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Measuring the Innovation Potential of the Bulgarian Economy

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ABBREVIATIONS

AEAF - Agency for Economic Analyses and Forecasting
BARDA - Bulgarian Association of Regional Development Agencies
BAS - Bulgarian Academy of Sciences
BCCI - Bulgarian Chamber of Commerce and Industry
BG - Bulgaria
BIA - Bulgarian Industrial Association
BNB - Bulgarian National Bank
BPO - Bulgarian Patent Office
BSA - Business Software Alliance
BSMEPA - Bulgarian SMEs Promotion Agency
CEE - Central and Eastern Europe
CEECs - Central and Eastern European Countries
CERN - European Organization for Nuclear Research
CMEA - Council for Mutual Economic Assistance
CSD - Center for the Study of Democracy
DCM - Decree of the Council of Ministers
DNS - Domain Name Server
EBRD - European Bank for Reconstruction and Development
EC - European Commission
EFTA - European Free Trade Area
EPC - European Patent Convention
EPO - European Patent Office
ERP - Enterprise Resource Planning
EU - European Union
GDP - Gross Domestic Product
GVA - Gross Value Added
HU - Hungary
IASTC - International Association of Science-Technology Centers
ICT - Information and Communication Technologies
IP - Internet Protocol
KAM - Knowledge Assessment Methodology
MA - Medical Academy
MBA - Master of Business Administration
MEE - Ministry of Economy and Energy
MES - Ministry of Education and Science
MLSP - Ministry of Labor and Social Policy
MVI - Market Value Index
NACE - Nomenclature des Activites de Communaute Europeenne
NCAS - National Centre for Agrarian Sciences
NDP - National Development Plan
NGO - Non-Governmental Organization
NIF - National Innovation Fund
NII - National Innovation Initiative
NIPE - National Intellectual Products Exchange
NK-NA - Does Not Known - No Answer
NPO - Non-Profit Organizations
NPP - Nuclear Power Plant
NSF - National Science Fund
NSI - National Statistical Institute
OECD - Organization for Economic Cooperation and Development
PIRLS - International Reading Literacy Study
PISA - Programme for International Student Assessment
R&D - Research and Development
RIS - Regional Innovation Strategy
SCR - South Central Region
SG - State Gazette
SIBIS - Statistical Indicators Benchmarking the Information Society
SMEs - Small and Medium Sized Enterprises
SU - Sofia University
TIMSS - Third International Mathematics and Science Study
TLD - Top-Level Domain
UN - United Nations
UNCTAD - United Nations Conference on Trade and Development
US - United States
USA - United States of America
USB - Union of Scientists in Bulgaria
USPTO - United States Patent and Trademark Office
VC - Venture Capital
WEF - World Economic Forum
WIIW - Wiener Institut fur Internationale Wirtschaftsvergleiche

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SUMMARY

Bulgaria has reached a stage of economic development which **requires that public policies are increasingly focused on innovation**. The economic factors and prerequisites for such a shift are already visible. After the financial and economic crisis of 1996-1997, the Bulgarian economy marked eight consecutive years of economic growth. Fixed capital investment reached 20% of GDP in 2004 for the first time since transition started and continues to increase, credit activity booms and unemployment is steadily decreasing. Despite this revival, according to most economic indicators, Bulgaria still lags significantly behind the average EU-25 level. At present, Bulgaria competes with homogeneous, labor- and material-intensive products and the driving factor behind its competitiveness is low costs. Escaping this low technology trap requires the **development of a flexible and open national innovation system within a competitive market economy framework** that would ensure:

- an influx and wide diffusion of foreign innovation in the country;
- gradual development of local innovation capacity of European and global quality.

Innovation.bg aims at assisting the efforts of the public and private sector for a successful transition to innovation economy by providing a reliable **analysis of the structure, current status and opportunities for development of the Bulgarian innovation system**. The report takes into account the specific national economic political and institutional framework in which the Bulgarian innovation system is developing.

Sustaining a favorable business climate is one of the main prerequisites for setting up an innovation economy. According to data for 2005 of the Heritage Foundation, Bulgaria is among the countries with the fastest improving economic freedom and continues to strengthen its position of a predominantly free economy (place 52 of 155 countries). Nevertheless, serious outstanding problems of reform in the judicial system and public service delivery still hamper the effective functioning of businesses in Bulgaria. The rules of competition and protection of intellectual property are well regulated from a legal point of view, yet the actual enforcement of the law is still inadequate.

In the past several years, there has been a certain improvement in **strategic planning regarding the national innovation policy**. Yet the organizational and institutional structure of the national innovation system remains **disproportionately dominated by state organizations while three fourths of the economy of the country is already in private hands**. The main state bodies responsible for public innovation policy are the Ministry of Economy and Energy and the Ministry of Education and Science. In 2005 they have developed two strategic documents, which shape the policy framework for development of the innovation system: a) *The Innovation Strategy of the Republic of Bulgaria* and b) *The National Strategy for Research and Development of the Republic of Bulgaria*. Due to the lack of sufficient specific results and performed tasks it is still too early to draw conclusions regarding their impact on the national innovation system.

There are a number of international indexes that compare the Bulgarian innovation system (or parts of it) with the innovation systems of EU-25 countries and/or the developed OECD economies. Due to their general character these indexes do not examine in great detail the individual characteristics of the national innovation systems and policies of the separate countries. *Innovation.bg* fills this gap by **analyzing in depth the Bulgarian innovation system through five groups of indicators:**

- **gross innovation product** – reviews the results of the national innovation system, the main innovation targets of the enterprises and the problems they face in their innovation activities;
- **entrepreneurship and innovation networks** – outlines the characteristics of two major sources of innovation in the Bulgarian economy – the setting up of new enterprises and the participation of Bulgarian producers in national and international value chains for the development of new products and services;
- **investment and financing of innovation** – examines the role of foreign direct investment and import of investment goods in the transfer of foreign technologies and knowledge; R&D investment and the existing instruments for financing innovation;
- **human capital for innovation** – describes the available human resources for the adoption of foreign and the creation of local innovation in the economy;
- **information and communication infrastructure** – analyses the current status and the level of utilization of the existing information and communication infrastructure.

The gross innovation product is formed by the results of the national innovation system at every stage of the innovation process: science, technology and innovation. Despite the fact that these three elements can exist independently from each other, their collective impact on competitiveness is stronger when they function harmoniously.

- **The innovation product** is determined by the number and the activity of innovative enterprises. **Compared to EU-25 the share of innovative enterprises in Bulgaria is approximately four times lower, which means that only 1 in every 10 Bulgarian enterprises with personnel of more than 9 people innovates.** Innovative enterprises in Bulgaria develop mostly product innovations. Their innovation activity is based primarily on the acquisition of new machinery and equipment, while investment in R&D, marketing and staff training remain secondary. This behavior reflects the relatively early stage of market and innovation development of the economy, which is characterized by the manufacturing of inexpensive products with low levels of differentiation

and market distinction. Accordingly, innovative enterprises in Bulgaria single out the overall business environment among the most significant problems for their innovation activity rather than issues specifically related to the innovation system. Nevertheless according to a 2005 Eurobarometer survey **Bulgaria is one of the European countries with the highest share of the population who does not accept innovation (20%)**. **The national innovation policy** should take into account these realities and **emphasize on increasing the innovation demand of enterprises.** Efforts for establishing a more innovation-conducive economic environment need to go hand in hand with **further improvement in the business and investment climate**.

- **The technological and the scientific product** encompass new high-quality technologies developed within the country and new written knowledge, respectively. **Bulgaria lags half-way behind** the new EU member states in the number of patent requests and issued patents by the two main international patent administrations – the European Patent Office (EPO) and the Unites States Patent and Trade Mark Office (USPTO). The same standing is repeated in relation to the number of scientific publications in internationally peer-reviewed and referenced journals. The share of Bulgaria in the population of EU-8+2 in 2001 was almost twice as large (8%) compared to her share in the peer-reviewed publications of this region (5%). In the past several years there has been a revival in the local and international patent activity of Bulgarian entities. Foreign enterprises and patent holders still value **highly the ability of the Bulgarian scientific and technological system to recreate or adapt technologies**. Public innovation policy should be better focused on transforming **the comparatively more developed technological and scientific abilities of the country into a higher innovation product**.

Entrepreneurship and **innovation networks** are important sources of innovation in the market economy. **The entrepreneurial activity of Bulgarian citizens is approximately twice as low compared to the countries of EU-15** and lags behind compared to the leading countries of EU-8 – The Czech Republic, Hungary and Poland. **The innovation networks of Bulgarian enterprises are still based more on broad market relations rather than specific innovation and technology clustering.** Bulgarian enterprises focus foremost and almost exclusively on innovation cooperation with their local and international clients and suppliers, and the organizations that finance them. Their connection to the existing R&D organizational infrastructure is rudimentary. The average assets size of Bulgarian SMEs is significantly smaller than that of EU enterprises, which largely determines their strategies for partnership in innovation. Hence, innovation policy should be differentiated:

- **micro enterprises** (approximately 91% of the total number of enterprises) need programs for improvement of the overall business environment, entrepreneurship promotion, investment in technology intensive capital goods, efficiency enhancement and growth;
- **small and medium enterprises** (approximately 7-8% of the total number of enterprises) call for competitiveness enhancement policies based on diversification of product lines and ranges, clustering, integration in international production networks, adapting and creation of new innovation also through R&D investment;
- **large enterprises** (approximately 1-2% of the total number of enterprises) and foreign direct investors necessitate a targeted policy that supports investment in R&D.

Investment in innovation is an instrument for improving the competitiveness of Bulgarian enterprises in the long-run. During the last few years, **R&D expenditure**

in Bulgaria has been limited. R&D has been largely financed by the state and performed by budget supported public sector organizations. Bulgarian enterprises still find it more profitable to upgrade technologically through foreign direct investment and import of investment and consumer goods, which contain the technologies and knowledge they need.

- **The industries with the highest accumulation of FDI in Bulgaria have a larger share of innovative enterprises compared to the average for the economy.** In the last five years Bulgaria's inward FDI has tripled. In 2004 cumulative FDI stock topped 7 billion euros or 30% of GDP. Nevertheless, the **Bulgarian economy's FDI intensity remains lower compared to the average EU-8 level**. In order to make full use of its investment and commercial integration with the countries of EU-15, which allocate an average of 2% of their GDP for R&D, the Bulgarian innovation policy should:
  - focus on attracting FDI with higher R&D content; and
  - stimulate the integration of current and potential foreign investors in the national innovation system.

- In the past ten years **R&D expenditure** as a percentage of Bulgaria's GDP (0.5% in 2004) **has remained approximately four times lower than the average EU-15 level**. In addition, the contribution of enterprises in total R&D expenditure remains less than half that of the state, which is exactly the opposite situation as observed in the leading innovation economies in Europe. As a result **the physical R&D capital in Bulgaria has been almost fully depreciated and the accumulated human capital has lost a substantial amount of its value.** Worst hit has been the part of the R&D system dealing with applied and experimental research and development, which are of particular importance to innovation in contemporary market economies. The reversed structure of financing and performance of R&D in the Bulgarian economy is a direct reflection of the low R&D demand by the enterprises and the very low commercialization capacity of the Bulgarian R&D sector. The national innovation policy should therefore be directed towards eliminating the existing imbalances in R&D expenditure financing:

  - **A reasonable medium-term goal (i.e. until 2010) is bringing the state and private contribution to R&D expenditure to parity, while increasing its total amount to 1,2 – 1,5% of GDP.** In the somewhat longer-term Bulgaria should aim at achieving a comparable position among the EU-8 countries as regards the EU's strategic goal of raising R&D expenditure to 3% of GDP.
  - **Public sector support should primarily focus on improving R&D infrastructure.** Better infrastructure is strategically important for the successful integration of the Bulgarian innovation system into the European Economic Area, and for the participation of Bulgarian R&D organizations and innovative enterprises in the specialized programs of EU and NATO.

The lack of adequate public and private sources of **innovation financing** is one of the main constraints Bulgarian innovative enterprises face in their innovation activities. During the last several years, there has been a significant improvement of financial intermediation in the country, which has resulted in an **increase in the volume and diversity of financial instruments offered on the market**. Nevertheless, the level of financial intermediation in Bulgaria remains lower than the average in EU-8. Most **Bulgarian enterprises finance their innovation activities through their own internal resources**. **Venture capital** finance **is limited** in Bulgaria for a number

of reasons such as low liquidity of the local stock market, limited exit options for investors, lack of reliable financial information on enterprise performance, etc. In this respect, the innovation development of Bulgarian enterprises could benefit from a more adequate use of the EU Framework Programs for research, technological development and innovation, in the same way that Bulgarian NGOs, universities and R&D organizations have already gained positive experience from participation in these programs.

A crucial determinant of the long-term development of the Bulgarian innovation system is the quality and quantity of the available **human capital**. The ability of the Bulgarian economy to absorb, use and adapt new knowledge, as well as to introduce outside innovation, is determined by the quality of the secondary and higher education (bachelor and master degree), and the system of life-long learning. On the other hand careers in science (PhD) and employment in R&D define the internal potential of the economy to generate innovation.

- **Secondary education** in Bulgaria was particularly negatively affected by the transition period. Comparative international research reveals an alarming **reduction in the quality** of secondary education. This could become **a major long-term barrier to the successful innovation development of the Bulgarian economy**. Bulgarian **higher education faces** similar problems. Bulgaria lags significantly behind the average EU-25 level of participation of the population in vocational education and training outside the formal education system. Nevertheless, there have been indications that **universities have already started responding more adequately to market demands**. This is especially true for technological majors in particular in relation to IT training. Policy makers should strengthen the efforts to multiply such emerging positive trends. At the same time more attention should be devoted to increasing the quality requirements at the exit of the education system.
- R&D employment per thousand inhabitants in 2002 in Bulgaria (5,2) was below the level of the 10 new EU member states (8,4). In fact it is even lower in the private sector and if it was not for the public sector to compensate overall R&D employment would have gone further down. **State subsidized over-employment in R&D is inherited from the past.** It has certainly contributed to preserving part of the country's scientific potential during the years of transition, but the imbalance between public and private sector R&D employment is inefficient and unsustainable in the long-run. Careful dismantling of state-subsidized employment in the sector is an important step towards improving the market efficiency of the science and education system.

Information and communication technologies support and reinforce the innovation system by allowing for better, faster and more efficient combination of the efforts, instruments and talent invested in innovation. Despite its fast and relatively homogeneous development during the last five years, the information and communication infrastructure in Bulgaria lags significantly behind the average level of the new EU member states. **The use of computers and the Internet doubles the probability for a Bulgarian company to innovate.** Nevertheless, the prevailing comparatively low technological level of production in Bulgarian SMEs has not until recently required well-developed ICT. Bulgarian enterprises are still equipping themselves with e-business tools while their actual participation in e-business is relatively low and ineffective. In the next few years, enterprises would seek a **more effective use of the available ICT equipment to integrate and manage their business and innovation processes**. Faster development of e-governance and the introduction of more public administrative e-services could provide a significant impetus in this direction.

* * *

The main public institutions necessary for the establishment and proper functioning of an effective innovation system have already been set up in Bulgaria. The main challenges for the country's innovation policy are: ensuring the most effective linkages between public and private institutions dealing with innovation; integration of the Bulgarian innovation system in the European innovation infrastructure; and reforming the public R&D and innovation support to better focus on the market needs of Bulgarian enterprises. This calls for a fast elimination of existing imbalances in the national innovation system regarding public and private sector participation in R&D financing and employment, as well as quick reforms to improve the quality of education.

INTRODUCTION

The National Development Plan (NDP) of Bulgaria for the period 2007 – 2013 defines two strategic goals for Bulgaria's development in the context of the country's accession to the European Union:

- to reach and sustain high economic growth;
- to increase its human capital potential[1].

The macroeconomic stabilization, the privatization and restructuring of the economy, and the progress in its EU membership negotiations have helped Bulgaria reach the average GDP growth rates of the new EU member states from Central and Eastern Europe during the period 2000 – 2005. Nevertheless, according to Eurostat, the EU's statistical body, the purchasing power of Bulgarians remains at a relatively low level – 30% of the average for all EU member states (EU-25), and 56% of the average for the new EU member states (EU-10). **To implement its strategic NDP goals and to close the gap to EU-25 Bulgaria should maintain or increase its rate of economic growth**.

Until recently, Bulgaria's economic growth has been driven by two factors: 1) the increase in the effectiveness of use of the existing capital and labor resources, resulting from the financial stabilization, privatization, liberalization and institutional reforms, and 2) the gradual recovery of the physical capital lost during the transition period through a pick-up in domestic and foreign investment. Bulgaria's main competitive advantage thus far has been its low labor costs. But this advantage will quickly be eroded in the face of growing international low cost competition. Hence, the country should redirect its long-term growth strategy towards investment in technological upgrading, innovation and improvement of the quality of human capital. This new strategy should be centered around the development of a dynamic, market oriented and internationally open national innovation system, which stimulates entrepreneurship and investment in the acquisition and creation of new technologies and skills.

[1] Vision, strategic goals and priorities of the NDP 2007-2013, approved by the Council of Ministers on 19.08.2004 (http://www.aeaf.minfin.bg/cms/docs/bg/ops/n_plan/NDPstrategy2007_2013.pdf, last visited on 08.09.2005).

There are three main characteristic features of a modern innovation-driven economy[2] which Bulgaria should aim at:

1) routine innovation activity in the companies – in order to maintain their competitive advantages companies should create special R&D departments to plan and perform innovation;

2) secure prorerty rights and revenues for entrepreneurs – this includes but is not limited to rule of law, protection of intellectual property rights and developed market for technologies; and

3) abundant opportunities for quick interaction and networking for innovation among economic agents through developing modern ICT infrastructure, quality education and better communication culture.

Innovation.bg aims at supporting the efforts of the public and private sector for a successful transition to an innovation economy through providing a reliable **analysis of the structure, current status and opportunities for development of the Bulgarian innovation system**. The report recognizes the specific economic, political and institutional framework in which Bulgaria's innovation system develops. Bulgaria is a middle income country[3] with relatively short history of market development and its economy is dominated by low technology production. In such a setting the demand for domestic R&D is low. Bulgarian companies prefer to innovate and upgrade technologically by importing new foreign products and/or processes. The main policy challenges for the development of the national innovation system in Bulgaria are: 1) encouraging a swifter transition of the economy to higher value added products with higher knowledge content; 2) improving the absorption capacity of domestic enterprises for foreign innovation and knowledge; and 3) refocusing the domestic R&D sector from basic research towards applied research and innovation in response to market demand.

Innovation.bg puts an emphasis on the **capacity of the national economy to absorb and diffuse foreign innovation and investment in new technologies**. This should gradually lead to an increase in demand and the emergence of domestic capacity for innovation, technological development and scientific breakthroughs. The report takes into consideration not only narrow technological innovation (defined as the creation and diffusion of technologically new products and services in the economy) but also innovation of a non-technological nature (i.e. changes in the production organization, and the methods and processes of marketing and distribution of products and services).

Innovation.bg studies **three key components for the development of the national innovation economy** by: 1) making a short review of the country's current level of economic development and the capital and technological intensity of its economy; 2) describing the existing institutional and organizational structure of the national innovation system and the market environment in which it functions and 3) analyzing the current status and opportunities for development of the national innovation system on the basis of **five groups of indicators**:

[2] Baumol, W. J., The Free Market Innovation Machine: Analyzing the Growth Miracle of Capitalism, Princeton University Press (2002).

[3] According to the classification of the World Bank.

- gross innovation product;
- entrepreneurship and innovation networks;
- investment and financing of innovation;
- human capital for innovation;
- information and communication technologies (ICT).

The chosen grouping of the indicators is based on European and international experience with similar assessments. It aims at reflecting as objectively as possible the status of the innovation system and of separate groups of factors which influence its operation. Each indicator had to satisfy several criteria: to allow comparison to EU and OECD countries; to be easily understandable; and to measure phenomena which are important to the business and the population. Methodologically the report is based on several existing models for measuring and comparing the performance of innovation systems: 1) The European Innovation Scoreboard; 2) The OECD Science, Technology and Industry Scoreboard; 3) the US National Innovation Initiative, and 4) Index of the Massachusetts Innovation Economy.

Innovation.bg continues in the area of innovation a tradition set by ARC Fund's *e-Bulgaria* report which makes an annual review and assessment of the country's achievements towards becoming an information society. Following the current more detailed edition, *Innovation.bg* aims at providing an objective, concise, annual assessment of Bulgaria's progress in the area of innovation. It will contain more specific public and private policy recommendations for improving the innovation performance.

The structure of the report was presented for discussion to participants at the First National Innovation Forum in 2004 and was published in the *Vesti* bulletin of the Innovation Relay Centre – Bulgaria. The views of experts from the public administration, the private sector and the academic community were reflected, and the adopted methodology was approved by ARC Fund's Expert Council on Innovation.

The Bulgarian Economy – It is Innovation Time

Worldwide, competitiveness is increasingly based on investment in new technologies and innovation. The level of economic development of a country sets the framework, characteristics and development potential of the national innovation system.

Bulgaria reached a stage of economic development that requires a change in the public innovation policy. The economic necessity and prerequisites for such a changes already exist. Following the long transition recession in the beginning of the 1990s and the financial and economic crisis of 1996-1997, the Bulgarian economy marked eight consecutive years of economic growth. The average annual growth rate of the economy during the last five years reached 5%. The main factors behind Bulgaria's recent economic success have been: macroeconomic stability imposed by a currency board arrangement; reduced foreign debt level and improved access to cheaper debt resources from international markets; accomplished structural and institutional reforms underpinned by the requirements for the country's EU accession; and improved investment climate and access of companies to bank credit. As a result, the share of GDP invested in fixed capital formation in the last five years increased by more than 33%. Despite this economic revival, Bulgaria lags significantly behind the average EU level on most indicators, e.g. annual per capita income, investment growth, employment, etc.

Bulgaria will be one of the EU countries with the lowest standard of living[4] at the moment of accession in 2007. According to Eurostat forecasts at the end of 2006 the level of per capita GDP in Bulgaria will be twice as low as that in the new EU member states. It appears that the main challenge Bulgaria faces in the mid term is sustaining high economic growth through discovering new sources of competitive advantage.

To a great extent Bulgaria's economic growth during the last several years is due to increased effectiveness of the utilization of available economic resources as a result of privatization and liberalization. However, this alone cannot provide long-term competitive advantages for the economy. Internationally more countries than ever before offer stable macroeconomic environment, good investment climate, low taxes and labor costs, good public administrative services, open economy, dynamic domestic private sector, stable public finances, and high degree of economic freedom. Under these circumstances international competition shifts increasingly to high-tech industries and replies on innovation capacity. Bulgaria lags behind this trend. The main competitive advantage Bulgaria boasts on remains low cost of labor. However, such a comparative advantage is strongly vulnerable. It is characteristic of labor intensive industries, which face mounting competitive pressure from low cost East Asia. The looming trade and current account deficit on the Bulgarian balance of payments shows that competitive advantages based on low cost labor are wearing out. **The level of technological development and its change in time[5] are crucial for the country's transition to new sources of competitive power and growth.** Bulgaria, like the new EU member states from Eastern Europe, needs to re-direct its economy towards higher value added products through technological upgrade and innovation.

The locomotives of Bulgaria's economic growth during recent years have been **manufacturing, finance and communications**. They have grown faster in value added than the economy as a whole.

To a great extent growth in manufacturing powered by the information and communication technologies industry, the financial sector and the business services **determine Bulgaria's long-term technological progress**. The recovery and growth dynamics in manufacturing have been the basis for Bulgarian export growth of recent years. Manufacturing is most strongly exposed to international competition, and together with the tradable services sector, e.g. financial services and tourism, it is the point of entry for new foreign technologies and innovation.

Output and employment in Bulgarian manufacturing are dominated by low- and medium-tech industries.

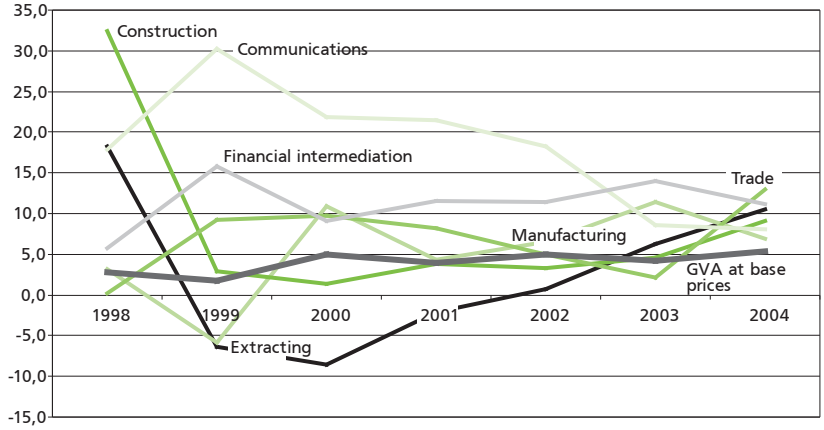
[4] Measured by per capita GDP at purchasing power parity.

[5] The World Bank, Economic Growth in the 1990s: Learning from a Decade of Reform (2005).

Bulgarian competitiveness is based on low cost homogeneous, labor- and raw material-intensive products[6]. Bulgarian industry creates low-paying, low-quality jobs. Comparative research on Central and Eastern European economies' progress towards higher value added goods by industries and products, reveals that in contrast to the rest of the region, Bulgaria and Romania face a real danger of falling into the so called **low technology trap**[7].

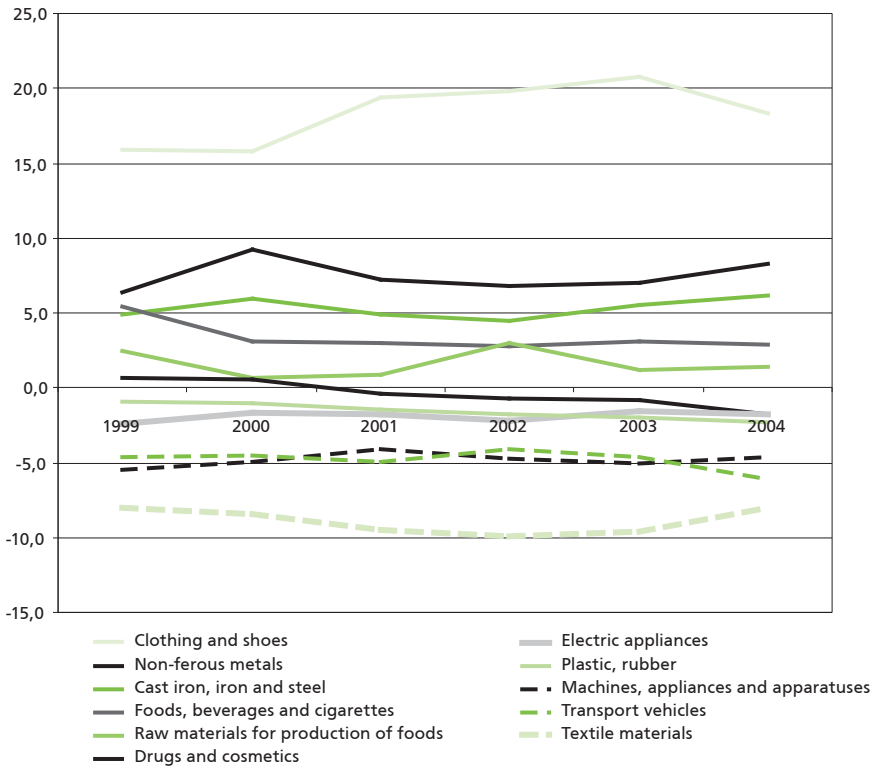
The low technology profile of the Bulgarian economy is also clearly visible in its revealed comparative advantages. They are most pronounced in clothes and shoes manufacturing, and black and non-ferrous metals, which form approximately 40% of the country's total export. Respectively, they are weakest In textile materials, machine building, appliances and apparatus manufacturing, and plastic and rubber, which form 33% of the country's import. **Practically there have been no significant changes in the country's revealed comparative advantages since 1992**[8]. Preserving the current structure and dynamics of technological intensity of the economy means low cost based competitiveness, fast depletion of the country's potential for growth and a gradual erosion of the available human capital. Avoiding the low-technology trap requires the development of a flexible and open national innovation system within the framework of a competitive market economy. Such an innovation system will provide for:
1) an influx and wide diffusion of foreign innovation in the country and 2) a gradual development of indigenous innovation capacity of European and global quality.

Figure 1: GROSS VALUE ADDED GROWTH RATES



Source: NSI.

Figure 2: REVEALED COMPERATIVE ADVANTAGES[9] IN BULGARIAN IMPORTS AND EXPORTS (1999 – 2004)



Source: BNB and Applied Research and Communications Fund

[6] See Pashev, K., Competitiveness of the Bulgarian Economy, Discussion Paper 34/2003, Bulgarian National Bank (2003).

[7] Dulleck, U., N. Foster, R. Stehrer and J. Woerz, Dimensions of Quality Upgrading in CEECs, Working Papers No. 29, WIIW (2004).

[8] See Bulgaria 1999, Economic surveys, OECD.

[9] Revealed comparative advantages are measured as the difference between the export share of a product group in total country export and the import share of the same product group in total country import (Xi/X – Mi/M).

Business Environment for Innovation

A friendly business climate for innovation is a fundamental prerequisite for the development of a knowledge based economy. Particularly important in this respect are the level of openness of the economy, competition policy and intellectual property rights protection. A well functioning market economy, based on the rule of law and effective enforcement of private property rights, is the foremost condition for the development of an innovation and technology market.

The level of openness of the economy is a fundamental factor for technology demand and supply. Under clear and transparent rules international competition encourages innovation and creativity in enterprises, boosts the search for new competitive advantages, stimulates improvement in product and process efficiency (including through innovation) and intensifies international partnerships for product development. Economies with higher degree of openness are also characterized by higher levels of innovation activity[10].

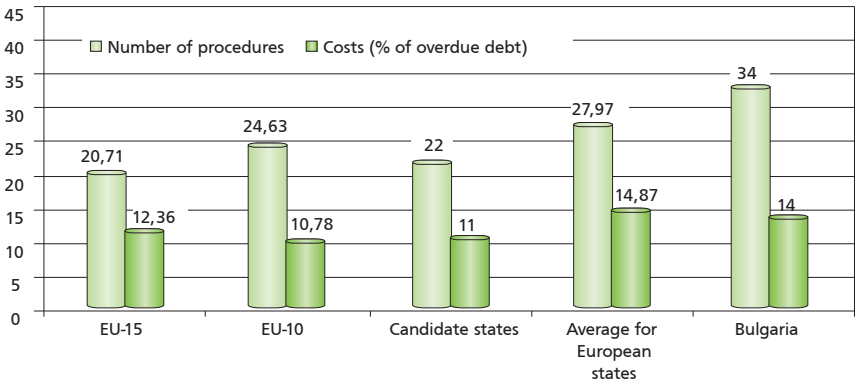
A broader and more comprehensive factor for innovation is **economic freedom.** According to the Heritage Foundation economic freedom includes openness but also corruption and black market levels, non-tariff barriers to trade, fiscal burden, the rule of law, regulatory burden, restrictions to financing, labor market regulations, etc.

According to Heritage Foundation's *Index of Economic Freedom 2005*, Bulgaria has improved its economic freedom by 0.24 points (only three countries have experienced faster growth – Madagascar, the Ukraine and Poland). Bulgaria has registered a significant improvement in its ranking during the last three years (similar to the worldwide trend after 2002) and according to the latest figures **it has entered the group of predominantly free economies** (place 52 of 155 countries).

Despite this significant improvement in the level of economic freedom in Bulgaria, companies still face considerable problems related to inefficiencies and slow reform in the judiciary and public service delivery[11]. The time companies spend interacting with the public administration is high and hinders entrepreneurship and investment. The *Law on Restricting the Administrative Regulation and Administrative Control on Economic Activity*[12], adopted on June 4th, 2003 (in force since December 2003), did not achieve the expected reduction of the regulatory burden in Bulgaria. There is a necessity of greater knowledge and understanding of the Law among the business community.

Bulgaria lags significantly behind most European countries in contract enforcement, e.g. it takes on average

Figure 3: NUMBER OF PROCEDURES AND COSTS (% OF OVERDUE DEBT) FOR ENFORCING CONTRACTS IN BULGARIA AND SELECTED GROUPS OF COUNTRIES IN 2005



Note: Due to lack of data, Cyprus, Luxemburg and Malta are not included in the calculations; Averages for European groups include Albania, Macedonia, Bosnia and Herzegovina.

Source: Doing Business in 2005, Removing Obstacles to Growth, World Bank.

[10] Global Competitiveness Report 2004 – 2005, World Economic Forum, 2005.

[11] For example, Bulgaria is one of the few countries in Eastern Europe that has not yet introduced a central electronic registry system of legal entities. The registration of companies is still performed by the 28 district courts with no connection among them and no central information exchange database. A positive step in this respect was the adoption in 2005 by the Bulgarian Council of Ministers of the *Strategy for Establishing a Central Register of the Legal Persons and an Electronic Registries Center in Bulgaria* (For more information please refer to the Report of the Working Group on the Register Reform at the Center for the Study of Democracy, C, 2004.). In compliance with the strategy a *Draft Law on the Commercial Register* was developed by an expert task force with the Ministry of Justice and submitted to the Council of Ministers. A positive, though small, step forward towards reducing the level of bureaucratic obstacles for starting a business in Bulgaria was the adoption in August 2005 of the new Law on BULSTAT Register, which united the business identification numbers issued before that by the National Statistical Institute, the tax administration and the National Social Security Institute.

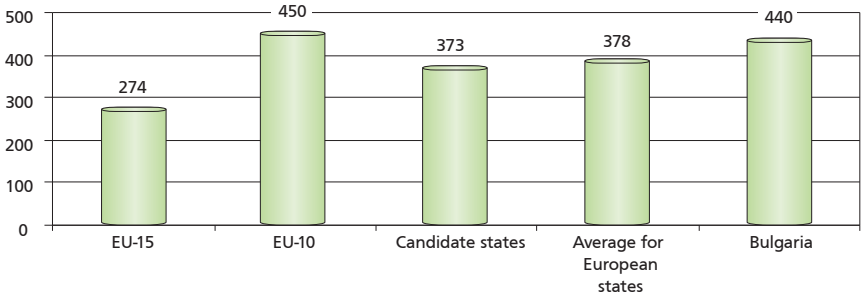
[12] Promulgated, State Gazette (SG) issue 55 of 17 June 2003 – in force as of 17 December 2003; amended SG issue 59 and 107/2003, 39 and 52/2004, 31/2005.

440 days in this country compared to 48 days in the Netherlands. This additionally decreases business confidence and reduces innovation performance.

Innovation activity in enterprises is also affected by the **level and quality of market competition**. It defines the entrepreneurial behavior and the choice between productive innovation and innovative rent-seeking. Competition drives new products, services and processes' development, their more effective usage, adaptation and diffusion. While the level of competition determines companies' intensity of innovation activities and demand for new technologies, the protection of property rights, which guarantees the return on R&D investment, moves the supply of new technologies and investment in their development.

According to the Index of Economic Freedom of the Heritage Foundation, **the legal protection of property rights in Bulgaria is the weakest spot in its economic environment**. The country is known for a significant share of grey economy and unfair competition, and a relatively poor enforcement of competition laws. This leads to legal uncertainty, high managerial time costs on non-business activities and corruption. At the end of the day the main goal of the competition policy reform in Bulgaria (which is a major part of its EU accession process), is the establishment of a favorable legal environment and functioning public institutions that assist enterprises in adapting to the changes and competition of the European Internal Market. Despite the fact that law enforcement remains relatively poor, Bulgaria has achieved significant progress in the harmonization of its legislation with the current European legal norms. The main legislative pieces of the harmonization process have been: the *Law on Protection of*

Figure 4: TIME (DAYS) FOR ENFORCING CONTRACTS IN BULGARIA AND SELECTED GROUPS OF COUNTRIES IN 2005



Note: Please refer to the previous Figure.

Sourse: Doing Business in 2005, Removing Obstacles to Growth, World Bank.

Figure 5: LEVEL OF LOCAL COMPETITION

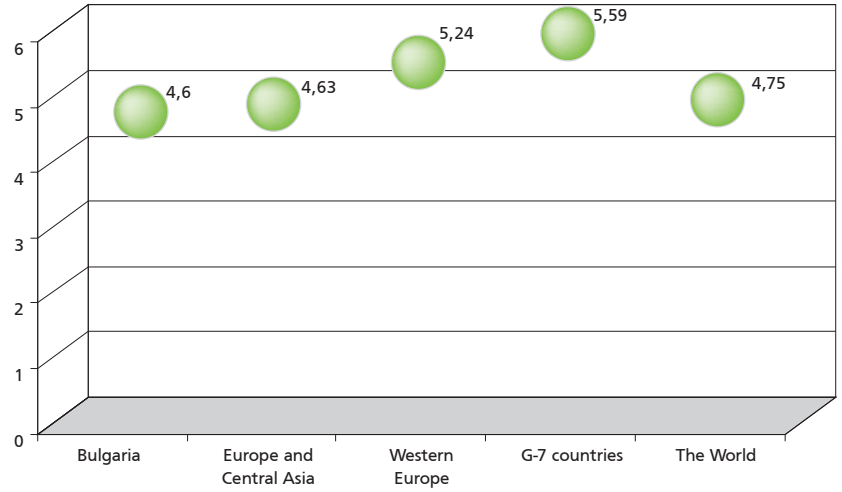
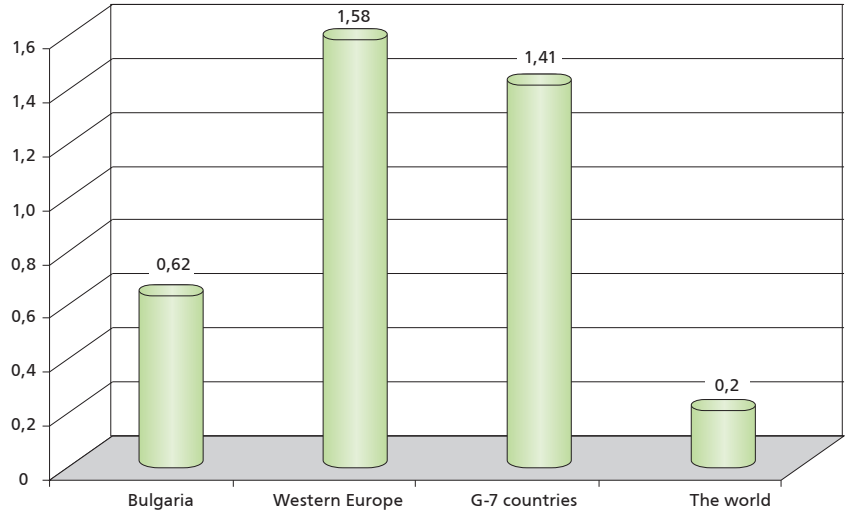


Figure 6: QUALITY OF REGULATION



Note: 2003/4 WEF Global Competitiveness Report, scale from1 to 7 (1 = limited local competition, 7 = intensive local competition, market leadership changes in time); In 2002 Kaufmann, Kraay, Zoido-Lobaton, World Bank, assessed the occurrence of market unfriendly policies, such as price controls, inadequate bank supervision and regulatory weight in international trade and business development.

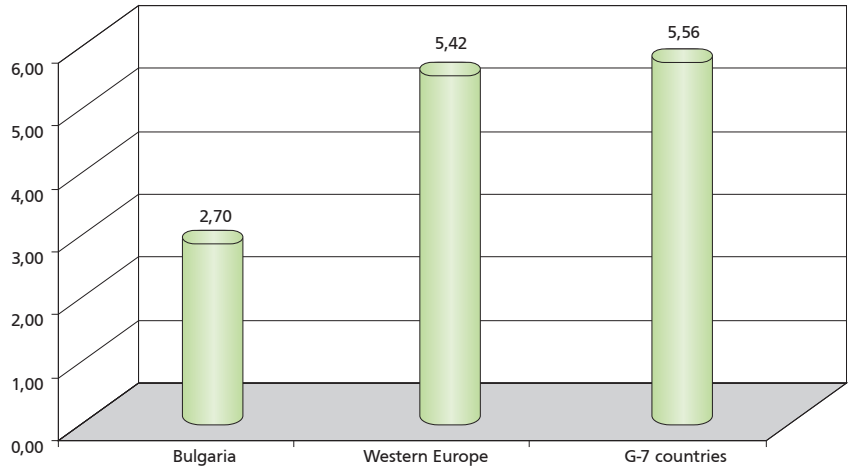
Source: The World Bank, Knowledge Assessment Methodology, KAM 2005

Competition[13] (May 1998); the *Law on State Aid*[14] and the *Law on Public Procurement*[15]. They affect companies' decisions on developing and/or introducing new technologies, and on the share of revenues to be allocated to R&D.

Of foremost importance to the innovation environment in Bulgaria, however, is the protection of **intellectual property rights**, which is a fundamental stimulus for innovation. Due to the public character of knowledge and innovation, without strong protection from illegal copying of innovative goods, inventors would not receive the necessary return on their investment in R&D. Companies, which invest in the protection of their intellectual property rights, are the ones most able to transform ideas into marketable products and to increase their competitiveness. Currently the protection of intellectual property rights in Bulgaria is legally well regulated[16] but actual enforcement of the law remains unsatisfactory.

Software piracy is a significant problem in Bulgaria. According to Business Software Alliance (BSA) (www.bsa.org) the level of software piracy in 2003 was 71%. Bulgaria was placed 22nd among the countries with the highest level of piracy in the First Annual Global Software Piracy Study (2004). There has been modest improvement in this relation during recent years as a result of increased incomes and measures taken by the government. According to the same BSA dataset, the level of piracy in 1994 was 94%.

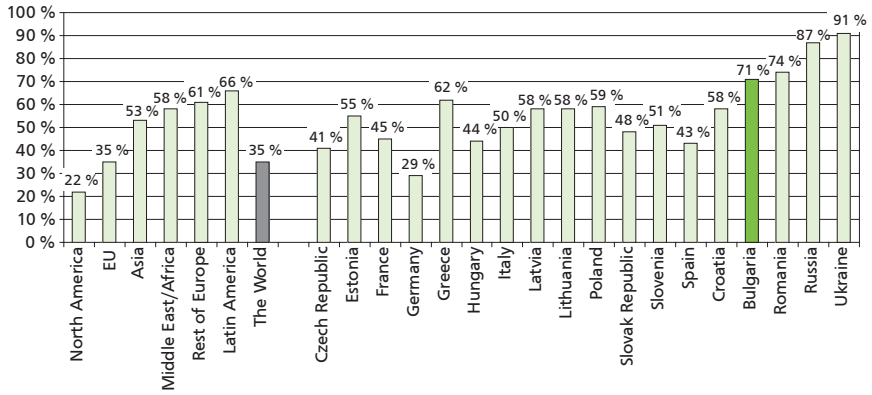
Figure 7: PROTECTION OF INTELLECTUAL PROPERTY RIGHTS INDEX



Note: 2003/4 WEF Global Competitiveness Report.
0 – min., 7 – max.

Source: The World Bank, Knowledge Assessment Methodology, KAM 2005

Figure 8: LEVELS OF SOFTWARE PIRACY, 2004



Source: Second Annual Business Software Alliance (BSA) and IDC Global Software Piracy Study, http://www.bsa.org/globalstudy/

The improvement of legal regulation[17] in the area of software protection (as part of the efforts of the Government of Bulgaria to be removed from the black USA Watch List) should be accompanied with adequate strengthening of law enforcement as well as with higher transparency regarding enforcement measures and imposed penalties.

[13] Promulgated in SG issue 52 of 8 May 1998; amended in SG issue 112 of 29 September 1998, issue 81 of 14 September 1999, issue 28 of 19 March 2002, issue 9 of 31 January 2003, issue 107 of 9 September 2003

[14] Promulgated in SG issue 28 of 19 March 2002, in force as of 20 June 2002

[15] Promulgated in SG issue 28 of 06 April 2004, in force as of 01 October 2004; amended and supplemented in issue 53 of 22 June 2004 – in force as of 01 October 2004, amended in issue 34/2005

[16] Intellectual property rights legislation comprises: the *Law on Copyright and Neighbouring Rights* of 1998, last amended in SG issue 28 and issue 43/2005 and the *Law on Patents* of 2 April 1993, last supplemented in SG issue 17 of 21 February 2003. In addition, Bulgarian property rights legislation includes: the *Law on Industrial Design*, the *Law on Topography of Integrated Circuits*, the *Law on Biological Diversity*, the *Law on Trademarks and Geographical Indications*.

[17] A bill No 402-01-1/12.01.2004 for the administrative regulation of the manufacturing and trade with optical discs, matrixes and other data storage devices, containing objects of copyright and its neighboring rights was adopted on 21 April 2005. The bill lists the regimes of the Council of Ministers Decision No 87/96 for control over the usage of objects of copyright and its neighboring rights, licensing of CD manufacturers and the manufacturers of matrixes (stampers) for production of CDs (published in SG issue 35 of 1996, amended and supplemented in issue 34 of 1997, issue 14 and 86 of 1998).

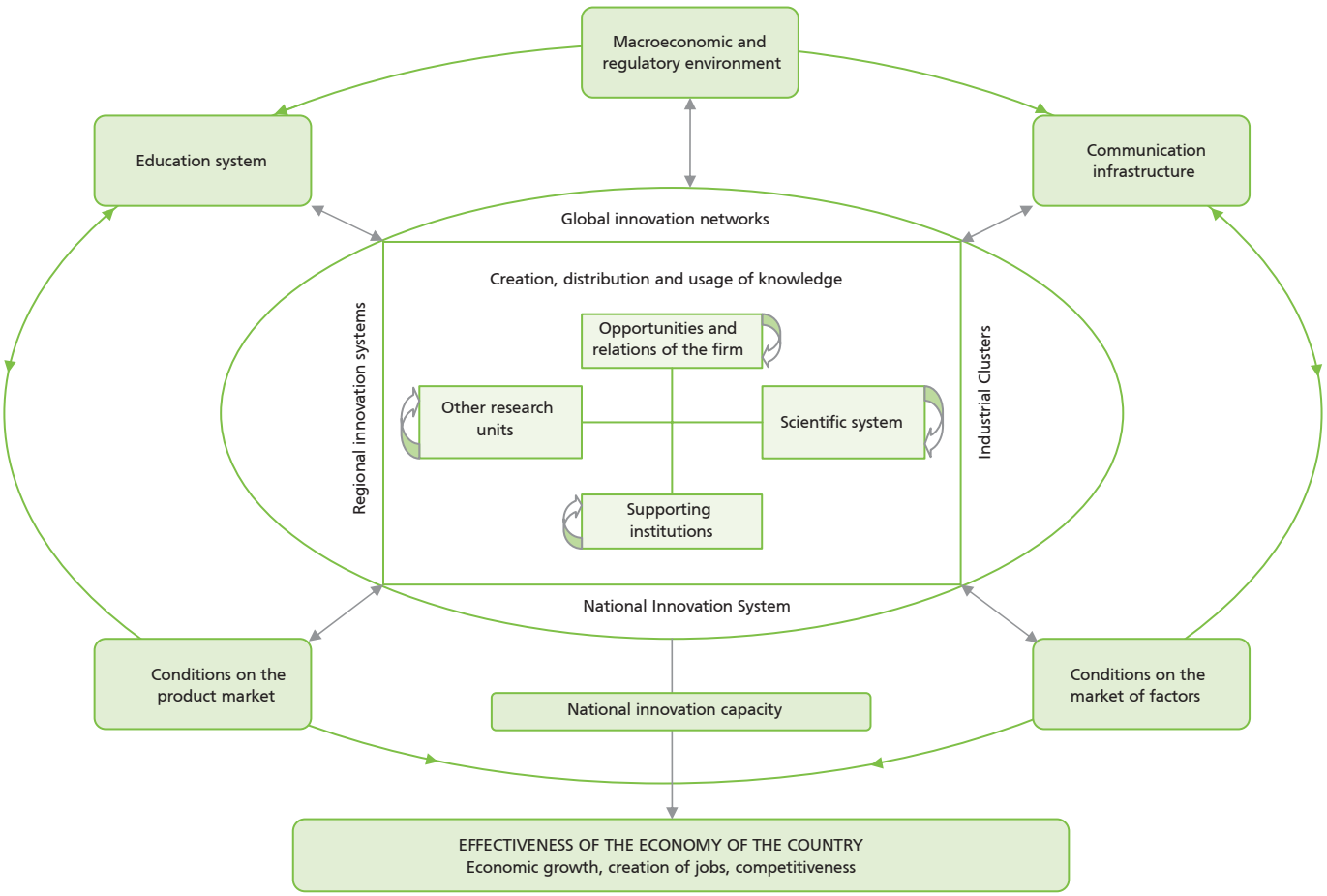
Institutional Framework of the National Innovation System

The institutional framework of the national innovation system includes the legal norms and regulations, as well as the private, public and state organizations, which shape and influence the innovation process in Bulgaria. The institutional structure of the innovation system directly affects its effectiveness and productivity. In their essence, institutions are inert systems, which are strongly path-dependent. Their change is both a means and an indication for the development of the national innovation system, its productivity and competitiveness.

Under central planning, the institutions of the Bulgarian national innovation system included R&D units at large production conglomerates, academic institutions and their own small enterprises and the state sponsored scientific and technical intelligence agency. The system ensured the country's specialization in narrow areas of fundamental science and in reverse engineering in certain industries, e.g. electronics. It concentrated significant human and financial R&D resources and produced a fairly large volume of scientific and technological production although with limited market value.

Under the pressure of structural changes in the Bulgarian economy during the past 15 years **the organizational and institutional structure of the innovation system lost touch with market reality**. The reform of the inherited state innovation system was partial and without strategic vision. As a result of poor

Figure 9: MODEL NATIONAL INNOVATION SYSTEM: PARTICIPANTS AND LINKS



Source: OECD (1998): Technology, productivity and job creation. Best policy practices. OECD, Paris, p. 62.

policy decisions and the transitional recession most R&D units at state-owned enterprises were closed down, the average size of the enterprises dropped significantly, and the financing for academic institutions was reduced to overhead costs and minimal wages coverage. Changing market conditions and enterprise strategies led to a cut in reverse-engineering-driven demand for R&D and to a break in business – science links.

The main outstanding reform challenge for the institutions and the structure of the Bulgarian national innovation system, is the faster refocusing of the activities of private, public and state R&D organizations towards servicing the needs of the enterprises for higher competitiveness. **Innovation will have to gradually displace low labor costs as the prime source of competitive advantage in Bulgaria.** This requires a more effective cooperation between science and business. Cooperation opportunities can and should be improved by a change in the mechanisms of public R&D financing and by the introduction of a new system of organization and management of the state and public R&D organizations.

Legislative Framework for Science, Technology and Innovation

The Bulgarian legislation on innovation has changed considerably over the last 15 years. As of 2005, it possesses all attributes necessary for the operation of a contemporary innovation system, although a great part of the legislation remains fragmentary and is the result of external pressure rather than purposeful, needs driven policy. There are also cases of outdated laws that still regulate aspects of the national innovation system activity. They have remained in force in spite of their obvious anachronism due to the lack of clear innovation policy priorities and strong vested interests for keeping the status quo within the system. The *Law on Academic Degrees and Academic Ranks*, which regulates the professional careers and promotion of scientists in Bulgaria, dates back from the 1970s. The push for harmonization of national legislation with EU regulations has been the main driving factor behind recent legislative changes and reforms in Bulgaria. This process has intensified after 1999 when the country was invited to start negotiations for EU accession. To this period we can trace back some notable legislative acts:

- the adoption of *the Law on Small and Medium-Sized Enterprises* (1999);
- the drafting of *the Law on Scientific Research Promotion* (adopted in 2003);
- the issuance of Government decrees regulating the Bulgarian participation in the EU's Fifth Framework Programme for Science Technology and Innovation (1999) and in CERN (the European Organisation for Nuclear Research); the establishment of the National Centre for Agrarian Sciences (NCAS – 1999), etc.

Table 1: SELECTED LAWS REGULATING THE SCIENTIFIC, TECHNOLOGICAL AND INNOVATION ACTIVITY IN BULGARIA

Law	Year of Adoption
Law on Academic Degrees and Academic Ranks	1972
Law on the Bulgarian Academy of Sciences	1991
Law on Patents	1993
Law on Copyright and Neighbouring Rights	1993
Law on Higher Education	1995
Law on Protection of New Plant Varieties and Animal Breeds	1996
Law on Investment Promotion	1997
Law on Protection of Competition	1998
Law on Small and Medium-Sized Enterprises	1999
Law on Industrial Designs	1999
Law on the National Centre for Agrarian Sciences	1999
Law on Trade Marks and Geographical Indications	1999
Law on Topographies of Integrated Circuits	1999
Law on Electronic Document and Electronic Signature	2001
Law on Scientific Research Promotion	2003
Law on Genetically Modified Organisms	2005

Table 2: PRINCIPAL ACTIONS FORESEEN BY THE NATIONAL INNOVATION STRATEGY FOR 2005

Action	Expected Results	Beneficiary	Start	Responsible Agency
1. Establishment of the National Innovation Fund	Financing of market orientated innovation projects	All prospective innovative firms	2005	Ministry of Economy and Energy (MEE)
2. Encouraging employment of young specialists in small and medium-sized enterprises	Accomplished employment opportunities for young highly qualified specialists in SME	SMEs and young specialists with high qualification	2005	MEE, Ministry of Labour and Social Policy (MLSP)
3. Establishment and/or expansion of technological centres	Increased opportunities for utilizing scientific results by the business	Scientific organizations and small technologically intensive firms, which cannot sustain their own R&D divisions	2005	MEE, MLSP, Bulgarian Academy of Sciences, National Centre for Agrarian Sciences, research divisions at universities

However, the overall quality of laws and especially their enforcement lag behind the level of development of the of the economy and hold back innovation activity.

The main policy documents which define the framework of public innovation policy in Bulgaria are:

- *The National Innovation Strategy* (2004);
- *The National Strategy for Science, Research and Development* (2005).

The National Innovation Strategy (2004) aims at raising the competitiveness of the Bulgarian economy and was adopted in support of the ***National Development Plan of the Republic of Bulgaria*** in the period 2000 – 2006. Most of the actions in the strategy have been borrowed from existing programs, which requires improvement in the coordination between the different public bodies responsible for its implementation. The main novelty introduced by the strategy is the establishment of the **National Innovation Fund (NIF)**, which task is to finance market orientated R&D for enterprises. NIF along with the existing **National Science Fund (NSF)** at the Ministry of

Table 3: PROJECT GRANT APPLICATIONS AT THE NATIONAL INNOVATION FUND (SPRING SESSION MARCH 15TH– MAY 5TH, 2005)

Total number of project applications	*115*
Research projects	*107*
Projects on techno-economic feasibility studies	*8*
Approved projects	*39*
Total worth of all projects:	*25 000 000 EUR*
Total subsidy requested by all projects:	*12 000 000 EUR*
Granted financing:	*2 900 000 EUR*

1. In 51 projects (44 % of all projects submitted) companies cooperate with scientific organizations and universities.
2. Companies will co-finance 51 % of all project expenses.

Submitted projects by sector	
Machine and equipment building	34
Information and communication technologies	14
Chemical industry	10
Biotechnology	8
Food industry	2
Energy (alternative energy sources, energy saving technologies)	10
Construction	10
Services	8
Environment	4
Other	15

Source: Bulgarian Small and Medium-sized Enterprises Promotion Agency

Education and Science (MES) have introduced competition in the procurement of public financing for innovation, which is an established practice in most developed market economies.

The upholding of sound market based competition in NIF's operation and the gradual shift of public financial resources for R&D away from direct budget subsidies towards competitive procurement mechanisms will be major indicators for the successful development of the national innovation system in the future. There is still no sufficient data for an objective assessment of NIF actions.

The National Strategy for Science, Research and Development[18] was developed according to the *Law on Science and Research Promotion* (2003) and is intended to closely correspond to the objectives and activities of the *National Innovation Strategy*. The strategy attempts to set the performance evaluation and targets against the achievements of leading OECD and EU countries. For the first time in Bulgaria the *National Strategy for Science, Research and Development* was published and discussed in the Internet which enabled interested parties to express their opinion. The slow-down in the Strategy's adoption by the Bulgarian Parliament however is a sign of existing inter-system opposition and/or lack of political will for the implementation of the foreseen actions. This delay may have long-term negative impact on fledgling reform attempts.

It would have been possible and certainly desirable to achieve higher degree of coordination between the objectives and activities of the *National Innovation Strategy* and *the National Strategy for Science, Research and Development* or even merge the two strategies into one strategy for science, technology development and innovation (as has been recommended by the European Commission (EC)). However, **it is currently more important to kick-start the actual implementation of the two strategies and to seek better coordination between their activities as they are implemented rather than try to perfect their texts.** This line of reasoning has been confirmed in a positive OECD assessment of the national education policy[19].

Bulgaria has begun elaborating **regional innovation strategies (RIS)**, an established European practice of strategic planning and development at local and regional level. RIS are public-private administrative capacity building mechanisms which expand the planning horizon and boost the innovation capacity at local and regional level. They are the first initiatives of this kind in Bulgaria which secure direct access of Bulgarian regions to European innovation policy and practice.

Other government documents, which have direct bearing on the functioning of the national innovation system and are based entirely or partially on the National Development Plan, are:

- *The National Strategy for Small and Medium-sized Enterprises Development and Promotion (2000 – 2006);*
- *The National Strategy for Life-Long Learning in Professional Education for the period 2005 – 2010;*

Box 1: REGIONAL INNOVATION STRATEGIES IN BULGARIA

The Bulgarian pilot ***Regional Innovation Strategy for South Central Region (SCR)***[20] was launched in October 2001 by a consortium led by the Applied Research and Communications Fund in cooperation with the Commission for Economic and Social Cohesion of the region, the Bulgarian Ministry of Regional Development and Public Works, tti Magdeburg GmbH private company from Germany and the Thessaly University of Greece.

The strategy rests on an analysis of the innovation needs of 400 enterprises from the ten leading industries of the SCR regional economy (agriculture, agro chemistry, food and beverage industry, machine building, electrical machinery and electronics, textile, wood and wood processing industry, furniture, tourism, leather and footwear industry, perfumes and cosmetics). It also incorporates a study on **the capacity of the main innovation suppliers** (scientific institutes and universities), as well as **intermediary organizations (**branch chambers, business associations, etc.).

As Bulgaria's RIS pioneer, the South Central region is uniquely placed to help the country's other regions develop their own plans to boost innovation. Indeed every Bulgarian region is now implementing RIS projects and tapping into South Central's experience and expertise. SCR is collaborating with the Ministry of Regional Development and Public Works and other bodies to establish a national network of Bulgarian RIS regions.

Source: Innovating Regions in Europe Newsletter, Issue 56, November – December 2005

[18] Adopted by a Council of Ministers Decision No. 450, 17.05.2005 but yet to be approved by the National Assembly.

[19] OECD, Review of National Policies for Education, Bulgaria: Science, Research and Technology, 2004.

[20] http://www.innovation.bg/

- *Human Resource Development Strategy (2000 – 2006);*
- *Information Society Development Strategy of the Republic of Bulgaria (1999);*
- *Strategy for the Establishment of Electronic Government (2002) and the Plan for its Implementation (2004);*
- *National Strategy and Action Plan for the Introduction of ICT in Bulgarian Schools (2005);*
- *Strategy and Action Plan for Bulgaria's Competitiveness on World ICT Markets (2004);*
- *National Strategy for Regional Development until 2015.*

The existence of numerous strategies with overlapping objectives, areas of action, tasks and instruments, which execution is coordinated by different public bodies; the insufficient financing and frequent delays in the approval of their action plans show a **lack of common priority** in national economic policy making. This leads to a dispersion of limited public and private resources. Undoubtedly, **innovation and the development of the national innovation system is a worthy focus** for these resources.

Organizational Structure of the National Innovation System

The lack of a clear strategy and political will for reforming the Bulgarian innovation system over the last 15 years led to a disruption in the activities of most of its divisions, accompanied by slow and painful structural changes. Thereby the contemporary innovation system of Bulgaria **is the result of partial reform and natural externally driven evolution.**

The Ministry of Economy and Energy and the Ministry of Education and Science are the main executive bodies of public innovation policy.

The **Ministry of Economy and Energy (MEE)** is responsible for the implementation of the public innovation policy concerning the business sector. MEE is the principal executive agency of the National Innovation Strategy adopted in 2004. MEE's Enterprise Policy Division and its two departments 'Promotion of SMEs and Entrepreneurship' and 'Business Environment and Innovation' attend to the daily management and implementation of public innovation policy. The National Innovation Strategy defined the establishment of the **National Innovation Council** as an advisory body to MEE, which consists of representatives of the business, scientific community, education and non-governmental organizations. The Bulgarian Small and Medium-Sized Enterprises Promotion Agency, an executive agency within the Ministry of Economy and Energy, runs the National Innovation Fund, the main financial instrument of the National Innovation Strategy.

The Ministry of Education and Science (MES) defines the national priorities in the field of education and science. MES coordinates the National Council for Science and Research, which comprises of representatives of government ministries and science organizations. **The Council of Rectors** (university presidents) and **the National Commission for Evaluation and Accreditation** (of academic achievements) coordinate science and research in Bulgarian higher education.

Different line ministries: Ministry of Defense, Ministry of Healthcare, Ministry of Regional Development and Public Works, Ministry of Labor and Social Policy, etc. define and implement science, research and development and innovation policy within specific industrial sectors and areas. **The successful development and implementation of public innovation policy requires close cooperation and coordination between MEE, MES and the Ministry of Finance**. They should jointly define the short and medium-term objectives for the accomplishment of the national innovation priorities.

Table 4: SECTORAL DYNAMICS OF R&D ORGANISATIONS IN BULGARIA DURING THE PERIOD 1994 – 2002

Sectors	1994	1995	1996	1997	1998	1999	2000	2001	2002
Enterprises	118	111	115	159	143	117	103	197	96
Government sector	227	219	228	208	207	222	207	163	159
Higher education	100	102	98	86	88	87	91	98	99
Non-profit organizations	5	4	33	5	9	10	9	9	7
Total	**450**	**436**	**474**	**458**	**447**	**436**	**410**	**377**	**361**

Source: National Statistical Institute.

The main elements of the national innovation system, which create and disseminate new knowledge, are the research and development and academic units. The Bulgarian Academy of Sciences, the National Centre for Agrarian Sciences and the Bulgarian universities are the most significant players amongst them.

In accordance with the *Law on the Bulgarian Academy of Sciences (LBAS)* adopted in 1991, the Academy is an autonomous scientific organization and national centre in the fields of fundamental and specialized applied research within mathematics, physics, chemistry and biology, as well as within technical, natural and social sciences and the humanities. During the early-reform attempts of the period 1991 – 1994, the number of scientific units at BAS was reduced by a third. Currently the Academy comprises 51 scientific institutes, one national and 12 regional laboratories, 8 research centers, 3 technical support facilities and 10 auxiliary units.

The **National Center for Agrarian Sciences (NCAS)** is part of the Ministry of Agriculture and Forestry and comprises 21 scientific institutes, 2 regional centers for applied scientific services, 1 center for scientific and technological information and 1 center for staff training. The NCAS system also includes 45 sites for experimental and production activity. The mission of the Centre as set by its management is to „restore the broken science – production – business – state link".

Almost all Bulgarian higher education institutions carry out science, research and development. The total number of universities in the country is 42, including six private universities. Industrial science is represented by 18 state institutes within different ministries and agencies. They carry out science and research projects serving specific needs of the respective state agencies and ministries in the fields of information technology, energy, international policy, environmental protection, security policy, culture.

The Bulgarian R&D system has a peculiar public sector dominated structure. According to latest available data (2002), 44% of Bulgarian R&D organizations operate in the public (budget) sector; 27,6 % – in the higher education sector; 26,5 % in the business enterprise sector and 1,9 % are non-profit organizations.

The state remains the biggest financial contributor to R&D organizations in Bulgaria. However, the lack of clear distinction between the functions and responsibilities of different state-sponsored R&D organizations coupled with their significant management autonomy has led to wasteful overlapping of activities at the taxpayers' expense and crowding out of private R&D investment. The scope of state subsidized R&D organizations seems beyond the reasonably efficient for the country's size and available resources. **Bulgarian budget financed R&D organizations should improve significantly their reporting practices, especially regarding the implementation of rigorous internationally recognized efficiency indicators such as attracted private financing per unit of budget subsidy, output per unit of financing, etc.**

There are a lot more organizations in the Bulgarian public sector, which have auxiliary or coordinating functions regarding innovation and related policies. The state financed part of the Bulgarian national innovation system preserved to a certain extent the country's scientific capabilities during the tumults of the transition period. The existing administrative experience and structures presuppose far better development opportunities for the currently underdeveloped private sector innovation infrastructure. To realize these opportunities, however, the country needs strong political will for refocusing the tasks and activities of the existing public and state R&D units towards the core objective of the innovation process – commercialization in the private sector.

Private sector innovation infrastructure in Bulgaria is rudimentary. The most prominent private initiatives in the Bulgarian innovation system are either privatized structures of the former state infrastructure or the result of innovative EU-financed projects. A number of private non-profit organizations, business innovation centers, incubators and high-tech parks play technology transfer and intermediary activities in Bulgaria's innovation system. The most important among them include **Bulgarian Industrial Association[21], Innovation Relay Centre – Bulgaria[22], International Association of Science-Technology Centers, National Intellectual Products Exchange – Union of Scientists in Bulgaria[23], Bulgarian Chamber of Commerce and Industry[24], Bulgarian Association of Regional Development Agencies[25].** The low level of cooperation between the state and the private innovation infrastructure

[21] www.bia-bg.com

[22] www.irc.bg

[23] http://www.usb-bg.org/Bg/NBorsa.htm

[24] www.bcci.bg

[25] www.barda.bg

is the main setback in the organization of the national innovation system. Government officials and the public administration still view private initiatives in the Bulgarian innovation system as rival to state efforts.

The brief review of the Bulgarian national innovation system reveals that it contains all public organizations characteristic of efficient innovation systems. The chief challenge Bulgaria faces in this respect is to reconnect public to private innovation efforts and institutions and to ensure their successful integration in the European innovation infrastructure so that there is an easy transition of responsibilities and activities from the public towards the private sector.

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Innovation fuels the impressive economic growth of developed market economies[26]. Similar to the other Central and Eastern European countries, the lack of free market institutions and the transition recession, resulted in a disruption of the links between the existing predominantly state-subsidized national innovation system and the emerging private sector in Bulgaria. Thus, a wide gap opened between falling domestic demand for local (nationally generated) innovation and the substantial accumulated physical and human capital in the national innovation system of the country during central planning[27]. Therefore, it is important that the Bulgarian innovation system and public innovation policy be directed towards the needs of the economy. The latter would determine the public and private resources to be invested in innovation.

There are no rules of thumb for successful development of an innovation economy. The examples of countries such as South Korea[28], Finland and to some extend Ireland, which have succeeded in catching up and joining „the innovators' club"[29], have outlined some similar patterns:

1) They began with active acquisition and adapting of knowledge, technology, and innovation from world innovation leaders. In the process they built up (i) adequate institutions and mechanisms for connection to the international innovation economy and (ii) capacity and abilities for acquiring and adapting knowledge;

[26] Baumol,W. J, The Free Market Innovation Machine: Analyzing the Growth Miracle of Capitalism, Princeton University Press, 2002

[27] Radosevic, S., Restructuring and Reintegration of Science and Technology Systems in Economies in Transition, Project Summary and Conclusions, University of Sussex (http://www.sussex.ac.uk/spru/1-4-6-1-2-2.html, last visited on Sep. 16th ,2005)

[28] Shahid, Y., Innovative East Asia: The Future of Growth, the World Bank (2003).

[29] The World Bank, Closing the Gap in Education and Technology, Latin America and Caribbean Studies (2003).

2) Next they climbed up the technological ladder towards acquiring and adapting more and more high-tech products and processes (edging towards the world technological frontier);

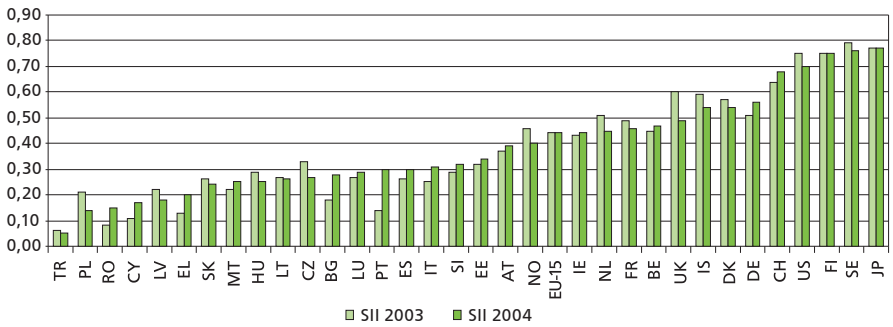
3) Finally they turned to the development of local capacity and national innovation system for creating indigenous innovation.

As a middle-income country Bulgaria should focus on more intensive import and adaptation of foreign innovation (both technological and non-technological), while trying to build up indigenous innovation potential[30]. Increasing Bulgarian competitiveness in the mid to long run would require better business environment to stimulate the development of new technologies both through increased innovation activity of companies and through closer alignment of the public R&D sector with market demand.

Generally, the performance of modern innovation systems is determined by the quantity and quality of human and physical capital inputs, which entrepreneurs and businesses turn into new products, technologies, and scientific achievements. The specific features of the Bulgarian innovation system outlined above demand that its analysis begins with the outputs, against which the use of existing resources and the need for investment are assessed. *Innovation.bg* presents the Bulgarian innovation system through the following five groups of indicators:

- **gross innovation product** – reviews the results of the national innovation system, the main innovation targets of the enterprises and the problems they face in their innovation activities;
- **entrepreneurship and innovation networks** – outlines the characteristics of two major sources of innovation in the Bulgarian economy – the setting up of new enterprises and the participation of Bulgarian producers in national and international value chains for the development of new products and services;
- **investment and financing of innovation** – examines the role of foreign direct investment and import of investment goods in the transfer of foreign technologies and knowledge; R&D investment and the existing instruments for financing innovation;
- **human capital for innovation** – describes the available human resources for the adoption of foreign and the creation of local innovation in the economy;

Figure 10: SUMMARY INNOVATION INDEX FOR 2003 AND 2004



Source: European Innovation Scoreboard 2003, 2004

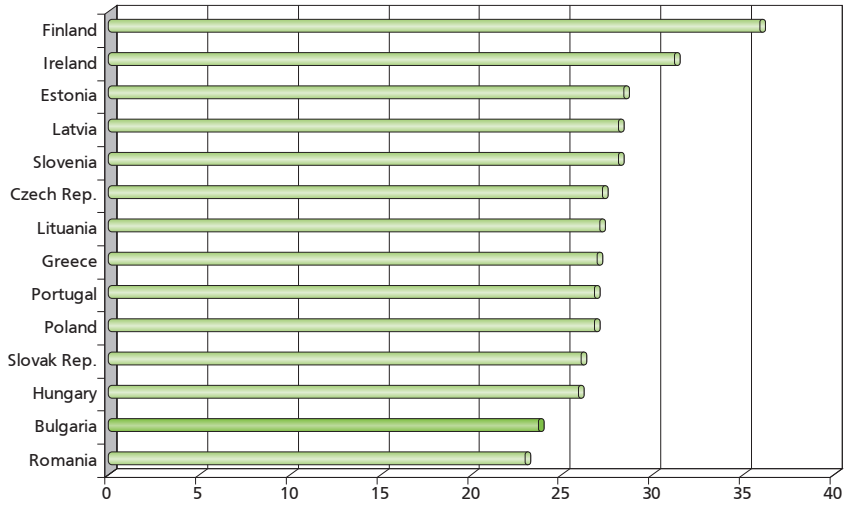
[30] Aubert, J.,-E, Promoting Innovations in Developing Countries, A Conceptual Framework, Policy Research Working Paper 3554, The World Bank, April 2005.

- **information and communication infrastructure** – analyses the current status and the level of utilization of the existing information and communication infrastructure.

Due to its specific history of central planning, non-technological, organizational, and/or marketing innovation is at least as important for Bulgaria's competitiveness as technological. Exactly non-technological innovation can improve the links between the Bulgarian R&D sector and the market. The latter is of primary importance for an economy that for a long time specialized in technology supply without caring for market and consumer value. *Innovation.bg* strives to reflect these country specifics wherever possible and appropriate although available systems for gathering internationally comparable data focus predominantly on technological innovation only.

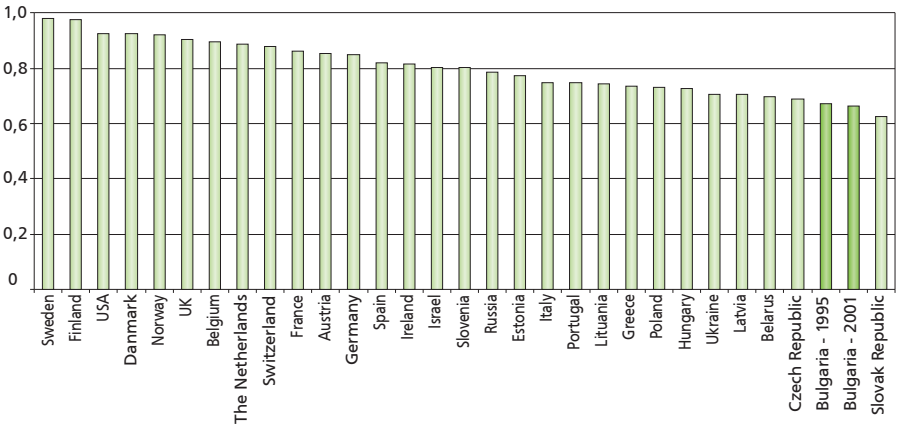
There are several international comparative assessments of the Bulgarian national innovation system that put in perspective the current detailed description of its functioning. The most popular among them are the Summary Innovation Index of the European innovation Scoreboard, the Business Competitiveness Index[31], and UNCTAD's Innovation Capabilities Index.

Figure 11: RANKING BULGARIA AND SELECTED EUROPEAN COUNTRIES ACCORDING TO THE INTERNATIONAL INDEX OF NATIONAL INNOVATION CAPACITY FOR 2003



Source: Porter M., Stern, S., Global Competitiveness Report 2004 – 2005, 2004.

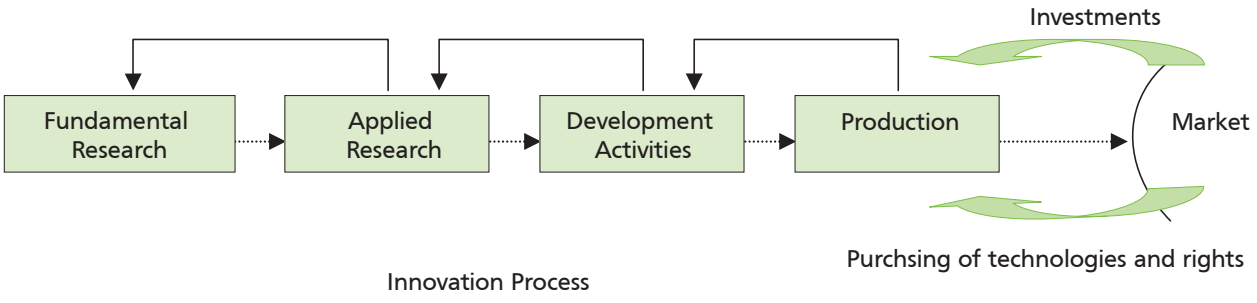
Figure 12: UNCTAD INNOVATION CAPABILITY INDEX (2001)



Note: The index ranks countries at three levels of innovation capability – high, medium and low. The figure represents only countries with high level of innovation capabilities. The combined index is an unweighted average of UNCTAD's Technological Activity Index and Human Capital Index.

Source: United Nations Conference on Trade and Development (UNCTAD), 2005.

Figure 13: THE INNOVATION PROCESS CYCLE



Source: Applied Research and Communications Fund

[31] By Michael Porter and Scott Stern, 2003

1. Gross Innovation Product

The gross innovation product represents the output of the national innovation system at each stage of the innovation process: science, technology, and innovation. The results and knowledge acquired at each stage can be used in the following stages and vice versa. The gross innovation product is an important reference point for the Bulgarian national innovation policy. It allows a comparison of the output of the national innovation system in time and geography and signals the need for change in the organizational and institutional structure and/or the amount of public and private resources invested in innovation.

The gross innovation product or the innovativeness of the economy comprises of the number of marketed innovative products and services, generated new technologies and new scientific discoveries. Although these three elements of the national innovation system can exist relatively independently in a certain country, their combined effect on competitiveness is the strongest when they interact. For example, the relatively high scientific and technological potential of Bulgaria during the period of central planning did not transform into high competitiveness, because of the lack of market incentives for innovation.

The measurement of national innovation output is difficult due to the lack of reliable indicators that cover the whole variety of innovation types in all industries: product innovation, process innovation, organizational innovation, and marketing innovation. Hence, most statistic observations of innovation focus on company level, on process and product technological innovation in manufacturing, construction, utilities and internationally tradable services[32].

[32] OECD, European Commission, Eurostat, Oslo Manual: Proposed Guidelines for Collecting and Interpreting Technological Innovation Data, OECD, 2002.

Innovation Product

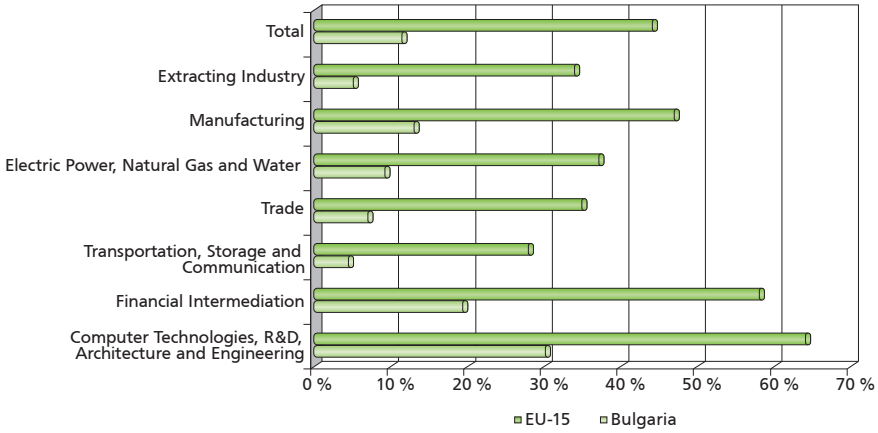
The innovation product includes the new and/or significantly improved goods and/or services, produced in Bulgaria, and introduced on the market, and the related improvements in the companies' organization and marketing. The innovation product is determined by the innovation activities of the enterprises and is of primary importance for the assessment of the functioning of the Bulgarian national innovation system. High-tech production and export is an important part of the country's innovation product that reveals the degree of technological intensity of the economy and its participation in international networks for higher value-added products and markets with substantial growth potential.

Innovative Enterprises and High-Tech Export

The increase in the number of innovative enterprises, which offer and/or introduce new products and/or processes on the market, and their integration into global high-tech production networks, is of utmost importance for the long-term competitiveness of the Bulgarian economy. For the period 1980 -2001 production in the high-tech industries of the world economy grew on average by 4% faster on a yearly basis than in the other industries[33].

The share of innovative enterprises in Bulgaria is approximately four times lower than in the EU. In 2003, only 1 in 10 Bulgarian companies with more than nine employees offered new products, introduced innovative processes, and/or started any kind of innovative activities. Although this data should be interpreted carefully because of its pilot character[35] and because most likely perceptions of what constitutes innovative activity differ in the EU and in Bulgaria, it seems to reflect the status and the capacity of the Bulgarian national innovation system quite fairly.

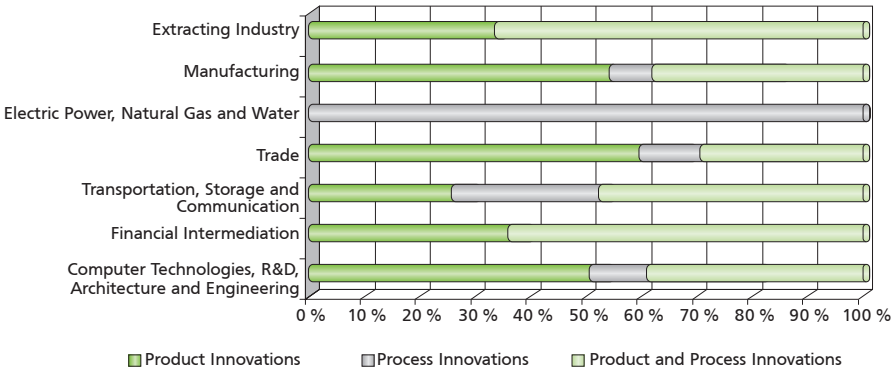
Figure 14: SHARE OF ENTERPRISES WITH INNOVATION ACTIVITY IN BULGARIA (2003) AND EU-15[34] (2000) BY TYPE OF ECONOMIC ACTIVITY



Note: The original nomenclature entries for economic activities were shortened for clarity.

Source: NSI, 2004, Eurostat, NewCronos 2001.

Figure 15: INNOVATIVE ENTERPRISES IN BULGARIA BY TYPES OF INNOVATION (2003)



Note: The original nomenclature entries for economic activities were shortened for clarity.

Source: Eurostat, NewCronos 2001.

[33] Science and Technology Indicators, 2004, National Science Foundation, 2004.

[34] All EC-15 data originating from Eurostat, NewCronos does not include the UK, Ireland and Luxemburg.

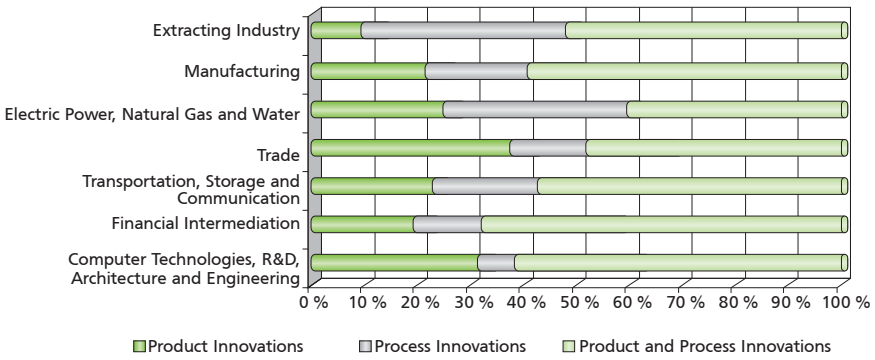
[35] In 2003, the Bulgarian National Statistical Institute surveyed Bulgarian companies' innovation performance using the EU's Community Innovation Survey (CIS) model. CIS was piloted in Bulgaria in 2002 by the sociological and marketing research agency Vitosha Research, which surveyed companies in the South-Central Planning Region of Bulgaria as part of the preparation of the region's innovation strategy. In the beginning of 2004 Vitosha Research repeated the study at national level. The more industries included in Vitosha Research'e pool of companies, compared to those of Eurostat and NSI, do not allow direct comparison between the results.

The Bulgarian population's low purchasing power and relatively conservative consumer behavior do not allow companies to experiment with new products on the market. Recently released Eurobarometer survey on population innovation readiness in the EU, has revealed that Bulgaria is one of the countries with the largest shares of the population that accept innovation reluctantly (28%) or directly reject it (20%)[36]. Thus, the main source of demand for innovative Bulgarian companies remains the foreign market and especially the EU market. However, in the EU indigenous producers have substantial competitive advantages over Bulgarian companies in satisfying the needs of their compatriots. Foreign investment in Bulgaria is an important channel for increasing local innovation capacity, as in the long run it transfers to local producers and consumers not only capital equipment and finance, but also tacit knowledge for the habits and demands of the European consumer.

Bulgarian services companies are on average more innovative than their counterparts from the other sectors of the economy. The available data refers only to internationally tradable services, though it probably holds true for the non-tradables as well. There are several reasons for higher innovation performance in services: (i) services are consumed at the moment of their production and their market value contains a significant element of local tacit knowledge; (ii) services were deliberately depressed in favor of industrial production during central planning and boomed in the transition period; (iii) service industries possess specific market features. For example, services in the fields of information technologies, R&D, architecture, engineering, consulting, and analyses, i.e. innovation services, are internationally tradable. That gives them access to larger international markets and better perspectives for development. At the same time, the biggest share of their costs is local knowledge paid for on the local market. The strategic importance of the Bulgarian banking sector as part of the common European banking market in the future led foreign (predominantly European) investors to acquire more than 80% of the sector's assets. Innovative products introduced by the new international owners of Bulgarian banks spread quickly as for most of them, like Internet banking for example, adding one more customer does not increase the bank's costs.

The relatively low innovation activity of enterprises in Bulgarian manufacturing is the result of the deep transition recession, which lasted until the late 90s and the inherited low-tech profile of its products. The full post-recession recovery and the upswing in the innovation activity of Bulgarian manufacturing enterprises accompanied by growth in telecommunications and information technologies would be the primary source of competitiveness in the Bulgarian economy in the next several years.

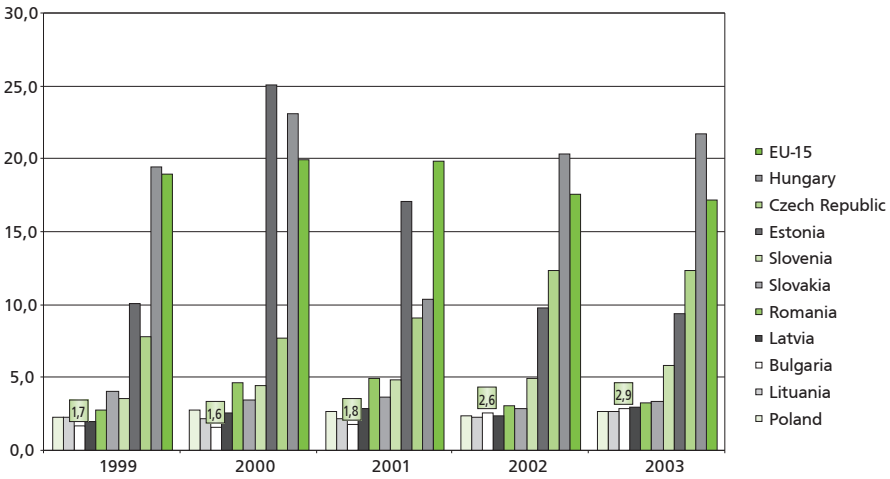
Figure 16: INNOVATIVE ENTERPRISES IN EU-15 BY TYPES OF INNOVATION (2000)



Note: The original nomenclature entries for economic activities were shortened for clarity.

Source: NSI 2004, Eurostat, NewCronos 2001.

Figure 17: EXPORT OF HIGH-TECH PRODUCTS AS A SHARE OF TOTAL EXPORT IN BULGARIA, ROMANIA, EU-8 AND EU-25 (1999-2003)



Source: Eurostat Comext, 2004, UN-Comtrade, 2004.

[36] Population Innovation Readiness, Special Eurobarometer, European Commission, August 2005.

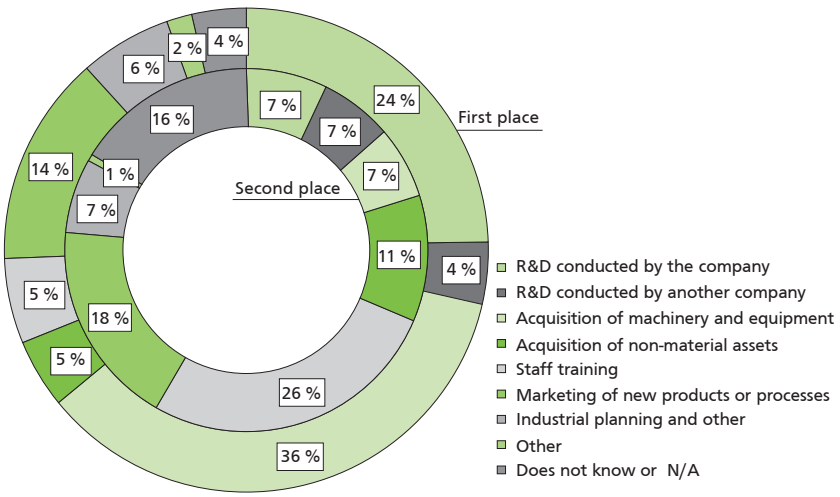
The present stage of economic maturity of Bulgaria influences the type of innovation offered by its enterprises. Innovative **Bulgarian companies introduce to the market predominantly new product innovation** in contrast to EU companies, which champion combined product/process innovation and/or process innovation only. Generally, product innovation refers to an earlier stage of market maturity and has lower return on capital compared to combined and process innovation. This suggests that Bulgarian products on average have lower market visibility and face stronger competition. Usually, innovative Bulgarian products are new only for the national market. Internationally, they are standard products produced at more competitive terms. A major field for Bulgarian innovative companies to explore in the future should be the adaptation of indigenous innovation to international market demand. For such strategies to succeed, Bulgarian companies need to increase significantly investment in quality standardization, direct marketing access to global customers, and participation in the production and innovation networks of multinational companies.

Currently, the Bulgarian economy has a low-tech production profile. The Bulgarian innovation system should be focused on supporting the faster shift of the national economy towards products and industries with higher value added and knowledge content. The share of high-tech products in Bulgarian export is low, though quickly rising. **A reasonable goal for the Bulgarian public economic and innovation policy would be to increase the share of high-tech export to above 20% in the next 5 – 7 years.** Attaining this target would require a significantly better business and innovation environment, friendlier investment climate, more and better innovation financing opportunities, highly developed ICT infrastructure and world class education system. High-tech industries would increase R&D investment and employment, providing more and better innovative products and processes. Bulgaria already has some positive experience in high-tech production in the chemical industry and some sectors with high FDI concentration (e.g. medicines, pesticides, agrochemicals, etc[37]).

The Innovation Activity of Bulgarian Enterprises – Specifics and Barriers to Development

In contemporary innovation economies, the competitive advantages of enterprises are built upon routine innovation through investment in R&D, and upon marketing aiming at differentiating the companies' products from those of competitors[38]. **The specific character and objectives of the innovation activities of the Bulgarian companies confirm the relatively early stage of market maturity of the country's innovation system.** Companies, which innovation activity is based primarily on buying new machines and equipment, i.e. investments in fixed capital, still dominate the Bulgarian economy. Only at second place, come Bulgarian companies, which innovation activities are based on R&D investment, marketing, and staff training. The main objectives of the innovation activities of Bulgarian companies, in contrast to their European counterparts, are increasing their market share or access to new markets, and achieving the necessary quality and ecological

Figure 18: WHAT DOES THE INNOVATION ACTIVITY OF BULGARIAN COMPANIES COMPRISE? (% OF INNOVATIVE COMPANIES)



Note: Surveyed companies were asked, „What would best describe the innovation activities of your company in 2003?" Respondents had to name the three items that best described their innovation activities. The figure represents the aggregated first two choices of the respondent companies.

Source: Vitosha Research, 2004.

[37] *Innovation.bg*, Index of the Bulgarian Innovation System, *Vesti* bulletin, 4/2004, Innovation Relay Centre (2004).

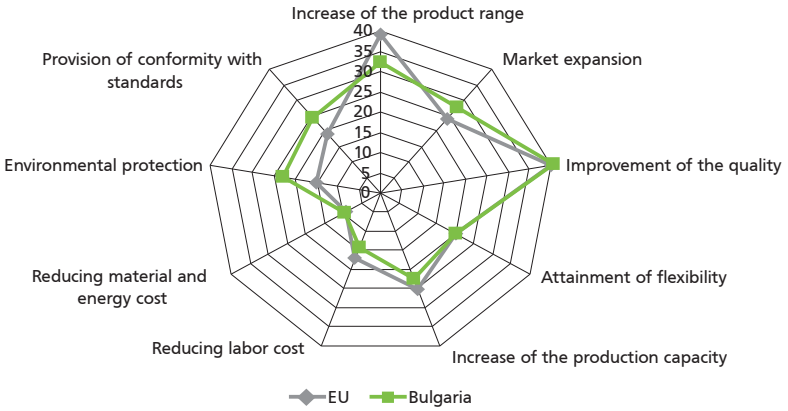
[38] Baumol, W. J, The Free Market Innovation Machine, Princeton University Press, 2002.

standards. Expanding their product range remains in the background for Bulgarian innovative enterprises, which supports the notion that **they still compete with homogeneous low cost products.** In the next couple of years, Bulgarian companies will be facing increasing competition from countries with abundant cheap labor (such as China and India, but also Turkey and the Ukraine). They will have to redirect their strategies towards competition based on differentiated products, more investment in R&D (or purchase of investment goods with higher R&D content), human capital and marketing while preserving the pace of investment in machinery and equipment.

The most significant barriers to their innovation activities pointed out by Bulgarian companies concern the general business environment rather than innovation specific issues. One in five Bulgarian innovative companies single out the lack of legislative flexibility as a problem to innovation activities, which is about two times higher than the EU-15 average. This problem should also be viewed in the light of the higher economic risk Bulgarian companies face and their poorer awareness about existing and potential markets than that of their EU counterparts. Therefore, **public policy efforts to improve the innovation environment should go together hand in hand with further enhancement of the investment and business climate.**

The most serious barrier to innovation in Bulgaria by far is the lack of appropriate financial sources and instruments for innovation. It is further exacerbated by the relatively bigger weight of innovation expenditures on Bulgarian companies compared to EU ones considering that on average they are much smaller both in assets and employment terms. **These are typical problems for companies in countries with younger market economies,** where risk capital is not

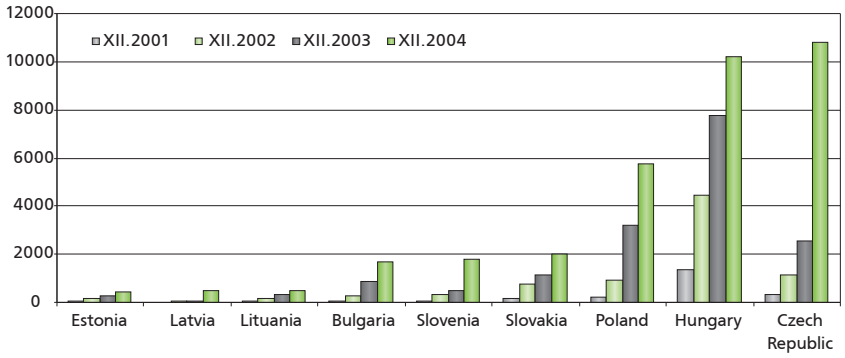
Figure 19: OBJECTIVES OF THE INNOVATION ACTIVITIES OF INNOVATIVE COMPANIES IN BULGARIA (2003) AND THE EU-15 (2000)



Note: Nomenclature names were shortened for clarity; companies have pointed out these answers as most important to their innovation activities; the total sum of the percentages may exceed 100, as companies have been able to choose more than one answer; the data includes only companies with more than nine employees.

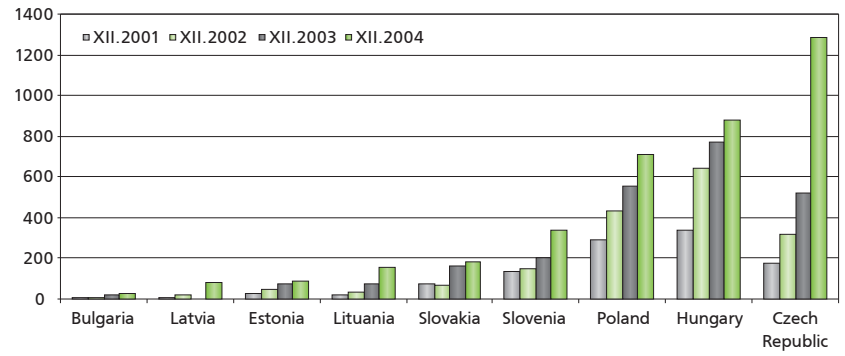
Source: NSI, 2004, Eurostat, NewCronos, 2001.

Figure 20: NUMBER OF CERTIFIED COMPANIES IN BULGARIA AND EU-8 BY ISO 9001:2000



Source: The ISO Survey – 2004, ISO Central Secretariat, 2005.

Figure 21: NUMBER OF CERTIFIED COMPANIES IN BULGARIA AND EU-8 BY ISO 14 001

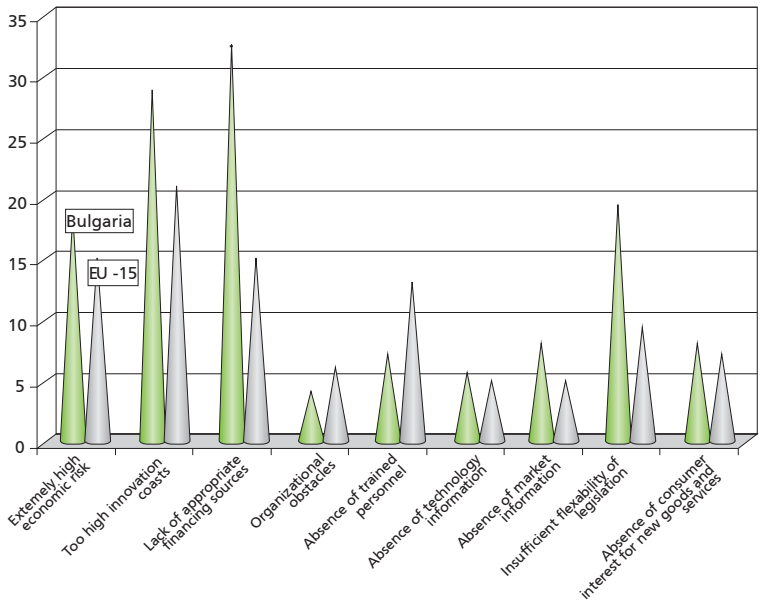


Source: The ISO Survey – 2004, ISO Central Secretariat, 2005.

available and the small and micro companies have to finance costly innovation projects by themselves. **Public innovation policy should stimulate the further deepening and broadening of the Bulgarian financial system and the development of new financial instruments for innovations, including in the public sector domain.**

In comparison to EU-15 companies, Bulgarian enterprises seem to underestimate „traditional" innovation-specific barriers such as lack of technology information and quality human capital as well as internal organizational obstacles. It also seems that the lack of popular customer support for innovation among the Bulgarian population[39], is not felt as a problem by Bulgarian companies either. There are a number of reasons behind such apparent inconsistencies. Bulgarian enterprises are still at an early stage of their innovative development compared to their European partners and competitors. The Bulgarian market is small with low purchasing power and unsophisticated customers. It cannot create high demand for innovation at this stage of the Bulgarian economic development. The innovation activity of the Bulgarian enterprises is predominantly export oriented, driven equally by factors of supply and demand. Their access to the European market and the more sophisticated European consumers happens mostly through foreign investment of European companies in the country and through the acquisition of obligatory quality standards. Therefore, **apart from the gradual sophistication of local customer demand, public policies on competition, standardization, and customer protection will play a key role in stimulating the innovation behavior of Bulgarian companies.** Coupled with high level of economic freedom and private initiative they can stimulate continuous improvement in the quality of existing products and the creation of new ones.

Figure 22: COMPARING BARRIERS TO INNOVATION IN BULGARIA (2003) AND EU-15 (2000) (% OF COMPANIES RECOGNIZING THE BARRIER AS VERY SIGNIFICANT)



Note: Nomenclature names were shortened for clarity; the total sum of the percentages may exceed 100, as companies have been able to choose more than one answer; the data includes only companies with more than 9 employees.

Source: NSI 2004, Eurostat, NewCronos 2001.

[39] Population Innovation Readiness, Eurobarometer, 2005.

[40] Ulku, H., R&D, Innovation and Economic Growth: an Empirical Analysis, IMF Working Paper 04/185, International Monetary Fund (2004).

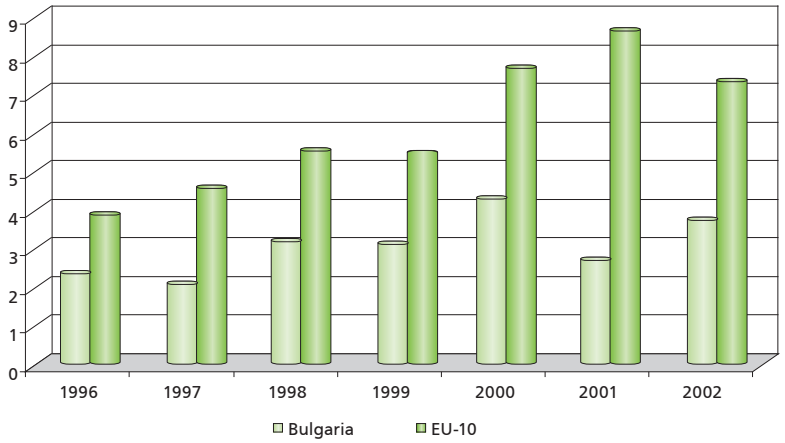
Technological Product

The technological product of the country includes the new technologies generated in Bulgaria. It shows the capacity of the economy to absorb foreign and to generate local technological innovation, as well as the level of technological culture in the country. The most common indicator for measuring the level of new technologies generated in a country is the number of registered patents. In addition, patents issued in the high-tech industries depict the capacity and readiness of the Bulgarian economy to generate and use new knowledge in high-growth-potential industries.

Patenting

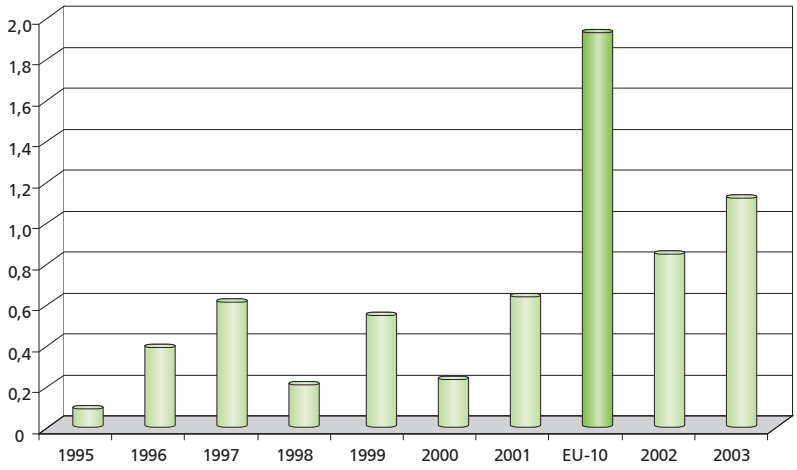
Despite ongoing academic disputes, in the developed market economies **patenting is recognized as the best proxy of a country's technological product and innovation potential.** Patent research on the influence of patents on innovation capacity of nations emerged as a separate field in innovation theory[40]. Researchers developed a number of specific indicators such as 'number of patent quotations' and/or 'market value of patents'[41] to complement the older but relatively imprecise measure 'number of patents per million inhabitants'. Nevertheless, patent analysis should be employed with caution to avoid misinterpretation of data. Patents refer to only a part of the economy, mostly related to industry; due to market maturity and data availability patent analysis is naturally skewed towards giving advantage to countries more closely associated with the American patent system, etc. Despite the above-mentioned shortcomings, patent data is one of the few available statistical measures of R&D and innovation output. At the current stage of economic development, the Bulgarian technological and innovation potential can be captured even by less sophisticated indicators of patent analysis.

Figure 23: NUMBER OF EPO PATENT APPLICATIONS PER MILLION INHABITANTS IN BULGARIA AND THE NEW EU MEMBER STATES (EU-10) (1996-2002)



Source: Eurostat, 2005.

Figure 24: NUMBER OF USPTO PATENTS PER MILLION INHABITANTS IN BULGARIA (1995-2003) AND EU-10 (2001)



Source: Eurostat, USPTO, 2005.

In terms of the number of patent applications and the number of patents issued at the two major international patent offices – the European Patent Office (EPO) and the United States Patent and Trade Mark Office (USPTO), **Bulgaria lags behind the new EU member states,** though patent activity inside the country remains relatively stable for the last 5 years. This trend reflects

[40] Ulku, H., R&D, Innovation and Economic Growth: an Empirical Analysis, IMF Working Paper 04/185, International Monetary Fund (2004).

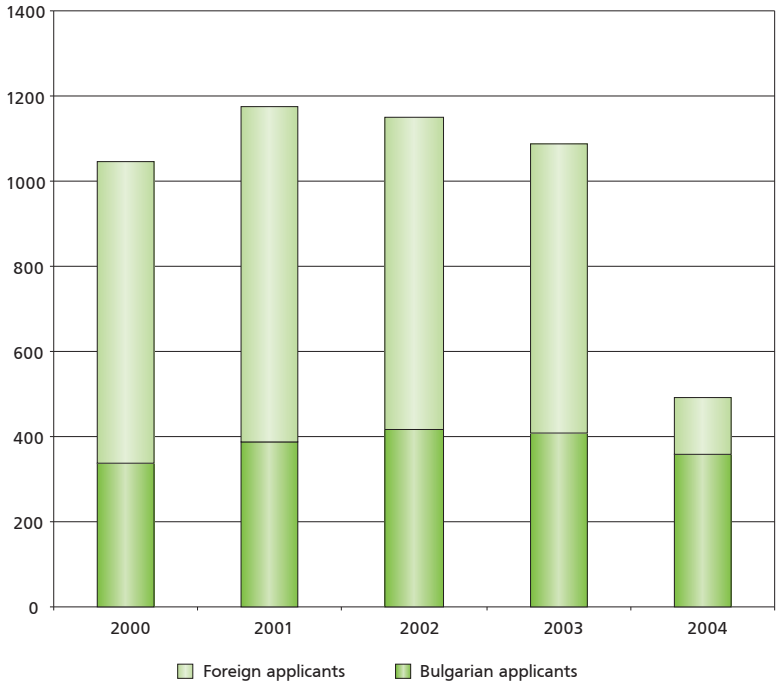
[41] In Search of the World's Innovation Hot-Spots, Financial Times, May 19, 2003.

a number of factors, which hamper invention in Bulgaria: the deep financial crisis of 1996 – 1997; the loss of considerable share of the human and physical capital of the former state-owned R&D sector in the years of transition; the significant legal and organizational changes in the process of patent application and approval both in Bulgaria and in Europe. In 2003, Bulgaria joined the ***European Patent Convention (EPC)*** becoming a part of the common European patent space. The full effect of the country's EPC membership will not be felt until the next couple of years. One of the direct effects of the membership, already visible in 2004 was the fall in patent applications submitted by foreign persons at the Bulgarian Patent Office (BPO). They can now rely on protection of their inventions in Bulgaria through the EPC if they have already applied at the EPO. In 2004 Bulgaria was selected as a target country for EPC protection by more than 82%[42] of the submitted patent applications at the European Patent Office – more than any other country-member of EPC from Central and Eastern Europe. Although this data should be interpreted carefully because of possible technical mistakes or delays in information from other CEE countries, it seems to indicate that **foreign applicants have a relatively high esteem of the capabilities of the Bulgarian scientific and technological system to reengineer and/or adapt technologies.**

Due to the many legislative and organizational changes during the last five years and the lack of current EPO data, most international comparisons of patent performance by country employ USPTO statistics. Considering the high costs of the application procedure, it can be reasonably assumed that applying for patent protection at the USPTO reveals a high degree of certainty of the international inventor in the marketability of his/her invention. The experience of innovation champions such as Finland, Israel, and Switzerland shows that improvement in their innovation performance goes together with a significant increase in patent applications at USPTO. It should also be noted that American companies are recognized international leaders in high-tech, patent heavy industries such as pharmaceuticals, biotechnology, electronics, etc. **Both EPO and USPTO data provide similar assessment of the Bulgarian technological product – it is roughly two times lower than in the new EU member-states.**

Despite the negative economic and financial shocks of the 90s, the pat-

Figure 25: NUMBER OF PATENT AND INDUSTRIAL DESIGN APPLICATIONS AT THE BULGARIAN PATENT OFFICE (2000 – 2004)



Source: BPO, 2005.

Table 5: USPTO PATENTS ISSUED TO BULGARIAN INVENTORS (1991 – 2004)

Bulgaria	Years
10	1991
5	1992
6	1993
4	1994
1	1995
1	1996
5	1997
1	1998
2	1999
1	2000
3	2001
3	2002
9	2003
3	2004

Source: USPTO.

[42] EPO Annual Report (2004).

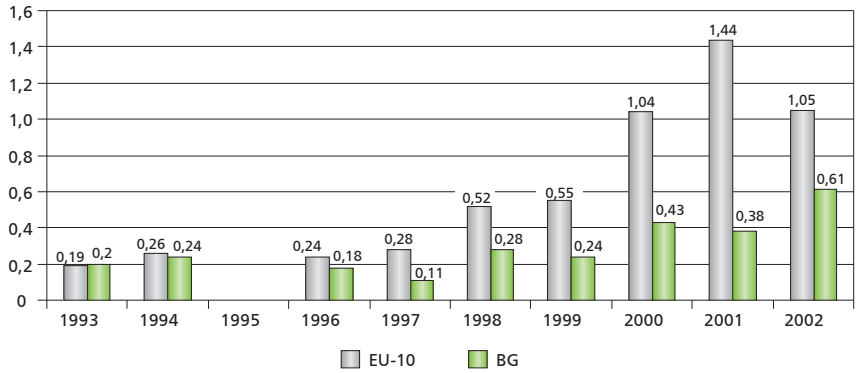
ent activity of Bulgarian persons began to recover during the last 4–5 years. The 18 patents granted by the USPTO to Bulgarian applicants for the period 2001-2004 are twice higher than the grants for the period 1997-2000. At the same time, Bulgarian USPTO patent applications returned to the two-digit zone and marked a historical record of 105 in 2004 compared to an average of 40 in the 70s and 80s. Similarly positive is the trend observed in Bulgarian EPO patent applications, which went up from three in 2002 to 16 in 2004. BPO patent applications are much higher though their international significance is limited. Although there is no precise statistical data available, it can be reasonably expected that **the economic effect and significance of Bulgarian patenting, both domestic and international, are limited** compared to the impact of absorbed foreign technologies through imported investment goods and/or foreign direct investment.

Patenting in High Tech Industries

High tech patents' data confirms the conclusions drawn from general patent analysis for Bulgaria. Bulgarian high-tech patent applications[43] at EPO for the period 1996-2002 have increased both in absolute terms and as a share of all submitted applications. Yet Bulgaria lags behind the average EU-10 level in high tech patenting.

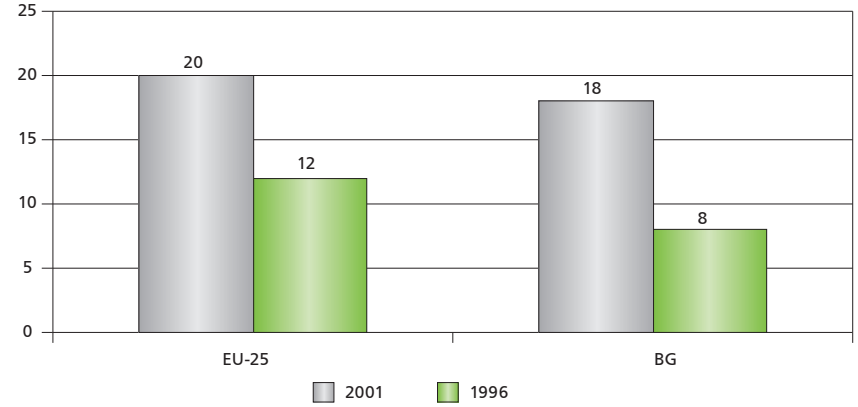
In terms of the share of EPO high-tech patent applications in Bulgarian total, the country compares well to EU-25. However, total Bulgarian high tech patent applications are so few in absolute terms that it is hard to draw conclusions about changes in high-tech patenting trends.

Figure 26: EPO HIGH-TECH PATENT APPLICATIONS PER MILLION INHABITANTS IN BULGARIA (1993-2002) AND EU-10 (1993-2002)



Source: Eurostat, 2005.

Figure 27: EPO HIGH-TECH PATENT APPLICATIONS AS A PERCENTAGE OF ALL PATENT APPLICATIONS IN BULGARIA AND EU (1996 AND 2001)



Source: Eurostat, 2004.

Currently the Bulgarian technological product does not play a significant role in the innovation activities of the companies but its growth is of key importance to the future innovation development of the country in at least two aspects. First, for a more effective absorption of new foreign technologies in the Bulgarian economy and for preserving a bigger part of the value added in the national income. Second, for nurturing indigenous potential for generation, application, and export of local technologies. In this aspect, **the Bulgarian national innovation system faces several significant challenges:**

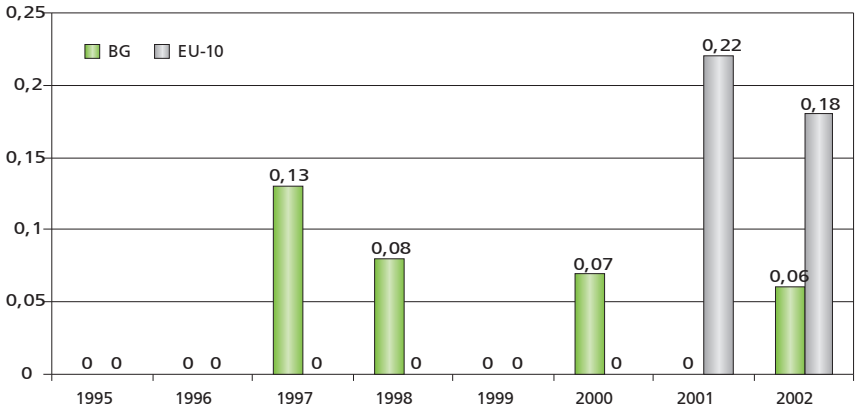
- to stimulate, train and help Bulgarian inventors and producers to benefit fully from EPO and the USPTO patent protection. The key players here are the Bulgarian Patent Office and other public bodies responsible for the adequate enforcement of intellectual property rights laws;
- to take stock of the number and optimize the management of publicly owned patents and intellectual property rights. Those that are not of key importance for the activities of public organizations should be sold out on the free market. As of 2004, Bulgaria has 285 different patents registered at USPTO, which places

[43] High-tech are patents registered in the fields of pharmaceuticals, biotechnology, information technologies, space equipment and technologies.

the country at a relatively high rank in the patent world;

- to increase the yearly technological product flow to at least 40 USPTO patents and twice as much EPO patents in the next five years.
- to increase revenues from the technological product, raise the share of high-tech patents and make better use of the available national technological capacity.

Figure 28: NUMBER OF USPTO HIGH-TECH PATENTS PER MILLION INHABITANTS IN BULGARIA (1995-2002) AND EU-10 (2001-2002)



Source: Eurostat, 2004.

Scientific Product

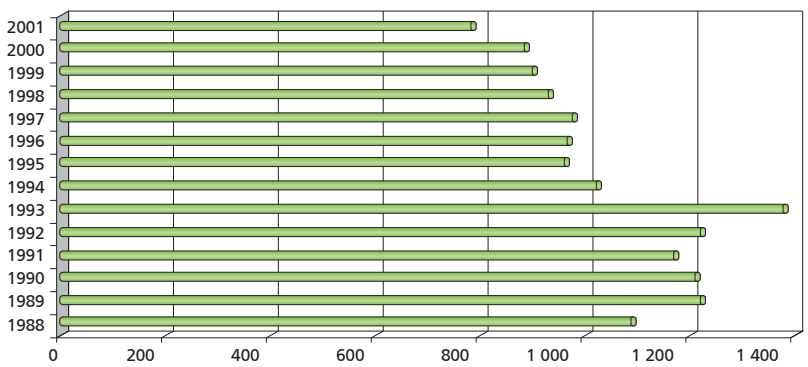
The scientific product represents the new written scientific knowledge generated in Bulgaria. Scientific publications are an important intermediate product of the national innovation system, because they indicate the condition of the scientific sector in the country. The contribution of the scientific product to the economic development and the innovation potential of Bulgaria is directly linked to its international convertibility and significance. In modern economies, the differences between applied and fundamental science are more and more blurred, and the scientific product is increasingly oriented towards the needs of a country's economic development.

Scientific Publications

The scientific product of Bulgaria is approximately at the same level of development as its technological and innovation products compared to EU-8 countries. It is one of the lowest among EU8+2 countries and registers a continuous decrease until the latest available data in 2002. The number of Bulgarian scientific publications per million inhabitants in 2002 was 182, which was about 1,5% less than in 1995. Bulgaria and Slovakia are the only countries in EU8+2, which scientific product falls between 1995 and 2002.

Similar to the other countries of Central and Eastern Europe, the deep

Figure 29: S&E ARTICLES FROM BULGARIA REGISTERED AT THE INSTITUTE OF SCIENTIFIC INFORMATION (1988-2001)



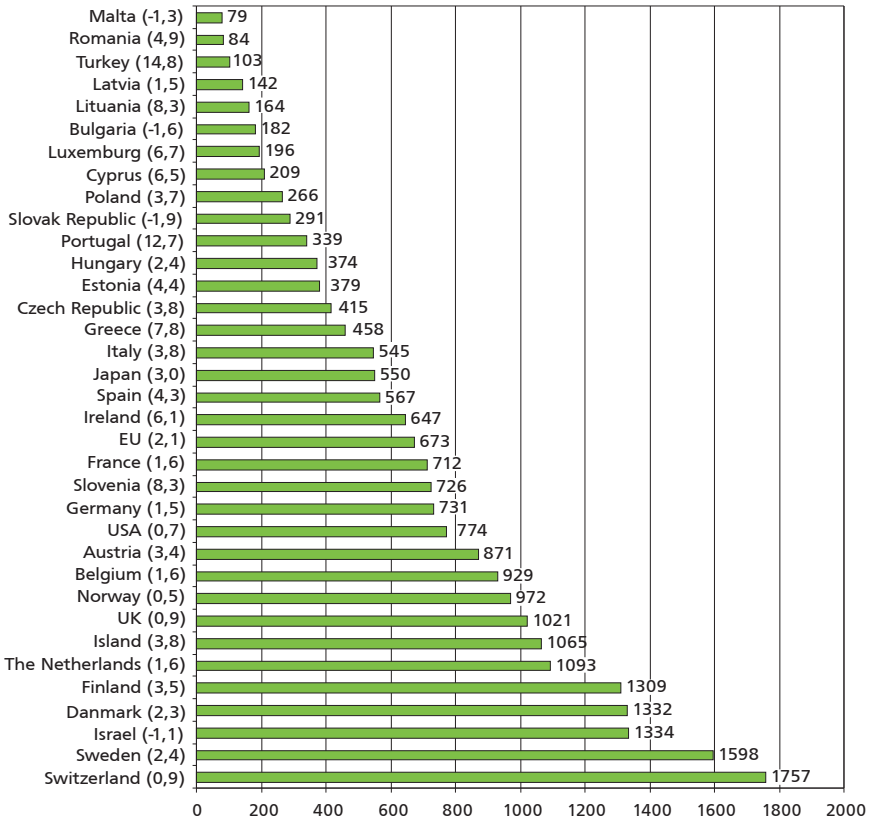
Note: Article counts are from a set of journals classified and covered by the Institute for Scientific Information's Science Citation and Social Sciences Citation Indexes. Article counts are based on fractional assignments; for example, an article with two authors from different countries is counted as one-half of an article for each country. Therefore, no direct comparison to numbers in fig. 29 is possible.

Source: National Science Foundation, Science & Engineering Indicators, 2004.

social and economic transformation in Bulgaria during the 90s led to a significant shrinking and restructuring of the Bulgarian scientific system. The opening up of the country's borders to the world and the introduction of free movement of labor resulted in a substantial brain drain from Bulgaria towards the USA, Germany, the United Kingdom and Scandinavian countries[44]. According to surveys, those who left the country in the first half of the 90s were among the most capable in their respective scientific fields. The scientific activities and respectively employment in science organizations in the country dropped significantly, which led to real loss of scientific capacity. For example, only about 13,8% of Bulgarian science personnel who left the state science system until 1995 moved to a similar position in the private sector. The same number for the Czech Republic was 47[45]. These processes had a negative impact on the scientific product of the country. While in the first years of transition the number of Bulgarian scientific publications, registered at the Institute of Scientific Information, increased, at the end of the first emigrant wave in 1994 it quickly dropped below its 1988 level. **The fall in the number of Bulgarian scientific publications continued through 2001,** the year of the latest available data. This prolonged crisis influenced the structure of the Bulgarian scientific product as well.

While in 1988 almost 40% of the Bulgarian scientific publications were in the area of biomedical research, by 2001 their share has dropped to 12%. Compared to the developed market economies of Europe in 2001 it seems that clinical research remains underdeveloped in Bulgaria and that **the country's scientists**

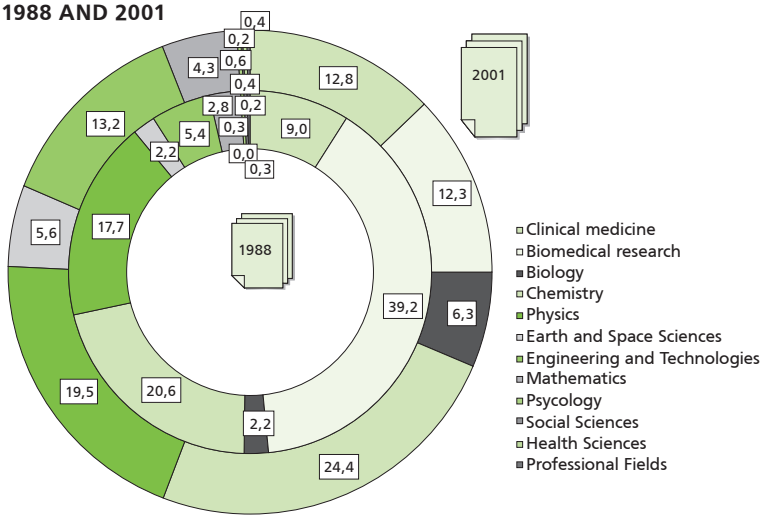
Figure 30: NUMBER OF SCIENTIFIC PUBLICATIONS PER MILLION INHABITANTS IN BULGARIA IN 2002 AND ITS GROWTH DURING THE PERIOD 1995-2002 (%)



Note: Growth in scientific publications for the period 1995-2002 is shown in brackets. Publications are research articles, reviews, notes and letters that were published in referenced journals which are included in the SCI database of the Institute of Scientific Information (ISI). A full counting method was used at the country level, however for the EU-15 aggregate, double counts of multiple occurrences of EU Member States in the same record were excluded. In the period under review an important Bulgarian science journal Reports of the Bulgarian Academy of Science was excluded from ISI counting.

Source: European Commission, Directorate General 'Research', Towards the European Research Area – Science, Technology and Innovation, Key Figures, Edition 2003-2004.

Figure 31: CHANGES IN BULGARIAN S&E ARTICLES PORTFOLIO BETWEEN 1988 AND 2001



Note: See previous figure. Articles are assigned to fields based on journal field classifications developed by CHI Research, Inc. See Appendix 2.

Source: National Science Foundation, Science & Engineering Indicators, 2004.

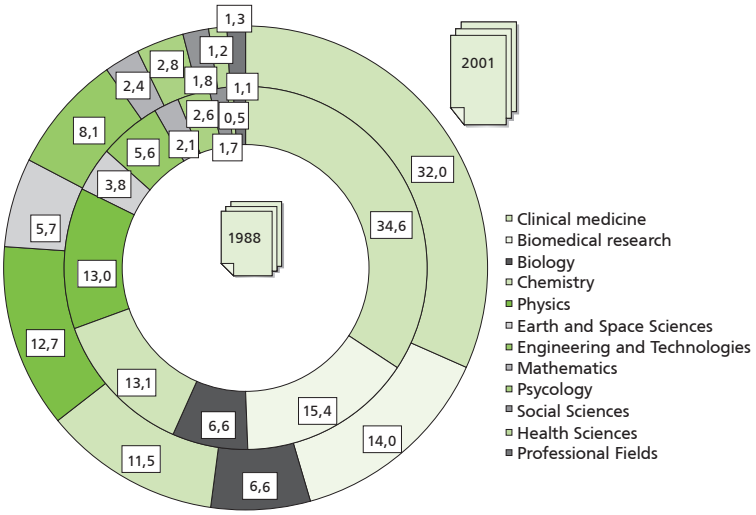
[44] For a more detailed analysis of the tendencies and results from the brain drain in the early 90s see Bobeva, D and colleagues, Migration - European Integration and Brain Drain, Center for the Study of Democracy, 1995.

[45] Ibid.

focus predominantly on fundamental (as opposed to applied) science publications in chemistry, physics and biology. This is the logical result of the fall in domestic demand for applied research and of the historically inherited specialization in science. The deep structural changes in the Bulgarian economy broke the science – industry connections and led to a significant shrinking in the available state financing, necessary for the more expensive applied research. Additionally, most science emigrants before 1994 belonged exactly to medicine and biology, which are currently of particular importance for the development of one of the most dynamic high-tech branches of the world economy – biotech. These developments are a worrying sign of the decreasing potential of the Bulgarian national science to contribute to the innovation development of the country.

There are reasonable expectations that the negative trend in Bulgarian science development will soon end as available national resources and instruments for scientific research increase. Bulgarian participation in science programs of the EU, NATO and other international scientific institutions will also contribute to the reversal. The total amount of grants to scientific projects provided by the Bulgarian Ministry of Education and Science in the 13th session of the National Science Competition (BGN 1,48 million, € 0.76 million) in 2003 was approximately 7 times higher than the one in the 9th session (BGN 0.2 million, € 0.1 million) in 1999[46]. In the last couple of years, the access of Bulgarian scientists to science programs of the EU, NATO, and EU member states has increased significantly. In this respect, **public policy should be directed towards stimulating the publication activity of Bulgarian scientists through introducing higher requirements for publishable results of publicly funded research, incl. in peer-reviewed international scientific journals.** The government should also seek ways to promote links to Bulgarian scientists who left the country in the early 90s, in order to restore some of the lost scientific capacity of the country.

Figure 32: CHANGES IN WESTERN EUROPE[47] S&E ARTICLES PORTFOLIO BETWEEN 1988 AND 2001



Note: See previous figure.

Source: National Science Foundation, Science & Engineering Indicators, 2004.

[46] Annual Report 2003, National Scientific Research Council, Ministry of Education and Science, C, 2004.

[47] Western Europe includes EU-15, Croatia, Cyprus, Iceland, Macedonia, Norway, Slovenia, Turkey, and former Yugoslavia.

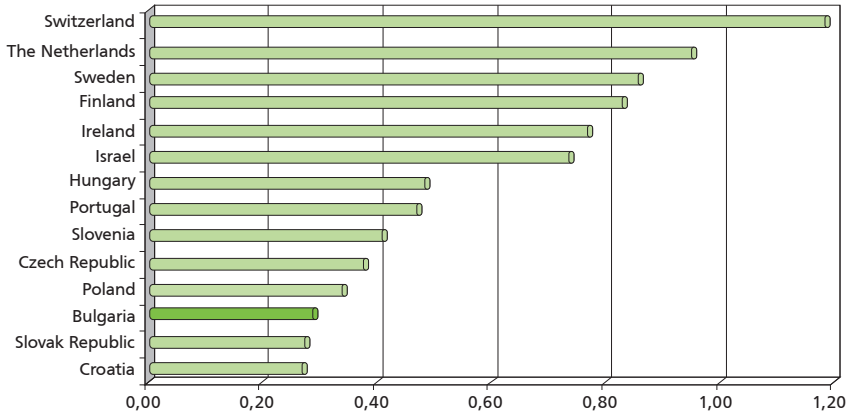
International Scientific Prominence

The most frequently used indicator for the international convertibility of the knowledge generated in a country is the **relative citation index** of the Institute for Scientific Information. Although it naturally favors English-speaking countries and its values for the different countries depend on their history of the scientific cooperation and specialization, it still is considered the best tool for international comparisons of scientific prominence.

The Bulgarian scientific literature is relatively prominent by South-East European standards, but lags significantly behind leaders from Central Europe – Hungary and the Czech Republic. Citations of Bulgarian scientific literature increased significantly in the early 90s because of the opening up of the country and its scientific system to the world. After 1996, citations of Bulgarian science literature continued to increase, though at a slower pace but their share in world citations remained relatively constant, even slightly decreasing.

Bulgarian mathematics boasts the highest international prominence. In 2001, one of every two Bulgarian publications in Mathematics was quoted in the world literature. Then come Engineering, Physics and Chemistry. Biomedical research and Engineering and technologies registered the biggest growth rates among all S&E fields for the period 1994-2001. The increase of science citations of Bulgarian literature in the applied fields of engineering and computer sciences could be a sign for the increasing commercialization of Bulgarian science. This could trigger positive impact on the technological development and innovation in the economy.

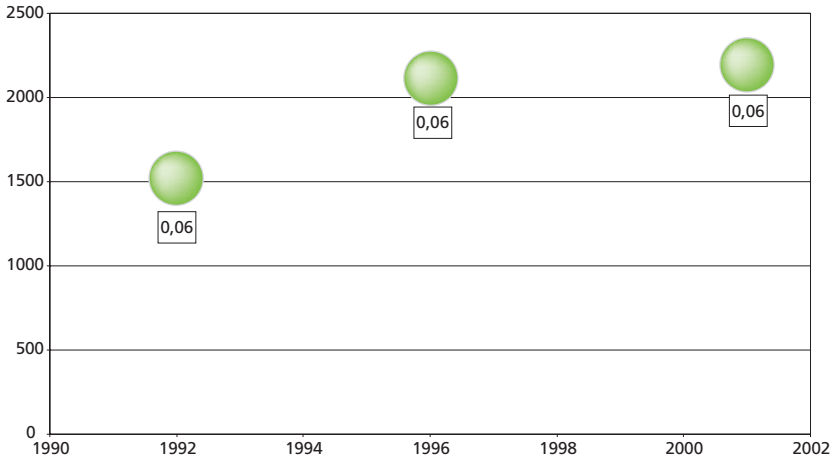
Figure 33: REALTIVE CITATION INDEX: RELATIVE PROMINENCE OF CITED S&E LITERATURE OF SELECTED COUNTRIES (2001)



Note: Relative prominence of S&E literature is measured on the basis of the relative citation index of the country. This index is the country's share of cited literature adjusted for its share of published literature. A country's citation of its own literature is excluded. An index of 1,00 would indicate that the country's share of cited literature is equal to the country's world share of S&E literature. An index greater (less) than 1,00 would indicate that the country is cited relatively more (less) than is indicated by the country's share of S&E literature. Countries with less than a 0.10 percent share of world publications in the cited field or that did not cite S&E literature over the period are excluded. Countries ranked by descending order of relative citation index in 2001.

Source: National Science Foundation, Science & Engineering Indicators, 2004.

Figure 34: CITATION OF BULGARIAN S&E ARTICLES (NUMBER OF CITATIONS FOR 1992, 1996, AND 2001)

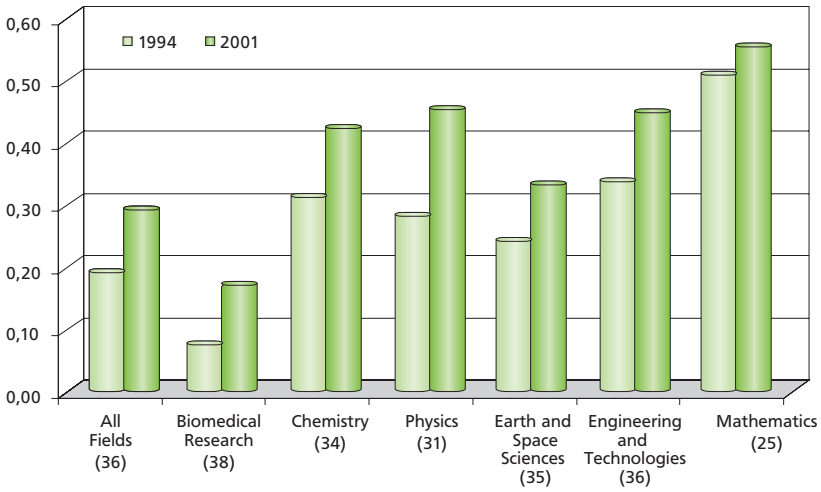


Note: The size of the bubble represents the share of Bulgarian citations in worldwide citations. Citation counts are based on a 3-year window with a 2-year lag. For example, citations for 1999 are references made in articles published in 1999 to articles published in 1995–97. Country/economy is determined by the cited article's institutional address.

Source: National Science Foundation, Science & Engineering Indicators, 2004.

Despite the positive trend of increased citation of Bulgarian scientific literature, the output of the Bulgarian scientific system remains below its potential, considering the available human resources in the country. Bulgaria's share in the population of EU8+2 countries is about 8%, which is much higher than its share in the scientific publications (5%) coming from that region. The only country in a worse position is Romania, with Latvia and Lithuania taking similar to Bulgaria's rank. This indicator, though very imprecise, shows that **there is potential for improvement in the activity of the Bulgarian science system.**

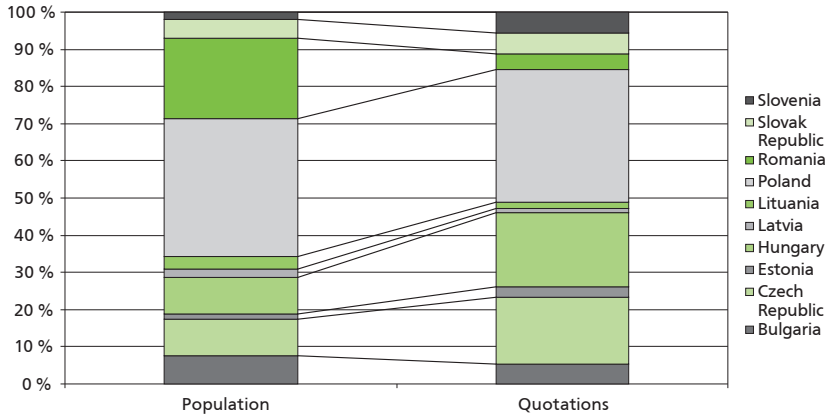
Figure 35: RELATIVE PROMINENCE OF CITED BULGARIAN S&E LITERATURE BY SELECTED FIELDS: RELATIVE CITATION INDEX (1994 AND 2001)



Note: Numbers in brackets show Bulgaria's position among the 40 most cited countries. Relative prominence of S&E literature is measured on the basis of the relative citation index of the country. This index is the country's share of cited literature adjusted for its share of published literature. A country's citation of its own literature is excluded. An index of 1,00 would indicate that the country's share of cited literature is equal to the country's world share of S&E literature. An index greater (less) than 1,00 would indicate that the country is cited relatively more (less) than is indicated by the country's share of S&E literature. Computer sciences are included in the engineering and technologies. The numbers in the brackets show Bulgaria's position among the top 40 most cited countries in the respective field.

Source: National Science Foundation, Science & Engineering Indicators, 2004.

Figure 36: RELATIVE PERFORMACE OF SCIENCE SYSTEMS IN EU 8+2 COUNTRIES FOR 2001 (COMPARING THE SHARE OF EU 8+2 COUNTRIES IN THE REGION'S CITATIONS TO THEIR RESPECTIVE SHARE IN THE POPULATION OF THE REGION)



Source: National Science Foundation, Science & Engineering Indicators, 2004.

2. Entrepreneurship and Innovation Networks

Innovation stems from: a) entrepreneurship – improvement of existing products and business processes, introducing new ideas to the market, etc. and b) structured research and development within larger companies or within networks of enterprises, science, and research and development organizations. The first type is usually found in small and medium-sized enterprises in competitive markets with low concentration and numerous business entries and exists. The second type is characteristic of big multinationals or oligopoly markets with high business concentration. Most analyses, particularly those covering the developed market economies of the OECD, focus on the entire lifecycle of the R&D process. For Bulgaria's national innovation system, as for all middle-income countries, entrepreneurship development and connecting to existing global innovation and production networks is essential.

Entrepreneurship

Entrepreneurship is the main source of innovation in the market economy. It is related to the concept of creative destruction[48] – the introduction of revolutionary new technologies, products, and/or processes, which quickly render existing technologies obsolete. Creative entrepreneurship is particularly important to Bulgaria's economy and innovation system, where the ability to undertake risk was limited for a long time during central planning.

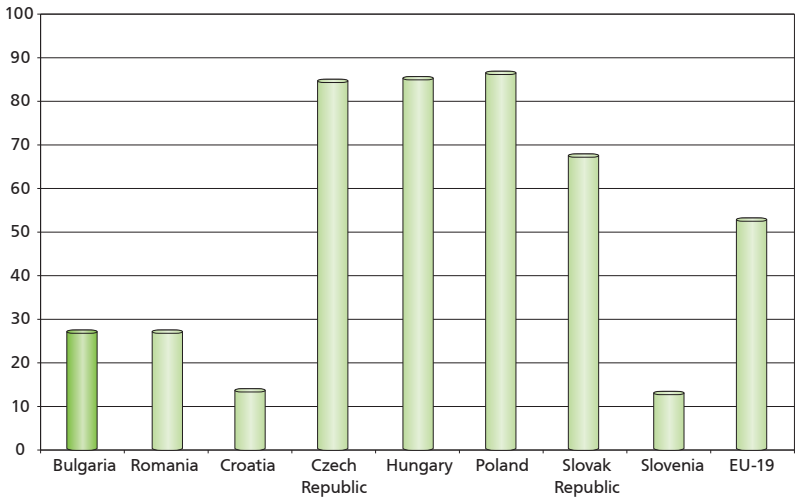
Many factors hinder the accurate analysis of entrepreneurship in Bulgaria, e.g. the existence of a significant grey economy, the lack of unified, comprehensive, and reliable statistical information[49], etc. Nevertheless, the available data on the number and structure of small and medium-sized enterprises in the country and their evolution over time provide a relatively reliable picture of the level of entrepreneurship activity in Bulgaria's economy and its impact on the innovation potential of the country.

Entrepreneurship activity in Bulgaria is nearly twice lower than in the EU. In terms of the number of enterprises per 1000 inhabitants in the period 2000 – 2003, Bulgaria lagged behind the leading countries of EU-8, i.e. the Czech Republic, Hungary and Poland. Although this indicator might be influenced by existing cultural differences and probably statistical errors as well, it still reflects a substantial difference in entrepreneurship between Bulgaria and its peers. **Therefore, Bulgaria should do a lot more in terms of improving its business environment especially with regard to the micro and small enterprises.**

The Bulgarian economy has witnessed two positive trends over the last couple of years:

- the number of newly created enterprises has been growing steadily, particularly after 2002. Among others this is attributable to the continuous political and economic stability within the country and the significant improvement of the Bulgarian banking system's credit activity;
- the share of small enterprises has been constantly rising, which is related to both the set-up of new bigger than micro businesses and the expansion of existing ventures. Simultaneously, the share of medium-sized enterprises remains stabile but is likely to grow in the very near future. Many of the enterprises, set up in the 1993 to 1995 period, have grown up, reached maturity, and have already established themselves on the market. This trend is likely to continue and even intensify in the future as a result of further improvement in financial intermediation.

Figure 37: Level of entrepreneurship: number of enterprises per 1000 inhabitants in Bulgaria and selected European countries



Note: Data on Croatia, the Czech Republic and Hungary are for 2002; Slovakia and Slovenia – for 2001; Bulgaria, Romania and EU-19 – for 2000; EU-19 includes EU-15 and Iceland, Lichtenstein, Norway and Switzerland.

Source: EBRD (2004).

Thus, if only the number of employed is considered, the structure of SMEs into micro, small, and medium enterprises in Bulgaria is already similar to that in most economies in the EU. **The average asset size of the Bulgarian SMEs, however, is considerably smaller in all three**

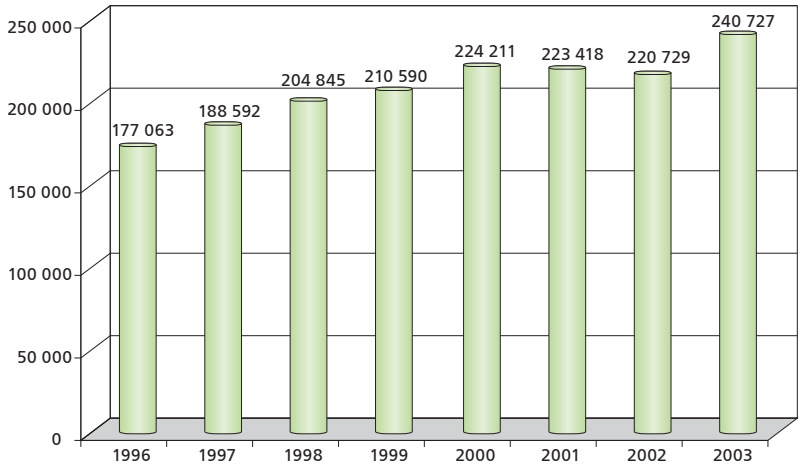
[48] Schumpeter, J, Theorie der wirtschaftlichen Entwicklung, 1911. American Journal of Economics and Sociology, Vol. 61, No. 2 (April 2002).

[49] In this respect, it is advisable that Bulgaria adopts contemporary methodologies for entrepreneurship studies, e.g. the model of the Global Entrepreneurship Monitor.

categories. Its growth rate will largely depend on the successful technological upgrade of Bulgarian SMEs and the speed, with which they shift towards manufacturing higher value-added products.

The structure of Bulgarian enterprises and particularly the specific capital constraints they face require a differentiated policy approach for the support and development of their innovation capacity. The majority of enterprises in Bulgaria (91 %) are micro enterprises, which as a rule do not perform formal R&D. Small and medium-sized enterprises, which are the main potential source of innovation and investment in R&D, account for another 7%. The share of large enterprises, most of which have been privatized by foreign investors, who define their investment policy for innovation and R&D, stands below 2 % of all firms. Micro enterprises would benefit most from policies focused on programs for entrepreneurship development, investment in existing technologies, improvement of efficiency and growth. Small and medium-sized enterprises should be targeted by policies for raising competitiveness through product diversification, entry into international production networks, adapting and creating innovation, including by formal R&D. A specific policy for supporting R&D investment should be adopted regarding large enterprises already established in the country as well as potential green-field investors.

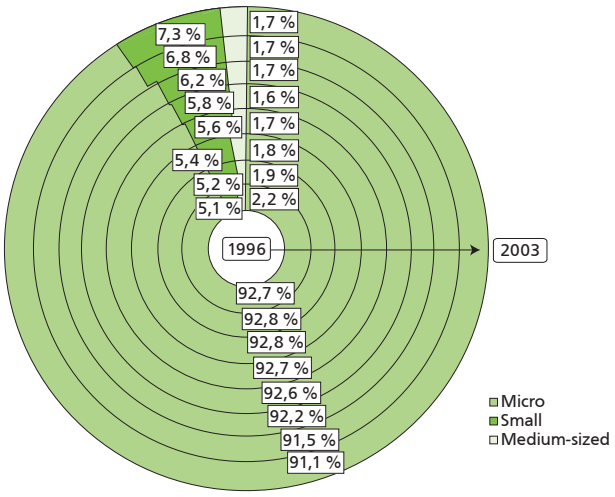
FIGURE 38: NUMBER OF SMALL AND MEDIUM-SIZED ENTERPRISES IN BULGARIA (1996 – 2003)



Note: The sharp increase in the number of SMEs in 2000 was probably due to the introduction of obligatory registration of enterprises for general practitioners as part of Bulgaria's healthcare sector reform.

Source: 2001 – 2003, NSI, (2004); 1996 – 2000, Report on Small and Medium-Sized Enterprises in Bulgaria (2003).

FIGURE 39: SMEs STRUCTURE DYNAMICS IN BULGARIA (1996 – 2003)



Note: Enterprises are classified by the number of their employees based on the definition for SMEs, introduced by Bulgarian *Law on SMEs* in 2005: micro = < 10 employees, small = 10 < 50 employees, medium = 50 < 250 employees.

Source: 2001 – 2003, NSI, (2004); 1996 – 2000, Report on Small and Medium-Sized Enterprises in Bulgaria (2003).

Box 2: INNOVATIVE SMES – BEST PRACTICES

Since 2004, the Innovation Relay Centre at the Applied Research and Communications Fund has been carrying out the Innovative Enterprise of the Year Award competition. The number of submitted innovative projects increased from 33 in 2004 to 48 in 2005.

The winner in the Most Innovative Small Enterprise category in 2004 was the company „Point L" OOD. It has a long experience in the development and introduction of automated systems for production process management in Bulgaria and abroad. In 1996, the company launched a series of indigenous programs and devices, comprising an entire system of instruments for planning, application, and maintenance of open automated systems for technological process management. In the period 1993 to 2005, the company introduced successfully 17 innovation projects in a number of industrial enterprises in Bulgaria and France.

Source: Innovation Relay Centre, Applied Research and Communications Fund, 2005.

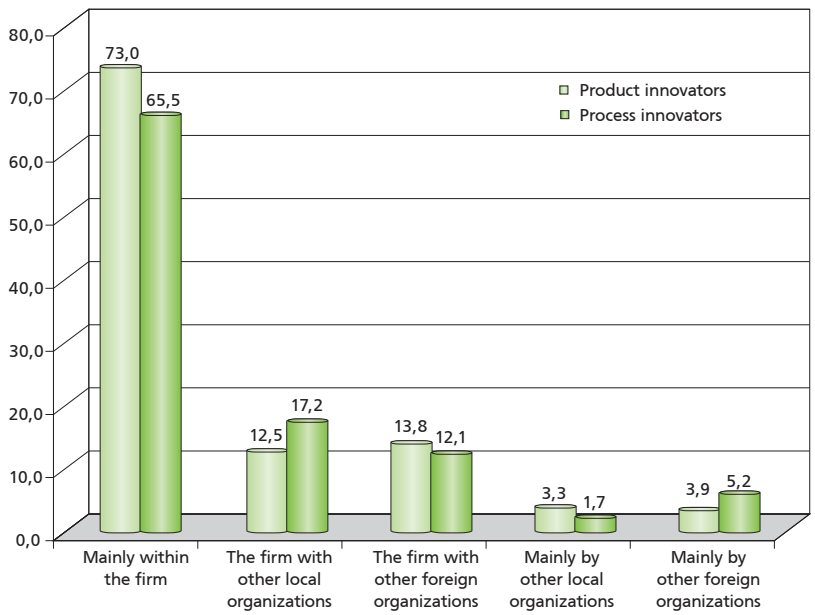
Innovation Networks

Innovation networks represent the level of collaboration and cooperation between the participants in the national innovation system and the Bulgarian economy. The lack of innovation skills and experience among the Bulgarian entrepreneurs, enterprises and the innovation system as a whole require the development of more and denser local and international innovation networks, partnerships, and clusters. Innovation networks would enable local entrepreneurs to pool their scanty resources, on the one hand, and take advantage of the knowledge and means of their international partners, on the other hand.

The available data allows only a quantitative analysis of the established links between Bulgarian enterprises and the other stakeholders in the national innovation system and their international partners. It is still difficult to define the quality of the links, e.g. duration, technology intensity, etc., although this is less important at the current stage of development of the Bulgarian innovation system. Quality assessment of the innovation networks of the Bulgarian enterprises will be crucial in the very near future in order to ensure a better orientation of the innovation policy in the public and private sectors.

Innovative Bulgarian enterprises rely on their own resources and capabilities in the development of innovative products, processes, and services to a much greater extent than their partners in the EU-15. The share of innovative Bulgarian enter-

Figure 40: PARTNERSHIP TYPOLOGY OF THE BULGARIAN INNOVATIVE ENTERPRISES IN THE DEVELOPMENT OF INNOVATIVE PRODUCTS AND/OR PROCESSES IN 2003 (%)



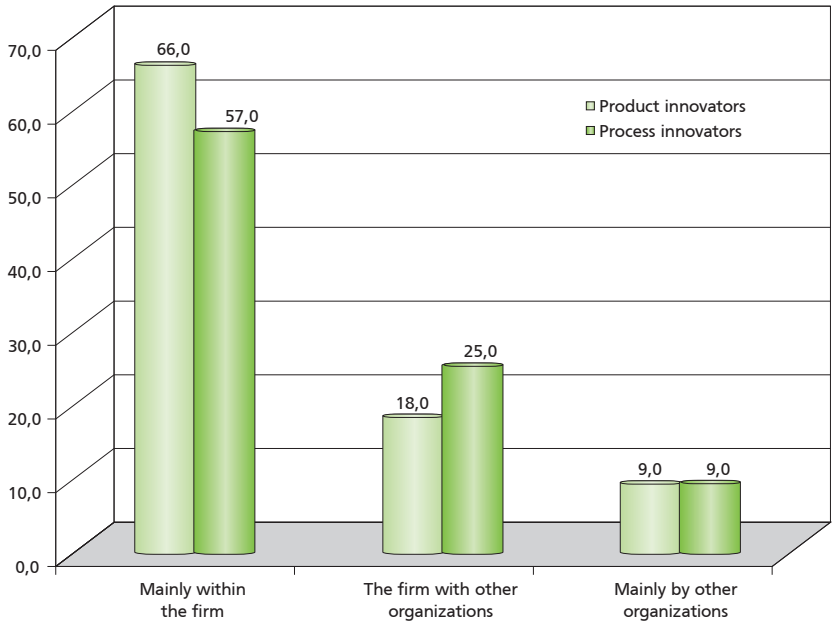
Note: Innovative are the enterprises, which have introduced new (or improved) products and/or processes on the market; the data is not directly comparable to that of EU-15.

Source: Vitosha Research (2004).

prises developing innovations primarily internally is 73 % for innovative products and 65,5 % for innovative processes. The same numbers in the EU-15 are 66 % and 57 %, respectively. Bulgarian enterprises rely to a lesser extent on partnerships and to a much lesser extent on outsourcing product/process development. This specific pattern of enterprise development in Bulgaria is most probably the result of the relatively worse business and innovation environment in Bulgaria compared to the EU, the earlier development stage of the national innovation system, as well as the specific nature of the innovation activity of the Bulgarian enterprises. Product innovation is predominant in Bulgaria. It is related primarily to investment in new machines and equipment (i.e. absorption of new technologies) and to a lesser extent to a formal R&D process (i.e. creation of new technologies). **The most important innovation partnerships to Bulgarian innovative enterprises are the ones to their local and international customers and suppliers as well as to their financing organizations.**

The nature of **innovation collaboration of Bulgarian enterprises can be characterized as a market rather than innovation and/or technology specific.** The significance of specialized local state and private R&D organizations is therefore relatively less important to their innovation activity than that of customers, suppliers, and financial intermediaries. Thus, the link between enterprises and the existing, primarily public, R&D infrastructure in Bulgaria is weak. In this respect, the Bulgarian public innovation policy should target, on the one hand, to **redirect the state-financed science and R&D system towards the market needs of the Bulgarian enterprises**, and on the other hand, **to raise the awareness of Bulgarian small, medium-sized and large enterprises about the opportunities for innovation development,** provided by

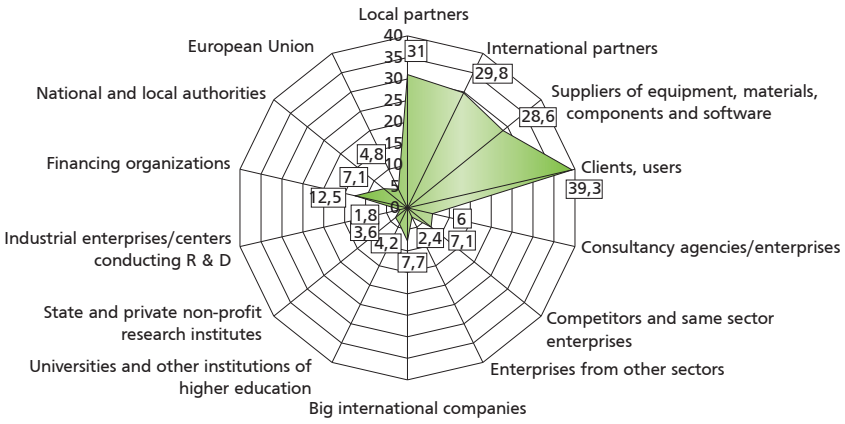
Figure 41: PARTNERSHIP TYPOLOGY OF THE EUROPEAN INNOVATIVE ENTERPRISES IN THE DEVELOPMENT OF INNOVATION PRODUCTS AND/OR PROCESSES IN THE PERIOD 1998 – 2000 (%)



Note: Innovative are the enterprises, which have introduced new (or improved) processes, products or processes and products on the market.

Source: Eurostat, NewCronos, (2001).

Figure 42: SHARE OF INNOVATIVE ENTERPRISES IN BULGARIA, WHICH HAVE INDICATED AS „VERY IMPORTANT" TO THEIR JOINT INNOVATION PROJECTS THE LISTED PARTNERS (%)



Source: Vitosha Research (2004).

the local and national authorities, and the EU. This can be achieved though different instruments such as:

- raising the share of competitive tender-based state financing for collaboration projects (through the National Innovation Fund and the National Science Fund) in the total budget outlays for science and technology;
- supporting existing private initiatives in the R&D field, financed by EU and international donors' programs such as innovation centers, technology exchanges, technology centers and incubators;
- spreading best practices of innovation collaboration, such as companies founded by scientists, based on the existing in the

past small enterprises within the universities, etc.

The Bulgarian innovative enterprises start to recognize the significance to their innovation efforts of their local competitors and their relations to large multinationals. However, Bulgarian enterprises still consider sector-internal cooperation as more important to their innovation success than intra-sectoral cooperation. In this respect, **the potential of local and national authorities in the development of appropriate policies for stimulating clustering and linkages to multinationals remains underutilized.** Better coordination is needed between the main strategies and policies in the fields of innovation, R&D, investment support, SMEs, etc. Thereby, the available public resources can be used more effectively without establishing new administrative structures and/or adopting strategic documents on paper.

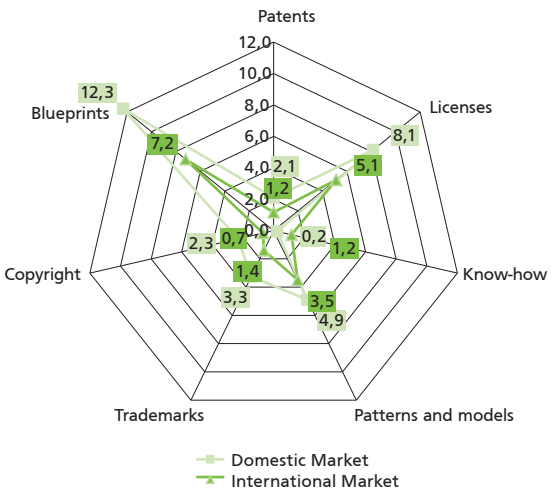
Technology Market and Information Sources

The level of development of the Bulgarian technology market is determined by the number and volume of contracts involving patents, licenses, know-how, samples and models, trademarks, copyright, blueprints, etc. It is an indicator of: a) the level and quality of innovation collaboration within the narrow innovation system, i.e. the Bulgarian science and technology system; b) technology demand by Bulgarian enterprises. The information sources innovative enterprises use in their innovation activity are another important indicator of the existing channels of cooperation within the national innovation system.

Bulgarian enterprises do not resort to the domestic technology market and its development is not yet a determining factor of their innovation activity. In 2004 Bulgarian enterprises spent on acquiring new technologies on the local and the international technology market 0.4 % and 0.26 % of their turnover, respectively. Their revenues from technology sales for the same period were 0.29 % and 0.06 % of their turnover, respectively[50]. These numbers reflect the low-technology character of the Bulgarian economy. They are even more telling if the relatively small size and respectively turnover of the average Bulgarian enterprise is taken into account. **Licensing and blueprints rank first both on the technology revenue and technology expenditure side, while patents come third.** Bulgarian enterprises use primarily the internal technology market to meet their technology needs.

The reasons for the relatively weak development of **the Bulgarian technology market** are both on the demand and the supply side. The structure of the Bulgarian science and technology system remains highly unbalanced, mostly targeted towards supply management, rather than the market. The relatively high scientific potential of the country in the past and the existing broad public organizational infrastructure presuppose much better development opportunities of the Bulgarian technology market both within the country and internationally. In this respect, the

Figure 43: SHARE OF BULGARIAN ENTERPRISES, WHICH HAVE PURCHASED NEW TECHNOLOGIES ON THE DOMESTIC OR INTERNATIONAL MARKET BY TYPE IN 2003.



Source: Vitosha Research (2004).

[50] Source: Survey of the Innovation Potential of Bulgarian Firms commissioned by the Innovation Relay Centre, Vitosha Research, 2004.

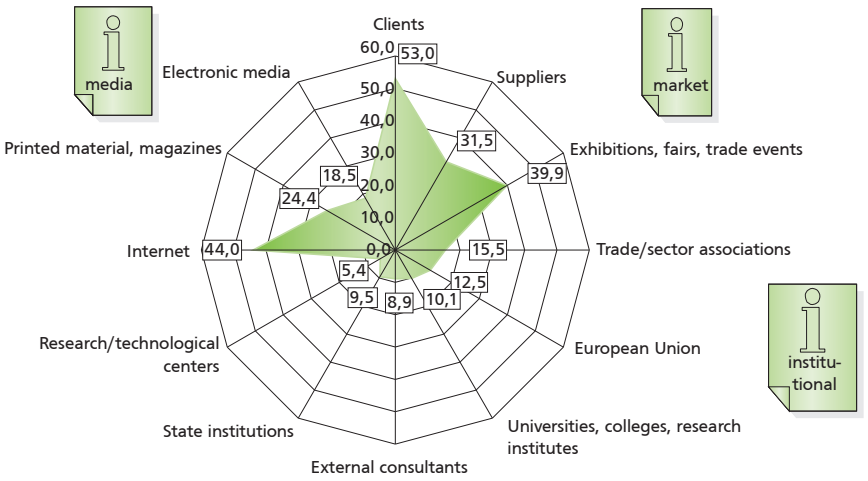
major public policy instruments for influencing the technology market should target the demand side, i.e. the adoption of technologies by the firms. The production of new knowledge and technologies by the publicly financed science and technology system in Bulgaria should above all correspond to market demand.

The demand for new technologies depends on entrepreneurship incentives. A friendly business environment is an essential but insufficient prerequisite for stimulating the technological upgrade of companies. Developed market economies provide additional tax incentives and subsidies for stimulating investment in higher technologies: from tax investment credits to rapid depreciation schemes for technology intensive assets and tax breaks on R&D investment. The technology market development in Bulgaria is also slowed down by the lack of adequate financing instruments and knowledge among the local financial community to manage projects of a more sophisticated technological nature. Technological piracy is yet another important problem present in Bulgaria, which should be solved adequately in order to develop a vibrant technology market.

The main **information sources,** pointed out by the Bulgarian enterprises as important to their innovation projects, reflect their partnership models. Most important to Bulgarian enterprises are primarily market information sources such as clients, suppliers and specialized exhibitions and fairs. In this respect, they quite resemble their European counterparts. As can be expected, national institutions and specialized research and development organizations are among the least important providers of information for the enterprises.

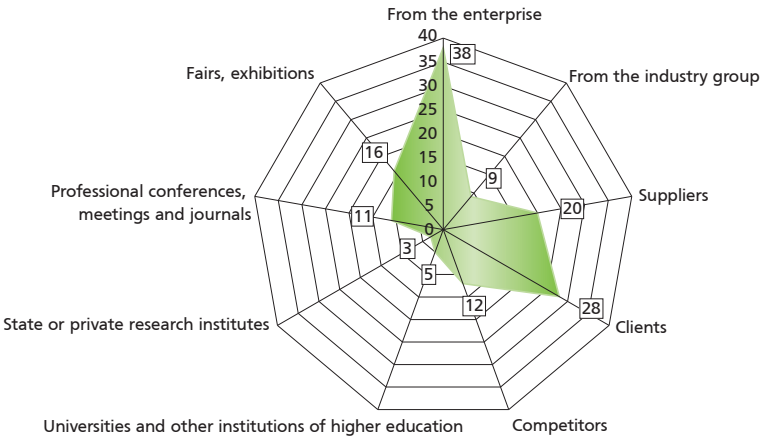
The Internet is the main media information source for the Bulgarian innovative enterprises. In this respect, **there is room for considerable improvement in the information function of state institutions and public and private intermediary organizations within the national innovation system.** The creation of web-based knowledge databases and communities similar to the Bulgaria Development Gateway[51] could serve best the information needs of the Bulgarian innovative enterprises.

Figure 44: SHARE OF THE BULGARIAN INNOVATIVE ENTERPRISES, WHICH HAVE INDICATED AS „VERY IMPORTANT" TO THEIR INNOVATION PROJECTS THE LISTED INFORMATION SOURCES (%)



Source: Vitosha Research (2004).

Figure 45: SHARE OF THE EU-15 INNOVATIVE ENTERPRISES, WHICH HAVE INDICATED AS „VERY IMPORTANT" TO THEIR INNOVATION PROJECTS THE LISTED INFORMATION SOURCES (%)



Source: Eurostat, NewCronos, (2001).

[51] The Bulgaria Development Gateway (www.bgrazvitie.net) is part of the Global Development Gateway initiative of the World Bank. In Bulgaria it is coordinated by the Applied Research and Communications Fund.

BOX 3: ADAPTATION OF BULGARIAN SCIENCE & TECHNOLOGY ORGANIZATIONS TO MARKET DEMAND – BEST PRACTICE

The adaptation of the work of the Bulgarian Academy of Sciences' institutes to market demand and their active participation in international projects are essential for the future of the organization. Over the last years some academic institutes have successfully restored their links to firms in the country and abroad.

The Institute for Metal Science, which is part of BAS, has marketed 26 products with a combined value of 1 300 000 BGN and $256 000. In 2005 the helicopter armor plates against hand grenade launchers, devised by the Institute, made Bulgaria a leading country in NATO's projects for helicopter defense. Products of the Institute have found significant market application in the automotive industry in the USA and Korea. The Institute's clients on the Bulgarian market include the nuclear power plant Kozloduy, Arsenal AD, Elmet Engineering, etc. The Institute is certified under the international standard for quality control ISO 9001 : 2000 and the NATO standard AQAP 2110.

Source: Bulgarian Academy of Sciences, Annual Report 2004, Sofia, 2005 and Institute of Metal Science.

3. Innovation Investment and Financing

Investment in innovation is an important instrument for improving the competitiveness of Bulgarian enterprises in the long run. Over the last years, R&D expenditure in Bulgaria has been limited and the demand by the private sector for R&D products offered at the local market is weak. It is still more profitable for Bulgarian enterprises to upgrade technologically though foreign direct investment and/or by importing investment and consumer goods from developed market economies, thus obtaining the needed technologies and know-how. Bulgarian entrepreneurs have specific financing needs, which can only be met by specific tools - programs for micro lending, venture capital funds, EU business development programs, etc. These needs are shaped by the relatively high economic risk in Bulgaria, which puts an additional burden on innovative initiatives, and by the lack of specific innovation experience among entrepreneurs.

International Transfer of R&D Investment

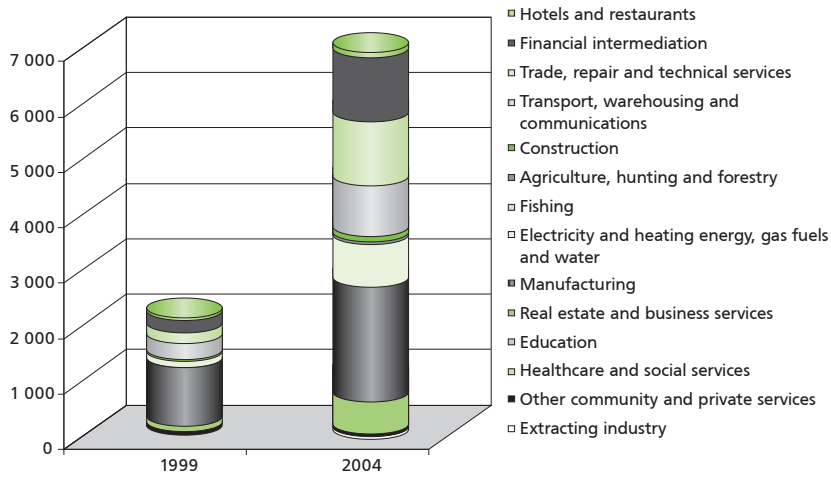
Investment in foreign technologies and knowledge are of major significance for the technological upgrade of Bulgarian enterprises. The main channels for acquisition and distribution of foreign knowledge are imports and foreign investments from countries with significant innovation capacity and high investment in R&D.

Foreign direct investment (FDI) is the driving force behind recent growth in the countries of Central and Eastern Europe, including Bulgaria. Their impact on the recipient economy is best seen in the formation and accumulation of new capital and in the technological upgrade of local enterprises[52]. The R&D content, i.e. the share of new knowledge and technologies in FDI in Bulgaria, and the speed of their adoption and dissemination in the Bulgarian economy depend on the structure of the economy and in particular on the functioning of the national innovation system as well as on the quality of the government's economic policy.

The sectors of the Bulgarian economy with higher FDI stock have a greater number of innovative enterprises as compared to the average for the whole economy. The main sources of foreign direct investment in Bulgaria are the countries of the European Union and OECD. Bulgaria is thereby connected to a region with total R&D expenditure of 2 % of EU GDP in 2003 and can take advantage of a considerable transfer of technology and know how, if the necessary conditions are provided.

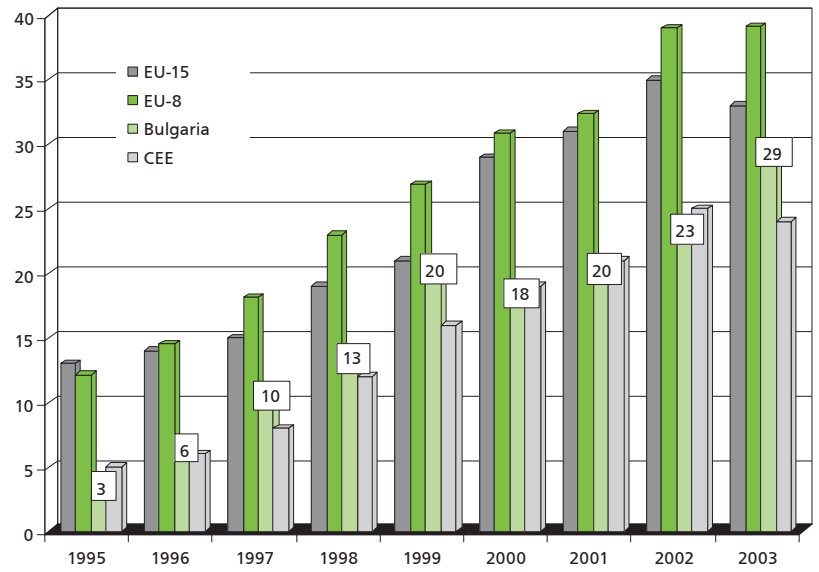
Foreign direct investment stock in Bulgaria has tripled over the past five years and exceeded 7 billion euro in 2004. Its share in GDP reached 30 %. However, **the level of foreign direct investment stock in the Bulgarian economy remains lower as compared to the average for EU-8**.

Figure 46: FOREIGN DIRECT INVESTMENT STOCK IN BULGARIA BY SECTORS (1999 AND 2004)



Source: BNB (2005).

Figure 47: FDI INTENSITY - FOREIGN DIRECT INVESTMENT STOCK AS A PERCENTAGE OF GDP IN BULGARIA AND SELECTED GROUPS OF COUNTRIES (1995 - 2003)



Source: UNCTAD (2005).

[52] Neuhaus, M., FDI: The Growth Engine in Central and Eastern Europe, EU Monitor No. 26, Deutsche Bank, 2005.

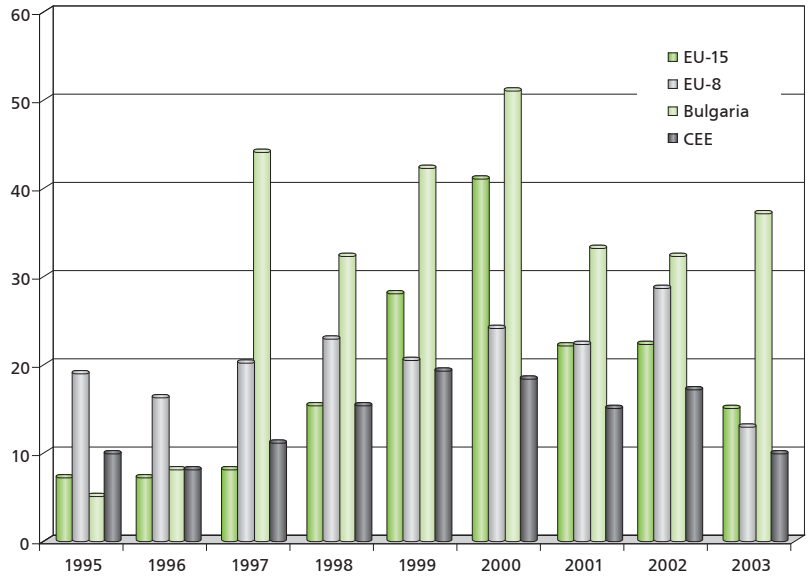
Furthermore, the characteristics of large and important foreign investment projects in recent years reveal that Bulgaria is still a preferred destination predominantly by low-tech investors[53].

FDI accounts on average for 39 % of the annual gross capital formation in the Bulgarian economy for the past 7 years. This relatively high share is evidence of the still low capitalization of the economy and the lack of sufficient and efficiently targeted domestic resource for investment, including investment in innovation. On the other hand, the preference by foreign investors of green-field investment to privatization of existing assets, especially in the Bulgarian industry, reveals that they attach exceptionally low market value to the inherited Bulgarian industrial base[54], including its links to the Bulgarian science and technology system. Therefore, **the Bulgarian innovation and FDI policy should target to**:

- attract FDI in economic sectors, which add more value and have higher R&D content;
- restore the links between the national science and engineering system and the economy, and in particular the present and potential foreign investors.

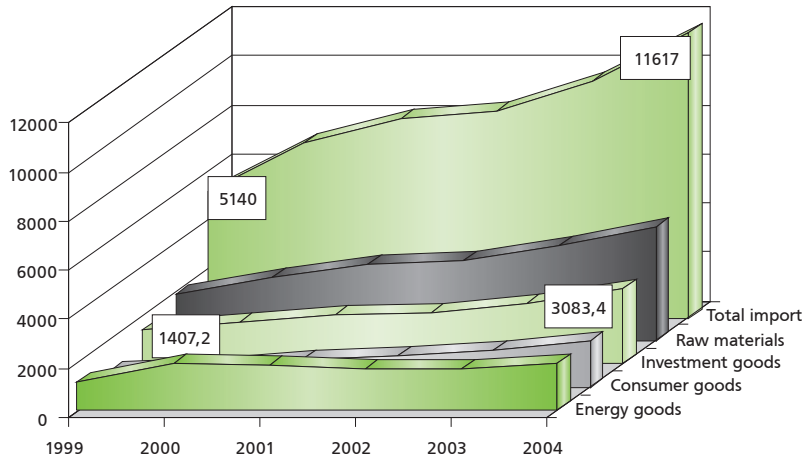
The structure and dynamics of Bulgarian import largely reflect FDI patterns. The import of investment goods, which are the main source of knowledge and technology transfer towards the Bulgarian economy, have doubled over the past 5 years. The import growth of investment and consumer goods tends to replace raw materials as the biggest import group in total Bulgarian import. This trend is particularly visible with respect to import from the EU, which accounts for 60% of total non-energy import.

Figure 48: SHARE OF FOREIGN DIRECT INVESTMENT STOCK IN GROSS CAPITAL FORMATION IN BULGARIA AND SELECTED GROUPS OF COUNTRIES (1995 - 2003)



Source: UNCTAD (2005).

Figure 49: IMPORTS BY PRODUCT GROUPS IN BULGARIA (1999 - 2004)



Source: BNB (2005).

However, the current continuing predominance of raw materials in total Bulgarian import is a direct sign of the low-value added character of the bulk of Bulgarian production. In this respect, it is advisable, that **along with raising the economy's technology absorption capacity, Bulgaria's innovation policy introduces additional incentives for investment in manufacturing sectors with higher R&D content**.

[53] According to the Annual Report of Invest Bulgaria Agency for 2005, the main green-field investment in the period 2003 – 2005 worth $220 million was accomplished in the low-tech production of glass and glass products.

[54] Although it is not part of the focus of this analysis, the ineffective and corrupt enterprise restructuring and privatization policy also had a significant negative effect on the market value of a number of inherited industrial assets.

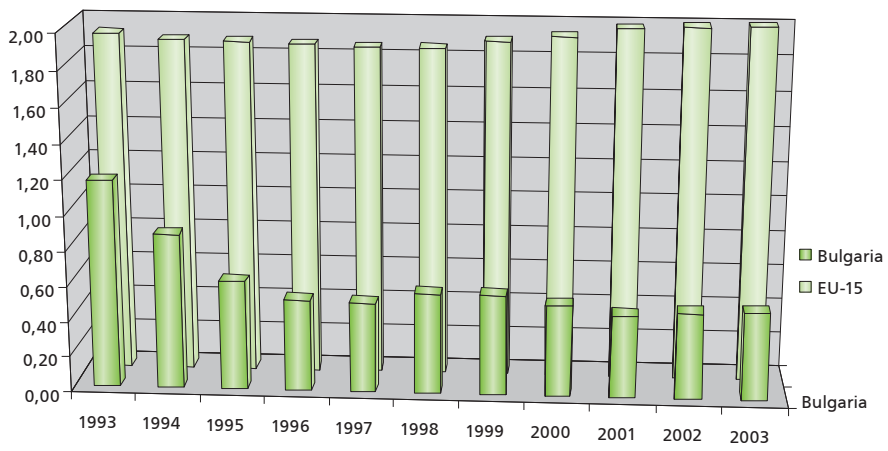
R&D Investment – Sectors of Performance, Sources of Funds, Types of R&D

The main indicator for the current state, the internal and external links of the Bulgarian national innovation system is the structure of R&D expenditure with regard to the sectors of performance and the sources of funding of R&D. R&D investment stock determines the long-term innovation potential of the economy. The proportion of R&D expenditure devoted to applied and fundamental sciences provides additional insight into the present market orientation of the science and technology system in Bulgaria.

R&D expenditure is the most widely used indicator for gouging investment in innovation and for assessing a country's economic growth potential, globally. A number of empirical research studies show, however, that R&D expenditure has a positive impact on innovation only in countries with high per capita income and/or with a large domestic market[55]. In turn, productivity in the countries that lack these factors is influenced largely by the intensity of the transfer of products, services and processes with high R&D content from developed countries[56].

Thus, there is a significant gap in R&D investment between the developed and the remaining countries in the world economy[57]. This applies especially to private expenditure on R&D. Bulgaria has been no exception to that trend. Domestic R&D expenditure is still of comparatively little significance to the innovation performance of local enterprises. Only the richest countries can develop homogeneously all stages of the innovation process through R&D investment in all (or at least most) innovative business sectors. **It is therefore very important that Bulgarian public R&D expenditure be strictly focused towards the market and towards building up the local enterprises' potential both for indigenous and for adaptation of foreign innovation.**

FIGURE 50: R&D INTENSITY - PERCENTAGE OF R&D EXPENDITURE IN GDP IN BULGARIA AND IN EU-15 (1993 - 2003)



Source: NSI, Eurostat, 2004.

The size of R&D expenditure as a percentage of GDP is a suitable comparative measure of **the science and technological intensity** of economies of different sizes. In the period 1993 - 2003, the R&D intensity in Bulgaria lagged considerably behind most other European countries.

In 2003, R&D intensity in Bulgaria was four times lower than the average level in the fifteen EU member states. The increasing gap in R&D intensity during the years of transition reveals better specialization of EU-15 countries in the creation of new ideas and technologies compared to Bulgaria. This confirms the findings of some research studies[58] that in the world economy countries with access to greater knowledge base specialize in the production of new knowledge.

In contrast to most EU-15 countries, in Bulgaria R&D is primarily performed by organizations of the government sector. Enterprises' contribution in

[55] Ulku, H., R & D, Innovation and Economic Growth: An Empirical Analysis, IMF, 2004.

[56] Coe, D. T., E. Helpman (1995), International R & D Spillovers. European Economic Review, 39, pp. 859-887; Coe, D. T., W. Helpman, A. Hoffmaister (1997), North-South R & D Spillovers. Economic Journal, 107, p. 134-149.

[57] Westholm, G., B. Tchatchoua, P. Tindermans (2004), The Great Global R & D Divide. The Political Economy of R & D, July/August 2004, p. 24-30. Sachs, J., The Global Innovation Divide, Innovation Policy and the Economy, Volume 4, National Bureau for Economic Research, 2004.

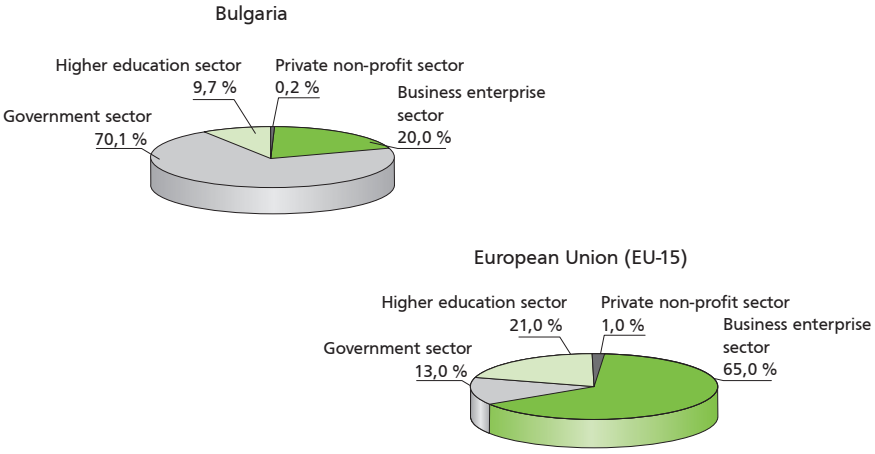
[58] Gancia, G., F. Zilibotti, Horizontal Innovation in the Theory of Growth and Development, Handbook of Economic Growth, 2005.

the funding of total R&D expenditure is less than half that of the state. This proportion is exactly the opposite in the EU. The highly distorted structure of R&D financing and sectors of performance in Bulgaria is **a mark of the weak domestic demand for R&D by the enterprise sector as well as of the unreformed organizational infrastructure of the Bulgarian public R&D sector and its low market efficiency.** Since 1995, the government sector has been dominating the distribution of R&D expenditure by sectors of performance in Bulgaria. In 1993, organizations in the government sector realized projects worth 70,1 % of the total R&D expenditure for that year. In theory, higher public R&D expenditure should stimulate private R&D expenditure through creating a larger base of accessible knowledge. This effect, however is still not seen in the Bulgarian case.

In 2003, the business enterprise sector performed projects accounting for only 20 % of the total R&D expenditure in Bulgaria. In most EU-15 member states, the contribution of the R&D projects carried out in the enterprise sector predominates, accounting for 65 % of total R&D expenditure of EU-15 in 2001. Correspondingly, the government sector provided funding for roughly 67 % of total R&D expenditure in Bulgaria in 2003; whereas in EU-15 enterprises funded 56 % of total R&D expenditure in 2001, although the contribution of the enterprises in R&D financing varied considerably in the different countries. Still, **innovation leaders in the global economy are countries, which share a common pattern – the private sector provides 2/3 of the total R&D financing.**

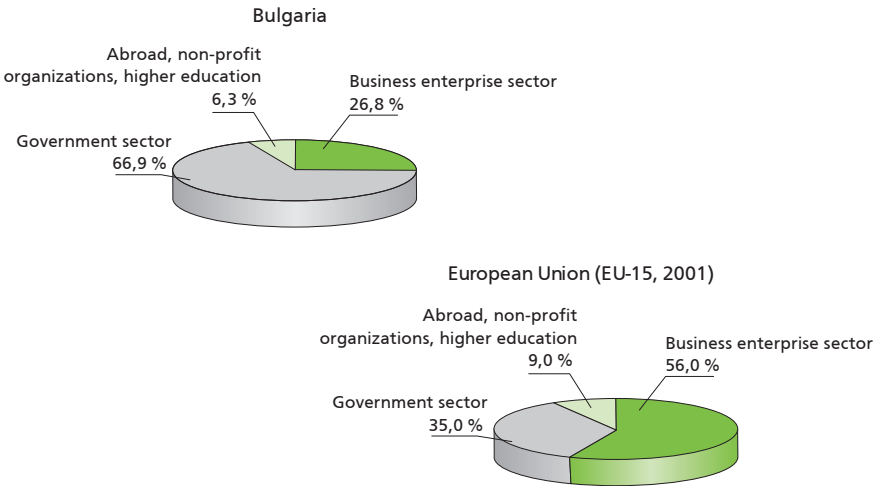
In addition to (and to some extent in relation to) the distorted structure of R&D performance and funding in Bulgaria comes the dilapidated R&D infrastructure. It has lost most of its value due to moral and/or physical

Figure 51: STRUCTURE OF R&D EXPENDITURE BY SECTORS OF PERFROMANCE IN BULGARIA (2003) AND EU-15 (2001)



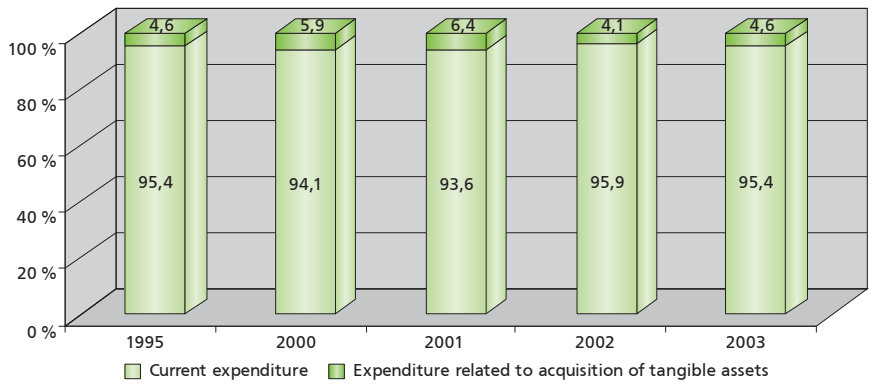
Source: NSI (2004), Eurostat (2005).

Figure 52: STRUCTURE OF R&D EXPENDITURE BY SOURCES OF FUNDS IN BULGARIA (2003) AND EU-15 (2001)



Source: NSI, Eurostat, 2004.

Figure 53: STRUCTURE OF R&D EXPENDITURE BY TYPE OF COSTS (1995 - 2002)

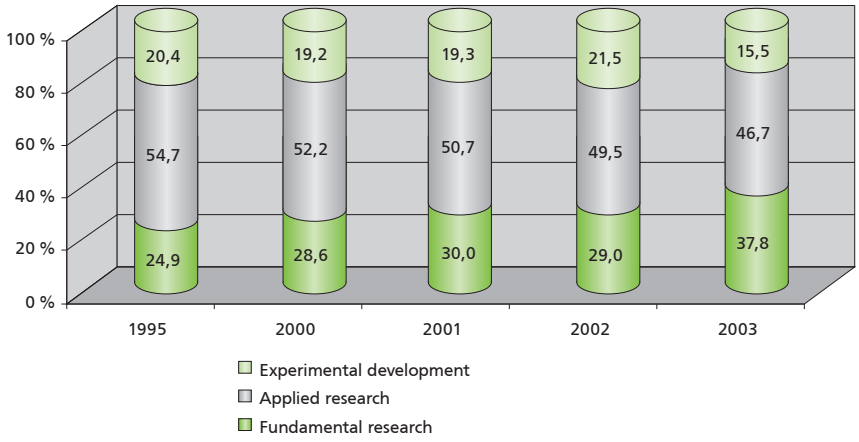


Source: NSI, 2004.

depreciation and its current state does not allow the performance of contemporary research and development. Limited current R&D expenditure in Bulgaria are swallowed by the large payroll of the public R&D sector and by the huge renovation needs of the sprawling R&D infrastructure built during the years of central planning. Thus, the scarce state financial means for R&D and the meager contribution of the private sector just about cover the costs for keeping the once huge system from falling apart and cannot ensure any technical modernization of the existing infrastructure. In the past 10 years, on average over 95 % of total R&D expenditure in Bulgaria was spent on covering current/operational costs. Expenses on capital investment, i.e. on the acquisition of new machines and equipment, did not exceed 4,0 % of total R&D expenditure in 2002. Bearing in mind the constant shortening of the technological lifecycle of devices and materials necessary for quality R&D performance in the past two decades, it can be reasonably expected that **the depreciation of physical R&D capital in Bulgaria has led to a loss of a substantial part of the accumulated human capital.**

The impact of the continuous underinvestment in R&D capital in Bulgaria is also visible **in the distribution of the current R&D expenditure by research type.** Although applied and experimental research still dominate, since 1995 their share in total R&D expenditure has constantly declined. This trend grew even stronger with the increase in available public financing for the R&D sector in 2003. Then the share of applied and experimental research fell to their lowest level of 47 % and 16 % respectively. Basic science, whose share in total R&D expenditure rose to 37 % in 2003, is indeed important for the long-term vitality of the Bulgarian innovation system, but in contrast to applied research,

Figure 54: STRUCTURE OF THE CURRENT R&D EXPENDITURE BY RESEARCH TYPE IN BULGARIA (1995 – 2003)



Source: NSI, 2004.

it has relatively limited impact on the country's innovation performance in the short- to medium-term.

There are many reasons for the inadequate size and structure of R&D expenditure in Bulgaria, which are to be found on both the demand and the supply side. However, there are a number of steps that can be taken to improve the use of available resources for raising the Bulgarian innovation product:

- Due to their low capitalization, the lack of management experience and difficult access to financial resources, Bulgarian enterprises prefer to buy knowledge through acquiring knowledge intensive products on the foreign market than to produce new knowledge locally. The former strategy ensures lower but faster return, than the latter, which is more profitable in the long run but forbiddingly expensive and with slower return. Local demand and hence R&D financing by enterprises in the Bulgarian economy therefore tends to be lower. International experience teaches that it is not realistic to expect a change in this status quo before the economy reaches a considerably higher level of capital accumulation compared to the present 20 % of GDP. However, the process of capital accumulation in Bulgaria is very dynamic and it is necessary **to create an adequate environment and incentives for raising the demand for and investment in R&D by local and foreign enterprises,** e.g. through tax, customs and administrative regulation.
- It is important **to improve the market orientation of public supply in the R&D sector** even through retraining part of the existing science organizations to perform consultancy/brokerage services for technological development of enterprises.
- Although public R&D expenditure is relatively low in absolute terms, at 0.5% of GDP it is at comparable level to EU-8 leaders. However, it should be better targeted to attract additional funding from the private sector. A **reasonable target in the medium-term, e.g. by 2010 would be to achieve parity between public and private R&D expenditure while increasing its overall size to 1,3 – 1,5 % of GDP.** Thereby, the private sector should receive incentives to take up R&D participation, while public expenditure on R&D will be limited by market discipline. In the long-term,

Bulgaria will have to win its place among the leaders within the wider EU strategic goal of raising R&D expenditure in the Internal Market to 3 % of GDP.

- The Bulgarian government should focus **public resources at improving the R&D infrastructure in the country**, especially the one of strategic importance for the positioning of the Bulgarian innovation system within the European Economic Area. Bulgaria's access to global knowledge will thereby expand and the costs per unit of acquired knowledge will fall. Another important aspect in this respect is ensuring public co-financing of the participation of Bulgarian scientific organizations and innovative enterprises in the specialized programs of the EU for the development of entrepreneurship, science and innovation.

Box 4: PUBLIC INSTRUMENTS FOR SUPPORTING R&D INVESTMENT IN BULGARIA – THE EXAMPLE OF THE „DEVELOPMENT OF SCIENTIFIC POTENTIAL" PROGRAM OF THE MINISTRY OF EDUCATION AND SCIENCE, 2005

The program has been devised as part of the implementation of the Innovation Strategy of the Republic of Bulgaria. It is coordinated by the Science Department of the Ministry of Education and Science and comprises three modules:

- improving of scientific infrastructure;
- supporting young scientists;
- upgrading specialized scientific equipment.

The first module of the program backs initiatives approved by the EU for financing under European projects. International experts evaluate the projects submitted under the other two modules. The approved projects are co-financed by state and private resources in a ratio 70:30.

Source: Science Department, MES, 2005.

Financing Innovation – Venture Capital

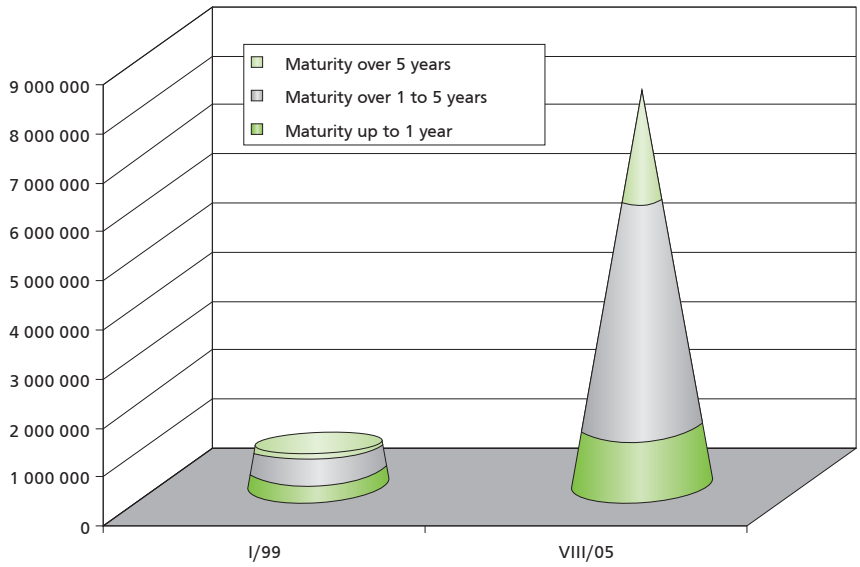
Bulgarian innovative enterprises point out the lack of adequate public and private sources of innovation financing as the main challenge to their innovation activity. The high risk intrinsic to R&D investment and the relatively small average size of Bulgarian enterprises require specific measures for financing their innovation activities such as venture capital funds, local and international public programs, etc. to complement bank financing in the country.

The macroeconomic stability and the stable economic growth in Bulgaria over the last 8 years restored confidence in the national financial system. This resulted in a significant improvement of the country's financial intermediation and **financial markets grew both in volume and diversity.** Over the past 8 years, the outstanding credit stock supplied to Bulgarian private non-financial enterprises by the bank system increased 10 times and reached 4 billion euro in 2005. Loan maturity structure also improved significantly. While as of January 1999, 5-year bank loans comprised only 12,8 % of the outstanding credit stock (excluding bad loans) in the banking system, as of August 2005 their share had risen to 27,8 %. Over the same period, domestic credit, as a percent of Bulgarian GDP, doubled and exceeded 36 % in 2005[59]. The main expansion of credit activity took place only recently, in 2003 and 2004, and it is still early to assess its impact on the innovation activity in the country. At the same time, the indicators for capital intensity of the economy reveal that financial intermediation in Bulgaria remains at a lower level than the EU-8 average and high-risk financial instruments are still rare in the country's financial practice.

The main source of funding for the innovation activity of the majority of the Bulgarian enterprises is the firm's own revenues. Only 8,3 % of the enterprises in Bulgaria recognize the banking system as a source of financing for their innovation activity. Venture capital funds are even less familiar. Only 1,2 % of the enterprises in Bulgaria have used venture capital, which ranks this financial instrument only after the state budget and the local and international partners in importance to innovation financing. Available data for countries in Europe and the USA shows a strong and statistically significant correlation between R&D expenditure in a country, as an indicator for the innovation intensity of the economy, and the deployed venture capital[60]. Each unit increase in invested venture capital corresponds to eleven units increase in R&D expenditure for 2002. This correlation holds true in dynamic aspect as well. There has been a tendency for faster venture capital growth in Europe over the past years in Europe. Although this growth is not stable, the rise is visible both in seed capital, as well as in venture capital for expansion and restructuring. As a rule, this growth in risk capital should lead to higher R&D expenditure.

Although there is no official data on venture capital in Bulgaria, expert assessments give it a marginal role.

Figure 55: CREDIT EXPANSION IN BULGARIA – A COMPARISON OF THE MATURITY OF OUTSTANDING CREDIT STOCK TO PRIVATE, NON-FINANCIAL ENTERPRISES IN BULGARIA AS OF JANUARY 1999 AND AUGUST 2005 (IN BGN).



Source: BNB, 2005.

[59] According to BNB statistics.

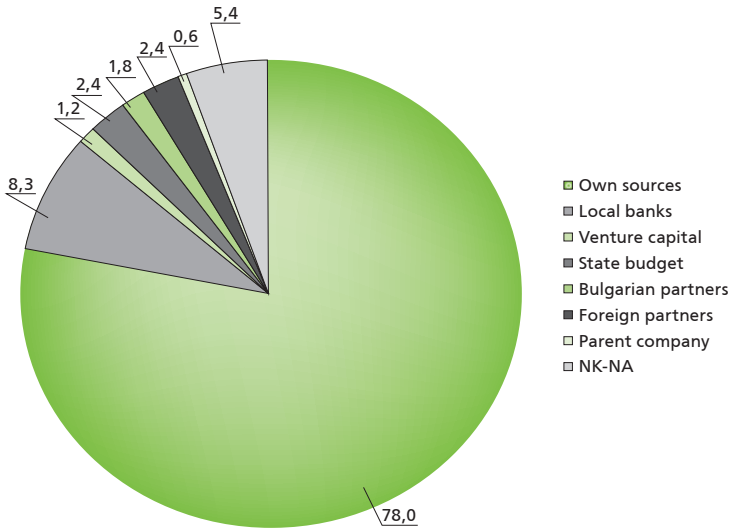
[60] Applied Research and Communications Fund.

The total volume of the available venture capital reported by venture capital funds in Bulgaria amounted to 0,06 % of the banking system's assets as of 2003. A logical conclusion would be that low venture capital financing in Bulgaria goes hand in hand with low private R&D expenditure. Thus, Bulgaria ranks among the lowest in Europe on venture capital and private R&D expenditure. It can be expected that the **continuing increase of capitalization of Bulgarian companies will raise the growth potential for financing private R&D expenditure through venture capital.** In this respect, there remain numerous drawbacks for venture capital in Bulgaria the most significant of which are: (i) the lack of liquid stock exchange market, which implies limited opportunities for exiting ventures; (ii) high grey economy in certain industries, in which many enterprises conceal their actual financial data to avoid tax duties, thus artificially lowering indicators of business activity in these industries.

The improved general financial and economic environment in Bulgaria over the last few years allows the government and the private sector to consider the development of additional **specific instruments for financing R&D and innovation** such as:

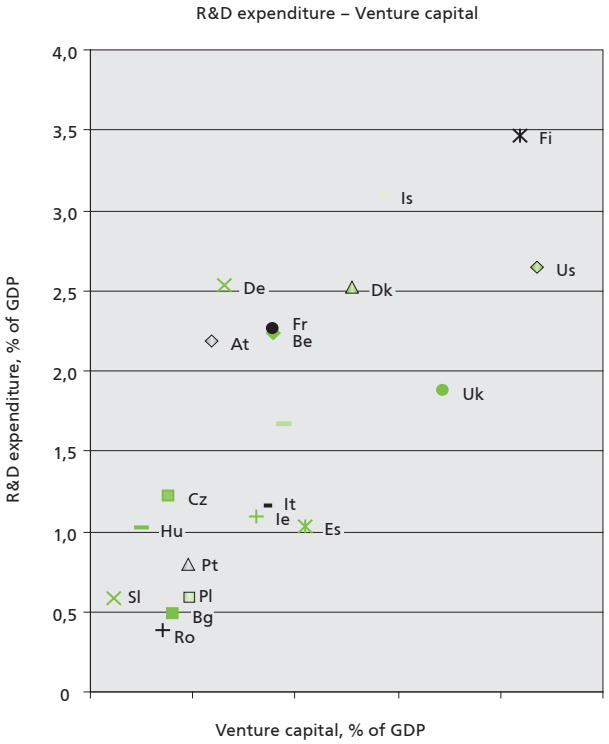
- public-private partnerships for venture capital, including incentives for the entry of new VC funds and business angels on the Bulgarian market;
- encouraging the participation of Bulgarian firms in EU framework programs for science, technology and innovation. Bulgarian science and research organizations, as well as NGOs have accumulated considerable experience in this respect. Still only 1,2 % of the innovative firms in Bulgaria have indicated EU funds[61] as significant sources of financing.

Figure 56: MAIN SOURCES OF FINANCING OF THE INNOVATION ACTIVITY OF INNOVATIVE ENTERPRISES IN BULGARIA IN 2003 (% OF ENTERPRISES)



Source: Vitosha Research (2004).

Figure 57: CORRELATION BETWEEN VENTURE CAPITAL AND R&D EXPENDITURE



Note: Data on Bulgaria is based on expert assessment of the Applied Research and Communications Fund.

Source: Eurostat (2003).

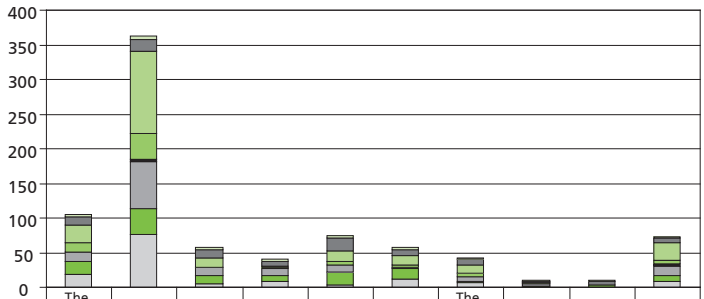
[61] According to a national representative poll of innovative enterprises in Bulgaria, conducted in 2004 by the marketing and sociological survey agency Vitosha Research and commissioned by the Bulgarian Innovation Relay Centre at the Applied Research and Communications Fund.

Table 6: PARTICIPATION OF BULGARIAN ORGANISATIONS IN PROJECTS UNDER THE FIFTH FRAMEWORK PROGRAM OF THE EU FOR SCIENCE, TECHNOLOGICAL DEVELOPMENT AND INNOVATION (ACCORDING TO PROGRAM AREAS)

Acronym of the program area	Organization type						
	Private companies and NGOs	BAS institutes	Universities	Public organizations	NCAS institutes	MA institutes	Total
LIFE	9	3	4	0	8	8	32
IST	41	9	20	6	0	0	76
GROWTH	24	8	9	4	2	0	47
EESD	16	42	12	12	3	0	85
INCO II	2	10	3	1	1	0	17
INNOVATION SMEs	2	0	2	0	0	0	4
IMPROVING	21	7	13	1	0	1	43
FP5 EURATOM	3	5	2	1	0	0	11
Total	**118**	**84**	**65**	**25**	**14**	**9**	**315**
Share in total (%)	**37,5**	**26,7**	**20,6**	**7,9**	**4,4**	**2,9**	**100**

Source: Petrov, M. (ed.), Innovation – policy and practice, the Applied Research and Communications Fund, 2004.

Figure 58: PARTICIPATION OF NEW EU MEMBER STATES AND CANDIDATE COUNTRIES BY PROGRAM AREA IN THE SIXTH FRAMEWORK PROGRAM OF THE EU (NUMBER OF PROJECTS)



	The Czech Republic	Poland	Lithuania	Slovenia	Bulgaria	Hungary	The Slovak Republic	Latvia	Estonia	Romania
Per 1000 scientists	4,3	4,3	4,2	4	2,8	2,6	2,4	1,8	1,7	1,2
Citizens and management	12	18	11	6	20	10	8	1	4	7
Sustainable growth, energy and transport	25	118	14	3	15	12	11	2	0	26
Safe foods	13	38	1	1	4	4	6	0	1	5
Aeronautics and space	0	2	0	0	1	0	0	0	0	3
Nanotechnologies	14	68	11	10	10	2	6	3	0	14
Information and communication technologies	19	37	12	8	18	15	3	2	3	8
Life sciences	18	77	5	9	4	12	6	0	0	9

Source: Petrov, M. (ed.), Innovations – policy and practice, the Applied Research and Communications Fund, 2004.

4. Human Capital for Innovation

The main determinant of the long-term development potential of the Bulgarian national innovation system is the quantity and quality of the available human capital. In this respect, the secondary and higher education systems in the country play a decisive role. The contemporary dynamic global economy requires that human capital skills be constantly improved and upgraded, which entails the development of a formal life-long learning education. The specialization of the Bulgarian economy and its ability to create indigenous and adapt foreign technologies and knowledge are reflected in changes in the employment of R&D personnel, as well as in the employment in high and medium-tech industries.

However, human capital alone, without a proper system of organization and financing of its constant upgrading, cannot lead to increased innovation and productivity of the economy. The lack of entrepreneurship skills and a functioning organization of Bulgarian education and labor markets in the past two decades resulted in the depreciation of a significant part of the accumulated human capital during central planning so that it could not reveal in full its expected innovation potential.

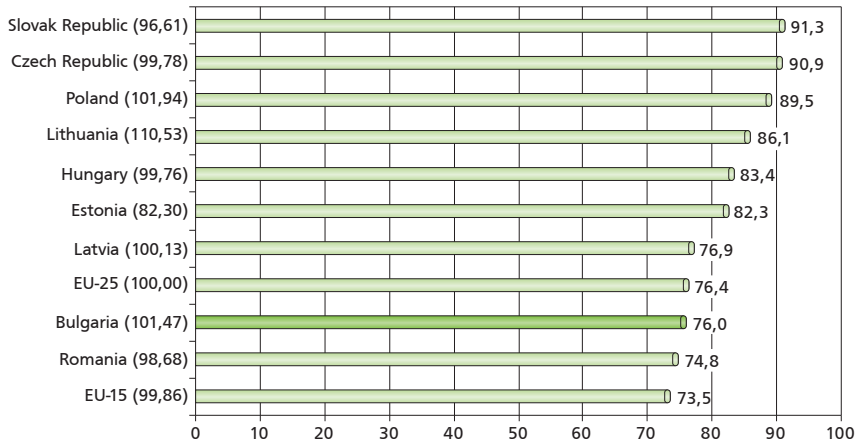
Education Outcomes, Quality of Education and Lifelong Learning

The quality of the secondary and higher education (bachelor and master degrees) in the country is crucial for the ability of the Bulgarian economy to absorb, utilize and adapt new knowledge, as well as to generate and introduce innovation. Additionally, under the current dynamic global economy the demand for new skills is constantly growing, which requires the development of new aspects of the Bulgarian education system such as life-long learning education.

Like the other former socialist countries, Bulgaria entered the transition period with a relatively high level of educational attainment among the population. The deep economic restructuring in the country during transition, however, led to a decrease and a sharp shift in the skills demanded on the labor market. Simultaneously, similar to the situation of other social sectors in Bulgaria during transition, public expenditure on education fell drastically. These developments had a negative impact on the structure and quality of the Bulgarian education system and created sizable disproportions on the labor market in the country. On one hand, currently there is demand for low qualified, low-paid labor in the Bulgarian economy, and on the other hand, there is an abundant supply of well-educated workforce, which however lacks essential market skills. Nevertheless, **Bulgarian innovative enterprises do not yet consider the lack of qualified personnel a significant constraint to their innovation development, which might be an indication that the economy is far below its innovation potential**.

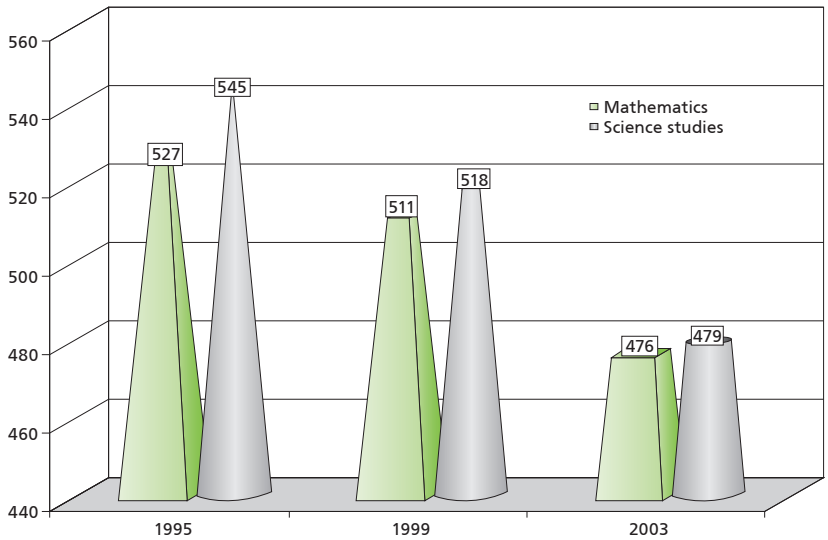
Bulgarian secondary education has been seriously negatively affected during the transition period. Not only did enrolment in secondary education decline, but international comparative studies have revealed an even more worrying drop in education quality as well. **In 2003, Bulgarian 8-graders registered the steepest fall in their results in mathematics and science compared to 1995 among all countries** included

Figure 59: SHARE OF THE POPULATION AGED 20-24 WITH COMPLETED SECONDARY EDUCATION, 2004 (FIGURES IN BRACKETS REFER TO GROWTH RATES WITH YEAR 2000 = 100)



Source: Eurostat (2005).

Figure 60: FALLING AVERAGE PERFORMANCE OF BULGARIAN 8-GRADERS IN MATHEMATICS AND SCIENCE FOR 1995, 1999 AND 2003



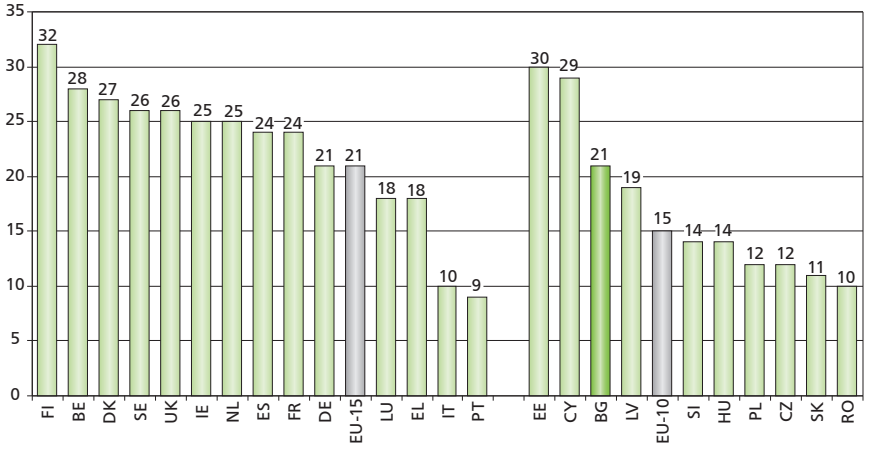
Source: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS), 1995, 1999, and 2003.

in TIMSS[62]. Due to its mass character, to a certain extent, it is obligatory for all citizens under Bulgarian law, the secondary education determines the long-term ability of the Bulgarian economy to absorb and utilize effectively new knowledge, technologies and innovation. Therefore, if no adequate measures are taken to stop the current negative trend, the fall in the quality of Bulgarian secondary education **may become the biggest long-term barrier to the economy's innovation development and growth.**

The first two degrees of **higher education** – bachelor and master, are an obligatory requirement on the Bulgarian labor market for coordinating and/or management positions. In the period 1995 – 2003, the number of Bulgarians, aged 25 to 64, holding higher education degrees, was close to the average for Europe but still far below the level typical for the most innovative economies. A number of surveys in recent years on the links between the labor market and the higher education in Bulgaria registered significant mismatches. Although the supply of higher education increased quantitatively (i.e. the number of people holding a higher education degree), its quality fails to meet market requirements. It seems that only recently some **higher education organizations have started reacting more adequately to market demand, mostly in the science and technology areas and in particular regarding the training of IT specialists.** This emerging trend, along with the perspectives for better professional accomplishment in the global knowledge economy is probably the reason for the increased number of higher education graduates in the science and technology fields. The relative share of S&T graduates as percentage of the total number of graduates grew from 19,2% in 2001 to 20.2% in 2003 in Bulgaria. The average figure for the 15 old EU member states in 2003 was 25,7 %, and for the 10 new EU members – 13 %. These developments come to confirm and boost the emerging specialization of the Bulgarian economy in IT.

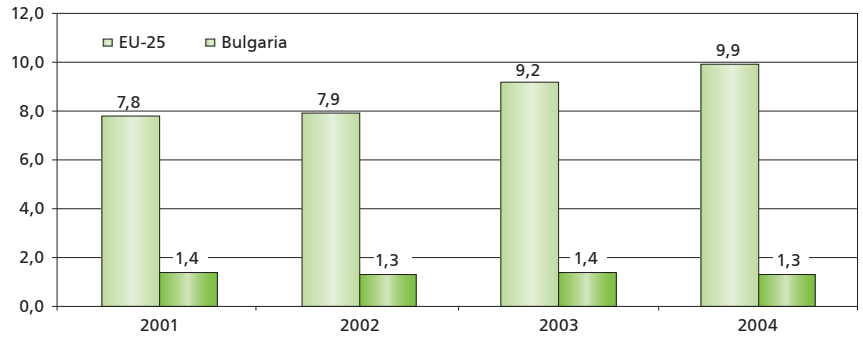
The shortening of the innovation life cycle and the need for sustaining competitiveness require the personnel, employed in the Bulgarian economy, to acquire new knowledge and skills through life long learning, i.e. permanent education. This is particularly important for Bulgaria because of the very weak or no market orientation of the Bulgarian education system over the decades of central planning. **Bulgaria falls considerably behind the average EU-25 level in terms of the share of population taking part in additional training and education during their career.** In 2004, its share stood at 9,4% in EU-25 but at hardly 1,4% in Bulgaria. **Electronic/distant training** in Bulgaria also has the lowest penetration rate among all EU member and candidate states – 3,17%[63]. In this respect, it is advisable to develop with priority an adequate public policy for

Figure 61: SHARE OF THE POPULATION AGED 25 TO 64 HOLDING HIGHER EDUCATION DEGREE – EU (2002), BULGARIA (2003)



Source: NSI (2004), Eurostat (2004).

Figure 62: LIFE-LONG LEARNING – SHARE OF THE POPULATION AGED 25 – 64, TAKING PART IN EDUCATION AND TRAINING



Source: Eurostat (2004).

[62] Trends in International Mathematics and Science Study (TIMSS) - A study of the trends in international education in mathematics and science of the International Association for the Evaluation of Educational Achievement (IEA).

[63] SIBIS General Population Survey.

continuous education and training, including participation in EU-wide projects. The revised *Lisbon Strategy* of the EU commands that education and professional training in the EU should become the global golden standard and should be organized according to three principles – quality, accessibility and responsibility.

Scientific Career, R&D and High-Tech Employment

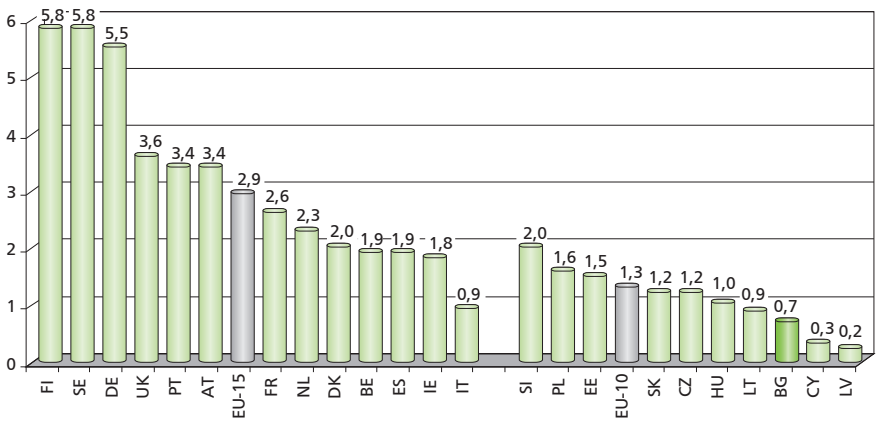
The share of the population engaged in scientific career and/or the highest degree of university education i.e. PhD, is a key factor for the Bulgarian economy's ability to create new scientific and technological knowledge, i.e. the potential supply of innovation. On the other hand, the number of personnel employed in R&D and high-tech sectors of the economy shows the present and potential future demand for R&D employment in the economy.

During the entire period from 1995 to 2003, there was a steady though gentle upward trend in the number of people acquiring the highest university and science degree, PhD in Bulgaria. It has grown from 236 in 1995 to 401 PhD graduates in 2003. However, the share of PhD holders in the population aged 20 – 29 in Bulgaria is one of the lowest among the EU member and candidate states. **Graying academic personnel and the very low new PhD inflow in the years of transition may become a strong drag on the long-term potential of the Bulgarian economy to create new knowledge and innovation.** This trend reflects both the relative unattractiveness of the scientific profession in Bulgaria over the last two decades and the relatively weak domestic demand for qualified science and technology personnel. In many cases, young university graduates start PhD studies only to postpone their entry on the labor market and possible unemployment. These conditions do not stimulate science and naturally lead to a relatively low number of successfull PhD graduates. Therefore, **public policy should be targeted** at **preserving the upward trend of graduating science degree students, while gradually raising the requirements for the PhD candidates' entry and exit skills.**

Comparative studies on middle-income countries' experience show that markets tend to concentrate local human capital in industries for final goods assembly, which as a rule have low or at best medium innovation intensity. Indeed, final product assembly can also give rise to new ideas and technologies, but they usually happen by chance or informally and only marginally improve the market utility of an existing good. This partly explains the sharp decline during transition and the current relatively low level of market demand for R&D personnel in transition economies, including Bulgaria.

R&D personnel per 1000 employees is a standard measure for the level of utilization of a country's human capital in the creation of new scientific knowledge and market applications. For the whole period 1995 – 2002, this indicator remained relatively low in Bulgaria and even declined after 1996. R&D personnel per 1000 employees in 2002 in Bulgaria (5,2) is well below the level in the 10 new EU member states (8,4). Demand and hence R&D employment in the private sector is actually even lower and if the public sector did not compensate for it, total R&D employment in Bulgaria would have fallen further. **State subsidized R&D employment has helped to retain part of the scientific potential of Bulgaria during the years of transition, but the continuing R&D employment mismatch between**

Figure 63: NUMBER OF NEW PhD GRADUATES PER 1000 INHABITANTS AGED 25 – 29 IN EU (2001), BULGARIA (2003)

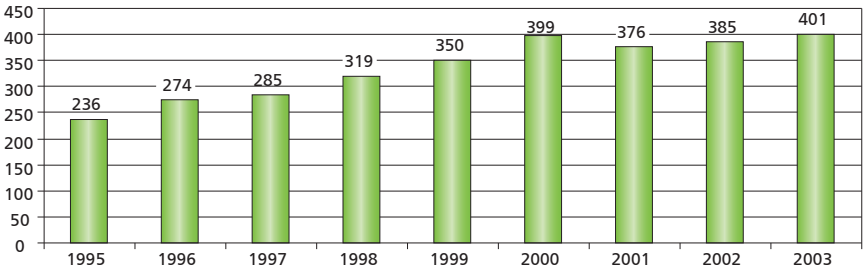


Source: NSI, 2004, Eurostat, 2004.

the public and the private sectors is not sustainable over the long run. To prevent this mismatch from becoming a burden on the operation of the Bulgarian national innovation system, public policy should target incentives for R&D employment in the private sector while at the same time gradually limiting state subsidies for public R&D employment.

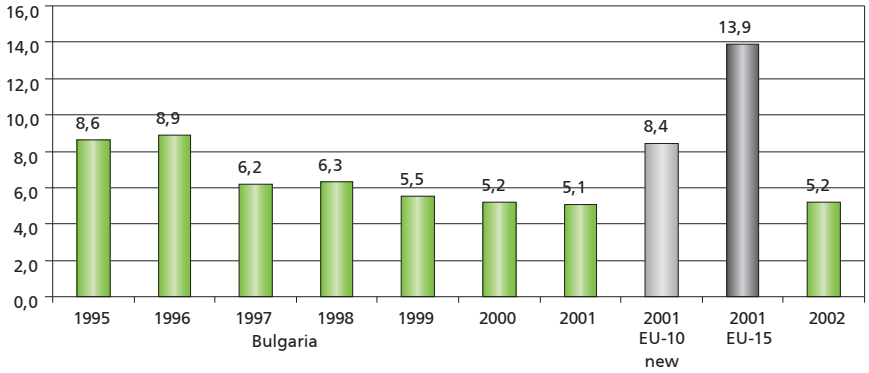
Economic restructuring, increasing global competition, as well as the lack of financial resources for research and development investment funding are serious barriers to the ability of enterprises to maintain their own R&D divisions. In the period 1995 – 2003 most of the R&D personnel in Bulgaria was employed by the government sector. The structure of R&D personnel employed by sectors of performance in Bulgaria differs greatly from the prevailing structure in the 15 EU member states. The difference is most notable with regard to the business enterprise sector, which in contrast to Bulgaria plays a dominant role in R&D employment in most European countries. Thus, in 2002 R&D employment in the private sector in the EU-15 reached 55,4% of total R&D personnel, followed by the sectors of the higher education (29,8%), government (13,6%) and NGOs (1,2 %).

Figure 64: NUMBER OF NEW PhDs IN BULGARIA (1995 – 2003)



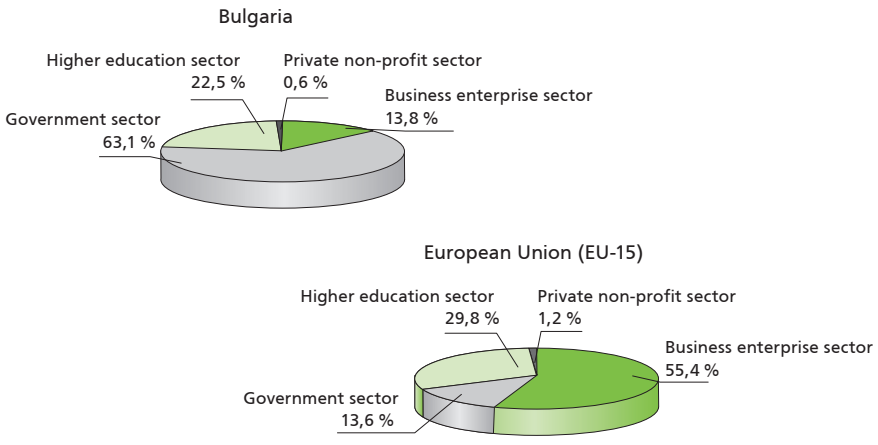
Source: NSI, 2005.

Figure 65: R&D PERSONNEL PER 1000 PERSONS OF THE WORKFORCE (1995 – 2002)



Source: NSI, Eurostat (2004).

Figure 66: R&D PERSONNEL BY SECTORS – COMPARISON BETWEEN BULGARIA (2003) AND EU (2002)



Note: Structure of R&D personnel (full employment equivalent), by sectors of performance (2002)

Source: NSI, Eurostat (2004).

5. Information and Communication Infrastructure

The successful implementation and use of ICT may have significant spill-over effects on knowledge economy and firms' competitiveness in Bulgaria. ICT improves the innovation system's performance, allowing for a better, faster and more efficient match of efforts, means and talent for innovation.

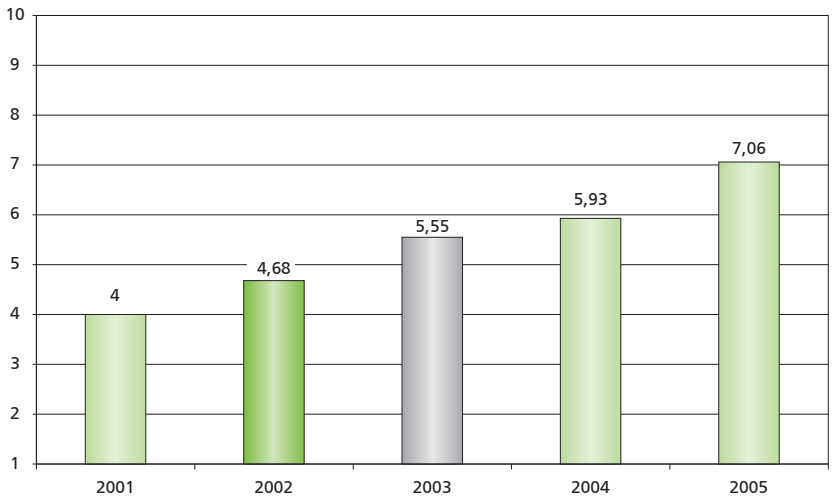
ICT Infrastructure as a Business Environment

The development of ICT infrastructure increases the positive externalities of enterprises' connectivity, decreases transaction costs for doing business and creates an environment conducive to development, production and consumption of new products in new ways. The main benchmarking indicators for ICT infrastructure include Internet penetration among citizens and enterprises, fixed line and mobile connectivity, the number of hosts and domains in the Bulgarian top-level domain. A synthetic assessment of ICT is provided by the composite indices *e*-Bulgaria[64] and e-Readiness[65], which among others reflect factors such as economic access to the infrastructure, its security, quality and bandwidth.

ICTs are embedded in the modern innovation systems of each country in various ways: ICTs are innovation products themselves, they constitute a critical part of modern infrastructure, and process innovations are currently inconceivable without integrated software and communication applications. Investment in ICT increases capabilities to innovate, productivity and efficiency at firm level. ICTs are also key policy instruments for institutional change and globalisation.

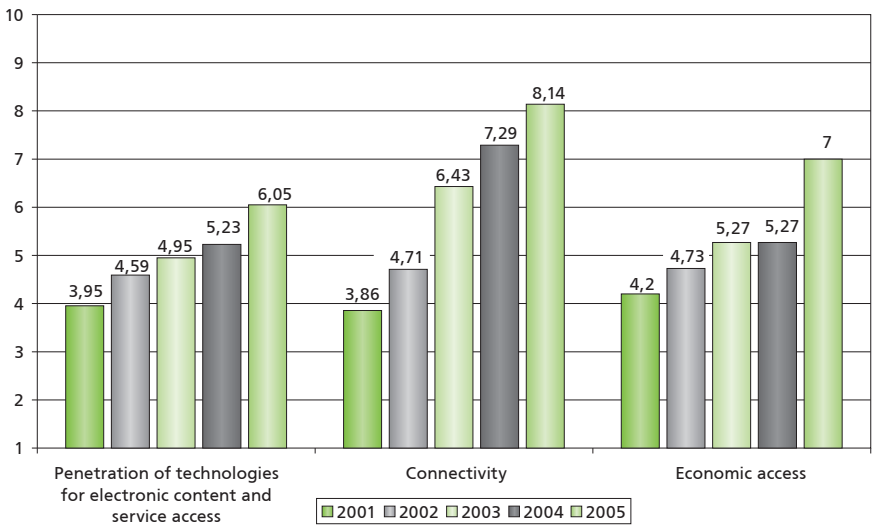
Information and communication infrastructure comprises two levels of the environment for information storage and transfer, macro –, which includes national and regional fixed and wireless networks for voice and data transfer and the end-user devices for access to that infrastructure, and micro – the internal enterprise computer and communication networks, software applications and protocols. The ICT infrastructure development depends on exogenous factors (such as technology innovation and price reductions, etc.), national policy, public investment and other macroeconomic factors, as well as endogenous factors (such as the production-related and marketing needs of enterprises, ICT market structure and available e-content).

Figure 67: E-ACCESS INDEX



Source: *e*-Bulgaria 2005, Applied Research and Communications Fund

Figure 68: DYNAMICS OF E-ACCESS INDEX COMPONENTS



Source: *e*-Bulgaria 2005, Applied Research and Communications Fund

Despite its rapid and homogeneous development during the last five years, the information and communication infrastructure in Bulgaria still lags considerably behind the average level in the new EU member states, being only ahead of Lithuania and

[64] http://www.arcfund.net/artShow.php?id=4425

[65] http://www.eiu.com/site_info.asp?info_name=eiu_2005_e_readiness_rankings#

Latvia. *Ceteris paribus*, this gives new member states countries a comparative advantage in attracting high-tech FDI.

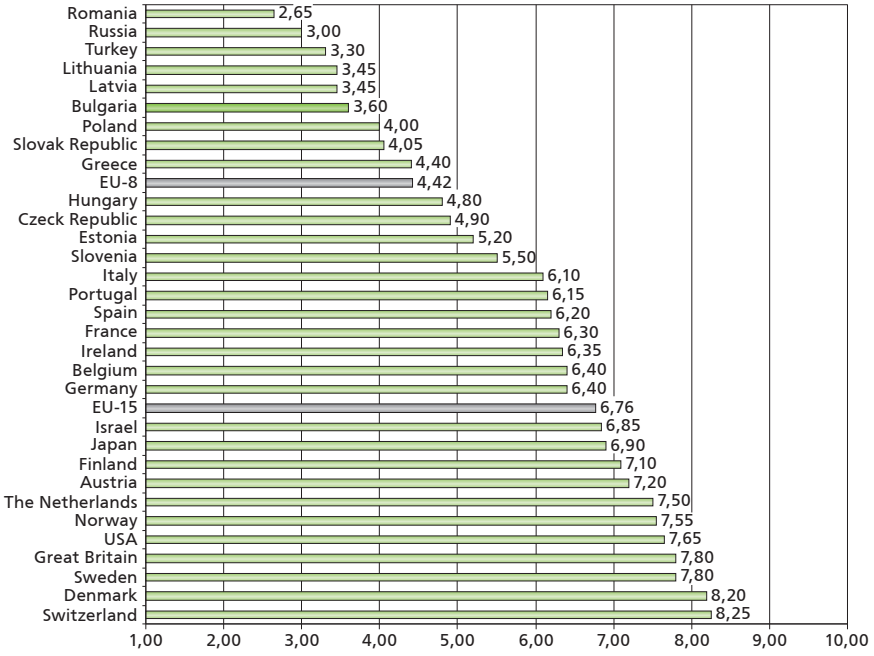
The growth in the *e*-Access index[66] of the *e*-Bulgaria composite index in 2005 can be attributed to improved economic access to information and communication infrastructure vis-a-vis previous years, when the growth factors were broader bandwidth and coverage of Internet connections. However, neither citizens nor businesses use efficiently the created technical potential.

About one-fourth of the population and three-fourths of the enterprises already use the Internet[67]. For over two-thirds of both user groups the access speed is faster than dial-up. The most visible effects of the increased use of Internet and telecommunication services can be seen in the area of marketing innovation. Enterprises in a number of industries such as hotels and restaurants, tourism, trade, media and leisure services are pressured by market forces to expand the range of their distribution and advertising channels, including Internet and mobile services. The major challenges in the development of Bulgarian ICT infrastructure ahead are the broader spread of end-user devices for access and interactive use of information through the information and communication infrastructure (for the population) and the implementation of integrated management information applications (for enterprises). Fixed line connections marked a major decline of over 15 percentage points in the period 2002 – 2005, while mobile connections almost tripled over the same period. Bulgaria is lagging considerably behind in the process of digitalisation of its fixed telephone network compared to countries from the first EU enlargement wave.

The average annual growth in hosts (computers, connected with the global network via an active IP), increased steadily during 2002 to 2005 by about 5 – 7 percentage points. It cannot however compensate the significant gap to the countries of Central and Eastern Europe. For example, Hungary, a country of similar in size to Bulgaria in terms of population and territory, has about eight times more hosts than Bulgaria in 2003 and 2004.

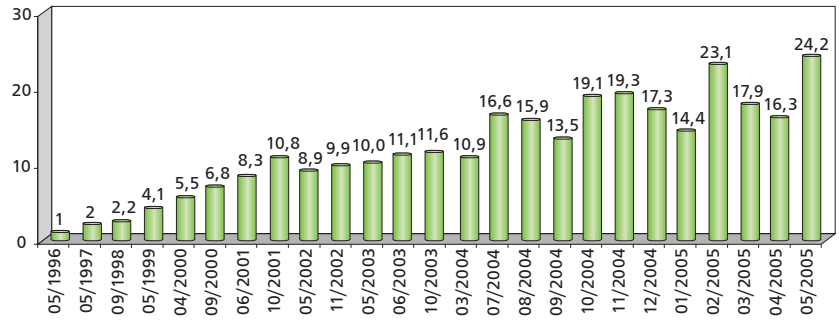
Due to complicated procedures for domain-name registration in the Bulgarian TLD and relatively high prices of the private monopoly Register.BG[68], the number of .bg

Figure 69: CONNECTIVITY AND ACCESS TO INFORMATION AND COMMUNICATION INFRASTRUCTURE (INDEX)



Source: The 2005 e-readiness rankings, Economist Intelligence Unit

Figure 70: INTERNET PENETRATION AMONG ADULTS (1996-2005)



Source: Vitosha Research, 2005.

[66] For the e-Bulgaria composite index, evaluating the development of the information and communication infrastructure *see* e-Bulgaria 2005, Applied Research and Communications Fund.

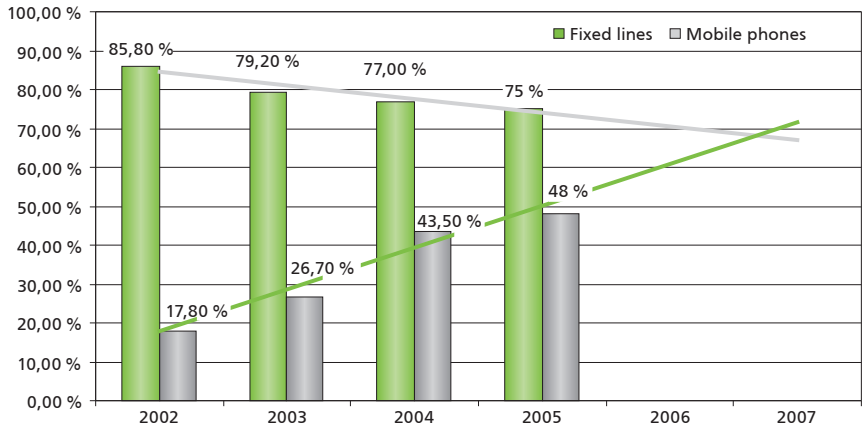
[67] Vladimirov, G., O. Harizanova, „Bulgarian SMEs' Readiness to Join The Information Society", Sofia University „St. Kliment Ohridski", Sofia, 2005.

[68] Register.bg Ltd started its operations in 2001 and inherited all the rights and duties of the state-owned Digital Systems Ltd.

domain names grows slowly (by several domains per day). Companies prefer to avoid complications and register namebg.com instead of name.bg. As of the beginning of 2004 it is also possible to register domains in Cyrillic in the .com and .net domains, as the actual domain is registered in Latin with a written „xn-" in front of it, which might further depress .bg registrations.

Reliable data on the number of domain names registered by Bulgarian entities outside the .bg domain (in particular in the commonly applicable address domains .com, .net, .org, .biz, .info) is contained in the international rank list of WebHosting.Info (http://www.webhosting.info). Until May 2005, Bulgaria with its total 41,840 registered names in the above-mentioned five domains stood at rank 39 globally, close to Portugal and Taiwan. Bulgaria outstrips a number of European countries – Ukraine, Romania, Hungary, Greece, Slovenia, Croatia, Cyprus and Serbia and Montenegro. At the same time the country lags behind countries such as Turkey (265,043), Poland (84,778) and the Czech Republic (66,465 domains)[69].

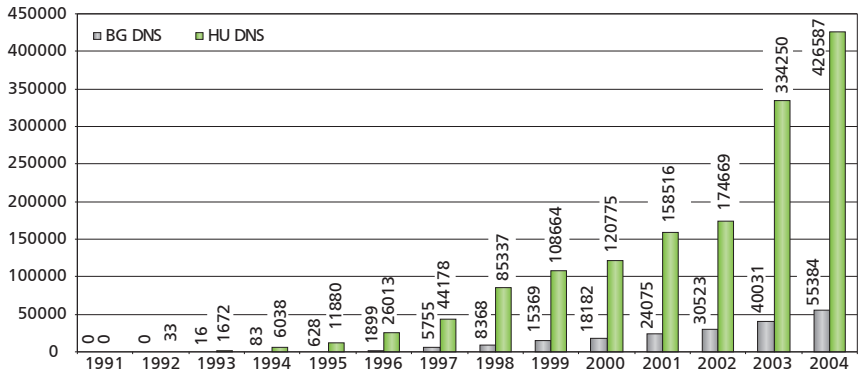
Figure 71: FIXED VERSUS MOBILE TELEPHONY AT HOUSEHOLDS



Note: 2005 data is as of February; 2004 data on fixed lines telephony is an expert estimate.

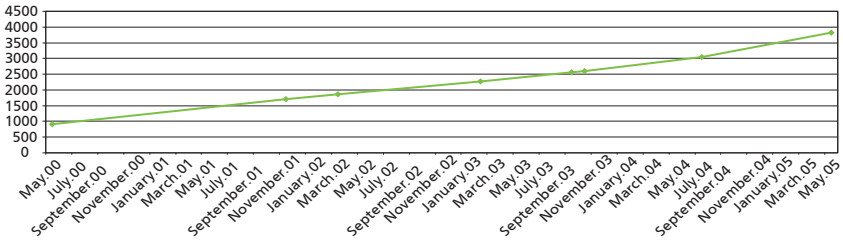
Source: Vitosha Research

Figure 72: TOTAL HOSTS NUMBER IN BG AND HU DNS DOMAINS



Source: RIPE, August of each year

Figure 73: REGISTERED NAMES IN .BG DOMAIN



Source: NSI, 2004.

[69] Data of WebHosting.Info is based on regular monitoring of over 35 million domain names, 1,3 million DNS servers, more than 35,000 web hosting services companies and about two billion IP addresses under a methodology, described in detail at: http://www.webhosting.info/about/technology/.

ICT Infrastructure as a Means for Doing Business

Investment in R&D is related closely to consistent investment in ICT. ICT systems of enterprises provide opportunities to excel business processes ensure and manage the quality, knowledge and production networks. Internet proved to be the second most important (second best only to customers) source of information for innovation at Bulgarian enterprises[70] and is the main tool for marketing innovation. Important indicators of innovation at firm level are PC and Internet penetration, the use of intranet and various information systems and the personnel's readiness to work with new ICT.

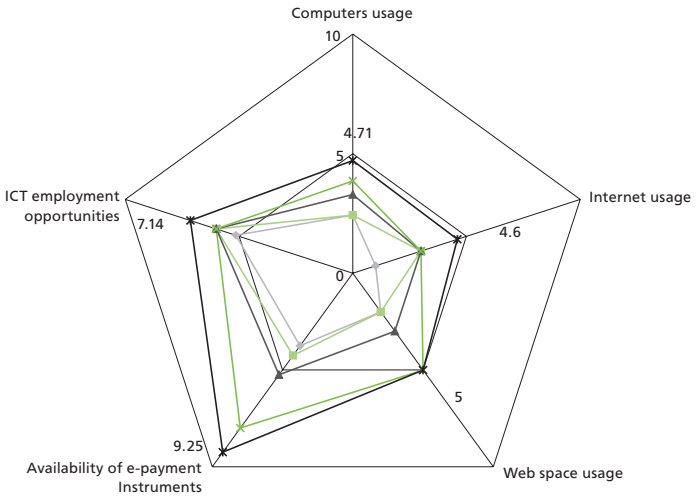
The prevailing technological level of production at Bulgarian SMEs does not require sophisticated ICT. The majority of SMEs are still in a process of equipping their businesses with peripheral devices rather than in an active networking communication as a production factor. **Although a significant share of Bulgarian enterprises use the Internet, it is not utilized to the extent of doing e-business.** Management at Bulgarian enterprises is not prepared enough for doing business in e-networks. The share of personnel with at least basic computer skills is low (an average of 20 % per SME), and the share of employees possessing special IT training, who are the basis of e-business and knowledge economy is even lower (hardly 5 %).

The size of the enterprise is a key factor for the use of computers in the business and their connection to the Internet. The level of Internet use in micro enterprises (with a staff of less than 10 persons) is up to 25-30 percentage points lower compared to the average for Bulgaria. This difference however is steadily decreasing. The level of Internet use at companies with a staff of less than 10 persons has risen two times in recent years and in 2004 almost reached the level of Internet use at companies with a staff of between 11 and 100 persons.

The share of enterprises that use the Internet increased by 10 percentage points from February to August 2004. At some of the smaller enterprises, although access to the Internet is available, it is not utilized to add business value, but rather for personal use.

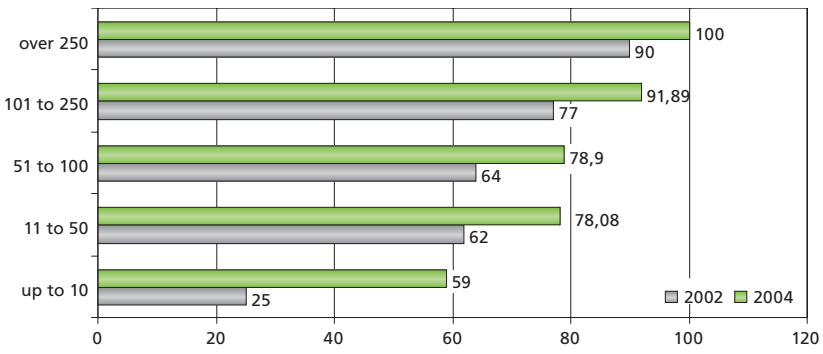
Only 1,33 % of the enterprises in Bulgaria have IT systems for supply chain management, linked automatically with other IT systems[71]. Hardly 4,5% of Bulgarian companies, which possess computers, have any

Figure 74: E-BUSINESS INDEX



Source: *e*-Bulgaria 2005, Applied Research and Communications Fund.

Figure 75: INTERNET CONNECTIVITY IN COMPANIES BY NUMBER OF EMPLOYEES



Source: Vitosha Research (2004).

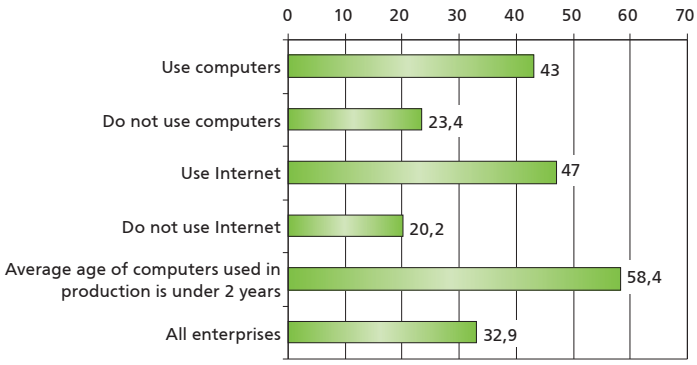
[70] See Section Technology Market and Information Sources of *Innovation.bg*.

[71] Estimates based on a comparison of the data on e-commerce use and ERP system use, Vitosha Research, Business survey „Innovation Potential", August 2004

enterprise resource planning (ERP) system, while only 6,4% have applications for groupware. If only enterprises with 20 or more computers are considered, 19 % of them have ERP systems and 28 % some form of groupware application. The introduction of such information systems in Bulgarian enterprises is induced mostly by interoperability requirements imposed by a parent company or a main commercial partner of the local enterprise, rather than by its quality features or the strengths and weaknesses of the enterprise's currently employed operating systems.

For most enterprises in Bulgaria, the Internet remains just a communication tool – 32,6% of the employed use the Internet for e-mailing, 18,5% for communicating with public institutions, 34,7% for searching information and analyses, rather than online marketing (6,2%) and electronic commerce instrument (4,7%). It is telling that the share of Bulgarian enterprises with websites is about two times lower than that of enterprises with Internet access.

Figure 76: INOVATIVENESS OF BULGARIAN ENTERPRISES BY LEVEL OF ICT USE



Source: Vitosha Research, 2004.

Computer and the Internet use double the probability for a Bulgarian enterprise to innovate. The main challenge for Bulgarian enterprises in the short-term would be to utilize available ICT equipment for reengineering their business processes. **Permanent investing in ICT** (accompanied by keeping the average age of company computers under two years) **is also associated with a considerably higher average degree** (almost double the average for the country) **of innovativeness in Bulgarian enterprises.**

* * *

Bulgaria has already established all main public institutions, necessary for the development and functioning of an effective innovation system. The main challenges for the national innovation policy of the country are linking most effectively public innovation institutions to organizations in the private sector, integrating the national innovation system into the European innovation infrastructure and readjusting the national science and technology system towards the market needs of Bulgarian enterprises. This demands the quick alleviation of existing imbalances in the national innovation system in terms of public sector domination in both R&D expenditure and employment and the remedy of education quality.

Bulgaria has a relatively well-developed science and technology system, which also has abundant R&D personnel at its disposal. The Bulgarian economy has already witnessed the first examples of innovative enterprises, science institutes and intermediary organizations that offer market oriented innovation at a global level. Therefore, the efforts of the public and private innovation institutions in Bulgaria should be directed towards a more efficient support to and spread of similar positive practices. At the same time, public resources allotted to innovation development should be tied tighter to private and/or international co-financing, and their disbursement has to follow stringent quality requirements in correspondence with globally acknowledged methodologies. This requires a closer interconnection between the different national sector strategies and policies on the one side – for example in the fields of environment, quality, defense, etc., and the national innovation strategy and policy on the other within the framework of the country's accession into the EU.

Appendix 1: Notes on Methodology, Information Sources and Definitions

Availability of data, information sources and definitions

Innovation.bg is based on several existing models for measuring and comparing innovation systems:

- The *European Innovation Scoreboard* of the European Commission is an instrument of the Lisbon strategy for economic, social and environmental renewal of the European Union, which compares the innovation systems of EU member and candidate countries to the innovation systems of USA, Japan and the countries of EFTA. The scoreboard aims at coordinating innovation activity at European level and at stimulating innovation and investment in R&D. *Innovation.bg* is an attempt to further develop and adapt that instrument to the specific conditions in Bulgaria, following the example of countries such as Great Britain and Estonia[1] (http://trendchart.cordis.lu/scoreboards/scoreboard2004/index.cfm).
- The *National Innovation Initiative – NII* and the *Index of the Massachusetts Innovation Economy in the USA* monitor the condition of the innovation system in the country and in the state of Massachusetts respectively in an international comparative aspect through an innovation index[2]. The governments of the different states draft their own initiatives for annual benchmarking and strategies for development of their regional innovation systems, most widely recognized of which is the innovation index of the State of Massachusetts (http://www.mtpc.org/institute/the_index.htm);
- *The OECD Science, Technology and Industry Scoreboard 2003* is the most wide-ranging model for comparing science, technology and innovation achievement of OECD member countries. It also depicts the changes in the characteristics and functioning of the innovation process in time (http://www1.oecd.org/publications/e-book/92-2003-04-1-7294/).

Innovation.bg combines five groups of indicators, which describe the national innovation system and its functioning:

1. Gross innovation product.
2. Entrepreneurship and innovation networks.
3. Investment and financing of innovation.
4. Human capital for innovation.
5. Information and communication infrastructure.

Each group contains several synthetic indicators. For them and for naming the above groups *Innovation.bg* uses working definitions, which can differ from similar and more narrow definitions used in innovation literature. In turn, the synthetic indicators comprise a different number of statistical indicators, presented in graphic form. They have been grouped so that they ensure the most thorough idea of the respective component of the national innovation system. The indicators presented in graphic form have been chosen to reflect internationally acknowledged definitions and concepts.

The report uses the term *innovation* in numerous meanings and forms. ***Innovation*** is the marketing of a new or considerably improved idea, good, service, process or practice with the purpose of satisfying a particular need.

EU-25 includes all current (as of 2006) member countries of the EU; ***EU-15*** includes the member states as of January 2004; ***EU-10*** includes the newly

[1] The Estonian Economy, Competitiveness and Future Outlooks: R & D and Innovation Policy Review.

[2] Porter, M. and N. Stern, The Challenge to America's Prosperity: Findings from the Innovation Index, US Council on Competitiveness (1999).

acceded member countries to the EU in April 2004; ***EU-8*** is EU-10, excluding Cyprus and Malta; ***EU-8+2*** is the EU-8 plus Bulgaria and Romania.

Innovation.bg contains statistical and administrative data and data from nationally representative surveys of enterprises, conducted by the sociological and marketing agency Vitosha Research (www.vitosha-research.com). The report uses a number of freely accessible Bulgarian and foreign sources, which in some cases has resulted in differences in time horizons, definitions of the used variables and graphically represented indicators. Wherever possible and appropriate the Internet source of the data used in *Innovation.bg* has been provided in this appendix. Authors cannot guarantee that the links provided here will be the same over time. This appendix summarizes notes, definitions and methodological explanations to the separate chapters. The Applied Research and Communications Fund will annually update the *Innovation.bg* report aiming at making it a reliable and effective instrument for monitoring the Bulgarian national innovation system with respect to public and private innovation policy.

Gross Innovation Product

Innovation product

Every three years the European Commission and Eurostat (the EC's statistical body) conduct the Community Innovation Survey (CIS) – a EU wide survey of enterprises. In 2003 for the first time, a pilot CIS compliant survey was carried out by the National Statistical Institute (NSI) of Bulgaria, and the data derived from it was presented in the beginning of 2005. *Innovation.bg* combines this data with results from a special nationally representative survey of Bulgarian enterprises of the sociological and marketing agency Vitosha Research, contracted by the Innovation Relay Centre (IRC) in Bulgaria in 2004. Vitosha Research has adopted and slightly adjusted the EIS methodology, in order to provide both maximum comparability of the data to the one of Eurostat and NSI and to capture Bulgarian specifics. By 2008 IRC and Vitosha Research will carry out two more nationally representative surveys for Bulgaria. Data from the International Organization for Standardization (ISO) has also been used in the report.

Eurostat and NSI data are accessible on the Internet at: *http://epp.eurostat.cec.eu.int/portal/page?_pageid=0,1136250,0_45572555&_dad=portal&_schema=PORTAL (theme Science and Technology – Science and technology) technology; ISO (http://www.iso.org/iso/en/iso9000-4000/certification/isosurvey.html).*

In all tables and figures in this section, EU-15 excludes Ireland, Luxembourg and Great Britain. Manufacturing is defined to include NACE's sections C to D. Respectively, services comprise NACE subdivision 51, sections I and J, subdivisions 72 and 73 and groups 74.2 and 74.3.

Innovative enterprises are enterprises, which introduce on the market new or considerably improved innovation goods (products and services) or/and innovation processes, including new methods for providing services and channels for marketing goods. Innovation products and processes have to be new for the enterprises themselves, but not for the market they serve. ***Product innovation*** is a good or service, which is new or considerably improved when it comes to its main features, technical specifications, purpose, incorporated software and/or other intangible components. ***Process innovation*** is the adoption of a new or considerably improved production technology, new or considerably improved method for offering services and/or marketing a product. ***Innovation economy*** is used as a synonym of knowledge economy and knowledge-based economy. ***Tacit knowledge*** is obtained through on the job experience and is usually passed on though personal contact.

According to OECD definition ***high-tech sectors*** are: a) the production of medicinal substances and products, b) the production of office and computing technology, c) the production of radio, TV and communication technology, d) the production of aircraft and spacecraft and their engines.

Technological product

The data in this section is taken from the European Patent Office (http://www.european-patent-office.org/index.en.php), the U.S. Patent and Trademark Office (http://www.uspto.gov/) and the Bulgarian Patent Office (http://www.bpo.bg/bg/). Because of the numerous changes in the European patent legislation and the more complicated information service of the European Patent Office, the available primary administrative data on submitted patent

applications and registered patents cannot be used. Therefore, *Innovation.bg* uses secondary data provided by Eurostat:
http://epp.eurostat.cec.eu.int/portal/page?_pageid=0,1136250,0_45572555&_dad=portal&_schema=PORTAL (theme Science and Technology – Science and technology).

Scientific product

The National Science Foundation of the USA provides the most comprehensive and accessible database for internationally comparative information on scientific publications and citations of science literature. It is in turn based on data from the Institute for Scientific Information (USA), Thomson Scientific, and CHI Research. The classification of science areas, according to which CHI Research distributes the scientific publications and quotes, is presented in Appendix 2.

The data from the National Science Foundation is available at:
http://www.nsf.gov/statistics/

Entrepreneurship and Innovation Networks

Entrepreneurship

There is no systematically developed methodology and data on entrepreneurship in Bulgaria. The Bulgarian SMEs Promotion Agency (BSMEPA) is the main source of information on the current state and development perspectives of entrepreneurship and start-ups. The report uses data from NSI and comparative entrepreneurship data from the European Bank for Reconstruction and Development (EBRD).

According to the *Law on Small and Medium Sized Enterprises* (State Gazette, No.84/24.09.1999):

- micro are small enterprises with an average number of payroll employees under 10 persons;
- small are enterprises which: 1) have an average number of payroll employees of under 50 persons and 2) have an annual turnover of up to 5,000,000 BGN or the value of their long term assets is up to 1,000,000 BGN and 3) are independent;
- medium sized are enterprises, which 1) have an average number of payroll employees under 250 persons and 2) have an annual turnover of up to 15,000,000 BGN or the value of their long term assets is up to 8,000,000 BGN and 3) are independent.

The annual reports of BSMEPA are available for download on the Internet at: *http://www.sme.government.bg.*

Innovation networks

Innovation networks in Bulgaria have been studied based on data from sociological surveys: for EU – Community Innovation Survey 1998–2001, published in 2003; for Bulgaria – the nationally representative survey of the sociological and marketing agency Vitosha Research, contracted by the Innovation Relay Centre in Bulgaria in 2004. Vitosha Research has adopted and slightly adjusted the EIS methodology, in order to provide both maximum comparability of the data to the one of Eurostat and NSI and to capture Bulgarian specifics. By 2008 IRC and Vitosha Research will carry out two more nationally representative surveys for Bulgaria.

The data on EU are available on the Internet at:
http://epp.eurostat.cec.eu.int/portal/page?_pageid=0,1136250,0_45572555&_dad=portal&_schema=PORTAL (theme Science and Technology).

Technology market and information sources

In this section, the report uses the same data sources, as in the Innovation networks section.

Innovation Investment and Financing

International transfer of R&D investment

The data on foreign direct investment and import in Bulgaria are provided by the Bulgarian National Bank (BNB) and the United Nations Conference on Trade and Development (UNCTAD).

For the purposes of the economic analysis, the Bulgarian National Bank publishes the tables on Bulgarian ***import*** by end-use. The basic principles in the distribution of the commodities in the respective groups are: purpose of their use and degree of processing. ***Direct investment*** is a category of international investment in which a resident of one economy – a direct investor – acquires a lasting interest (at least 10% of the ordinary shares or the voting power) in an enterprise resident in another economy – a direct investment enterprise. The direct investment includes both the initial transaction, through which the relationship between the direct investor and the direct investment enterprise is established, and all subsequent transactions between them[3]. The data are available on the Internet websites of BNB and UNCTAD:
www.bnb.bg and www.unctad.org (section Statistics).

R&D Investment

Sources of the data for this section are NSI and Eurostat. The data are available on the Internet website of Eurostat, theme Science and Technology:
http://epp.eurostat.cec.eu.int/portal/page?_pageid=0,1136250,0_45572555&_dad=portal&_schema=PORTAL

R&D expenditure includes current expenditure on R&D and expenditure on the acquisition of long term assets, intended for R&D use, which are made by domestic and foreign enterprises in Bulgaria. R&D expenditure is made by various ***economic agents***, classified in four institutional sectors:

(i) The *business enterprise sector* includes all companies and organizations, whose core activity is the production of market goods and services (excluding those included in the *higher education sector*);
(ii) The *government sector* includes public organizations and institutions, which offer, rather than sell, services, which satisfy individual and collective needs of society and which are primarily financed through the state budget (excluding the entities of the *higher education sector*);
(iii) The *higher education sector* includes universities, colleges, higher education institutions, science institutes within higher education institutions and university hospitals;
(iv) The *private non-profit sector* includes private foundations, associations, societies, etc, offering non-profit services.

[3] Source: BNB

R&D expenditure by sources of funds represent financial transfers between the enterprises and the organizations, classified under the above mentioned sectors, as well as through resources, provided from abroad. In this regard, there are five sources of R&D funding: (i) enterprises' revenues; (ii) the state budget (excluding those of the higher education organizations and the university hospitals); (iii) the higher education organizations and university hospitals' budgets; (iv) non-profit organizations' resources (foundations and associations); (v) foreign entities. ***R&D expenditure by type of costs*** is divided into: (i) current R&D costs, which include the costs of materials, external services, personnel and other operating costs. Depreciation costs are not included; (ii) costs on long-term asset acquisitions, intended for carrying out R&D, including the costs for purchasing land, construction costs and purchase costs of buildings, costs of building overhauls and costs of machinery and equipment acquisition. ***R&D expenditure by type of research*** includes: (i) expenditure on *fundamental research*, which comprises experimental and/or theoretical research, whose main purpose is to acquire new knowledge on the essence of phenomena and observed facts. Usually, fundamental research results do not have commercial outputs and are intended for publication in science magazines or to exchange among interested persons and organizations; (ii) expenditure on *applied research*, which comprises indigenous research, carried out with the purpose of acquiring new knowledge, which however is primarily directed towards achieving certain practical aims and tasks; (iii) expenditure on *experimental development*, which comprises systemic explorations, based on available knowledge, derived from science and/or practical experience. The purpose of experimental development is to create new materials, products, and devices; to implement new methods, systems, and services or to improve considerably the already existing ones.

Financing innovation

The data on the level of financial intermediation in Bulgaria is provided by the Bulgarian National Bank. The data on the sources of innovation financing at enterprises has been gathered through a nationally representative survey of the sociological and marketing agency Vitosha Research, commissioned by the Innovation Relay Centre in 2004. The availability of venture capital in the country is an expert estimate of the Applied Research and Communications Fund.

Human Capital for Innovation

Education outcomes, quality of education and lifelong learning

This section uses data from NSI and Eurostat. To put the quality of high school education in Bulgaria in an international perspective the section also employs data from the tests of the International Association for the Evaluation of Educational Achievement (IEA) and the Third International Mathematics and Science Study (TIMSS) in 1995, 1999 and 2003.

The TIMSS results are available on the Internet website of the National Centre for Education Statistics (USA):
http://nces.ed.gov/timss/index.asp

Scientific career, R&D and high-tech employment

This section uses data from NSI and Eurostat. The Eurostat data is available on its Internet website, under the theme Science and Technology:
http://epp.eurostat.cec.eu.int/portal/page?_pageid=0,1136250,0_45572555&_dad=portal&_schema=PORTALhttp://epp.eurostat.cec.eu.int/portal/page?_pageid=0,1136250,0_45572555&_dad=portal&_schema=PORTAL.

R&D personnel includes employees, directly involved with R&D, as well as employees, who provide direct support to R&D (managers, administrators, clerks) working in the country, measured by physical entities or by the equivalent of full employment. Employees who are only indirectly related to R&D, such as guards, doorkeepers, canteen personnel, accountants, cashiers, etc. are not counted. ***R&D personnel by sectors of performance*** follows the same pattern of division as R&D expenditure by sectors of performance, according to the type of enterprise and organization, in which the personnel carry out the R&D activities (see the definitions on the range of the institutional sectors under the R&D expenditure indicator in this appendix). Participation in continuous education, also known as ***lifelong learning***, comprises all forms of education and training – the education in the formal education system, as well as outside the system, participation in organized courses, seminars, conferences, lectures, etc.

Information and Communication Infrastructure

The data, presented in this section, is explained in detail in the *e-Bulgaria 2005* report of the Applied Research and Communications Fund, and can be found on the Internet at:
http://www.bgrazvitie.net/e-Bulgaria/

Appendix 2: Science Literature Classification

Clinical Medicine

Addictive diseases
Allergy
Anesthesiology
Arthritis and rheumatism
Cancer
Cardiovascular system
Dentistry
Dermatology and venereal disease
Endocrinology
Environmental and occupational health
Fertility
Gastroenterology
General and internal medicine
Geriatrics
Hematology
Immunology
Miscellaneous clinical
Nephrology
Neurology and neurosurgery
Obstetrics and gynecology
Ophthalmology
Orthopedics
Otorhinolaryngology
Pathology
Pediatrics
Pharmacology
Pharmacy
Psychiatry
Radiology and nuclear medicine
Respiratory system
Surgery
Tropical medicine
Urology
Veterinary medicine

Biomedical Research

Anatomy and morphology
Biochemistry and molecular biology
Biomedical engineering
Biophysics
Cell biology, cytology, and histology
Embryology
Genetics and heredity
General biomedical research
Microbiology
Microscopy
Miscellaneous biomedical research
Eastern Europe/Central Asia
Parasitology
Physiology
Virology
Nuclear technology
Operations research and management

Biology

Agriculture and food science
Botany
Dairy and animal science
Ecology
Entomology
General biology
General zoology
Marine and hydrobiology
Miscellaneous biology
Miscellaneous zoology

Chemistry

Analytical chemistry
Applied chemistry
General chemistry
Inorganic and nuclear chemistry
Organic chemistry
Physical chemistry
Polymers

Physics

Acoustics
Applied physics
Chemical physics
Fluids and plasmas
General physics
Miscellaneous physics
Nuclear and particle physics
Optics
Solid state physics

Earth and Space Sciences

Astronomy and astrophysics
Earth and planetary science
Environmental science
Geology
Meteorology and atmospheric sciences
Oceanography and limnology

Engineering and Technologies

Aerospace technology
Chemical engineering
Civil engineering
Computers
Electrical and electronics engineering
General engineering
Industrial engineering
Materials science
Mechanical engineering
Metals and metallurgy
Miscellaneous engineering and technology

Mathematics

Applied mathematics
General mathematics
Miscellaneous mathematics
Probability and statistics

Psychology

Behavioral and comparative psychology
Clinical psychology
Developmental and child psychology
Experimental psychology
General psychology
Human factors
Miscellaneous psychology
Psychoanalysis
Social psychology

Social Sciences

Anthropology and archaeology
Area studies
Criminology
Demography
Economics
General social sciences
Geography and regional science
International relations
Miscellaneous social sciences
Planning and urban studies
Political science and public administration
Science studies
Sociology

Health Sciences

Gerontology and aging
Health policy and services
Nursing
Public health
Rehabilitation
Social studies of medicine
Speech/language pathology and audiology

Professional Fields

Communication
Education
Information and library science
Law
Management and business
Miscellaneous professional fields
Social work

Source: Institute for Scientific Information, Science Citation Index and Social Sciences Citation Index; and CHI Research, Inc. *Science & Engineering Indicators – 2004*.

Appendix 3: Additional Data

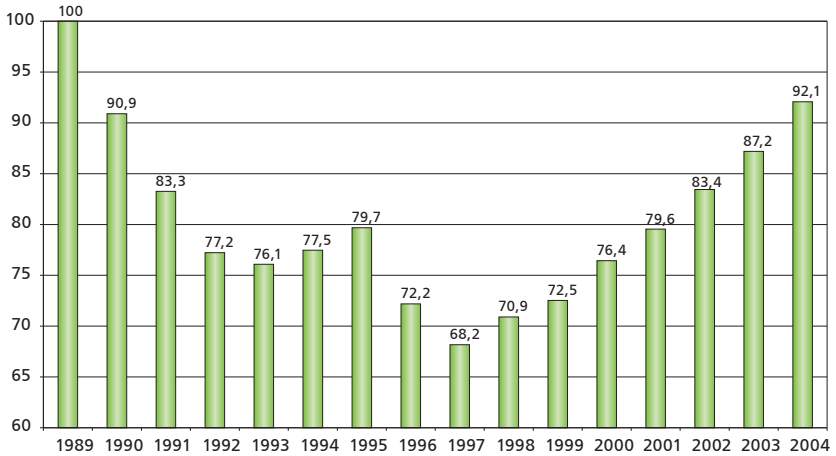
Table 1.1.: MAIN MACROECONOMIC INDICATORS FOR BULGARIA

Item/Year		2000	2001	2002	2003	2004
GDP, current prices (million EUR)		13679,00	15190,00	16533,00	17663,00	19433,00
Real GDR annual growth (%)		5,40	4,10	4,90	4,50	5,60
Investment (% GDP)		15,70	18,20	18,30	19,40	20,90
Inflation (CPI year end, %)		11,30	4,80	3,80	5,60	4,00
Population economic activity (%)		50,40	49,70	50,60	52,50	54,20
Employment (%)		60,70	62,50	61,90	60,90	61,80
Unemployment (% of workforce)		16,40	19,20	17,80	13,60	11,90
Budget cash balance (% GDP)		-0,60	-0,60	-0,60	0,00	1,70
Currant account balance	million EUR	-761,00	-1102,00	-926,00	-1630,00	-1447,00
	% GDP	-5,60	-7,30	-5,60	-9,20	-7,40
FDI	million EUR	1103,00	903,00	980,00	1851,00	2114,00
	% GDP	8,10	5,90	5,90	10,50	10,90
Internal credit stock	million EUR	2557,00	3172,00	3917,00	5241,00	7041,00
	% GDP	18,70	20,90	23,70	29,70	36,20
Labor productivity (annual growth rate, %)		9,20	4,49	4,52	-1,75	3,28
Real wage (annual growth rate, %)		1,20	-0,40	1,40	3,60	3,90
Goverment debt (% om GDP)		73,60	66,20	54,00	46,30	38,80

Note: Data on economic activity and employment refers to the population, aged 15 – 64.

Source: AEAF, BNB, Eurostat, NSI

Figure 1.1.: TRANSITION RECESSION IN BULGARIA (GDP INDEX, 1990 = 100)



Source: Agency for Economic Analyses and Forecasting (AEAF), NSI, own estimates

Figure 1.2.: GDP per capita in selected new EU member states and Bulgaria (purchasing power standard; EU 25 = 100)

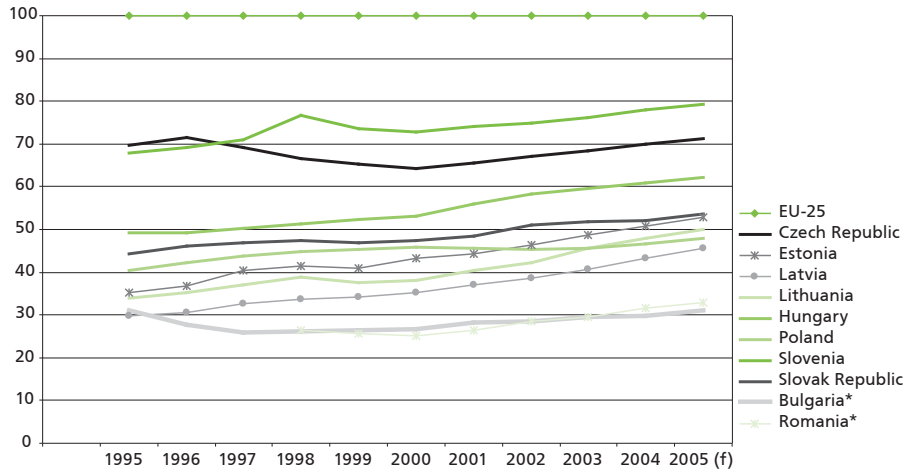
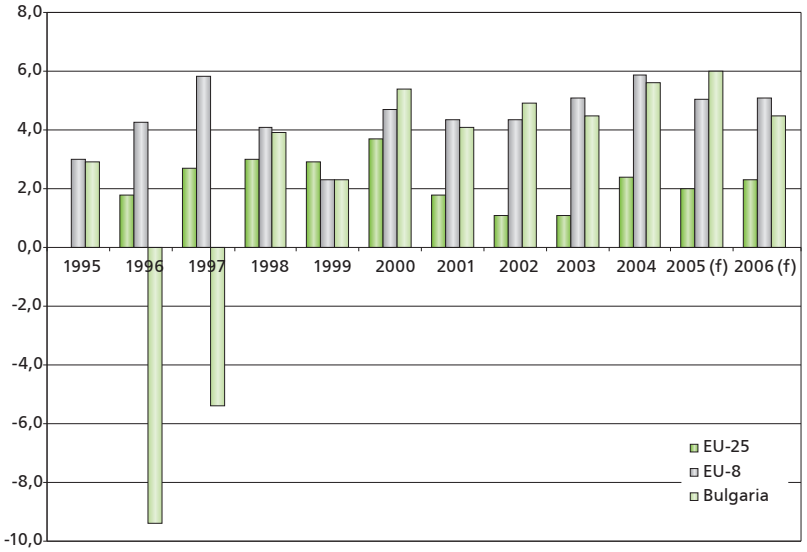
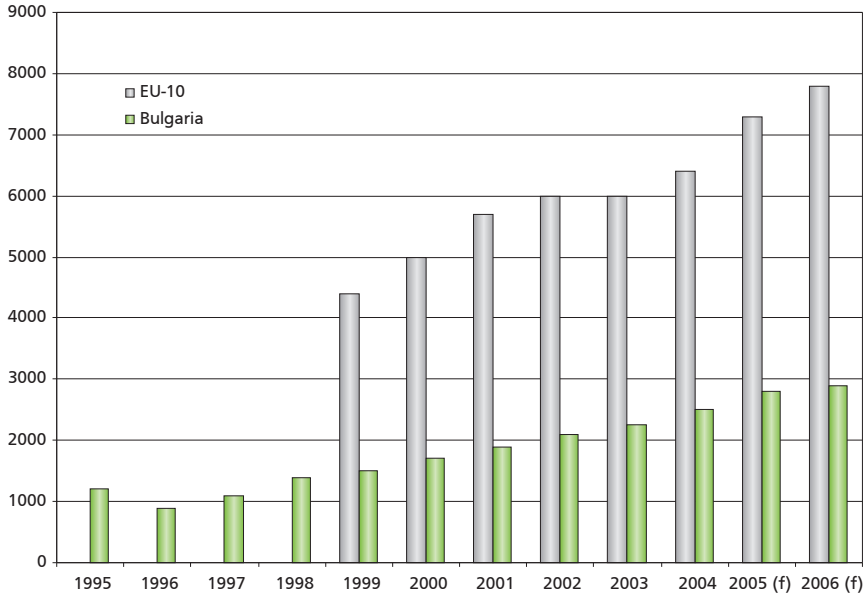


Figure 1.3.: Real annual GDP growth in EU-25, EU-8 and Bulgaria (1995 – 2006)



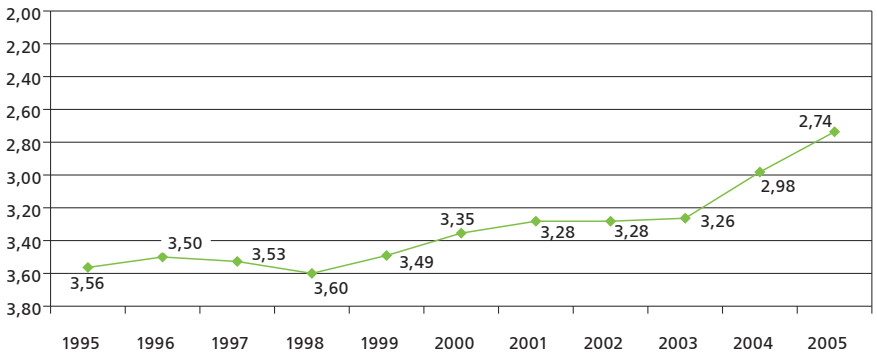
Note: Real GDP growth for EU-8 is the average of real GDP growth in the separate economies

Figure 1.4.: GDP per capita in euro in EU-10 and Bulgaria (1995 – 2006)



Source: Eurostat

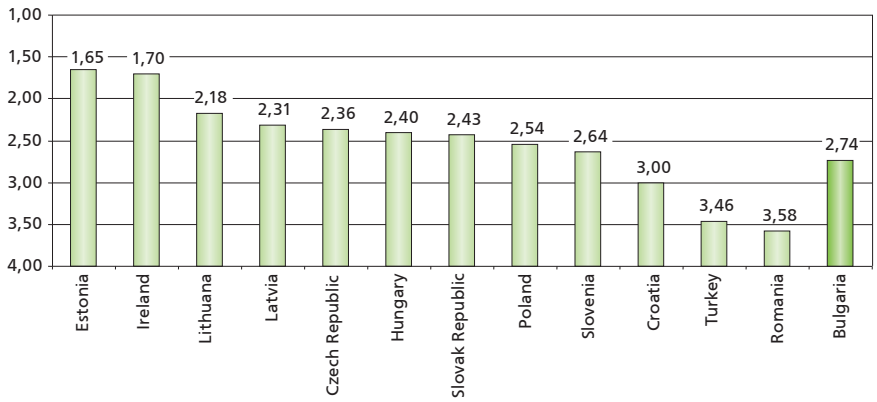
Figure 1.5.: Index of economic freedom for Bulgaria (1995 – 2005)



Note: Economically free countries – score under 1.99 on a scale of 1 to 5

Source: The Heritage Foundation

Figure 1.6.: Index of economic freedom – selected European countries



Note: Economically free countries – score under 1,99 on a scale of 1 to 5

Source: The Heritage Foundation

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