ACOMPETITIVE ADVANTAGES OF ADOPTING BIOTECHNOLOGICAL INNOVATIONS

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Abstract: *The underexploited potential of the national economy results in a low standard of living and a poor investment environment. Due to the current condition of economic processes, Bulgaria ranks at the bottom in terms of its GDP compared to other EU member-states and is one of the countries with the fastest declining population in the world. Low competitiveness and innovativeness of Bulgarian enterprises underlie the lack of any serious economic progress. This finding is true even for the economic spheres which contemporary biotechnological innovations are based on and in which our country has real advantages in terms of its natural resources and climate. The objective of this research paper is to analyse the main economic aspects of Life sciences and to present some major European accomplishments and partnerships in the pursuit of competitive advantages by enterprises operating in the sphere of biotechnologies.*

Key words: *Life sciences; biotechnological innovations; quality of the living environment; competitiveness.*

JEL: *Q57, O32, L21.*

Introduction

Life sciences and the biotechnology industry are defined as 'the application of science and technology to living organisms as well as parts, products and models thereof, to alter living or non-living materials for the production of knowledge, goods and services' (OECD, 2018, Commission of the European Communities, 2007). Life sciences and biotechnologies develop in several different fields that are labelled with different colours, i.e. red, green and white biotechnologies, in order to distinguish between the areas they are applied to.

The term 'Red biotechnology' refers to applying genetic engineering and other scientific achievements in the use of living organisms (micro-organisms) for

the purpose of developing new medical products and healthcare methods to improve the quality of life (Markova, 2007, p. 59).

Green biotechnology is a new expanding field of modern biotechnologies. It refers to applying biotechnologies to economically significant varieties of plants in order to produce new crop varieties or improve existing ones (Markova, 2007, p. 83).

White biotechnology refers to applying biotechnology to industrial production. It is based on the use of molds, bacteria, micro-organisms and enzymes in the production of goods and services (Markova, 2007, p. 107).

Life sciences are the basis for the development of industrial production in economic areas such as healthcare and pharmaceuticals; processing industry and agri-food industry. Production practices which are based on biotechnologies contribute to improved healthcare and better quality of life. Over the last years, the EU has actively been seeking to encourage the use of alternative energy resources in bio-economics.[1]

Research work in the sphere of life sciences goes beyond the development of national economies. The significance of life sciences must be approached from a global perspective, that is, in terms of their contribution to the development of global economy, employment, incomes, and improving the quality of the living environment.

The issues that are subject to analysis in this paper are rendered crucial by the economic significance of biotechnological innovations. On the one hand, they affect the development of Bulgarian companies whose production is based on biotechnologies. On the other hand, biotechnological innovations have an immediate impact on the overall economic development of the country in terms of the contemporary requirements for ensuring a sustainable high-quality living environment.

The thesis we define for this research is that Bulgaria has an enormous variety of natural resources that are the primary raw materials which bio-industrial enterprises use in their production. At the same time, the development of bio-based production, research and development, and the establishment of partnerships between the participants in the bio-technological eco system are significantly lagging behind. One of the major tasks of this research, therefore, is to review the major economic fields to which Life sciences are applied, since they underlie bio-industrial development, and successful practices on the Old Continent in terms of putting bio-technological innovations into practice. In our opinion, regardless of the specific features of different economic environments, the conditions for developing bio-industries are universal in nature and good awareness about them is essential for actively employing and developing such innovations in Bulgarian economic environment.

[1] Biofuels have certain natural advantages – they are renewable, their use contributes to reducing the emissions of greenhouse gases and to increasing the EU's energy security, my note.

1. Major Spheres of Developing Bio-technological Innovations

A key aspect of biotechnological innovations is their application in the industrial production that is related to public healthcare. One of the major features of the activity of enterprises operating in the healthcare sector is their focus on pharmaceutics. A biotechnology may be defined as a processing technology whose end product is not biological, but a chemical one, and whose results are widely applied in the pharmaceutical sector (Commission of the European Communities, 2007). Hence, the essential role of Life sciences and bioindustry in dealing with challenges such as the ageing of the population or fighting potential pandemics. Other prospective applications of biotechnological industries and research are genomics and genetic research, including the so-called 'advanced therapies' that refer to tissue engineering, gene and cell therapies, and nanomedicine. Industrial biotechnologies are another issue that has attracted a lot of attention. There has been an upward trend in their development since the beginning of the 21st century as they offer an alternative to chemical technological processes and fossil fuels and have enormous potential in terms of their long-term economic and environmental benefits. A case in point is the fact that switching from chemical to biotechnological methods in the production of a group of commonly used antibiotics resulted in reducing the consumption of electricity by 37%, of solvents – by nearly 100% and a 90% decline in the quantity of waste water (Commission of the European Communities, 2007). We should note, though, that the implementation of biotechnological practices in production is much below the capacity of European industry. In addition to insufficient funding which European enterprises regularly point out, another factor that hinders the more dynamic growth in the market application of biotechnologies is the slow transfer of technologies.[2] Two other fields of application of biotechnological innovations are primary production and the agri-food industry. Biotechnologies have a number of modern applications in primary production and in the agri-food industry which, although less obvious, are essential to the economy, to the environment and to public health.

Nowadays, biotechnological production is mainly used in the so-called 'input' sectors of the economy that relate primarily to animal breeding, diagnostics, production of fine chemicals (animal food additives) and coenzymes (Commission of the European Communities, 2007). The results are different products for diagnostics, veterinary medicine and vaccines that are of key significance to the treatment, control and monitoring of some of the most serious diseases that afflict animals.

[2] The technology transfer may be defined as the movement (diffusion) of information, ideas, knowledge and know-how from R&D centres to innovator enterprises and vice versa. Scientific achievements and inventions are put into practice through technology transfer, my note.

The economic benefits from using biotechnologies go beyond their economic application. Biotechnologies are also used to select or improve specific characteristics of species. Examples include modified plants that are highly resilient to sharp changes in weather and have high production yield. We should note, though, that it is necessary to make accurate assessments and apply strict legal regulations to reduce the risks of using genetically modified plants and animals (GMOs) and prevent any potential harm on human health as a result of using them.

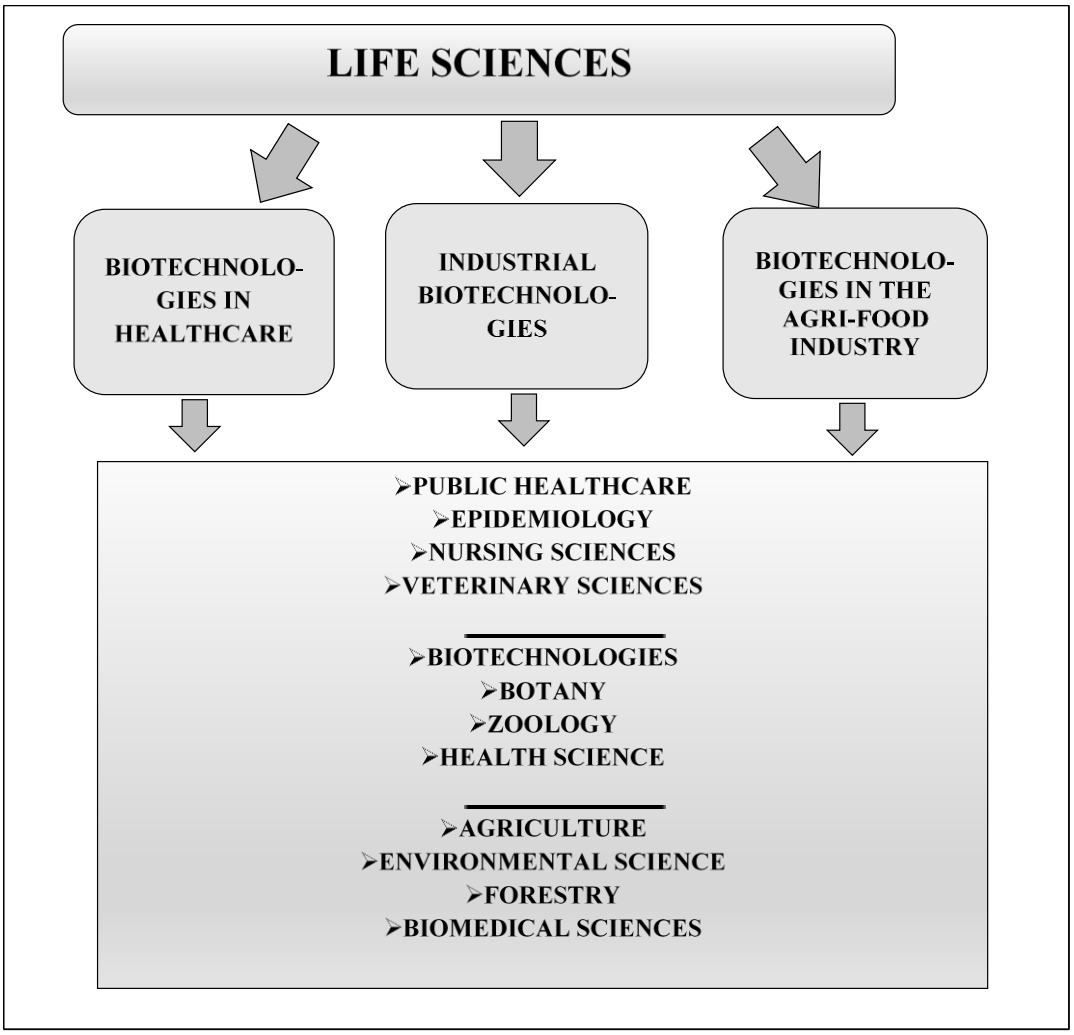

Figure 1. Economic application of Life sciences
Source: Research conducted by the author

2. Life Sciences and the Biotechnology Industry in Europe

Europe is the continent where biotechnological productions have a comparatively favourable environment for development. Although the global economic leader, the USA, are also leaders in biotechnological production, the Old Continent has well established traditions and years of successful experience in the implementation of innovation-related practices and centralized policies. Over the last years, there have been considerable accomplishments in a number of practical developments that are based on biotechnologies in different economic spheres, especially in healthcare, in the agrarian sector, and in the food industry. Those spheres develop rapidly and offer a huge potential for the further development of many European enterprises and their production competitiveness, which accounts for the intense interest in biotechnologies on the continent.

Europe's industrial image has been changing dynamically over the last three decades due to the increasing number of enterprises that have started to employ the achievements of Life sciences and biotechnological innovations. This has produced positive results in a wide range of bio-based products and raw materials that are successfully sold across the globe. Accumulated knowledge and expertise in the field contribute to exploiting more efficiently that potential on a European and a global scale, including in terms of raising the economic potential and improving the quality of the living environment in countries with less developed economies. Therefore, the European Council (EC) and the European Parliament (EP) assigned the European Commission to develop a draft strategy for counteracting potential challenges and risks and efficiently benefiting from newly arising opportunities for social and economic development. The strategy was designed on the basis of Life sciences and biotechnologies and was adopted by the Commission in 2002. It includes thirty specific actions that were to be implemented by 2010, with the provision that the timeframe for their implementation could be extended to 2020. This was the first strategy adopted at an EU level. Initially, the strategy was designed to cover a wide range of opportunities and measures for promoting the adoption of biotechnologies by EU member states in different sectors of the economy. Planned measures referred to actions in four specific areas: (1) harnessing the existing research, financial, etc. potential; (2) promoting the better management of biotechnological projects (through social dialogue, ethical compliance); (3) meeting global challenges (promoting scientific collaboration with developing countries) and (4) ensuring a high level of coherence in the whole range of related policies (COM (2002) 27, 23.1.2002).

Although central European institutions have been working seriously to accomplish these objectives, in our opinion, most of the results that have been achieved so far relate to the activity of research and development centres and project teams in innovator enterprises. One of the major issues for Bulgarian enterprises seeking innovative solutions in terms of the economic applications of

Life sciences is the access to successful practices of the leaders in the development of biotechnologies. The next part of the research paper will therefore review some of those practices, the objective of the review being to identify their contribution to the economic development of the continent and to analyse the overall implementation of those practices in a highly competitive environment.

2.1. European Practices for Smart Growth in Biotechnologies

There are two major reasons for life sciences and biotechnologies to be on the European agenda – they create prerequisites for long-term economic growth, stable employment and high incomes through the sustainable development of a number of economic sectors and subsectors and provide opportunities for improving the quality of the living environment. Despite the success achieved so far by using newly developed products of better quality, there have been a number of challenges to the development of the biotechnology industry in Europe. They relate to intense global competition; ongoing reforms in public healthcare to reduce public expenses and to improve the access to health services; rising research and development (R&D) costs; strict government regulations and higher investment risk which complicate access to project funding and weaken the motivation of individual and institutional investors. Hence the effort of businesses to seek various alternatives for optimizing their activity. One of the solutions is the establishment of partnerships between scientific centres and business organisations in a similar line of business, since such partnerships contribute to enhancing the transfer of knowledge, ideas and innovations, and substantially reducing the risk related to innovations in bioindustry by sharing it.

European countries that are leaders in innovations have realized the mutual benefits from log-term collaboration between partners creating an investment environment that is based on biotechnologies. On the one hand, it is in the interest of business organisations and project investors to fund scientific research and development, since this creates favourable prospects for the long-term development of research and development centres. Governments, on the other hand, also benefit from that partnership between businesses and science centers, since bio-industrial enterprises create jobs, generate incomes and revenue to the budget, and on a macro-economic level bio-industry is predicted to become increasingly important to global economic growth.

In terms of industry, biotechnological and pharmaceutical companies and equity investors [3] are the major players in identifying new opportunities for

[3] Risk equity investors are individual (wealthy persons – business angels; friends; family investors) and institutional investors (companies specializing in funding - Venture capital funds; SWORD - Stock and Warrant Off-Balance Sheet R&D companies) that provide project funding and expert consulting at each stage of the innovation project implementation in exchange for gaining a share of the enterprise equity, my note.

establishing strategic alliances and relationships. Risk capital has a major role in acquiring shares of ownership in enterprises that operate in the biotechnology sector. Furthermore, the economic application of the achievements of Life sciences in leading European countries is promoted as a result of that partnership with risk equity capital.

2.2. Development of Red Biotechnologies – the Healthcare Sector

Red biotechnology, which is based on genetic engineering and scientific accomplishments in using microorganisms to develop new products and methods for improving human healthcare and the quality of living, is one of the major economic bio-industrial applications of Life sciences that have been developing extremely dynamically on a global scale for more than two decades. Enterprises that speciliase in healthcare are predominantly medium-sized and large companies. Hence, the establishment of long-term partnerships with universities, science centres and hospitals is essential to the development of the sector, since it is larger business entities that have the capacity to fund and implement scientific research projects as a result of which improved and newly developed health products are launched on the market.

The European Innovative Medicines Initiative (IMI) is one of the sources for successfully implementing projects in the field of medicine. It is a plan for long-term partnership between the EU and the pharmaceutical industry in Europe whose major objective is to promote open collaboration in scientific research in order to advance developments and improve patient access to personalized medicines.[4] The aim of the Initiave is to improve human health by speeding up the development of, and patient access to, innovative medicines, particularly in areas where the quality of health service is unsatisfactory. The focus of the Initiative is on facilitating the collaboration between the key players in health research and healthcare practice, including universities, research centres, pharmaceutical and other related industries, small and medium-sized enterprises, patient organisations and medicine regulators. The IMI is the world's biggest public-private partnership (PPP) in the sphere of healthcare. This fact is supported by the enormous budget that has been allocated for innovative health projects for the 2014-2020 period, the sum amounting to EUR 3.3 billion (IMI, 2013).

Figure 2 presents the parties in the partnerships established under the IMI. As the figure indicates, R&D centres and universities are a key player, since they are the driving force of innovations and projects in the sphere of biotechnologies.

[4] Those are medical products developed for a particular client, by taking into account the specifics of their organism and disease, my note.

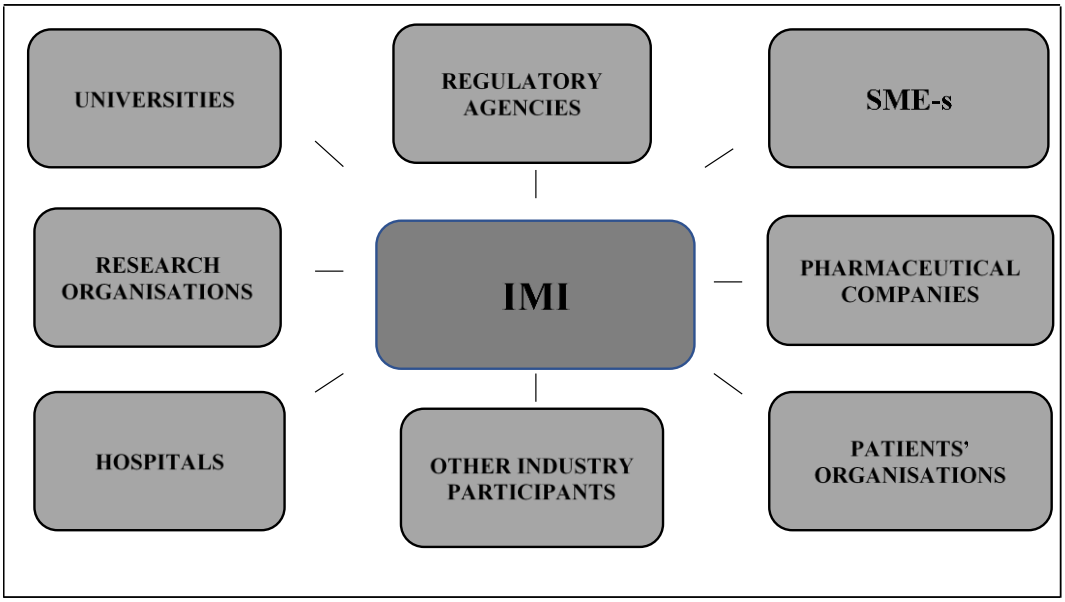

Figure 2. Economic application of Life sciences
Source: Research conducted by the author

The Innovative Medicine Initiative is expected to create new opportunities for developing biotechnologies in immunological, respiratory, neurological and neurodegenerative medicine. An example of some significant achievements that have already been made due to the implementation of the Initiative is the first genetically engineered human pancreatic β-cell line that can survive in vitro and is expected to play a key role in diabetes research in future. The innovation was made by the French biotechnology company 'Endocells' in collaboration with academic entities (IMI, 2013).

Another notable example is the Collaboration on the Optimisation of Macromolecular Pharmaceutical to Cellular Targets, the COMPACT[5] project, which inspires opening new prospects for the development of pharmaceutical companies in Europe. The objective of the project is to encourage research for developing innovative medicines based on biological macro-molecules, such as protein/peptide nucleic acids (ribonucleic acid) (COMPACT, January 2014).

In addition to healthcare, red biotechnologies contribute to the prospects for European growth based on the economic applications of Life sciences, since they also relate to the development of white biotechnology and similar bio-based industries. More specifically, this applies to the sustainable transformation of renewable resources into bio-based products or biofuels to gradually replace non-renewable energy resources since their industrial and household consumption results in the emission of harmful substances in the air and their

[5] Collaboration on the Optimization of Macromolecular Pharmaceutical Access to Cellular Targets, my note.

extraction leads to changes in the geographical relief, pollution of agricultural land, waste accumulation at quarries, soil degradation and erosion, etc.

2.3. Joint Initiatives for Developing Biotechnologies through Public Private Partnerships

An outstanding example of a public private partnership in bio-industry is British practice where a number of innovative biotechnology projects have been implemented successfully in various spheres of the economy through PPP funding. A good case in point is the activity of the 'Welcome Trust' research charity, which provided initial capital of GBP 200 million to 'Syncona'[6], thus enabling the company to invest a substantial financial resource (including its own contribution) into healthcare business and innovative technologies (Wellcome Trust, media release, 3 January 2013). The portfolio of the company is made up of a small group of enterprises (mainly healthcare companies whose number is less than 20) which deliver a wide range of healthcare services to their customers. The company applies a highly selective approach to its beneficiaries. The major criteria in the process of selecting an alternative innovative project is the quality of the healthcare services provided by the healthcare establishments and innovative spheres of health science and practice which focus on applied medical science. As a result of that substantial funding, the company is able to acquire shares of other companies (as a rule, between 20 and 30% of their equity) which raises further managers' commitment to directly contribute to research and development with ideas, contacts with other centres, etc. This renders invested capital more profitable and raises the worth of acquired shares. At the end of the investment period, the cost of the initial investment is covered by selling acquired shares to an outside investor or through redemption of its own shares.

The Biomedical Catalyst (BMC) is another example of successful collaboration between the public and the private sector in the sphere of biotechnologies. As a result of implementing the funding programme of the Technology Strategy Board (TSB) and the Medical Research Council (MRC) in Great Britain, a financial resource of GBP 180 million has been ensured. The programme is unique since it is designed to attract private entities, individual investors, and thus provide funds in collaboration with the Government. The initiative is open to academic scientific circles and to businesses, and aims at supporting scientific and practical activity in pharmaceutics, diagnostics and mobile healthcare. To this end, the organisation provides various grants to bio-industrial companies at different stages of project executions – from seed funding

[6] The company specializes in the sector of healthcare services in close collaboration with universities and R&D centres in Great Britain, author's note.

(at the early stages of project implementation) to bridge funding (at the later stages of project implementation).[7]

2.4. Development of Biotechnology Innovations Based on Clusters

Clusters represent a type of cooperation between potential partners from interrelated industries, their major objective being to improve the overall production and commercial performance of the enterprises from a particular economic sector. Clusters may also be defined as a self-organised production system in which participants cooperate along vertical and horizontal 'chains' to generate additional value added and to raise their competitiveness (Dan, 2012). They are groups of enterprises that have already established some partnership relations. What brings them together are similar innovations, design, quality, product development and marketing. A major factor to the establishment of clusters are the incentives for the development of assets, technologies, infrastructure or joint investment projects that are in most cases beyond the potential of a single enterprise, regardless of its capacity or scale of production.

Biotechnology clusters play a crucial role in the development of business sectors that are based on Life sciences. They contribute to industry growth and development in Europe by providing platforms for academia, industry, policy makers and investors platforms to interact and collaborate through the exchange of knowledge and experience. Practical outcomes and benefits from the existence of biotechnology clusters are in five major aspects – improved potential for innovation, commercialization, creation of spin-offs and start-ups,[8] funding and investment attraction, business development opportunities.

Biotechnology clusters in Europe are typically concentrated in Central and North Eastern regions and countries (see Figure 3). Those are countries with established traditions in Life sciences and biotechnology research and industry activity such as pharmaceuticals, chemicals, agri-production, and medical technologies. At present, the leading biotechnology companies that operate in the Healthcare sector are located in Belgium, Denmark, France, Germany, Sweden, Switzerland, Great Britain, Italy, Spain and Austria (Mizuho Industry Focus, 2018).

[7] See more on: https://mrc.ukri.org/funding/science-areas/translation/biomedical-catalyst/

[8] We should note the relationship which exists between the development of entrepreneurship in the sphere of biotechnologies and the geographical location of clusters in the branch illustrated in Figure 3.

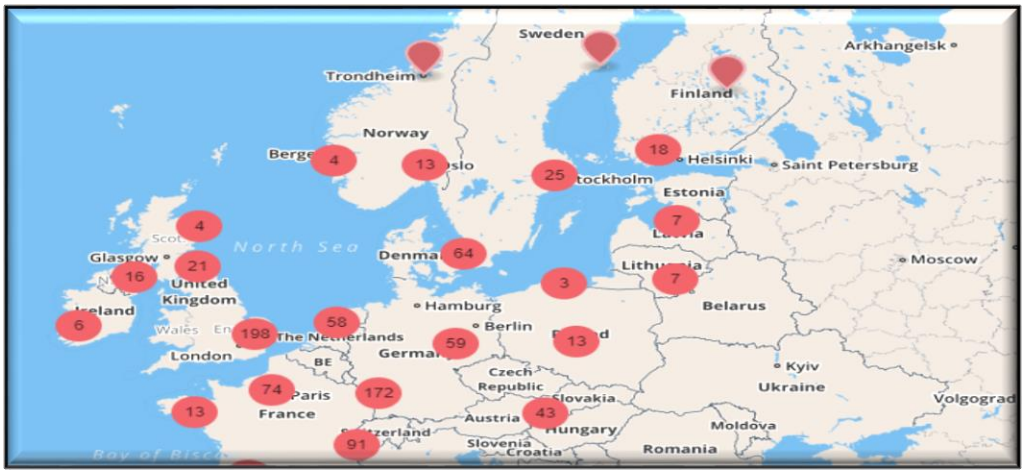

Figure 3. Geographical distribution of biotechnology clusters in Europe in 2018
Source: research conducted by the author.

2.5. Partnerships Between Biotechnology Companies and the Pharmaceutical Industry

Biotechnologies are essential to the development of new medicines and the improvement of already existing ones. This is confirmed by the fact that by the end of 2018, sales of biotechnology products in the healthcare sector accounted for 25% of the global pharmaceutical market (Evaluate Pharma, 2018). It should be noted that the research and development which are the result of establishing and developing long-term partnerships between biotechnology companies and the pharmaceutical industry shifts the focus of attention to the pursuit of high economic performance through increasing and expanding contacts between R&D units and businesses and sharing the risks that are inherent to the activity. The process is of mutual benefit since biotechnology companies are largely dependent on public grants and private funding of innovations by private investors and pharmaceutical companies, while successful practices increase the worth of enterprises and their equity. Typical partnership models include intellectual property (IP) sharing, co-development, in/out-licensing, joint ventures, investment, mergers and acquisitions (M&As).

A notable trend that has occurred as a result of long-term partnerships between biotechnology companies and pharmaceutical companies, is the growing number of investors in Life sciences and biotechnologies projects who shift their interests from earlier stage pipelines toward later stage companies (see Figure 4). This shift of focus can be accounted for by the lower risk and uncertainty that are inherent to such projects, as well as the consequences of the 2007 financial and economic crisis that led to the failure of a number of individual and institutional investors. In our opinion, if the positive trend in the development

of the global economy is preserved in the medium term and there are no major risks of a long-term global recession, it would be realistic to predict that more substantial financial resources will be re-allocated to early-stage innovation projects and pharmaceutical companies with an insignificant market share. One example of an early-stage venture firm is the risk investment company 'Merck Ventures'. The portfolio of the company consists mainly of small companies, including start-ups, that specialize in the production of medicines through biotechnologies. The company is a market leader and has contributed to the establishment of long-term collaboration between R&D and the pharmaceutical industry, thus providing the opportunity for the development of a number of highly successful medicinal products.[9]

Figure 4 presents the findings of an analysis of equity investments in Life sciences and biotechnologies in Europe according to the stage of development of innovator enterprises. The conducted analysis refers to the period from 2008 to 2010 and to the year 2018.

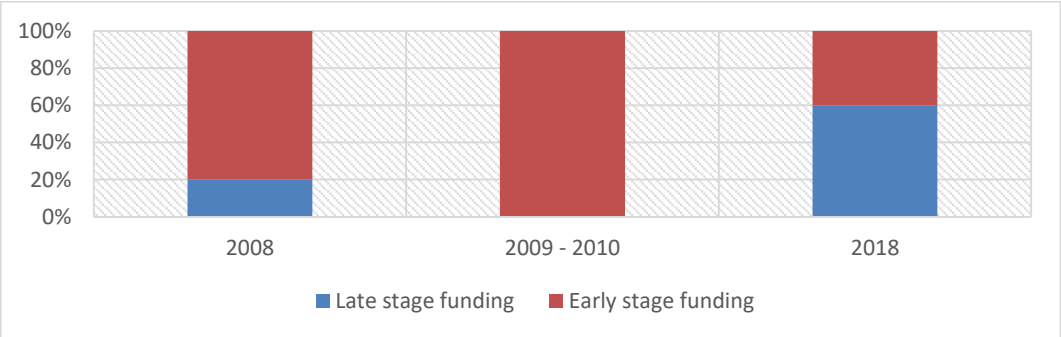

Figure 4. Funding of biotechnology projects in Europe according to the stage of development of innovator enterprises
Source: Mizuho Bank analysis on Ernst & Young (EY), 2014, Research conducted by the author.

Data presented by the research of the Japanese Investment Bank are indicative of the correlation between the global economic environment and the trend in global economic development and the interest of equity investors in biotechnological projects of start-ups and companies with long traditions, history and successful production practices.

[9] The risk investment company 'Merck Ventures' has a budget of EUR 300 million for projects in Healthcare and Life sciences. Specialised investment teams in the company work in areas that of strategic importance to Merck's core business, including the production of a new generation of medicines in the sphere of oncology, immunology and immuno-oncology; equipment and services for biotechnological research; and new business areas, such as digital medicine, my note.

3. The Market of Biotechnologies in Bulgaria

A major characteristic of Bulgarian economy is its low innovativeness when compared to the EU average. Despite the low percentage of total annual expenditure on R&D (0.78% of the GDP for the year 2017, in contrast to the set goal that government expenditure on innovation development should amount to 2% of the GDP by the year 2020), there are certain grounds for optimism for the Healthcare sector which, alongside technical and natural sciences, accounts for the major share of R&D expenses in the country.

A research we conducted established that by the end of 2018, the number of biotechnology companies in the country was 81, and the number of employees working in them – 581, i.e. the average number of employees in an enterprise was 7 people. The total turnover of enterprises amounted to EUR 3.4 million at the end of the third quarter (ME, 15 October 2018).

Table 1
Summarised data about the biotechnologies market in the country for the year 2018.

R&D in biotechnologies	Turnover (in mln. EUR)	Enterprises (number)	Employees (number)	Average number of employees in a company (number)
	3.4	81	581	7

Source: ME, 2018, Research conducted by the author.

Despite its limited scope, biotechnological production in the country accounts for a relatively high share of production. Contemporary achievements in the development of biotechnologies, technologies and science contribute to the development of a number of economic sectors like the production of lactic acid products (where lactic acid bacteria and enzymes are used to produce yoghourt, sour cream butter and a variety of cheeses); brewing (the major substrate that is used are germinated barley grains (malted barley), and Saccharomyces yeast cultures are used to start the process of fermentation); wine and liquor production (where products rich in carbohydrates are used as a substrate and are transformed into alcohol by adding highly productive Saccharomyces genus); production of vinegar that is based on the use of substrates containing alcohol to which selected acetic acid bacteria are added; production and use of bread yeast (single celled fungi). In addition to bread yeast, hydrolytic enzymes like amylase, cellulase and lipase are also used in the production of some breads and bakery products; production of bio fertilizers and

bio insecticide products (Ministry of Economy, Innovation Strategy for Smart Specialisation of the Republic of Bulgaria 2014-2020).

A more detailed analysis of the development of innovative biotechnology projects in our country is a serious challenge. One of the major reasons is that research and development in the sphere of Life sciences and biotechnologies in Bulgaria is extremely limited. According to the findings of this research, in 2018, most of the employees in the field (a total of 581 people) were working in enterprises whose staff did not exceed 7 people, i.e. in micro- and small enterprises. This indicates the limited staff capacity for developing innovative projects as well as the lack of significant potential to attract funds, including from local commercial banks which are the primary source of funds for project implementation in the country.

At present, there are several sources that could provide funds for developing innovative biotechnology projects in Bulgaria. Those are the InnovFin financial tools; the EU Research and Innovation Programme 'Horizon 2020'; the Fund Manager of Financial Instruments (the Fund of Funds) that was established to provide financial support to scientific research; the Jeremie instrument; specialised venture capital funds (VC funds). This exhausts the options of financial support for R&D not only in the sphere of biotechnologies, but also for any innovative projects at a national level. The lack of any major achievements in the development of innovative biotechnology projects is supported by the fact that the total turnover of innovator enterprises in the country in 2018 was as little as EUR 3.4 million. There were no foreign purchases of local enterprises assets, which implies that there were no innovative projects designed to improve existing products or to develop new ones based on the achievements of biotechnologies. Bulgaria, therefore, has a very weak presence in terms of innovations on the European map and qualifies in the group of 'Modest Innovators' (Eurostat, European Innovation Scoreboard Interactive Tool, 2019). There are still some positive indications, mainly in terms of creating legal opportunities for practical research in the sphere of innovations, including that of biotechnologies. University science centres can create intellectual products and then sell them. To this end, university units will be allowed to establish companies whose activity will put into practice the results of their research, thus stimulating the creativity of research teams involved in different projects. Higher schools will be allowed to invest in companies whose line of business is one of these aspects:

- Research, development and implementation of scientific products, innovative ideas, industrial research and development of new products and technologies;
- Adoption and sale of scientific research products, including the delivery or design of equipment for producing innovative products and intellectual property items, as well as national and international registration of patents and trademarks;
- Innovative intermediation for knowledge and technology transfer between technological centres and technological parks.

The draft proposal of the Ministry of Education and Science also provides that higher schools shall be authorized to have ownership in the companies with a minimum equity share amounting of no less than BGN 5,000. This is a reasonable proposal, despite the fact that it puts university R&D centres in a dependent position, which might limit the scope of their activity and call into question the efficiency of their management and overall business activity.

Special attention should be paid to Measure 16.1 that has been designed to promote innovations. The focus of the Measure is on the funding of projects in agriculture and the development of biotechnologies, in particular, to promote their contribution to raising the performance of enterprises in the sector. The financial resources provided by the Measure for the next three-year period amount to BGN 39,116 million. Those shall be allocated to projects in five priority project areas (DFZ [in English: State Fund Agriculture], 2019):

- Fostering knowledge transfer and innovation in agriculture, forestry, and rural areas;
- Improving the viability of farms and the competitiveness of all types of agriculture on a regional scale; promoting innovative technologies in agriculture; sustainable management of forests;
- Promoting food chain organisation, including processing and marketing of agricultural products, animal welfare and risk management in agriculture;
- Restoring, preserving, and enhancing ecosystems related to agriculture and forestry;
- Promoting resource efficiency and supporting the shift towards a low carbon and climate resilient economy in the agriculture and food sectors and the forestry sector.

Conclusion

Innovations in biotechnology projects have been developing rapidly due to increased awareness about the need to significantly improve the quality of life. Contemporary global business seems to have realized the correlation between employing scientific achievements and creating added value as a result of input effort, entrepreneurship, capital and risk in a number of economic spheres to develop products that contribute to making the living environment more attractive. Statistics indicates that there has been a sustainable upward trend in life expectancy in advanced economics, a fact which supports the importance of biotechnological innovations in pharmaceutics, healthcare, agriculture and the food industry.

Conducting research and development of Life sciences and putting their accomplishments into practice requires a number of favourable conditions that are equally important to all investment projects in innovations. This refers to biotechnologies, too, since their further development implies sufficient resources, highly qualified specialists, modern equipment, capital and a favourable

investment environment. High quality and quantity requirements in terms of the conditions required for the development of biotechnologies are some of the major reasons why these technologies have been developing dynamically in certain regions, while other regions tend to consume, rather than develop products by adopting the achievements of biotechnologies, despite their numerous benefits.

This research focused on reviewing the activity of leading European clusters whose scientific and practical accomplishments in the development of biotechnologies have a major impact at a regional and a global scale. The analysis revealed that those clusters are predominantly located in two geographic regions of the Old Continent, that is, Central and Northern Europe. On the one hand, this is due to the fact that the countries with the most developed economies are situated in those parts of the continent, and on the other hand, those are countries with long-standing traditions and successful practices in Life sciences and especially in the development of scientific research and industries like the production of pharmaceuticals, chemicals, agri-products, medical technologies, foods and agriculture products.

As a result of our research we can conclude that European economy is dramatically lagging behind in innovations, especially those in biotechnologies. The United States, Japan, South Korea and China are the leaders in research and development in the sphere. What is more, while the financial and economic crisis that began in the 2007 weakened the interest of risk capital in investments in innovative biotechnological projects on a global scale, there seem to have been no major positive developments in Europe in that aspect in the post-crisis years, either. In our opinion, in order to raise the competitiveness of European biotechnology enterprises significantly, it would be necessary to allocate much more substantial public financial resources to the scientific centres that work in collaboration with businesses and have the capacity required for producing high quality intellectual products to meet the needs of the production sector.

It would not be realistic to predict that the overall competitiveness of the pharmaceutical sector in Europe could significantly improve provided that enterprises with smaller production capacity were involved. Market specifics clearly put in a more advantageous position larger established producers that have alternative sources of funding, high caliber staff and better material security and are therefore able to make economies of scale. Those enterprises can thus focus their efforts on improving their production capacity in terms of quality, as well as quantity. Nevertheless, government policies, which give priority to science centres, should be designed so as to substantially encourage the development of project innovations, and hence, the more notable presence of European biotechnology companies on a global scale.

The findings of this research about Europe lagging behind in terms of biotechnologies development when compared to market leaders are even more applicable to Bulgarian economy. There proved to be no overall government strategy to support research in Life sciences, despite the availability of extremely favourable environmental conditions (e.g. weather, soils) for developing different

lines of businesses based on biotechnologies.[10] The insignificant share of bio-industrial production in the total GDP of the country means that the industry has very little impact upon the overall socio-economic development of the country. On the other hand, this indicates that the potential of bio-industrial production in Bulgaria has largely been underestimated despite the prospects it offers. Two of the prerequisites for promoting their development are the consistent work of the government in that aspect and a high level of initiative and involvement on behalf of science centres and businesses whose collaboration would be of mutual economic benefit.

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[10] For example, nearly 2,500 varieties of herbs grow naturally on the territory of the country, many of them being a major raw material in contemporary bio-industrial production, my note.