assisted job search for graduating students.[96]

Box 17. Business Technology Incubator of Belgrade University: An example of a university-integrated incubator

The Business Technology Incubator of Technical Faculties of the Belgrade University was established in 2006 as a partnership between four technical faculties of the university, the Municipality of Palilula and an NGO. The Organization for Security and Cooperation in Europe (OSCE) sponsored the project through a transfer of technical competencies (information on good practices and business advice) and some financial support (EUR 12,000 in 2007).

The goal of the incubator is two-fold: to foster spin-offs and improve the conditions for the commercialization of R&D results obtained in the university; and to encourage and support young and educated people in starting up their own business in high-technology industries and prevent them from emigrating.

The incubator assists start-ups at both pre-incubation and incubation phases:

- At the pre-incubation phase, the incubator trains final grade students and young graduates of technical faculties in the modalities of starting their own businesses; it also facilitates the commercialization at the final stages of a research process.
- At the incubation phase, the incubator supports innovative start-ups though legal, accounting, training, mentoring and other advisory services.

During the four years of its operation the incubator developed a toolkit on legal, accounting and financial services for start-ups and trained 250 students on matters related to starting one's own business. It has had 11 registered tenants – new small enterprises, which have developed and commercialized five innovations. Over that period, as many as 20 new jobs appeared in the incubator itself and in the tenant companies.

Success Story: One of the incubator-based start-ups – **Teleskin Ltd.** was founded in 2007. This company is a producer of hardware and software solutions for biophysical skin diagnosis, focusing in particular on early diagnosis of skin cancer. Having increased the number of employees to eight, Teleskin Ltd. plans to establish a network of early diagnosis centres throughout Serbia.

Source: http://www.ecabit.org/; http://www.infodev.org; http://www.idisc.net/en/Incubator.309.html.

In EMEs, science or technoparks are a relatively new phenomenon and in many aspects their founders have to adjust their objectives to the realities of the local economy. In the first half of the 2000s, in Armenia, Viasphere Technopark (VT), founded in 2001 and centrally located in the capital of the country, housed 11 tenant companies specializing in information and communication technologies. Over that period, the technopark facilitated the creation of more than 400 jobs in the ICT sector.[97] In

[96] UNECE, *Enhancing the Innovative Performance of Firms...*, op. cit., p. 47.
[97] http://www.viasphere.com/partners/inctech.htm.

the mid-2000s, in Kazakhstan, technoparks are reported to have been relatively small ventures housing between 16 and 46 enterprises, not all of which were commercially active. On average, technoparks in Kazakhstan employed some 200 to 300 people. With the exception of few pharmaceutical companies, technopark-based firms operated mostly in traditional manufacturing industries and agriculture, and largely serviced the local market. Many tenant firms faced cash flow problems and regarded lower rents as an important benefit. In 2009, in the absence of their own financial means, the lack of Government funding was the major problem of technopark-based start-ups. Overall so far, technoparks in Kazakhstan have operated somewhat as business incubators for firms in traditional sectors. Their transformation into centres promoting innovation-based start-ups would require a more targeted support for these kind of firms.[98]

The participants of the Moscow Applied Policy Seminar "Early-Stage Financing and Investment Readiness of Innovative Enterprises", noted that contrary to the general view, the number of potentially profitable high-technology projects to be developed by technology parks in emerging market economies was relatively limited and the biggest issue for these institutions was the "deal flow" – a sufficient number of start-ups with good commercial prospects. Of the 280 project proposals which Kazakhstan technoparks received during 2004-2008, only four were found investment-ready and financed externally.[99] The heart of technology parks' activities should be the mentoring and coaching of entrepreneurs which would strengthen their investment readiness.[100]

Recent developments in the area of science parks in the Russian Federation are presented in Box 18.

According to a recent study, there is a direct correlation between the speed of firms' growth inside a science park and its proximity to a university, implying that the geographical closeness generates more collaboration between science parks and universities. The study also shows that science park-based companies outperform the average firms in their sectors in terms of revenues, quantity of new products developed and number of registered patents.[101] This attests to the effectiveness of science parks in terms of R&D commercialization and innovation development but also underlines the importance of geographical proximity and clustering.

Innovation support institutions also have beneficial spill-over effects on the local economy. At the beginning of the current decade, business incubators in North America provided employment to 82,000 persons every year and generated annual earnings of more than USD 7 billion. Along the same lines, their counterparts in Europe create over 40,000 new jobs every year.[102]

The International Conference "From Applied Research to Entrepreneurship..." noted in its recommendations that when establishing business incubators, proof of concept centres, science parks

---

98 S. Radosevic and M. Myrzakhmet, *Between Vision and Reality: Promoting Innovation through Technoparks in Kazakhstan*, Economics Working Paper No. 66, UCL Centre for Slavonic and East European Studies, 2006; presentation by Mr. A. Betekbaev, President of Engineering and Technology Transfer Centre (ETTC) of the Republic of Kazakhstan at the International Conference "Ways and Means of Attracting External Finance for New Innovative Enterprises", Astana, Kazakhstan, 21-22 May 2009; http://www.unece.org/ceci/ppt_presentations/ 2009/eed/Betekbaev_r.pdf; http://www.sodbi.kz/php/modules.php?name=main&menu_id=0&lm_img_flag=0; http://www.idisc.net/en/Incubator.36.html.

99 ECE/CECI/CONF.4/2, p. 2.

100 ECE/CECI/SEM.1/2, p. 2.

101 D. Siegel, P. Westhead and M. Wright, "Assessing the impact of university science parks on research productivity: exploratory firm-level evidence from the United Kingdom", *International Journal of Industrial Organization*, Vol. 21, Issue 9, November 2003, pp. 1357-1369.

102 ECE/CECI/CONF.9/2, p. 4.

and innovation clusters, due attention should be paid to factors contributing to their success, e.g. proximity to universities and their research base, a firm technological base of local industry and start-ups, a well-educated and trained local workforce and adequate social infrastructure.[103]

Box 18. Technoparks and science cities in the Russian Federation

In 2006, the Ministry of Economic Development of the Russian Federation approved the programme "Establishment of High Technology Parks", which set up pilot technoparks in seven regions of the country. Most of the funding for the project came from federal and regional budgets. In 2007, the last pre-crisis year, the overall public financial support to technoparks in the Russian Federation amounted to EUR 38 million. In early 2010, the number of operational technoparks was estimated at around 80, among which about 8 to 10 are reported to be highly successful (e.g. industrial parks established at Moscow State University Lomonosov, Moscow State Technical University of Electronic Technology (Zelenograd), Tomsk State University of Control Systems and Radio Electronics, Moscow Power Engineering Institute (MEI) and several others). Reportedly, one of the major problems of technoparks in the Russian Federation is their detachment from universities and research centres. To alleviate this problem, a group of 28 technoparks has created a "Russian Union of Innovation and Technology Centres" as a platform for information exchange and the advancement of innovation infrastructure. Along the same lines, as many as 60 technology transfer offices from 25 Russian regions have linked themselves through the Russian Technology Transfer Network (RTTN).

The Skolkovo Project:

Inspired by the "Silicon Valley", a large high-tech area in the United States, the Skolkovo project aims at establishing an innovation centre focused on energy efficiency, information technology, telecommunications, biotechnology and nuclear technology in the vicinity of Moscow. It is hoped that its operation will contribute to the diversification of the Russian economy and reduce its reliance on fuels and other raw material.

The project is expected to benefit from strong international support and partnerships with foreign high-tech companies (at the time of writing, cooperation agreements were negotiated with the Finnish telecommunication company Nokia and the US network developer Cisco Systems). A preliminary agreement reached with the Massachusetts Institute of Technology (MIT) stipulated its involvement in the inter-university academic center where 2000 students would study.

By the end of 2010, with the objective of encouraging private investment, a special legal regime for the Skolkovo center had been put into place. The innovation hub has its own tax and customs services, and patent authority. Tax exemptions as well as privileged conditions for public tender participation are envisaged for companies and individuals participating in Skolkovo activities. By September 2011, participant status at the Skolkovo Innovation Centre had been granted to 40 business operators and as many as 11 companies are reported to have received grants to implement their innovative projects. The volume of financing the individual projects varies between EUR 9-150 million.

Source: Order of the Russian Federation Government of 10.03.06, № 328; I. Semenova, "Current issues in the process of technopark establishment in the Russian Federation" (in Russian), *St. Petersburg University Journal*, Geographical section, No. 3, 2009, pp. 132-138; http://eng.unitc.ru/; http//www.rttn.ru; http://www.gazeta.ru/business/2010/05/28/3375812.shtml, http://www.gazeta.ru/business/2010/05/28/; http://www.i-gorod.com/en/about.

[103] Ibid., p. 9.

Annex I. Conclusions and Recommendations

Conclusions and Recommendations of the UNECE International Conference "From Applied Research to Entrepreneurship: Promoting Innovation-driven Start-ups and Academic Spin-offs"

9-10 November 2010, Kiev, Ukraine

Drawing on the comprehensive discussions and exchange of views during the UNECE International Conference “From Applied Research to Entrepreneurship: Promoting Innovation-driven Start-ups and Academic Spin-offs” held on 9-10 November 2010 in Kiev, Ukraine, the participants endorsed a number of conclusions and recommendations.

Conclusions

1. The commercialization of the results of research and development (R&D) and their transformation into marketable goods and services increasingly determines the pace of economic development and national competitiveness. The experience accumulated in developed and emerging market economies shows that the factors facilitating commercialization are:

(a) The scope of research and development, which determines the stock of inventions and innovations to be commercialized. Among other factors, the scope of R&D depends on the number of universities, research institutions and research communities in the country, investment in R&D from public and private sources and its effectiveness;

(b) The number, qualification and experience of researchers in public research organizations and the corporate sector. The availability of highly qualified personnel depends on the quality of education, in particular higher (university) education which, in turn, is largely determined by the funds allocated to education by the state and private sources, university enrolment rates and the quality of education and training therein;

(c) A regulatory and institutional environment conducive to innovation, which implies transparency and accountability in public spending and investment, stable property rights including intellectual property rights, independence of the judiciary, harmonization of relevant laws and regulations in accordance with international norms, transparent and stable rules, low costs and simple procedures governing the registration and operation of enterprises, hiring of workers and the registration of intellectual property, transparent tax administration and reasonable taxation rates, as well as ease of access to finance at the various stages of enterprise development;

(d) Openness to foreign technologies and to cross-border cooperation in innovation. Research and development is increasingly carried out across national borders and the national capacity to absorb and adapt technologies developed worldwide is one of key drivers of innovation. By participating in international R&D networks and technology transfer, countries can also tap into foreign sources of innovation finance and investment, and into knowledge accumulated abroad, and can increase the pace and quality of their own innovation.

(e) Wide use of information and communication technology (ICT) as evidenced by international experience. The latter shows that well developed internet and communication networks provide support for enterprises, while rendering the business environment more conducive to entrepreneurship.

(f) The intensity of linkages between the various actors involved in innovation. These links are provided by public, private or public-private organizations that support entrepreneurs in establishing spin-off companies, commercializing their innovations, bringing them to the market and finding financial solutions. Among others, such institutions include training, consulting and technology transfer centres, incubators and pre-incubators, seed capital funds and technology parks.

2. Available evidence shows that, during the 2000s, the drivers of innovation in emerging market economies of the UNECE region were generally less powerful than those in developed market economies. The emerging market economies lagged behind the OECD countries in terms of public and private investment in research and development, public expenditure on education and enrolment in higher education, the development of information and communication technologies, as well as the scope of the infrastructure supporting innovation. As a result, the process of commercialization in emerging market economies still faces considerable challenges regarding the effectiveness with which they convert the resources invested in R&D into commercial outputs.

3. While significant progress has been reported over the transition period, the overall business environment in many of the emerging market economies is still not sufficiently conducive to innovation and commercialization of R&D results. Weak protection of property rights, including IPRs, administrative hurdles and corruption, malfunctioning of the judiciary – all these factors hamper innovation. Equally significant, business operators often underestimate the critical role of innovation for remaining competitive in a market economy.

4. The available evidence also attests to the low level of financing from private sources, which is one of the major factors behind the insufficient funding for R&D in most of these countries. The lack of direct involvement of private companies in the process of applied research has discouraged the orientation of the latter towards commercial needs and has limited the demand for commercialized products of R&D.

5. As a result, during the 2000s, emerging market economies had rather low rates of resident patent applications per million inhabitants in comparison with more developed European economies. High cost of intellectual property (IP) protection (especially, for patents) as well as protracted patenting procedures also hamper the commercialization of R&D results by SMEs or public research organizations.

6. In emerging market economies, most universities and R&D institutions face additional, specific problems related to the commercialization of intellectual property, such as the lack of competent staff and internal expertise in the intellectual property area and insufficient financial autonomy of universities, which hamper them in developing their own policy vis-à-vis their research workers and IP protection of university inventions; as well as scarce resources to bear the costs associated with patent registration, renewal and litigation.

7. International experience shows that a coherent innovation and commercialization policy facilitates the transfer of academic knowledge produced by public research to the business sector (technology transfer). Methods of technology transfer include the sale or assignment of intellectual property rights, licensing, establishment of spin-offs and start-ups, various types of cooperation and partnership between academia and industry, and cooperation of companies with the education system.

8. Recently, many countries in the UNECE region have seen an increase in the number, scope and level of higher education courses that focus on commercialization and entrepreneurship. Inter alia, these programmes aim at facilitating communication between researchers and business managers. The curricula include cross-disciplinary issues related to technology, intellectual property rights, business management, entrepreneurship and IT, and emphasize practical know-how through established links with private business or university-based commercial operations.

9. The international experience also shows that high-technology SMEs grow and mature faster when effective innovation support institutions are in place. In particular, business incubators, proof of concept centres, science parks and innovation clusters demonstrate their effectiveness as

vehicles that support R&D commercialization and innovation. The science park-based companies are reported to outperform other firms in the same sectors in terms of revenues, quantity of new products developed and number of registered patents.

Recommendations to central and local governments:

10. Consistently implement measures aimed at improving the general business and innovation environment, in particular harmonizing the relevant laws and regulations with international norms; alleviating the administrative burden on enterprises, reducing costs and simplifying the procedures governing their establishment and operation and, where appropriate, implementing deregulation; preventing violations of property rights and fostering transparency of regulations and their application, in particular, with respect to intellectual property protection.

11. Promote private investment and involvement of the private sector in commercialization and technology transfer, using the broad spectrum of public-private partnership instruments. To this end, facilitate and forge closer links between industry, academia and universities. Such closer collaboration could take the form of training and re-training of practitioners from industry at universities and science parks, establishment of joint research laboratories and opening research facilities to external users. Public sponsoring of science parks, as well as some fiscal incentives, could be instrumental in achieving this.

12. Ensure compliance of the rules and regulations of commercialization with the existing laws and regulations, thus guaranteeing a fair distribution of income stemming from commercial results according to inventors' and other stakeholders' contributions. Encourage universities to develop coherent policies regarding the ownership of intellectual property, thus creating financial and non-financial incentives for successful researchers. Facilitate the use of R&D outputs generated within the research institution in the interest of the public at large (technology transfer) through licensing or other forms of commercialization. The establishment of technology transfer offices in universities could contribute to this endeavour. Ensure that research results remain in the public domain for use in future research.

13. Explore international good practices of open innovation, particularly applicable to SMEs, and the feasibility of their use nationally for the purposes of commercialization. Foster the participation of academia and enterprises in cross-border open innovation and facilitate the diffusion of new products and technologies developed abroad in the domestic market through consistent promotion of foreign trade and international direct investment, and the international mobility of knowledge workers.

14. Adopt a proactive approach to facilitating and fostering the financing of innovation-based start-up companies using, among other instruments, merit-based awards and feasibility grants, facilitate the development of national business angel networks and their links with research institutions and universities, and promote partnerships between industry and government. Put in place public initiatives to encourage the involvement of venture capital, and corporate venture capital firms in early-stage financing, including through hybrid public-private funds that create more favourable risk-reward ratios for private investors. Closer collaboration between different types of investors should be promoted to ensure the continuity of financing for start-ups at various stages of their life cycle.

15. Draw on and share the international good practices of regulation and operation of innovation support institutions, use them as a model, and promote linkages and networking among those institutions. When establishing business incubators, proof of concept centres, science parks and innovation clusters, due attention should be paid to factors contributing to their success, e.g. proximity to universities and their research base, a firm technological base of local industry and start-ups, well-educated and trained local workforce and adequate social infrastructure.

16. Collect information on existing innovative technologies, where appropriate, creating to this end national and subnational databases, and distribute this information through various channels, including the mass media.

17. Collect and disseminate information on good practices of promoting new innovative enterprises and strengthening industry-science linkages in developed and emerging market economies. On this basis, and in cooperation with interested private companies and entrepreneurs' associations, governments could initiate training courses and expert consultative services dealing with innovation and enterprise development, for company managers, academic entrepreneurs and public officials.

18. The International Conference invites the UNECE secretariat to review the good practices presented and discussed at the Conference, and ensure a wide dissemination of its outcomes to the stakeholders.

Annex II. European Innovation Scoreboard: measuring the innovation activities in the EU countries

In the early 2000s, the European Union started to use a special system of indicators to better measure innovation activities in its member States – the European Innovation Scoreboard (EIS).[104] The number of indicators used varied from 17 in 2001 to 29 in 2008-2010. These indicators are clustered into three groups - Enablers, Firms' activities and Outputs, each of which contains 2 or 3 "blocks".

1) The group of **Enablers** tries to quantify the main drivers of innovation that are external to the firm, such as:

- *Human resources* – measures the availability of highly-skilled and educated workers (using such indicators as science and engineering, and social sciences and humanities graduates per 1,000 inhabitants (first stage of tertiary education), percentage of population having accomplished tertiary education, percentage of those participating in life-long learning, etc.);
- *Finance and support* – measures the availability of funding and government support for innovation projects (using such indicators as public R&D expenditures as a percentage of GDP, venture capital investment as a percentage of GDP, etc.).

2) The group of **Firms' activities** tries to measure the innovation efforts that firms undertake themselves:

- *Firms' investments* – covers a range of investments that firms undertake in order to generate innovations (using such indicators as private R&D expenditures as a percentage of GDP, national expenditures on information technologies as a percentage of GDP etc.);
- *Linkages and entrepreneurship* – tries to measure entrepreneurial potential and collaboration efforts among innovating firms, and between the private and public sector (using such indicators as the number of scientific publications prepared in collaboration of the private and public sectors per million inhabitants, firm renewal rates (SME entries plus exits) as a percentage of the total number of SMEs, etc.);
- *Throughputs* – tries to quantify the intellectual property rights generated in the innovation process and technology balance of payments flows (using such indicators as the number of European Patent office applications per million inhabitants, Community (EU) trademarks and designs registered per million inhabitants, as well as the balance of payments technology flows as a percentage of GDP and some others).

3) The group of **Outputs** tries to quantify the outputs of innovative activities:

- *Innovators* – measures the number of firms that have introduced innovations which are either "new to the market" or "new to the firm", covering technological and non-technological innovations (using such indicators as the number of SMEs introducing product, process, marketing or organizational innovations as a percentage of their total number and some others);

[104] http://www.eis.eu/.

- *Economic effects* – captures the economic impact of innovation in terms of employment, sales and exports (using such indicators as employment in medium-high and high technology manufacturing as a percentage of the total workforce, employment in knowledge-intensive services as a percentage of the total workforce, and medium and high-technology manufacturing exports as a percentage of the total exports of goods, etc.).

On the basis of these indicators, the European Innovation Index (EII) provides an aggregated measure of national innovation development, its value ranging from 0 (no innovative activity) to 1 (highest possible level of innovation activities).

It is to be emphasized that in the last version of the Innovation Scoreboard (2008-2010) several indicators reflect the scope of innovative entrepreneurship as well as that of stakeholder support to small innovative companies. These indicators include, for example, the venture capital investment as a percentage of GDP, the number of SMEs innovating in-house, the number of SMEs collaborating with other entities as a percentage of the total number of SMEs, the number of SMEs introducing product or process innovations, or those introducing marketing or organizational innovations as a percentage of the total number of SMEs. Altogether, the indicators pertaining to innovating SMEs constitute more than a quarter of their total number.

Depending on the value of the EII, experts divide the EU countries into four groups:

- Innovation leaders: Denmark, Finland, Germany, Sweden, and the United Kingdom;
- Innovation followers: Austria, Belgium, France, Ireland, Luxembourg and the Netherlands;
- Moderate innovators: Cyprus, Czech Republic, Estonia, Greece, Italy, Portugal, Slovenia and Spain;
- Catching-up economies: Bulgaria, Hungary, Latvia, Lithuania, Malta, Poland, Romania and Slovakia.[105]

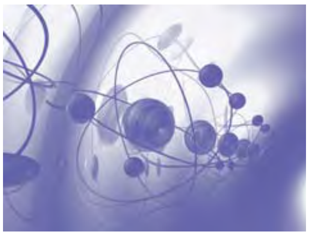
It is to be noted that similar calculations have been made for some of non-EU countries, including China, Croatia, Israel, Japan and the United States. For the first time in 2008-2010, calculations of EII were also made for Armenia, Azerbaijan, Kazakhstan, Russia, Ukraine and some other post-Soviet states.[106] The resultant estimates of EII values for these countries were 3 or 4 times lower than those for the leading EU countries, placing them in the fourth group of "catching-up" economies. For instance, in 2007-2009 the EII level of the Russian Federation and Ukraine was 0.21-0.24, while the respective value for the innovation leaders, Finland, Germany and Sweden, was three times higher at 0.6-0.64.

Experts noted that the European emerging market economies had strong positions in blocks, related to human resources, while they had the weakest positions in those incorporating the indicators measuring the intellectual property rights and innovation financing. The EIS has become a popular instrument for measuring innovativeness in Europe. It has also been modified for the purposes of comparative analysis of the levels of innovation in the regions of Europe.

---

[105] MERIT, *European Innovation Scoreboard 2008*, 2009, available at http://www.proinno-europe.eu/page/admin/uploaded_documents/EIS2008_Final report-pv. pdf.

[106] www.inco-bruit.eu; www.inco-ripka.eu.



Annex III. Disclosure of Inventions

Invention disclosure is a document that provides information on the inventor or inventors, the nature of the invention, the circumstances leading to the invention and related subsequent activities. It provides the basis for determining patentability and the technical information for drafting a patent application.

Submitting a disclosure is the first formal step towards obtaining proper intellectual property protection through a university or R&D institution. In the absence of a technology transfer unit, a university could have a committee responsible for receiving and processing disclosures of potentially patentable inventions.

The key information on the disclosure form should include:

- Invention title;
- Names of the inventors;
- Description of the invention;
- Sponsorship, if any;
- Design date and date put into practice;
- Publication dates, existing or projected, if any.

The written description of the invention should be as complete and accurate as possible to allow a patent professional to comprehend the invention and assess its patentability. The disclosure should be understood, witnessed and signed by a non-inventor. Inventors are strongly encouraged to submit invention disclosures early in the invention development process.

It is advisable for universities and R&D institutions to develop and adopt participation agreements or patent and copyright agreements to govern disclosures.

Intellectual property disclosures are normally considered confidential by the institution, so it will instruct the members of the Technology Transfer Unit or Disclosure Committee and experts involved accordingly.

Source: WIPO, Guidelines on Developing Intellectual Property Policy for Universities and R&D Organizations, 2002.

Annex IV. Major channels and forms of industry-science collaboration

Cooperation in R&D and patenting	Joint R&D projects Exchange of information on R&D results Sponsoring of research by the private sector Joint patenting
Publications	Companies' scientific publications used in academic research Academic publications used in corporate research Joint publications
Participation in relevant events	Participation in conferences Participation in fairs
Mobility of workers	Hiring of graduates by private companies Moves of scientists from public knowledge institutes to industry Moves of managers and research personnel from industry to public knowledge institutes Mobility of personnel among public knowledge institutions Training of students and post graduates in private companies Holding double positions in academia and industry Temporary exchange of personnel
Informal contacts	Networks based on friendship Alumni societies Other boards
Sharing of facilities	Shared laboratories Common use of equipment Sharing of R&D and office space (science parks)
Cooperation in education	Training or retraining sponsored by the private sector Private sector participation in developing the university curriculum Financing of students' education by the private sector Financing of PhD students by the private sector
Commercialization infrastructure	Organization of university-based science parks and business incubators

Source: R. Brennenraedts, R. Bekkers and B. Verspagen, *The Different Channels of University-Industry Knowledge Transfer: Empirical evidence from biomedical engineering*, Working Paper 06.04, Eindhoven Centre for Innovation Studies, February 2006, p. 4.

Annex V. Glossary

Assignment is a transfer (sale) of ownership of intellectual property rights from one entity (assignor) to another (assignee). Assignable intellectual property rights include copyright, patent or trademark registration as well as the rights to pursue protection or enforcement of any of those IP rights domestically or in other jurisdictions.

Business incubator is a company or facility that assists new companies at earlier stages of their development. Business incubators usually provide to start-ups physical space, business support services and often access to finance. The incubation process may also include coaching, mentoring, assistance in market analysis, as well as facilitated networking and contacts with industry experts and other entrepreneurs. The expected outcome of a start-up incubation is the stage of revenue-generating company or the stage when the start-up is considered attractive by outside investors.

Confidentiality agreement is an agreement between a company and an employee of a university or R&D institution, according to which the latter is bound not to release the company's confidential information unless expressly permitted by the company. In the same way, when applied to information on invention belonging to an employee of a university or R&D institution, the objective is to prevent the commercial use by a third party of such information without permission and protect the patentability of the invention.

European patent application is a patent application filed under the European Patent Convention (see below).

European Patent Convention (EPC) is an agreement among 36 countries aimed at harmonizing the patent law, and patent application rules and procedures. The EPC established a single European patent which is effective in all member-countries of the Convention.

Infringement is the violation of Intellectual Property Rights. Anyone who makes, uses, sells, places on sale, or imports a claimed invention is guilty of infringement.

Intellectual Property (IP) refers to property that is a result of some intellectual effort and enjoys legal protection. Examples of Intellectual Property include patents, trademarks, copyright and design protection.

International Patent Application is a patent application filed under the Patent Co-operation Treaty (PCT) in any of the member countries of the World Intellectual Property Organization (WIPO). The patent thus filed will be valid in up to 104 countries.

Invention disclosure is a document that provides information on the inventor or inventors, the nature of the invention, the circumstances leading to the invention and related subsequent activities. It forms the basis for deciding on patentability and communicates technical information for drafting a patent application. Such a disclosure is the first signal to the university that an invention has been made. This document is also used to report on intellectual property that cannot be patented but is protected by other means such as copyright.

License represents a permission of the owner of a patented invention ("licensor") granted to a third party ("licensee") to use the invention in specified geographical areas against a fee to be paid to the licensor ("royalties"). The amount of royalties usually represents a percentage of revenues obtained through the use of a patented invention.

Merit-based grants are a form of financing provided by public agencies, under which enterprises obtain financing unconditionally, i.e. the grant need not be repaid if the enterprise is not successful.

Material transfer agreement regulates the transfer of proprietary tangible property that is coming to a university or R&D institution from industrial and other sources, or the reverse.

Patent is a set of exclusive rights granted by a state (national government) to an inventor (the patentee or patent holder) for a limited period of time in order to prevent others from making, using, selling, or distributing the patented invention without patent holder's permission.

Patent Cooperation Treaty (PCT) is an international agreement regulating the filing of patent applications which would have effect in many countries. The treaty simplifies the process of filing patent applications, delays the expenses associated with applying for patent protection in foreign countries, and allows the inventor more time to assess invention's commercial viability. Under the PCT, an inventor can file a single international patent application in one language with one patent office in order to simultaneously seek protection for an invention in the PCT member countries.

Patent prosecution is a process of interaction between applicants and a patent office with regard to a patent, or an application for a patent. Broadly, patent prosecution can be split into pre-grant prosecution, which involves negotiation with a patent office for the grant of a patent, and post-grant prosecution, which covers the post-grant amendment and opposition. The respective fees paid to the patent representative or attorney can be also split into those referring to pre-grant prosecution (involving fees for negotiating with a patent office) and post-grant prosecution (involving fees for post-grant amendment and opposition).

Science park, which is often called a **technopark**, is an organization managed by specialized professionals, the main aim of which is to increase the wealth of the community by promoting the culture of innovation and the competitiveness of its associated businesses and knowledge-based institutions. To enable these goals to be met, a science park encourages the exchange of knowledge and technology amongst universities, R&D institutions, companies and markets; it facilitates the creation and growth of innovation-based companies through incubation and spin-off processes; and provides other value-added services together with high quality space and facilities.

Service agreement is a contract between the university or R&D institution and a company, in which the former agrees to perform certain tasks, such as evaluation, field testing or clinical trials, using protocols specified by the company or developed by the university, to meet criteria and data requirements set by the company.

Spin-offs are generally small, new firms established by research workers in universities or other research organizations with the objective of transforming the outputs of R&D into new marketable products or processes. Examples of spin-offs also include companies that license technology from a public institution.

Start-ups are newly created companies, often in high technology sectors. Typically, they experience uncertainty regarding their sources of financing and the choice of appropriate business model.

Technology transfer is the process, by which a technology, expertise, know-how or facilities developed by one individual, enterprise or organization, is transferred to another individual, enterprise or organization. Effective technology transfer results in commercialization of a new product or service or in the improvement of an existing product or process, and may occur from country to country, from industry to industry or from research laboratory to an existing or new business. It may be facilitated by financial or other types of assistance provided by government agencies at national, regional or local levels.

Fostering Innovative Entrepreneurship

This publications is a part of an ongoing series highlighting some of the results of the UNECE Subprogramme on Economic Cooperation and Integration. The objective of the Subprogramme is to promote a policy, financial and regulatory environment conductive to economic growth, knowledge-based development and higher competitiveness in the UNECE region.

It covers different thematic areas related to this objective including innovation and competitiveness policies, entrepreneurship and enterprise development, public-private partnerships for domestic and foreign investment, commercialization and protection of intellectual property rights.