CHINA-CEE INSTITUTE

SCIENCE AND TECHNOLOGY INNOVATION MECHANISM OF CEE COUNTRIES

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Content

Preface

Science and technology (S&T) capabilities are fundamental for social and economic development both in developing and developed countries and regions. Nevertheless, the capacity for scientific and technological innovation, which is an important standard of assessing social and economic development, varies from country to country and from region to region. As the world is experiencing an unprecedented health crisis due to the coronavirus pandemic, S&T capability comes to be one of most important instruments to cope with the challenges.

Since the pandemic broke out in Europe, it has been challenging all the countries that are struggling with combating the coronavirus. This book sheds light upon the status quo of scientific and technological innovation mechanisms in CEE countries and Greece with an aim of better understanding the countries and their S&T development. The reports included are originally published as Weekly Briefings, a core product by the China-CEE Institute. All the Weekly Briefings are written by the Institute's associate researchers from CEE countries. This book is a collection of the 2020 September economic issue of the Weekly Briefings. The views in the book are represented by the individual authors instead of the China-CEE Institute.

The China-CEE Institute, registered as a non-profit limited company in Budapest, Hungary, was established by the Chinese Academy of Social Sciences in April 2017. The China-CEE Institute is committed to build ties and strengthen partnerships with academic institutions and think tanks in Hungary, in Central and Eastern European countries as well as other parts of Europe.

The China-CEE Institute aims to encourage scholars and researchers in CEE countries to carry out joint researches, field studies, to organize conferences,

seminars and lecture series, to hold training programs for young students, and disseminate publication.

I hope the book would promote the exchanges among the academics as well as business fields between China and Central and Eastern European countries.

Prof. Dr. CHEN Xin
Executive President and Managing Director, China-CEE Institute
Deputy Director General, Institute of European Studies, CASS

Science, Technology, R&D and Innovation in Albania

Marsela Musabelliu

In July 2020, Albania recorded a trade deficit of 293.9 million US$ - this is not a number that is unknown for the country since it is overwhelmingly dependent on foreign trade, however, COVID-19 slowed immensely local production and some branches of industries had to altogether shut down their activity. But, goods and services are not the only commodities imported from abroad – scientific and technology innovation assets be this in the form of hardware, software or knowhow, are all imported from abroad. There exists not one single entity in Albania that properly innovates in science and technology. There remain some institutions focused on the above, however, they have not produced any significant achievement, or anything worth the market value of a technological/scientific innovative product. There are a multitude of reasons for these sectors being underdeveloped – in below some main categorizations.

Brain-drain

The main driving force for a country to have any kind of development is science and technology are human resources. Unfortunately for Albania the massive migration after the 1990s did not include only low-skilled labor force, but also a high percentage of intellectuals and researchers. Various national surveys demonstrate that from 1990 to 2000, approximately 40% of the professors and research scientists of the universities and scientific institutions in the country have emigrated. Especially starting from 1993, human resources in sciences and technology have drastically decreased. Driving forces for the brain drain in science are found in the deteriorated economic living conditions, the lack of state-of-the-art infrastructure and of course lack of funds which constitute serious obstacles for research (Cit. Albana Zotaj).

The first (failed) attempt to restructure scientific environment

In 2006, the Albanian government undertook a deep reform of the scientific research system. The Academy of Sciences was re-organized along the model of

many other European countries; it started to operate through a selected community of scientists and no longer administrates research institutes, these having been integrated into the higher education system. Two new faculties have been set up: the Faculty of Information Technology at the Polytechnic University of Tirana and the Faculty of Biotechnology and Food at the Agricultural University of Tirana. The University of Tirana has also gained an Applied and Nuclear Physics Centre and Biotechnology Department. Twelve government agencies and centers for technology transfer have also been created.

This is in paper – what about the reality? Where does this funding really end? One and half decade later, we see there is not even a single achievement is research, let alone innovation. The above-mentioned institutions are mostly focused on what is colloquially named “soft science” mainly humanities and social sciences, but no trace of a real development on the “hard science” areas.

Lack of serious policies

In 2009 the Albanian Government approved the "*National Strategy for Science, Technology and Innovation in Albania*". The intent was to triple public spending on research and development (R&D) to 0.6%, create “center of excellence” in science, and double the number of researchers, both through 'brain gain' incentives like a returning researcher grant scheme and through the training of new researchers (including 500 PhDs).

In order to stimulate innovation top 100 companies in the country were promised grants to win either via investment in local R&D or via consortia with academic research institutes or foreign partners. The interested parties (Albanian based companies) proposed prioritizing fields of research such as agriculture and food, information and communication technologies (ICTs), natural resources, biotechnology, biodiversity, defense and security. Again, as the results of the “reform” in 2006, the one of 2009 produced no tangible results in science and innovation, on the contrary it flooded the academia realm in Albania with a large number of PhD degrees which in reality had little to none academic value. To add insult to the already injured situation, in 2018, an Albanian scholar studying abroad, Taulant Muka, identified an issue which is not only indecent but also illegal - plagiarism. In an overall panoramic of the investigation he conducted, more than

60% of PhD degrees obtained in Albania to date had serious levels of plagiarism (sometimes even whole chapters of a thesis).

Eyes and hopes on European Union for financial resources

The European Union (EU) has set clear objectives for research and innovation as part of its Lisbon Strategy for becoming the most competitive and innovative. In order to include the Western Balkans (WB) into this path, in April, 2009, in Sarajevo, the WB signed a Ministerial Joint Statement calling for enhanced regional cooperation to promote innovation. The EU has been at the forefront of this approach, urging member countries to spend more and better on research and innovation. To support the effort in the Western Balkans, the EU contracted the World Bank in June, 2011, to assist the region in developing a Regional R&D Strategy for Innovation. As the cross regional cooperation appears also to have no tangible result, perhaps also the well-meant and well-funded EU projects are at a standstill. Like other Western Balkan countries aspiring to join the EU, Albania is trailing behind in the innovation development process.

The triple helix model (Government – Universities - Businesses)

According to the triple helix model of innovation, the three actors collaborate and form a complex set of links and networks that bind them together in multiple dimensions with the goal of creating innovation as an output of institutionalized and structured interactions. Governments take on the important role of promoting and funding strategic cooperation between universities and industry. Public grants for applied research, subsidies for seed investments, support for filing patents, etc. cover early-stage and resource-intensive collaboration of which a large part is unlikely to yield tangible returns on investment.

The research system in Albania includes a wide range of institutions in higher education, scientific research, development and technology, and the private sector. Businesses, however, have minor participation in R&D and other knowledge generation activities Even though innovation features heavily in several public policies not only in the education field, entrepreneurship and commercialization of research results are not included in any of the university strategies.

In 2019, a very deep survey initiated from the Swedish Embassy in Albania and EU in reported that definitions for innovation and start-ups by the Albanian

government that pave the way for interventions and legislation have been a compilation of the different definitions available in other European countries, not taking the local context into consideration, and have been used inconsistently along different strategies, funding streams and documents. For instance, in the "National Strategy for Development and Integration" which forms the national vision for the social and economic development of Albania over the period from 2014 till 2020, research and innovation are recognized key drivers for increased competitiveness. However, there is no definition of what innovation in the Albanian context means. Innovation seems to be reduced to the process of providing support to "existing Albanian enterprises that are seeking to modernize their technology by transferring and absorbing (in co-operation with academicians and researchers) innovations currently being applied in other countries or in other local enterprises[1].

Too many strategies – too little funding

Strategies and Action Plans of the Albanian Government are never the issue, for reference some of the most notorious below:

- National Strategy for Development and Integration (2015-2020): promoted by the Prime Minister – outlines several objectives to foster economic promotion, private sector development, science and research and innovation.

- Digital Agenda for Albania (2015-2020): promoted by the Prime Minister - focuses on ICT and digitalization supporting economic processes.

- Business and Investment Development Strategy (2014-2020): promoted by the Ministry of Finance and Economy - establishes a framework for creating partnerships between government and businesses on technology improvements, innovation and human capacities.

- Action Plan 2017-2021 Support the development of innovative policies: promoted by the Ministry of Finance and Economy - entails developing a virtual innovation support network that helps Entrepreneurs.

- National Strategy for Science, Technology and Innovation (2017-2022): promoted by the Ministry of Education – intends to maximize research (raise funds,

[1] Full report of the research available at: http://euforinnovation.al/wp-content/uploads/2019/12/Gap-Analysis_E-Publication.pdf

quality, cooperation with businesses & diaspora) from 0, 2% of GDP during 2009-15 to at least 0.6% (EU28 average: 2%, target EU in 2020: 3%).

Expenditure for scientific research and Development in Albania does not exceed 0.18% of GDP as of date, which marks the lowest level in Europe. Economic competitiveness and exports are low, with the economy still heavily skewed towards low technology. [1]

On the (slight) bright side, as for the latest data available the largest number of patent applications was in pharmaceuticals and cosmetics, followed by the chemical industry, biotechnology, and medical engineering. These industries account for over three quarters of all patents filed. Other important technological fields are civil engineering, architecture and mining, and service users and equipment.

Conclusions

There are many reasons and factors that have influenced the lagging behind of the country in such spheres.

The disastrous structural problems Albania is facing in its never-ending transition from a centrally planned type of economy to an open market one, have had their impact in the academic field with the same brutality it has affected the society and the nation as a whole. In this domino effect from political, economic, societal and developmental recklessness, as one crumbles because of, or as result of the other, the desperate outcome is a of a low level of innovation appears to be just a side effect of a perpetually broken system.

[1] Ibid.

Science and Technology Innovation Mechanism in BiH

Zvonimir Stopić

Considering the current development needs and prosperity strategies put forward by the technologically most developed countries in the world, Bosnia and Herzegovina does not invest enough in science to be able to be competitive in the field of technological innovations. In this article we will be addressing the general situation in the science and technology mechanism in Bosnia and Herzegovina, putting forward local expert opinions and finally taking a look at some positive examples in the field.

General situation in Bosnia and Herzegovina in the field of science and technology innovation mechanisms

According to the Global competitiveness index, Bosnia and Herzegovina holds the lowest position in the region. In 2019, globally, it ranked 92nd out 141 countries. Reasons behind such low ranking lie in the extremely low level of investments in research and development, transfer of new technologies and development of innovations. The state strategy follows this trend by budgeting science, new technologies and innovations with around 0.3 %. In comparison, the developed countries average around 3 %.

A large number of companies in Bosnia and Herzegovina do not produce or develop products of their own. Most produce for an industrial partner from European Union or elsewhere. The business concept of Bosnia and Herzegovina is problematic itself. Bosnia and Herzegovina is becoming a country with higher living costs that demand higher salaries, which inevitably leads to increase in production costs. Because of this, Bosnia and Herzegovina can hardly keep up with the Asian countries competition that offers cheaper labor. A next issue of the the development of Bosnia and Herzegovina and its companies is the inadequate investment into development of its own products and services. Private companies should venture, alone or with assistance of universities and state institutions, into opening research & development centers. Business philosophy of expecting the

work to be brought in from foreign investments should be changed into developing and offering high-technology products and services.

According to the research done by Bit Alijansa, the software industry already has significant share of the Bosnia and Herzegovina GDP. Although the software industry still cannot compare its export values to those of, for instance, wood industry, it does hold significant benefits to the other industries. Those are: the workplace quality and higher salaries being 50 % higher than the average salary in the country; it is not a significant import industry; it is an ecologically "clean" industry; it has the highest rise of export, income and employment; it demands lower initial funding, development and employment investments. The IT sector in Bosnia and Herzegovina has been continuously growing for the past several years, especially in software development and computer programming. In these fields the industry's income has doubled within the last eight years and had increased the number of employees by three times. Software engineers are high in the demand in the local market, with above average earnings. The local IT industry also creates new positions which contribute its values and are more focused on social sciences, such as: Scrum master, project manager or graphic designer.

Along these lines, Bit Alijansa association, along with its partner organizations, has been organizing free-of-charge schools for programming "CoderDojo". The programming schools are being organized for students of elementary and high schools in order to offer them a chance to learn programming and other IT knowledge. "CoderDojo" is a movement founded in Ireland which has turned into a global network of programming associations that are based on volunteer work by mentors and other staff.

Opinions of experts

Professor Amila Pilav-Velić from Faculty of Economics in Sarajevo thinks that building a national or even regional ecosystem based on triple-helix principles should become the imperative of the economic growth of Bosnia and Herzegovina. The triple-helix concept includes intensive cooperation between the educational, public and business sector by pointing out the innovation potential. In other words, economic growth of the country lies within a bigger incentive of educational and scientific institutions through their hybridization with the public and business sector. This creates an environment for creating a new institutional and social

framework for generating, transfer and practical implementations of knowledge. Considering the low Global competitiveness index position of Bosnia and Herzegovina, prof. Pilav-Velić identifies the underdevelopment of the innovation ecosystem as the key factor that contributes to the low competitiveness. This is due to the non-existence of adequate institutional and political framework for innovation. Bosnia and Herzegovina is the only regional country that does not have clearly defined institutional responsibilities in innovation policies. These policies are indirectly put through 18 ministries: 2 on state, 6 entity and 10 on cantonal level, alongside two state agencies FIPA (Agency to promote foreign investments) and Institute for intellectual property of Bosnia and Herzegovina. This decentralization of the innovation system is the reason why Bosnia and Herzegovina is the only regional country without an adequate law on innovation or an innovation fund.

Innovator Nađa Zubčević finds the innovation potential not recognized in Bosnia and Herzegovina. The Association of Innovators of Bosnia and Herzegovina has over 450 members and over 1,600 innovations awards. She says that only the Federal ministry of enterprise, development and craft and the Ministry of civil affairs give out an open concurs for innovators, but only once a year. Also, the amounts given through the concurs are usually not enough for the innovations research and developments, so the innovators usually have to wait a couple of years until they can get the sufficient budget. But Nađa Zubčević had found other financing sources. She was granted support by KULT, the Institute for youth development, had a chance to present around the world and has received the Semi Grande Prize in South Korea. She also will be expanding the budgeting to a crowd funding campaign. Further-more, says Zubčević, there is no informal education program established in Bosnia and Herzegovina that would help them with complicated patent applications. Often the innovations develop something that turns out not to be patentable.

Positive examples in the science and technology innovation field

The antibacterial toilet seat invented by the young Sarajevo innovator Nađa Zubčević is a positive example of a successful single long-term project in Bosnia and Herzegovina. She has been working on it from 2016, since the idea for it came up during a conversation with her friends. Since the beginning of the project, Nađa presented her innovation around the world and received acknowledgment for it. The

antibacterial toilet seat works on the principal of sensors that detect body movement. The sensor lights up UV LED diodes which are placed within the inside of the seat. Research has shown that it has a 99,8 % effect on eliminating bacteria and has a duration between 5 – 10 years.

Ministry of programming is a company oriented in the IT sector which invests in new and striving companies from Bosnia and Herzegovina and the world. At the 20th Deloitte concurs of the fastest growing technological companies of Central Europe, Ministry of Programming was the only company from Bosnia and Herzegovina and outside of the European Union that was included in the main category "Technology fast 50".

Another positive example comes from the city of Mostar, where the 12 people SPARK Company resides. SPARK is an advanced technological platform devoted to IT, business and digital professionals, startups, companies and projects. Its main programs are the SPARK school, SPARK startup and SPARKreators. The SPARK school educates future digital experts through certified and free-of-charge workshops that range from apps, operation systems, design to data analytics and project management. SPARK startup offers a program that has so far launched over 40 startups. The SPARKreators project focuses on education in robotics and had so far donated over a thousand educational robots to elementary schools in Bosnia and Herzegovina.

Conclusion

Bosnia and Herzegovina is, according to the Global competitiveness index, the most underdeveloped country in the region. The main reason for this setback in the field of science and technology innovation is the inefficient state bureaucracy and legislative mechanism that would put forward coherent development strategies and decisions for the future. Alongside is the very low GDP budget portion on investment into science, new technologies and innovations, which is only 0.3 %, when compared to the 3 % of the developed countries. This is pointed out by experts such as Prof. Amila Pilav-Velić od Faculty of Economics in Sarajevo or young inventor Nađa Zubčević. However, the IT industry is the fastest growing one in Bosnia and Herzegovina. The positive examples in the field can be found mostly due to individual incentives and private entrepreneurial business.

Bulgarian National Innovation System: Condition and Weaknesses

Evgeniy Kandilarov

Legal base of the formation of Bulgarian National Innovation System

The establishment and development of National Innovation System in Bulgaria is based on several regulations. The most important of them are: "The Innovation Strategy of the Republic of Bulgaria" (2004), "National Strategy for Development of Research 2020" (2011), the "Innovation strategy for intelligent specialization of the Republic of Bulgaria 2014-2020" as well as the "National Strategy for Development of Scientific Research 2017-2030 "Better Science for a Better Bulgaria", launched in June 2017. These normative acts formally regulate the existence of innovation policy, the main administrative bodies involved in its formulation and implementation, as well as the structures providing funding for this type of policy (these are mostly the Research Fund and the National Innovation Fund). At the same time, the analysis of the data related to the Bulgarian innovation development show a completely different picture.

At the end of the second decade of the XXI century, Bulgaria is at one of the lowest levels in terms of innovation potential and national competitiveness. In the 2019 issue of the European Innovation Scoreboard, Bulgaria ranks second to last in the EU-28 with an Innovation Index of 0.235. This result, as well as the progress made since 2011, rank the country at the bottom of so called "modest innovators", ahead only of Romania (0.165). The EU average index (0.525) is twice as high, while the index of innovation leader Sweden (0.713) is three times the result for Bulgaria. According to most of the science development and innovation indicators Bulgaria is not among the countries making progress. Despite the low starting positions, the country continues to "move modestly" forward, which, in comparative terms, contributes to its "stable" falling behind.

Although the existing available statistical data covers only the years until 2019 it shows clear tendency which is rather negative than positive and the current development with the social and economic impact of the COVID 19 pandemic will make this picture even worse. The data show that businesses - especially SMEs -

in Bulgaria lag significantly behind in the introduction of innovative practices. At the same time, there is still no national strategy for Bulgaria's involvement in the so called “Industry 4.0” to guide the country's overall policy in this regard, despite the conceptual document approved by the government in 2017, outlining the vision for the necessary policy changes.

Structure of the Bulgarian National Innovation system

The Bulgarian R&I system is composed of (non-integrated) public and private segments. The public segment comprises of the state-owned higher (or tertiary) educational institutions (i.e. universities, whose system can be described as unitary, but transforming into dual with the new Law on Higher Education), public research organizations (mainly the two leading academies - Bulgarian Academy of Sciences (BAS) and the Agricultural Academy (AA), both guided by separate laws) and other public research institutes (centres/labs) under different sectoral ministries or agencies. The private segment covers private performers, which could be higher institutions (i.e. private universities), private research organizations (including registered as non-profit NGOs) or enterprises, involved in R&D&I. The private non-profit sector is relatively weak, but applied research is increasingly carried out in smaller private sector organizations – private universities and private research institutions. The funding of the non-profit institutions is most often directed towards research-related activities, not R&D per se.

The system is highly centralized in terms of regulation and control, and the regions, the districts and the municipalities have limited responsibilities in the area of higher education, R&D and innovation policy. The competences have been clearly divided between the Ministry of Education and Science (oriented towards the public segment) and the Ministry of Economy (dealing with the private sector). Similarly, policies are devised and implemented separately, whilst funding and support primarily depend on the type of beneficiary, not the R&I field or the opportunities for joint projects and initiatives. The most serious challenge for the country’s R&I system thus is the continuous lack of integrated policy instruments, including shared R&I infrastructures, which play an increasingly important role in the advancement of knowledge and technology. They are the key instrument to stimulate public-private partnerships and also to create and stimulate markets.

One of the reasons and at the same time consequences of the practical dysfunction of the Bulgarian National Innovation System is the fact that the Bulgarian economy is dominated by sectors with low added value and narrow technological capabilities. About 75% of exports are formed from processed raw materials, low-tech products and products without significant added value. Basically, innovations form a very small part of the country's industry.

Expenditures on research, development and innovation

One of the indicators in which Bulgaria is experiencing serious difficulties in catching up with the more developed European economies is the state of investments in research and development and innovation.

Although during the last few years there is a very light upward trend, R&D expenditure in the private sector amounted to 0.53% of GDP within the last few years (compared to the EU average of 1.36%). Private R&D funding is mainly focused on applied research and experimental development in sectors such as pharmaceuticals, medicine, ICT and does not provide funding for capital expenditures and human resources.

Expenditure on research and development in the public sector is among the lowest in the EU. In 2017, they amounted to only 0.21% of GDP, far below the EU average of 0.69%.

In the structure of R&D expenditures by fields of science in the last few years, the largest relative share has the expenditures for research work in the field of technical sciences - 57.6%, or BGN 476.9 million, followed by medical and health sciences with a share of 17.4%, or BGN 144 million, and natural sciences - 14.1%, or BGN 116.4 million.

In 2018, R&D spending in Bulgaria in absolute terms reached BGN 827.621 million, which is an increase of just over 8% on an annual basis. However, as GDP growth amounts to the same value, the share of R&D spending to GDP remains at the level of 0.75% as in 2017, or exactly half of the national 2020 target of 1.5%. For the third consecutive year, government spending on R&D as a share of GDP remains at 0.17%, the lowest level for the whole period after 2000. The government subsidy of BGN 182.841 million for R&D in absolute amount represents an annual growth of just under 4% and is again compensated by an increase in business sector R&D spending. In 2018, enterprises spent a total of BGN 594.800 million (11%

annual growth) on R&D, equivalent to 0.54% of GDP. Compared to other institutional sectors, only the increase in business sector R&D spending is able to outpace GDP growth and form an increasing relative share.

After Bulgaria's accession to the EU, the main driving force for business has been the ability to use European structural funding through operational programs. In fact, over 88% of foreign-source R&D funding is allocated to enterprises. Since the launch of the OP Science and Education for Smart Growth, this applies to universities and research units, which receive respectively 6.6% and 3.7% of R&D funding from abroad.

There is a strong need to further support the integration and Europeanization of the Bulgarian science, research and innovation. The system deficiencies so far stem from both insufficient national public resources allocated to R&I and inadequate participation and success of national actors in EU framework and other programs and initiatives. It has become clear that participation of Bulgaria in EU Research and Innovation Strategies for smart specialization and European Strategy Forum on Research Infrastructures have led to improved coordination and cooperation among government, industry, education and research institutions.

Weaknesses and strengths of the Bulgarian national innovation system

According to the statistics the leading scientific areas in Bulgaria are: Physics and astronomy, Engineering sciences and Medicine.

Among the weaknesses inherent in the state policy for creation and development of the Bulgarian national innovation system we should note the following:

- Lack of strategic vision and focus for development of a unified policy on innovation and research;

- Sectoral fragmentation of the goals and priorities in this policy, expressed in the fragmentation of powers between two ministries plus a number of other institutions;

- As a result - inconsistent and sporadic funding, as well as inconsistency in the involvement of private institutions dealing with the topic.

There are, nevertheless, some areas in which Bulgaria has shown significant progress since 2011:

- Broadband internet coverage – 78% growth, which is however not enough to reach the EU-28 average. The indicator reflects the number of enterprises using broadband internet at over 100 Mbps and is seen as an expression of the digital potential of business and a factor for the full use of ICT in the process of creating products and services, B2B and B2C interaction.

- New doctorate graduates – 71%, with a 2018 result 1/3 below the EU-28 level.

- Design applications – 70%, and 2018 level 20% above the EU-28 average.

Traditionally the Bulgarian ICT sector is one with the strongest innovation potential indications. This is why it experienced steady growth in the last twenty years. Within the last years the sector accounted for 4.4% of the revenue and 4.6% of the employment in the Bulgarian economy. For the whole period the fastest growing ICT sub-sectors in terms of revenue have been "Computer programming, consultancy and other ICT service" and "Wholesale of computer, electronic and telecommunication equipment and software". The IT sector employs around 120,000 people, 2/3 of which are in the outsourcing industry (information & technology and business processes).

Conclusion

With the aim of focusing and centralizing the national policy in the field of innovation and research in September, 2020, the Government approved a decree establishing a "State Agency for Research and Innovation" as a specialized body at the Council of Ministers for the development and implementation of the policy on research, innovation and technology transfer. This Agency should deal with the strategic planning, management, financing and management of research and innovation programs and conduct and supports structural reforms in the area. Essentially a new policy that aims to maximize the effectiveness of activities in favor of the transformation of the Bulgarian economy into one based on knowledge, innovation and technology.

The Bulgarian economy has a chance to take advantage of the current situation, but it must become more innovative and more productive in terms of new technological and organizational solutions. It is therefore important that the field of research and innovation is treated as a subject of structured national policy. Let's

hope that the role of the new Agency will be fulfilled, namely to concentrate and make sense of national efforts in this direction.

Science and Innovation in Croatia: In General and during the Pandemic

Emir Šabić

Innovation in the last decade

In the interest of achieving the goals of the economic policy which include stimulating economic growth and development, reducing unemployment and encouraging investment, Croatian government in 2014 adopted a 'National Innovation Strategy in the Republic of Croatia 2014-2020'. The key starting point for preparing the innovation strategy was the fact that investments in research and development in Croatia amounted to about 0.8% of GDP, while other developed countries, such as Finland, allocate about 3% of GDP for innovation (R&D, new technologies, patents, competences for innovation, etc.). Thus, the strategy clearly identified the need to increase capital fund targeted to finance innovation (either public or private). According to the Organization for Economic Co-operation and Development, an increase of only 0.1% of investment in innovation can increase the overall GDP of a country and its economy by 1.2 - 1.5% in the period of 5 to 10 years.

An analysis preceding the final adoption of the strategy showed that it was necessary to transform the existing innovation system into a market-oriented system that raises the importance of the innovation process above the innovation product. (e.g. the Belgian Innovation Agency has a multiplier of almost 24; that is, for every EUR 1 invested in companies through projects, EUR 24 is produced, and almost EUR 9 is indirectly returned to the budget). Croatian government, through the consultation process with high value-added companies, prepared the innovation strategy that addressed shortcomings in institutional terms, offered clear definition of innovation policy, and listed indicators for monitoring the effects and results of the implementation of the strategy. The goal of the strategy was that by 2020, Croatia would become internationally recognized for excellence in scientific research. It would position itself as a valuable partner in the global innovation value chain based on an innovation system that permanently increases the competitiveness

of the economy, responds to societal challenges, and achieves effective application of knowledge and creativity.

This strategy will expire at the end of 2020 and it is expected that it will be followed by a new one, although there is no news if the consultation process for a new strategy has started. A follow-up strategy will most likely take into account results of the implementation of the current strategy, which are not yet known. However, looking at the Croatian economy, one can easily conclude that innovation often takes place in small, private companies. Description of a few of them follows in the rest of this article.

One of the most famous modern Croatian inventions is the world's first electric race car called Concept One, produced by the company 'Rimac automobili' (Rimac Cars), created in 2009 by a young entrepreneur Mate Rimac. Rimac started the company from his garage with financial help from his father. Today, he has multiple high-profile international investors. 'Rimac automobili' specialize in producing high-performance electric vehicles. However, Rimac's basic goal is not the mass production of electric cars. They serve, to put it simply, as a showcase of its individual components such as batteries and propulsion system. All of them are designed in 'Rimac automobili' and as such are sold to other manufacturers. For example, in February 2017, luxury car maker Aston Martin announced that 'Rimac Cars' would be working on a hybrid battery set for their new AM-RB 001 model. On that occasion, Rimac's company was presented as a recognized company whose battery technology is at the forefront of the world.

Another innovation coming from Croatia is 'Steora Smart Bench'. It is a bench that is powered by solar energy and has features such as usb ports for charging and wifi. 'Steora Smart Bench' is made by Ivan Mrvos, Croatian inventor. He presented his project to his hometown, Solin. The local community liked it and decided to support the innovation by investing in it. The first bench was installed in Solin, while today, these solar powered- benches are all over the world, from Europe to Asia to Australia.

A couple of other interesting innovations coming from Croatia are Get Kisha and LEAF. Get Kisha is the first Croatian smart umbrella. The Get Kisha umbrella is connected to a mobile application that will remind the owner of Get Kisha that, in case of rain, to take it with her or him. The team that developed Get Kisha sold

out the first batch of 1000 pieces in just three months, which testifies of the popularity of this device.

LEAF is a concept of smart jewelry that can be worn as a bracelet, necklace or brooch, and through the application it monitors women's activity, sleep, cycle and breathing. The popularity and distribution of this product is evidenced by the fact that Bellabeat, the producer of LEAF, has opened offices in California and China, and so far they have delivered their products to the famous retail chain, Target. The business venture started in 2013, and today the Bellabet team is one of the best start-ups in Croatia, attracting more and more investors.

Innovation during the pandemic

The contribution of science, technology and innovation is even more important at this unprecedented time in history caused by the coronavirus (COVID-19). Technology is one of the sectors that is booming as of right now because of its incredible prosperity and ability to transform everyday lives of humans, to allow people to conduct their everyday activities while also protecting them from the virus. There is a number of technological trends that help build a sustainable and safe society, and the trends that have taken place in the world, are also taking place in Croatia.

As a result of COVID-19, online shopping and food delivery is seeing increase in Croatia. In September 2020, the state statistical agency reported that online shopping increased 13.9% in the first six months of 2020. Online shopping has been transformed from a nice-to-have to a must-have. Contactless deliveries are also becoming an option in order to limit human-to-human contact and, therefore, robot delivery services are going to become a more popular means of delivery in the future.

Due to the fact that cash might carry the virus, many retailers, restaurants and bars are asking their customers to, if possible, use contactless method of payment in order to limit the possibility of spreading the virus. Remote work also became a preferred way of working during the pandemic. Through the use of virtual private networks (VPNs), voice over Internet protocols (VoIP's), virtual meetings, cloud technology and other technologies it became much easier to work from home and be as effective, if not more, than working from the office. Commute time is

eliminated from the equation and the work-life balance is significantly improved. Same as working from home, distance learning has become increasingly popular. Many educational institutions improved their technological capabilities and started using similar resources as companies providing work from home in order to ensure their students great chances of successful learning.

The innovation of the Croatian company 'Kristalna ideja' ('Crystal Idea') is a device for air filtration called iTherapy. In July 2020, it was awarded a gold medal in the competition among 202 products from 35 countries at the international competition 'Inventions VS Corona' organized by the International Federation of Associations of Inventors and Inventions (IFIA), the umbrella world association of innovators founded in 1968. iTherapy is a Croatian patent that deactivates bioaerosols, bacteria and viruses in the indoor air and prevents their spread. At the same time, it enriches the air with negative ions and antioxidants. The idea arose based on market research of available filters. All previous products could not simultaneously fulfill two important functions: purification of indoor air from most of the pollutants, with simultaneous adaptation for use in residential and commercial premises, hotels, hospitals and the like. The device has been available on the market since 2016, but its demand exploded since the pandemic started.

Another Croatian COVID-19 invention is a 'Mobile Corona Cabin' designed by Tehnix. It is a special mobile quarantine for the control and temporary isolation of either healthy or people with symptoms of the infectious disease COVID-19. The cabin can accommodate four people and is 3 × 6.40 m in size, equipped with a kitchen, bathroom and sleeping area, and has a heating and ventilation system. The cabin is primarily designed for Tehnix drivers who drive abroad, so they can stay in it and rest until a new ride. Thus, during the entire trip, they stay out of contact with other people and cannot become infected or, if infected, transmit the virus to healthy people. Upon arrival, drivers leave the truck to be disinfected and are placed in a sterile mobile corona cabin. The food is placed in a special compartment, without personal contact. Tehnix says that orders are already arriving from all over the world, and their innovation could be useful in the absence of hospital capacity.

Czech Science, Research & Innovation System: Wind of Change

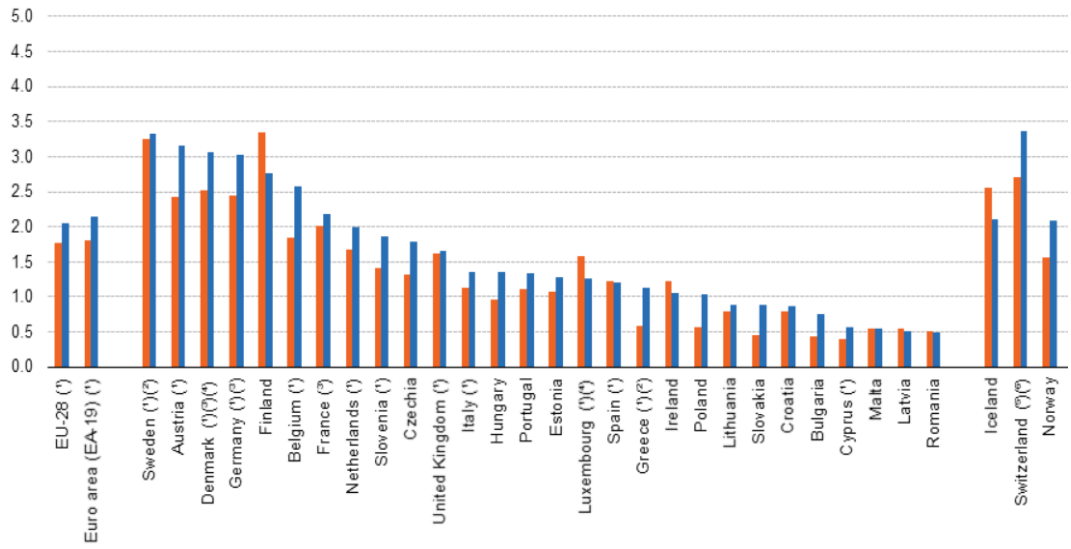
Ladislav Zemánek

The Czech Republic has the ambition to become one of the most innovative countries in Europe. The Government has recently adopted national strategies, focusing on the development of Industry 4.0 and innovative technologies. At the same, a gradual departure from the existing neoliberal model of science and its financing has started which is a path that other countries can follow. In this briefing, I will begin with basic state documents in the field, going on to an analysis of the system as such, taking account of its strengths and weaknesses.

At the highest level, the Czech Republic´s system of science, research, development and innovation is formulated and formed by the *Innovation Strategy of the Czech Republic 2019–2030*, approved by the Government in February 2019. This general Innovation Strategy is worked out by the *Czech National Research, Development and Innovation Policy 2021+*, passed in July this year, which is to contribute to advancement in the following areas: (1) management and financing of the system of research, development and innovation; (2) development of human sources; (3) quality and excellence in research and development; (4) cooperation between research and applications; (5) innovative potential. At the level of funding and technological innovation, the key long-term document is the *National Research and Innovation Strategy for Smart Specialisation of the Czech Republic* (RIS3), the objective of which is to effectively target funds (European, national, regional or private) at activities that lead to strengthening the research and innovation capacity.

Nowadays, the share of research, development and innovation expenditure amounts to 1.79% of GDP (see the table below), 60% being company resources and the rest government and EU resources. The Government has set a goal to increase the funding to 3% in 2030 of which two thirds should be covered by company resources. Financing splits into two pillars – institutional and targeted, grant support. A serious weak point is the linkage of the innovation chain: basic research – applied research – innovation – product – profit – reinvestment into research. In addition, there is an insufficient interconnection between educational institutions

and business, mistrust towards spin-offs and start-ups both on the side of education facilities and enterprises, leading to a shortage of venture capital. Start-up projects have been supported partially by means of the state CzechInvest agency through incubation and acceleration programmes but a lack of a comprehensive concept for their establishment, development and funding is obvious. The recently adopted national strategies aim to bring about a substantial change in the field, emphasising the support of Industry 4.0 and such branches like AI, space technologies, laser technologies, nanotechnology, biotechnology, energy-saving solutions or chemical technologies.



Gross domestic expenditure on research and development in 2007 (orange) and 2017 (blue) expressed by % relative to GDP

Source: Eurostat

Neoliberal system no more

In general terms, a substantial change is about to happen in the Czech science and research, characterised by a transition from the existing quantitative towards the quality-based system or a departure from the neoliberal system. So far, a neoliberal model and understanding of research have dominated at least since the second half of the 2000s. It is a concept imported from the West and applied in our country according to external practices. This neoliberal model is based on a grant system, formalisation and quantification of science, research and their results to the

detriment of quality, integrity and long-term outcomes. Scientists and researchers have been forced to permanent searching for financial means through grants, while a stable, long-term and institutionalised financing of science has been reduced. Budgets of academic and research institutions (including universities and the Academy of Sciences) financed from the state budget on the basis of a decision of the ruling Government and lawmakers and assigned to standard employment contracts have shrunk in favour of grants.

Several specialised institutions have been established and strengthened to manage the grant system, for instance, the Czech Science Foundation (GAČR) or Technological Agency of the Czech Republic (TAČR). The first one is a public organisation supporting basic research in a wide array of scientific disciplines. It is aimed to (1) provide financial support in research and development for research projects in basic research with a high potential for achieving world-class results; (2) to promote and expand international scientific cooperation; (3) to contribute to creating attractive conditions for high-quality development of young researchers; (4) to control effectiveness of the entrusted state financial means, and (5) to create user-friendly conditions and assistance within the administrative processes. The second organisation (TAČR) is a newer one, being set up in 2009 in connection with a shift towards the neoliberal policy and reforms in the Czech Republic´s research and development. A positive feature of this institution is a simplification and greater unification of the state financing system of applied research and experimental development which was fragmented in a much higher degree and implemented by many bodies before. The objectives of the Technological Agency as defined by the current legislation are (1) to prepare and carry out programmes of applied research, experimental development and innovation; (2) to evaluate and select individual proposals and applications; (3) to administrate financial support of applied research from the state budget; (4) to control and evaluate fulfilment of project contracts as well as approved goals of the projects, and (5) to assist in communication between research organisations and the private sector.

Risks of politicisation of research

These grant agencies do play a positive role in the system of grants. However, the very problem rests in the system as such, in the fact that the concept of grants and its logic has spread throughout the area of science and research, “colonising”

them all without differentiation needed. Therefore, opponents and critics of the neoliberal concept of research speak about scientists have transformed into a kind of entrepreneurs whose aim is to find finances. In a sense, they are right. But yet, it is not a proper term as entrepreneurs do business in order to make money but scientists under neoliberal conditions are forced to beg for sponsors to provide them with money to make research possible. Rather, they have become fundraisers and „professional chronic applicants "which deforms research. Moreover, it has another problematic dimension. Scientists and researchers and frequently obliged to deal with specific topics and issues, whereas a wide array of others find themselves beyond the permissible scope of research. Decision-makers have thus power to influence significantly the shape of the nationwide research which creates space for censure. Primarily, this problem applies to the social sciences and humanities where many topics are not supported and, given the abovementioned low institutional financing, cannot be analysed in fact. On the contrary, some others are favoured, which is not only a question of topics but also one of theory or methodology. As a result, research has become increasingly politicised and ideologised, which brings multiple negative effects.

Monetarisation of research is connected with a strong tendency towards quantification. Results are evaluated with regard to publication in the so-called impacted journals listed in databases formed by private, predominantly Western subjects. Their notion of science and research of these private subjects, therefore, have an immense influence, playing one of the main roles in the neoliberal system. Furthermore, these subjects capitalise on results which are reached thanks to state finances in individual countries. In the Czech Republic, the quality and potential of researched projects are too frequently assessed in terms of a number of publications in such journals. It leads to efforts to produce as many texts as possible irrespective of genuine quality and research benefit. It should be reiterated that this is primarily a problem of social scientists. In natural sciences, given their different substance, such a system makes more sense. Whereas in natural sciences, technological development and innovation it may stimulate excellence, in social ones, it petrifies the existing dominant paradigms and leads to the triumph of mediocrity.

To conclude, it is necessary to allow for differences among individual branches of science and research. Natural sciences are to be intertwined with business, the needs of economy and state in order to contribute to development and

innovation as efficiently as possible. In this case, the grant system can play a positive, stimulant role. Nevertheless, social sciences and humanities are of a different nature. And this fact should tell on a distinctive model of financing enabling a complex, fundamental, deep as well as first-rate, erudite research, findings of which are to be subsequently applied in other fields of human knowledge and practice including politics, economy or natural sciences themselves. Within such a model, the grant system would play only a minor, secondary, complementary role so as to minimalise the present dictate of quantitative evaluation, formalism and bureaucracy. At the same time, the number of institutions and branches in the field of social sciences and humanities financed from the state budget should be reduced as there are many which produce an excessive number of useless graduates who cannot be employed on the labour market and who then find their job in the non-profit organisations, the role of which is very questionable in many cases. This way, the state indirectly supports detriment activities of NGOs and their agenda. Therefore, it is desirable to revise the state policy towards education, science, research, development as well as innovation in the indicated direction.

Estonia: A Small Giant of Science and Technology

E-MAP Foundation MTÜ

The 'doom and gloom' of the pandemic, be it real or perceived, has negatively affected almost every single economy in the work, making it difficult for a high number of countries to have a quick recovery out of the COVIED-19's nightmare. In such a context, when, in August 2020, Standard and Poor's (S&P) report affirmed the Republic of Estonia's long-term rating at the level of **AA-**, it was a surprise for many, including quite a number of local experts in the country. The reputable credit rating agency noted that "Estonia can achieve 2019 real GDP levels in the second half of 2022, once there is no significant resurgence of domestic COVID-19 cases or a protracted downturn of the main trading partners"[1]. Considering the fact that the Estonian economy is rather small by all means, what is the basis for such a high credit rating to be given to Estonia by S&P when the pandemic does not seem to be over any time soon. Many would argue that it was primarily due to the country's pro-active attitude to research and development as well as promotion of science and technology in every-day life. In Estonia, even the COVID-19 can be treated as a chance to get better, faster, and smarter in responding to a challenge. In September 2020, while delivering her speech at the 75th UN General Assembly, Estonian President Kersti Kaljulaid noted that

[…] the pandemic and its aftermath give us an opportunity for a great global technological leap. Digital solutions can make our societies more equal, more resilient, more accessible and sustainable. But digital development comes also with its vulnerabilities and risks that is associated with cyber security. As an elected member of the UN Security Council since January this year we have kept our campaign promise to bring it to the formal table of the Security Council. Which we

[1] 'Standard and Poor's affirms Estonia's rating at high level' in *ERR*, 22 August 2020. Available from [https://news.err.ee/1126481/standard-and-poor-s-affirms-estonia-s-rating-at-high-level].

did already in March and continued in May. Because Estonia has the habit of keeping its word.[1]

Only three years ago, IT businesses used to "account for 7% of [the country's] GDP and the World Economic Forum rank[ed] Estonia's government as the most tech-savvy in Europe"[2]. What is the system in place that makes Estonia to be one of the most digitally advanced states on the planet? On the **governmental** (as well as semi-governmental) side, the country's Ministry of Education and Research is responsible for setting up the structure and advising on the normative basis to organise a system on research and development (R&D). At the end of the day it is no other but the Government that prepares the country's R&D plans and submits them for approval to the *Riigikogu*[3].

Structurally, the summit of the governmental system on R&D is led by the **Research and Development Council** (RDC) that is, in a way, "directing the systematic development of the national research, development and innovation system"[4]. The Council is chaired by the country's Prime Minister, has two Ministers by virtue of office, and a number of high-profile office-holders in academia. One of the main tasks of the RDC is to advise the Government on the process of preparation of the state budget's draft in regards of the prospective funds to be allocated for R&D[5]. Another important institution within the system is represented by the **Estonian Academy of Sciences**, which was founded back in 1938, two years before Estonia was occupied by the Soviet Union, with "commitment and responsibility to advance scientific research and represent Estonian science nationally and internationally"[6]. Currently, the Academy includes about 60 prominent Estonian scholars, while "[t]en research associations and societies and six research

[1] Kersti Kaljulaid, 'At the 75th United Nations General Assembly' in *Office of the President*, 24 September 2020. Available from [https://www.president.ee/en/official-duties/speeches/16181-at-the-75th-united-nations-general-assembly/].
[2] Joe Wallace in *The World Magazine*, August 2017. Available from [https://e-estonia.com/e-estonia-state-of-the-future/#:~:text=Information%20technology%20companies%20now%20account,digitally%20advanced%20in%20the%20world].
[3] 'Research and development' in *Haridus- ja teadusministeerium*. Available from [https://www.hm.ee/en/research-and-development].
[4] 'The Research and Development Council' in *Government Office*. Available from [https://www.riigikantselei.ee/en/research-and-development-council].
[5] 'The tasks of the Research and Development Council' in *Government Office*. Available from [https://www.riigikantselei.ee/en/research-and-development-council].
[6] The Estonian Academy of Sciences. Available from [https://www.akadeemia.ee/en/].

institutions have also joined the Academy in order to achieve common goals"[1]. On the administrative ground, however, the organisation that maintains and develops research, development and innovation (RDI) system in Estonia is called the **Estonian Research Council** (ERD). More specifically, it provides research and mobility grants, so "high-level research projects in all fields" are facilitated in order "to strengthen international competitiveness of Estonian R&D"[2]. The ERC has its headquarters in Tartu, office in Tallinn, and liaison-focused representation in Brussels. In plain digits, the organisation allocates about EUR 50 million a year in research grants, provides EUR 1.4 million towards supporting international research cooperation, and, what is no less important for both local and international researchers, runs the **Estonian Research Information System** (ETIS in Estonian abbreviation)[3]. The latter platform is a 'living' sign of openness that Estonian academic society is featured by – nearly every researcher has her/his account in ETIS, and almost every single R&D project has its informative page within the system. In principle, the ETIS is a national register on R&D institutions, researchers, projects, and, what is really important, research results[4]. The ETIS' usefulness can hardly be underestimated, because the platform generates a number comparative metrics used by all researchers to measure their performances and understand more about the impact of their projects.

Via ETIS, it is possible to detect the explicit range of the country's evaluated research and development institutions. Those are big and small, while informally led by **Estonia's major public universities** (Tallinn University of Technology, Tallinn University, the University of Tartu, and Estonian University of Life Sciences). In addition, the list of the positively evaluated organisations, operating on the R&D field, includes National Institute for Health Development,

Competence Centre on Health Technologies, Center of Food and Fermentation Technologies,

Cybernetica AS, Estonian National Museum, Estonian Crop Research Institute, National Institute of Chemical Physics and Biophysics, and some others.

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[1] 'Research and development'.
[2] 'Research funding' in *Estonian Research Council*. Available from [https://www.etag.ee/en/introduction/#funding].
[3] 'ETAg in figures' in *Estonian Research Council*.
[4] *Estonian Research Information System*. Available from [https://www.etis.ee/Portal/News/Index/?IsLandingPage=true&lang=ENG].

Each of the aforementioned organisations enjoys its unique niche in business, and the following paragraph can exemplify this factor.

For example, the **Estonian University of Life Sciences** (more recognised in the country under the name of *Eesti Maaülikool*) represents an R&D centre in "agriculture, forestry, animal science, veterinary science, rural life and economy, food science, biodiversity, nature protection, renewable natural resources and environmentally friendly technologies"[1]. As declared, the highest impact has been made in developing a new entomovector technology in crop protection (to control the grey mould on strawberry in open field conditions), establishing the first version of practical toolkit 'Humus Balance Calculator', implementing an Internet based Decision Support System for Integrated Pest Management, and developing transgenic cloning technology (a method of producing biotechnological drugs using transgenic bovine) with the first cloned and transgenic cloned calves being born[2]. **The University of Tartu**, the country's oldest institution of higher education, is in the "top 1% of the world's most-cited universities and research institutions in the fields of Clinical Medicine, Chemistry, Environment/Ecology, Plant and Animal Science, Geosciences, Social Sciences (general), Biology and Biochemistry"[3]. More specifically, the University of Tartu is the lead partner in the Centre of Excellence in Advanced materials and high-technology devices for energy recuperation systems, the Centre of Excellence for Genomics and Translational Medicine, and the Centre of Excellence in Molecular Cell Engineering[4]. As for **Tallinn University of Technology** (internationally known as 'home of Skype'), it is the only technological university in Estonia and one of the most innovative universities in the broader region. Its campus hosts more than 200 high-tech companies[5]. As noted, the university prioritises its R&D-associated activities to be focused on smart and energy-efficient environments (development and application

[1] 'Research and Development Activities' in *Eesti Maaülikool*. Available from [https://www.emu.ee/en/research/research-and-development-activities/].
[2] 'R&D outcomes with the highest impact' in *Eesti Maaülikool*. Available from [https://www.emu.ee/en/research/research-and-development-activities/randd-outcomes-with-highest-impact/].
[3] 'Research' in *Tartu Ülikool*. Available from [https://www.ut.ee/en/research].
[4] 'Research in University of Tartu' in *Tartu Ülikool*. Available from [https://www.ut.ee/en/research/research-university-tartu].
[5] 'University' in *Tallinna Tehnikaülikool*. Available from [https://old.taltech.ee/university/ttu-in-brief/about-university/].

of internationally breakthrough smart and energy-efficient environments), dependable IT solutions (attack-resistant IT systems and services, sustainable development of critical IT infrastructure, energy-efficient IT systems and data processing methods), and future governance (technological change, particularly the development and uptake of ICT, and related changes in patterns of human behaviour), considering the UN Sustainable Development Framework 4 and global ICT governance agreements[1]. As for **National Institute of Chemical Physics and Biophysics**, it is a major interdisciplinary research organisation that focuses on "basic and applied research in materials science, genetic engineering and biotechnology, environmental technology, in the field of particle physics and informatics"[2].

In short, considering its size and relatively small population, Estonia is 'punching above its weight', having become a valuable contributor to the global R&D field. Arguably, Estonia has proven the fact that being digital does not mean being vulnerable or insecure at the same time. This point has been recently underscored by the country's President who noted that Estonia's "small and medium sized enterprises are building e-services to other nations, co-operating with local partners to achieve tailor-made solutions and increase resilience of the digital ecosystems […] [b]ecause we know – every digital state will preserve its identity and culture also online"[3]. In a way, R&D for Estonia is a means to preserve the country's unique identity.

[1] 'R&D Management' in *Tallinna Tehnikaülikool*. Available from [https://www.taltech.ee/en/rd-management].
[2] 'National Institute of Chemical Physics and Biophysics' in *NICPB*. Available from [https://kbfi.ee/?lang=en].
[3] Kaljulaid.

Innovation in Greece

George N. Tzogopoulos

Innovation in Greece has made some progress over the last years but the country's performance remains poor in comparison to other member-states of the European Union. The main problem is related not only to the quantity but also to the quality of funding provided by the State. Greek start-ups, however, are flourishing. But this is mainly the result of the intellectual capacity and scientific ability of Greek individuals themselves who are prepared to stay in Greece in spite of the lack of opportunities. Some international companies are also making targeted investments in the country which can provisionally boost innovation. Chinese companies are among them. An important green energy deal was signed when President Xi Jinping visited Athens in November 2019. American and German enterprises are also looking for some new opportunities.

In November 2016, the German Institute for Economic Research published a study outlining that the Greek economy lacked crucial innovative and internationally competitive industries as well as large enterprises with high value added and sophisticated jobs. The study also mentioned that this was in stark contrast to the rich intellectual and scientific potential of Greece. In 2017, Greece was in the 22nd place in the EU and in 2018 in the 20th place. According to the 2019 European Innovation Scoreboard, Greece was above the European average in 'innovators' and 'linkages'. But it lagged behind in terms on other indicators such as 'intellectual assets', 'finance and support', 'innovation-friendly environment', 'foreign doctoral students', and 'venture capital expenditures'. The 2020 European Innovation Scoreboard placed Greece in the 20th place, again. The country showed the highest positive difference to the EU in enterprise births, employment share in services and average annual change in GDP. The biggest negative differences were monitored in top research and development spending, value-added share foreign-controlled enterprises and employment share high and medium high-tech manufacturing.

The National Documentation Center presents some data – albeit old – on the impact of Greek publications. In the period from 2012 until 2016, Greek publications approached the world average across all scientific fields, displaying citation scores from 1.24 to 0.86. The fields of 'Natural Sciences', 'Medical & Health Sciences', 'Engineering & Technology' and 'Agricultural Sciences' exceeded world average. They were followed by 'Social Sciences' and 'Humanities'. Additionally, the percentage of enterprises in Greece with product innovation amounted to 42.5 percent in the period from 2016 until 2018 compared to 30.7 percent in the period from 2014 until 2016. The Hellenic Foundation for Research and Innovation, an institution that was only established in 2016, plays currently an important role in improving Greece's record. It supports research and new researchers by providing scholarships for doctoral students and post-doctoral projects.

In the last years, following the exit of Greece from the so-called bailout, expenditures for research and development increased. According to statistics for state funding in Greece for the period 2008-2018, as they have been prepared by the National Documentation Center, the relevant 2018 amount reached to €1,141.62 million, the highest amount recorded in the afore-mentioned 10-year period. However, the 2020 OECD survey for Greece shows that spending concerns the deployment of existing technologies and the purchase of machinery and equipment, rather than scientific activities. The barriers to innovation, the same report asserts, include difficulties in obtaining public grants or subsidies in addition to the lack of internal and external finance. They also encompass difficulties such as weak links between industry, universities and public research institutes. As a result, the number of patents has been low.

As far as Greek startups are concerned, a study of Enterprise Greece published in June 2019 calculated circa 2000 of them. Most of the startups operate in the industrial technology and production hardware category. Their main operation model is business to business with some business to consumers type. The majority of startups enjoying profits (71.5 percent) earned up to €50,000 in 2018. That was the lowest position among European countries. 14.3 percent earned an amount vacillating from €50,000 to €150,000 and 14.3 percent had an annual revenue surpassing €150,000. In 2018, Athens was the winner of the European Capital of Innovation Awards, funded by the EU research and innovation program Horizon

2020. According to the website of the EU, some of the innovations promoted encapsulate the 'POLIS' project aiming at revitalizing abandoned buildings by providing small grants to residents and small enterprises, the renovation of the Kypseli quartier public market, the 'Curing the Limbo' initiative, that has given refugees and migrants the possibility to connect with other residents in order to learn the language and the Digital Council which is bringing together companies and educational institutions to offer trainings on digital literacy. It is also worth-mentioning that 'Alzheimer's Disease Prediction Service' – led by Ioannis Tarnanas – won the European Institute of Innovation & Technology 2018 award.

There are noteworthy cases sketching out the success of Greek start-ups and their international outreach. In early 2019, data analysis firm Data Artisans, a Berlin-based startup founded by Kostas Tzoumas, was acquired by Alibaba Group for circa €90 million. Also, in May 2020, Patra-based startup Think Silicon, specializing in the design and development of high-performance graphics processing units was bought by Nasdaq-listed Applied Materials. The costs exceeded €20 million. Moreover, in 2020 summer, Ferryhopper, an online tourism agency, managed to raise €2.6 million. According to newspaper *Hi Kathimerini* hi-tech companies such as Blueground, Workable, Upstream, Viva, Persado, Beat, Softomotive, Skroutz and others were valued above €100 million during the summer period.

A January 2020 report of the National Bank of Greece analyzed innovative activity in Greek manufacturing and considered support or future innovation endeavors by SMEs critical to narrow the relevant gap between Greece and other European countries. On the same wavelength, a 2020 EY survey shows that the majority of investors asked – 38 percent in comparison to 25 percent in 2019 – investments in innovation and high technology were important for Greece. On the whole, the Greek government is particularly interested in green energy projects. It seeks to proceed to the replacement of lignite with other forms of power production and to the liberalization of the energy market. It is also highly interested in the modernization of Greece's defense industry and potentially benefit by the relevant interest of the US and Israel. Imports of innovation projects from abroad is also placed on the agenda. In September 2020, for example, the first trial of an electric bus manufactured by China's BYD was carried out in Athens.

Despite problems, the good news for Greece is that some international companies have made targeted investments in the country which have the potential of boosting innovation. When Chinese President Xi Jinping visited Athens in November 2019, for example, China Energy Engineering Group, Industrial and Commercial Bank of China, British company Nur Energie and Greek company Prenecon, signed a multilateral agreement on the MINOS 50MW solar power. Some other companies that can be mentioned are SAP, Tesla, Volkswagen and Cisco. SAP recently announced a new talent program seeking to train 300 young people to become technology professional. Tesla is hosted in the Technology Park of Attica called 'Lefkippos', where the National Centre for Scientic Research hopes to contribute to Greece's efforts to promote human capital and to bring market innovation. Volkswagen is planning to pilot its autonomous driving program and could develop the required network on the island of Thasos. And Cisco is building a technology park in Thessaloniki, Greece's second largest city.

Conclusion

Most data about the innovation record of Greece are old. Although the EU and OECD regularly publish relevant reports, it is hard to find updated statistics based on Greek sources. The Greek state prefers to rely on existing technology methods and the acquisition of material instead of supporting quality research and link universities to the market. Several Greeks, however, manage to build start-ups, which occasionally become highly successful. Despite poor financing by the State and bureaucratic obstacles they are able to enter international competition and sometimes sell their high-tech companies. If Greece wants its young and dynamic part of the population either to return from abroad or immediately enjoy opportunities at the domestic level, it will need to improve conditions for quality research. Prime Minister Mitsotakis has pledged to support innovation but his commitment will be assessed in the medium-term.

Science and Technology Innovation Mechanisms in Hungary

Csaba Moldicz

This briefing tries to give a short description of the Hungarian science and technology innovation mechanism. Although the EU level research and development guides the countries, the implementation of the research and development policies comes within the purview of the EU member states. It is worth pointing out that the Single Market creates special conditions for the research and development policies and institutions of the EU member states, since the Single Market was created in the belief that a level playing field must be provided for the European firms, thus a significant amount of EU law was adapted to restrict state subsidies – which are otherwise typical tools in state research and development policy – in order to avoid market distortions and secure fair competition. The briefing first focuses on the basic data of Hungarian research and development in a Central European comparison, then it gives a short overview of the way and structure of how research and development funds are being spent and the institutions shaping this field. The reform plans and steps of the Hungarian government that are being taken to make research institutes and universities more competitive internationally are also touched upon in this briefing.

1. Basic data of Hungarian research and development

Hungary spent 1.53 percent of its GDP on development and research in 2018. This number is significantly below the EU-27 average; however, this share has undergone positive changes in the last decades (1995: 0.71; 2005: 0.92; 2015: 1.35). In the group of Visegrad countries, Czechia surpasses Hungary, while both Poland and Slovakia lag behind. (See table 1.) In the European Union, the increase of research and development expenditures (in defined in terms of GDP) is one of the key goals. The EU average target figure is 3.0 percent measured in GDP for 2020, while the Hungarian target is set for 1.8 percent. (In our opinion, whether Hungary can reach this goal in the aftermath of Covid-19 is not a significant question, since this indicator can be distorted by plummeting GDP. In this situation, sticking to the

nominal value of the originally earmarked research and development is more relevant.)

Table 1. Development and research Expenditures in terms of GDP (2018)	
Country	Share (%)
Czechia	1.93
Hungary	1.53
Poland	1.21
Slovakia	0.84
Source: Eurostat	

Looking at the separate activities related to science and technology, the overall picture improved in the last year, however certain elements show weaknesses: productivity, efficiency of the tertiary education and patent activity are the outliners, while R+D intensity, the added value of the manufacturing and high-tech intensity are strengths of the Hungarian economy. (See table 2!)

Table 2. Bloomberg Innovation Index		
Elements of the index	Ranking in 2019	Ranking in 2020
Total score	32	28
R+D intensity	30	25
Manufacturing value added	12	13
Productivity	50	40
High tech intensity	26	18
Tertiary efficiency	50	54
Research concentration	33	30
Patent activity	50	48
Source: Bloomberg		

According to the European Innovation Scoreboard, the Hungarian Innovation Index was 72.3 in 2019 which is significantly higher than in 2012 (64.8), the sub-indexes show the weaknesses and strengths of Hungary. The report evaluates the following areas this week: design applications; in-house, marketing

and organizational innovations of small and medium enterprises; respective research and development expenditures in the public sector. At the same time, strengths are the innovation friendly environment, the employment and sales impacts innovation and broadband penetration.

When looking at the sectoral distribution of innovation activities we can see that the share of innovative firms is the highest in the Hungarian pharmaceutical sector (63. 9 percent), while the information communication sector (50.3 percent), respective the petroleum refinery sector (50 percent) are also innovation-intensive economic sectors. Average levels are to be found around 30 percent, the share of innovative firms is above this level in the automotive industry (42.1 percent), chemical sector (44.7 percent) and finances, insurance sector (43.6 percent), just to name a few of the most important sectors.

2. Finance and the Institutional Framework

More than the half of the research and development expenditures originate from the private sector in Hungary (2018: 53 percent), while the public budget expenditure usually make up around one-third of the total expenditures. It is wort noticing that the figure 'public budget expenditures' stands for the Hungarian public sector and EU funds combined. Since EU funds must be linked to already earmarked national funds, it makes sense to publish these data combined. Around one-sixth of the expenditures come from foreign sources, this number was 15 percent in 2018.

The main players of innovations are the private firms, more than 70 percent of the research and development funds are spent by them, while tertiary both the educational institutions and the research institutes spend 13-13 percent of the total sum on research and development in Hungary. If we only investigate the source distribution of the corporate research and development expenditures, we see that 70 percent originate from the corporations, 17 percent from foreign sources and only 13.57 percent from the public budget. At the same time, it must be pointed out that micro and small enterprises (enterprises, in which the number of employees is below 50) mainly rely on public budget (37.6 percent) in their research and development spending, while the same ratio is 25.5 percent at medium enterprises (whose number of employees is between 50 and 249) and 3.1 percent at large enterprises (whose number of employees is above 249).

The Ministry of Technology and Innovation set the science and technology strategy of the county, which established the National Research Development and Innovation Office (NRDI) based on a law adapted in 2014.[1] The NRDI established the NRDI Fund, which is a fund earmarked only for the promotion of research and development and innovation. The fund is being financed from several sources: the contribution of the central budget and the so-called 'innovation contribution' of the enterprises. (The innovation contribution is built in the tax system of Hungary; the aim is to support the technological development of the Hungarian economy in a sustainable way.) Another special purpose of the fund is to complete and balance the EU funds. We should bear in mind that the EU's structural funds aim to give support to backward regions. In Hungary's case, backward regions are to be found in the countryside, while two-third of the Hungarian research and development facilities are located in Budapest or in Pest county. Budapest and Pest county form the NUTS statistical region, Central Hungary. That is the only Hungarian statistical region where GDP per capita is above the EU level. (2017: 139.7%). In other words, the amount of available funds is reduced here.

When it comes to international relation, the task of the NRDI is to coordinate the EU Framework Programme for Research and Development 'Horizon' 2020, which is an 80 Billion Euros fund available between 2014 and 2020. In the institutional framework of the NRDI, the so-called National Contact Points were established so that they inform and advise participants aiming to submit application for the calls. The NRDI also represents Hungarian interests in several strategic, decision-making bodies of the 'Horizon' program, the representation of Hungarian interests in the bodies is supported by a network of specialists and experts. The NRDI actively participates and represents Hungarian interests in the next bodies:

— European Research Area Committee,
— COREPER (Committee of Permanent Representatives),
— Competitiveness Council of the European Union.

3. Summary

Based on the European Innovation Scoreboard 2020, Hungary is a moderate innovator. The scoreboard categorizes the countries into four types: innovation

[1] http://njt.hu/cgi_bin/njt_doc.cgi?docid=172811.285433

leaders, strong innovators, moderate innovators and modest innovators. The label moderate innovator stands for countries whose innovation performance is below the EU average.

The Hungarian government appears to be determined to change this situation. It started reshaping the network of research institutes that were originally strongly linked to the Hungarian Academy of Sciences. The research institutes were organized into the so called Eötvös Loránd Research Network in 2019, the network functions from August 1, 2019. The network receives more financial support from the public budget, since the government's goal is to guide research more closely and link them more to the improving international competitiveness of the Hungarian economy.

The concentration of research and innovation capacities is a clear goal of the Hungarian government, the public research institutes and universities are watched over by the Ministry of Innovation and Technology, just as their budgets are as well. The budget provided to the Hungarian Academy of Sciences and the budget of the Eötvös Loránd Research Network, the NRDI and the Hungarian public universities is from the Ministry of Innovation and Technology. In order to strengthen the linkages between public and private, the Hungarian government transformed some Hungarian universities (Corvinus in Budapest, University of Veterinary Medicine Budapest, University of Miskolc, Moholy-Nagy University of Art and Design, John von Neumann University, University of Sopron, the Széchenyi István University in Győr). The new model includes the establishment of an asset management foundation, which basically is less strongly linked to the state, however allows for the inclusion of private enterprises bringing the Hungarian system close to a foundation-funded, enterprise-funded model.

Science and Technology Innovation Mechanism of Latvia

Nina Linde

The aim of the Science and Technology Innovation Mechanism in Latvia is to provide a knowledge base for the transformation of the national economy to higher added value, which was reflected in the Guidelines for Science, Technology Development and Innovation (hereinafter - STI) for 2014-2020.

In the period of 2014-2020, the development of the STI policy was closely related to the development of the National Industrial Policy in relation to the establishment of the national innovation system for the structural transformation of the Latvian economy into higher added value. Furthermore, the tasks were to concentrate resources in the strongest scientific institutions and to align research with the priorities of Latvia's smart specialization. During this period, the development of universities as centres of knowledge, technological development and innovation was started by integrating scientific institutes into universities and setting innovation-related goals. In the field of science policy management, the evaluation of research project applications in accordance with the standards of the European Union was introduced, and the basic principles of funding and strategic management of scientific institutions were based on performance.

Within the framework of the Latvian National Industrial Policy, innovation and increase of its capacity is one of the main pillars to improve the competitiveness of Latvia's industrial sectors and increase productivity and export volumes. The guidelines set out four equally important elements for the development of the Latvian innovation system - **knowledge capacity, innovation supply, innovation demand, transfer system**.[1]

[1] https://innovation.lv/inovacija/inovacijas-politika-latvija/

Currently, the work of institutions on the new document - the draft guidelines for the development of science and technology for 2021-2027 is underway.[1] The document defines Latvian research and innovation as an integral part of the European and world common research area, therefore its development must be directed considering both national development priorities and international processes and global challenges. Comparing to the previous programming period, the new document focuses more on **promoting research excellence and increasing the social and economic value of research**. The low level of R&D investment remains a challenge to ensure the long-term development of excellent research and innovation. Both an increase in state budget funding for research and the amount of investment in the business sector would be needed.

The strategic overarching goal of the STI policy is to promote the development of a smart, technologically developed and innovative society in Latvia, three goals have been set to achieve it:

1) to develop **research excellence and international cooperation**;

2) increase **innovation capacity and the social and economic value of knowledge and research**;

3) to improve the **efficiency of the management of the R&D** system.

In order to develop research excellence and international cooperation and for Latvia to fully integrate into the European and world research area, it is necessary to create an environment that stimulates the development of talents and supports the formation of purposeful and motivated research human capital in the long run. Achieving the goal requires stable and sustainable **scientific funding, and competent academic staff** with extensive networks.

Public funding for science in Latvia is still insufficient. Investment in science still does not exceed 50-million-euro threshold. The funding of the science base is unchanged from 2017 to 2022 - slightly over 27 million *euro*. Funding for public research programs is declining sharply, and the budget plans to halve it (see Table 1).

[1] https://izm.gov.lv/lv/aktualitates/4188-aicina-iesaistities-zinatnes-tehnologijas-attistibas-un-inovacijas-pamatnostadnu-2021-2027-gadam-sabiedriskaja-apspriesana

Table 1. State funding in the budget program "Science" of the Ministry of Education and Science"[1]

	2017	2018	2019	2020	2021	2022
Investment in science	47 917 797	51 046 323	49 636 054	49 947 565	49 703 576	50 937 391
Provision of scientific activity	4 912 518	12 296 785	12 511 033	13 120 468	14 620 468	16 120 468
Science base funding	27 187 532	29 484 155	27 866 590	27 786 688	27 636 444	27 636 444
National research programs	8 880 940	3 151 396	3 745 778	4 368 041	2 874 010	2 874 010
Ensuring the operation of the Latvian Science Council	99 128	99 367	99 894	99 894	99 894	99 894
Participation in EU research and technological development programs	5 334 897	4 708 556	4 208 971	3 368 686	3 267 483	3 001 298

The scientific excellence of the Latvian R&D system is insufficient for rapid smart growth, and this is directly related to low R&D investment, which in the 2014–2020 programming period ranged from 0.44 to 0.69% of GDP with a low share of private investment (National target for 2020 - 1.5% of GDP).

At present, the number of people employed in research in Latvia is still critically low (both in terms of the total number and the share in the total structure of the country's workforce), reaching only ~ 50% of the EU average. The share of innovative small and medium-sized enterprises in Latvia is one of the lowest in the EU - 30.3% (EU average 49.1%). The structure of Latvian industry is mainly characterized by low-tech companies. Latvian companies have insufficiently developed intersectoral and intersectoral co-operation, especially co-operation with research institutions in Latvia and abroad, as well as a weak capacity for commercialization of research results. Knowledge-intensive services account for almost 50% of total service exports. The share of medium and high technology products in total exports is 34.7% (EU average - 56.7%).

[1] https://www.izm.gov.lv/lv/zinatne/zinatnes-finansejums; https://titania.saeima.lv/LIVS13/saeimalivs13.nsf/webAll?SearchView&Query=([Title]=*par+valsts+bud%C5%BEetu+2020.gadam*)&SearchMax=0&SearchOrder=4; https://titania.saeima.lv/LIVS13/saeimalivs13.nsf/webAll?SearchView&Query=([Title]=*par+valsts+bud%C5%BEetu+2019.gadam*)&SearchMax=0&SearchOrder=4

R&D&I [1] development and investment, as well as the creation of new businesses, are hampered by existing market failures in the availability of finance for economic operators at all stages of development.

As academic and research staff form intellectual capital to develop the capacity of all sectors of the Latvian economy, Latvia is implementing measures that provide high-quality and internationally competitive academic and research career development opportunities, stimulate and provide opportunities for the involvement of bachelor's and master's students, doctoral students and young researchers in research work in scientific institutions, companies, public administration and public institutions, public organizations and promote mobility for the circulation of knowledge.

In order to strengthen scientific excellence and international cooperation, it is necessary to develop appropriate research, including digital infrastructure that promotes the quality of higher education and research. In order to improve international competitiveness and recognition, the involvement of Latvian researchers in strategically important cooperation networks and research consortia with other European and world countries should be promoted, including by using the opportunities provided by cooperation partners and the Latvian diaspora worldwide.

Excellence-oriented research infrastructure, funding and competent academic staff are prerequisites for the development of excellent and internationally competitive research, the creation and transfer of knowledge, as well as the provision of high-quality, research-based higher education and the training of highly qualified professionals.

Latvia still needs to **develop digital competences and skills**, as it limits the potential for innovation in companies, as well as hinders participation in lifelong learning and the participation of the unemployed in active employment measures. Latvians lack digital skills at all levels and the share of ICT specialists in the workforce is low. Only 43% of the Latvian population aged 16-74 have basic digital skills (58% in the EU as a whole), and ICT professionals make up a small part of

[1] R&D&I – Research and Develepment and Innovation

the workforce (1.7% compared to 3.9% in the EU, while ICT professionals as a percentage of employed women) is only 0.5% compared to 1.4% in the EU). [1]

Conclusions

Therefore, the ability to add value from knowledge is directly linked to **the competences and capacity of those working in research, the demand of the private and public sectors for research and the amount of funding allocated to research and innovation**. In order to reap the long-term return on investment in research and technological development, targeted measures are needed to develop public and private sector research and innovation capacity, as well as cooperation, ensuring both the development of basic science and the digital transformation of R&D systems and open science culture. Furthermore, the transfer between research and the business environment, the public sector and society at large, at national, regional and international levels.

The development and availability of an open, secure and interoperable public data infrastructure for research and innovation, as well as the transformation of traditional economic sectors in the regions towards greater resource efficiency and productivity, the creation of higher value-added products and services, are also essential for an efficient knowledge and technology transfer system. As well as, technologically intensive, internationally competitive, incl. niche markets, the development of innovation. The value of science as a socially and economically important field of intellectual activity lies in the direct social, economic and measurable benefits of research, as well as the diverse knowledge and understanding of wider interconnections and processes. In order to increase the value of knowledge and research in society, it is essential to create public awareness of the research and knowledge creation process, as well as to provide wider opportunities for public involvement in scientific research activities, creation and use of research data, incl. within the framework of amateur science initiatives.

[1] Digital Economy and Society Index 2020

Lithuanian Science and Technology Innovation Mechanism Boosted by the Prospects of Economic Growth

Linas Eriksonas

On 15 September Luminor Bank raised its GDP forecast for Lithuania to a minimally positive 0,2 per cent from 2,5 per cent contraction this year, as assumed at the start of the pandemic in March. The bank analysts now expect rapid growth in 2021, with the economy expanding by 4.4 per cent and by another 4.2 per cent in 2022. If the forecast is accurate, Lithuania should emerge as one of the least affected EU countries by the current pandemic-induced crisis, unlike during the last global financial and economic crisis in 2009, when it was hit hard. According to the analysis from Luminor, such a positive development could significantly reduce the gap between Lithuania and the more economically advanced EU countries and position the country onto the path of further growth. The Ministry of Finance has also issued a rather optimistic forecast raising its GDP projections for this year to -1,5 per cent from -7 per cent, thus subscribing to similarly positive sentiment.

It is not a coincidence that such significantly improved forecast figures and the overall positive sentiment about the prospects of the country's economic performance come after some 28.4 per cent of funds, part of the economic stimulus package has been absorbed by September 10, representing 1.4 billion Eur out of 4.9 billion Eur earmarked for investment in the economy until the end of next year. The further investment in digitalization, research and innovation forms a substantial part of the investment package.

Below is a brief overview of the science and technology mechanism in Lithuania which underpins the public investment in research and innovation support measures, explaining the importance that the government attributes to the research and technology development sector in the concerted effort to move Lithuania from a middle-income country to a high-income country.

The development of Lithuania's science and technology sector has closely followed the path of the country's political and economic transformation since the early 1990s. It transitioned from the top-down, hierarchically organised system of state-owned educational and research institutions into a conglomerate of

autonomous universities and relatively independent research and technology organisations. The transformation of the higher education institutions further followed Lithuania's negotiations for the accession to the EU. The EU placed research and innovation policies at the centre of its growth strategy trying to overcome the differences in growth and productivity with the global economies of the time (the US and Japan); hence, each EU Member State was required to align with these goals as articulated in the EU Lisbon Strategy in 2000.

In preparations for the EU accession, the Lithuanian Parliament adopted a Law on Higher Education in March 2000, which regulates research activities of higher education institutions. During the period 2000-2010, the institutions were established to support the research and innovation mechanism, namely: the Agency for Science, Innovation and Technology (established in 2010 from the reorganized Agency for International Science and Technology Development Programmes which was founded in 2002), the Research Council of Lithuania (in 2003 the Council became the state budgetary institution under the parliament and since 2007 has been administering the support schemes funded by the EU Structural Funds), the Research and Higher Education Monitoring and Analysis Centre under the Ministry of Education and Science (established in 2007 and in 2017 reorganised into the Government Strategic Analysis Centre under the Office of the Government of the Republic of Lithuania).

A high level of institutional instability and the changing aims characterized the period of the formation of the science and innovation support mechanism as Lithuania aimed to address different directions coming out of the EU bodies. It resulted in a streamlined, yet still underperforming by international standards and under-funded research and innovation sector in terms of the share of the gross expenditure on research and development. In 2019 GERD for Lithuania stood at 0,86 per cent GDP while BERD – at 0,3 per cent.

The European Commission country report for Lithuania released in February boldly stated that "R&D intensity is relatively low and spending remains inefficient and overly reliant on European funds. Likewise, public research and innovation are held back by a cumbersome institutional network and a shortage of talent".

The report acknowledged that to overcome the middle-income trap and making a successful transition to a knowledge-based economy requires deeper structural reforms. "The Lithuanian innovation eco-system remains fragmented,

while funds are poorly targeted and not available at all development stages of a company. Public funding still relies excessively on EU funds", - concluded the report.

As one way of readily addressing the identified deficiencies in the science and innovation support mechanism in Lithuania leading to the insufficient investment in R&D and the shortage of talents, the government pushed forward the Law on the Innovation Promotion Fund which was adopted by the parliament on 26 June. The Law stipulates that the Innovation Promotion Fund will be established next year to ensure that the adequate funding sources for research, development and innovation activities are available for companies.

The Fund has to increase the created added value, productivity, the number of innovative products created, their variety, sales and exports in enterprises that received the investments. The then Acting Minister of the Economy and Innovation Žygimantas Vaičiūnas was put on record by saying that "the Innovation Promotion Fund will ensure larger than before public investment in R & D & I and will allow attracting more private business investment. The Fund will be in particular beneficial for innovative start-ups which require funding for starting business activities and product development".

The Law stipulates that the Fund's investments will be carried out through financial instruments in the form of loans, guarantees and venture capital investments in innovative businesses. The Ministry of the Economy and Innovation announced that it "will allow the national businesses to adapt to the situation of decreased EU funding". From 2021 to 2040 the Fund's investments could reach 900 million Eur, as publicly reported.

Regarding the shortages of talent, two ways are envisioned to address this issue: first, to increase the existing pool of researchers and innovators in the system through supporting additional training and capacity building in the targeted sectors, and, second, to brain gain human resources from abroad by attracting technology companies to relocate to Lithuania and thus stimulate job creation in the local high growth economic sectors.

Until recently the possibilities to bring in a substantial amount of high-skilled workers from third countries have been limited due to the stringent migration policies followed by Lithuania, despite the individual initiatives to attract startup founders and entrepreneurs, for example, through a startup visa programme (a

procedure launched in 2017 to provides a streamlined entry process to the Lithuanian startup ecosystem for foreign entities from non-EU countries).

The recent social and political upheaval in neighbouring Belarus have created favourable conditions to bring in the additional talent from the country in turmoil. In September the state-funded investment promotion agency Invest Lithuania published the relocation guide for Belarusian firms. According to the Law on Investment, foreign companies planning to invest in the Republic of Lithuania should meet the following criteria: creating jobs for at least 20 employees (both relocation and new hires) and maintaining them for at least three years. The average salary cannot be less than the average monthly salary of the municipality where the investment is made. The aim is to relocate the companies or part of their operations in the growing IT and FinTech sector which lacks adequate human resources to underpin rapid growth of the sector.

The foreign direct investment could also play a role in contributing to the increased investment in research and development from the private sector if enough talent and research potential are made available over the coming years. Lithuania has already been ranked high on the aspects that are important for investors. It is ranked as 1st among Central and Eastern European countries for university-business collaboration (according to the Global Competitiveness Report, 2019). Further, Lithuania is ranked by Bloomberg as 2nd globally for "tertiary enrolment", which includes enrolment in higher education and the number of graduates in key innovation sectors. Moreover, one-fourth of all students in Lithuania has enrolled in innovation relevant studies (science, mathematics, computing and engineering). However, the main challenge remains to increase the levels of public and private funding in the high growth potential sectors.

The government has already earmarked substantial sums for the investment in human capital, scientific innovations, energy and climate change projects as part of the investment plan entitled as the Plan for the DNA of the Future Economy. According to the Plan, EUR 417 million will be invested in human capital, EUR 583 – in research and innovations, while EUR 359 – in the energy sector and the fight against climate change.

"Everything will depend on us – how fast and how efficiently we will invest. Everything is rushed now and the biggest complaint is that there is no time to assess and analyse the situation. But let's not forget that we do not have time because we

cannot miss this opportunity now, when the sharing of markets and the fight for investments and talents is taking place," the Minister of Finance Vilius Šapoka said at the launch of the Plan.

The speed with which the Plan was adopted and pushed towards the implementation (it was announced in May and the first investment decisions came at the end of the summer) has shown the strength of the public governance in Lithuania to flexibility adapt to the ongoing rapid changes in the external environment, and by using the existing science and innovation support mechanism to make unprecedently fast-paced decisions.

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Science and Technology Innovation Mechanisms in Montenegro

Milika Mirkovic

During the previous period, Montenegro has made significant progress in the field of science and innovation, primarily through the adoption of strategic and legislative framework that are in line with the orientation towards these issues. First of all, the improvement in the field of science and innovation is reflected through the adoption of the Smart Specialization Strategy, development of innovative ecosystem, financing of programs and innovative projects in order to encourage scientific research, but also initiating significant projects, including The South East European International Institute for Sustainable Technologies (SEEIIST) project.

Science development in Montenegro

During the previous period, the Ministry of Science of Montenegro implemented a number of activities and policies related to the encouragement of scientific research. Gross domestic expenditure on research and development (GERD) has increased in recent years. Namely, according to the data of the Ministry of Science, the total domestic spending on research and development for 2018 amounted to EUR 23.5 million or 0.5% of GDP. Compared to 2017, the amount increased by 56.7%, while the share in GDP increased by 15 percentage points. Compared to 2015, higher growth was recorded. Namely, total domestic spending on research and development in 2018 increased by EUR 9.8 million or 71.5% .in comparison to 2015.

Within the policies in the field of science and innovation, many programs and measures have been launched, which are implemented through project financing and other support mechanisms. These programs and measures primarily are related to the development of human resources and the improvement of their research capacities, innovation policy, the promotion of excellence and multidisciplinarity, internationalization and others. Namely, through the co-financing of projects during 2020, EUR 0.6 million was allocated for the co-financing of scientific research and innovative activities, which is one of the important mechanisms of support to the scientific community. First of all, these funds are intended for participation in

programs such as Horizon 2020, The International Atomic Energy Agency (IAEA), COST, EUREKA program, ICGEB activities, co-financing of scientific activities (mobility of researchers, participation in scientific and other events, organization scientific congresses and other activities). An important mechanism to support the development of science and innovation is the doctoral research scholarship program, where in addition to the scholarship, doctoral research and student mobility are financed, which is an important segment of this program.

Also, the Ministry of Science awards grants for scientific research projects. Projects for which a grant is awarded should be in accordance with the priorities defined by the Strategy of Scientific Research of Montenegro. This mechanism to support the development of science aims to strengthen the capacity of the research community in Montenegro, with a special focus on young researchers. In that case, the Ministry of Science awards grants to scientific research institutions in Montenegro in the amount of EUR 70,000 to EUR 100,000, while the total amount of the overall program is EUR 1.5 million for 2020. In addition to this mechanism of encouraging scientific research, the Ministry of Science also awards grants for innovative projects, which is a support to the start-up community. During 2017-2019, in total EUR 1.4 million was allocated under this program, where 23 innovative projects were co-financed. This mechanism to support the development of science and innovation plays a significant role in connecting the academic community with the economy and business, resulting in a joint solution to the real problems that companies face.[1]

One of the significant projects in the field of science and innovation development is the SEEIIST project, which was initiated three years ago. This regional project includes all countries of the WB region and Bulgaria and Slovenia. The main mission of this project is related to science for peace, Scientific Excellence, International Collaboration, Sustainable development of society, Education, Technology Transfer, Development of powerful digital network and High performance computing and Big Data handling[2]. The project was initiated and led by Montenegro has significance relevance and prospective and represents an important research infrastructure and platform for the entire region of Southeast

[1] Work Report 2019, Ministry of Science of Montenegro
[2] https://seeiist.eu/

Europe. Within this project, the establishment of an international institute for the application of hadron cancer therapy and research in the field of biomedicine using protons and heavier ions is envisaged, and the headquarter of this institute could be in Montenegro, which would be of great importance for positioning Montenegro on the scientific map of Europe. Macedonia, Slovenia and Bulgaria).

The new laws in the field of innovation and technological development

In the direction of encouraging innovation, during the previous period strategic documents and legislation has been adopted which will accelerate the development of innovative projects and start-ups and in general to support the development of science and creating innovative environments. In July this year, the Third Package of Measures to Support the Montenegrin Economy was adopted. This package of measures refers to the period 2020-2024 whose main goal is to help the economy overcome the problems caused by the COVID-19 pandemic virus. One of the segments of support measures refers to the competitiveness of the economy and the strengthening of economic activity in the field of information technologies. These measures are intended to support digital development and digitization for the purpose of social and economic development.

In July 2020, in order to support the implementation of these measures and the development of the innovative economy in general, Montenegro has adopted two laws: Law on Innovation Activities and the Law on Incentives for Research and Innovation Development, which follow the measures defined by the Third Package. The new regulations follow the measures defined by the Third Package of Measures, i.e. enable the implementation of the measures of this "economic strategy" for the next period. These laws provide incentives for the development of innovative economy and start-up companies, which relate to tax relief (start-up companies are exempt from tax for up to five years; reduction of taxes and contributions up to 50% for employees in innovation activities; tax exemption and contributions for work on innovative projects; exemption from profit tax if profits are reinvested in innovative projects, start-ups and funds for financing innovative projects, donations to scientific research institutions; reduction of real estate tax and taxes for construction of infrastructure for innovation activities, as well as the establishment of the

Innovation Fund). The value of these measures will be almost EUR 30 million over a five-year period[1].

The adoption of laws in the field of innovation present a positive signal for the creation of a new economic environment. Incentives related to the development of innovations, which are available to both domestic and foreign companies, could contribute to the attractiveness of Montenegro as a country for testing and creation of innovative technologies and favourable environment for starting a business in this area. In addition to improving the innovation environment, laws could also contribute to strengthening cooperation between the private and public sectors with the scientific research community, improving national support mechanisms for innovation, but also the application of innovation in all spheres of society. The system and structure set up in this way, through the implementation of all activities, will ultimately contribute to greater competitiveness of the economy, greater employment, transformation and modernization of the economy.

In addition, this legislative framework will contribute to the development of innovative companies and scientific research institutions. Through the incentives that have been defined, it can be expected an increase in private sector investments in innovative projects and in general in research and development, which can result in both practical and innovative solutions and new technologies.

In addition to the improvement of legislation in the field of support for innovation and technology development, during 2019, the Smart Specialization Strategy (3S) was adopted, which refers to the five-year period 2019-2024. The goal of the Strategy is to strengthen and enhance the sustainable development and use of technologies in order to improve the competitiveness of the economy. This innovation strategy traces a new path for the development of Montenegro in the future, and at the same time defines the direction of movement in order to achieve the goals of sustainable development of the UN and the new EU2030 agenda. The timing of the adoption of the Strategy and the EU's orientation towards merging sectorial policies with the UN Sustainable Development Goals reflects its additional importance. By passing this document „Montenegro has joined the initiative of the European Union that focuses on the new model of economic development at the

[1] Government of Montenegro, The Third Package of Economic Measures (July 2020) http://www.gov.me/ResourceManager/FileDownload.aspx?rId=410581&rType=2

national or regional level based on targeted support to scientific research activities and innovations"[1].

Therefore, in Montenegro there are numerous programs and mechanisms for encouraging scientific research. However, continuous activities and defining other support mechanisms need to be implemented in order to establish and strengthen links between academia and business and generally improve the research infrastructure, which would have the end result of better socio-economic development of Montenegro.

[1] Smart Specialisation Strategy of Montenegro 2019-2024, Ministry of Science, 2019

Science and Technology in North Macedonia: Underdeveloped and Underutilized Instruments for Advancing Economic Growth

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In the post-socialist period, both science and technology have been systematically neglected by state authorities and institutions. Throughout the years, insufficient attention was been paid on formulating and implementing science and technology policy, which has been mirrored in the continuous underfunding as well as the absence of an overall strategy and. As a result, the science and technology innovation mechanism remained underdeveloped and underutilized as an instrument for advancing the nation's growth, economy and well-being. In recent years however, some positive steps have been taken, most notably with the passing of the "Law for Innovation Activity" in 2013. Among other things, it stipulated the creation of the "Fund for Innovation and Technological Development" and started to lay the foundations for the formulation of a National Innovation Strategy. Nonetheless, in the absence of a strong anchor that can be provided by strong pre-existing scientific and educational capacities, the destiny of these initiatives remains uncertain.

Science and Scientific research

Throughout the post-socialist period, the Macedonian state[1] has failed to create an environment which is conducive to the advancement of scientific work and the development of high-quality researchers and scientists. This is evident in the insufficient funding of science and the structural neglect of the human scientific potential in the country. Whilst in most developed countries, around 2-3% of GDP is dedicated to research and science, in the Macedonian context these figures have been consistently low and experiencing a declining trend. Between 2010 and 2018, a period during which the country's budget increased by 63%, the funds for science have dropped by 16%. Since 2014, the total budget for Research and Development (R&D) as a percentage of GDP has been falling consistently - 0,51% in 2014, 0,44%

[1] The main institution responsible for developing science policy in the country is the Sector for science and innovations at the Ministry of Education and Science.

in 2015, 0,41 in 2016, 0,35% in 2017, 0,35% in 2018. In 2018, 98,5% of the funds of the Ministry of Education and Science were for education, and only 1,5% for science. This brings the current funding for R&D in the country to Europe's bottom. The situation is even more staggering upon closer examination of the figures. The share in the budget sub-category for 'scientific and research activities' was only 0,04% of GDP in 2018. These funds are distributed into 4 funding areas: 1) Business Sector; 2) Government Sector; 3) Higher Education; 4) Private Not for Profit Sector. As demonstrated in the table below the funds for Higher Education are consistently declining.

Total budget for Research and Development as a percentage of GDP from 2014 to 2018[1]					
Year	2014	2015	2016	2017	2018
Business Sector	0,06	0,08	0,10	0,09	0,11
Government Sector	0,08	0,06	0,04	0,04	0,03
Higher Education	0,37	0,3	0,27	0,22	0,21
Private Not for Profit	0,004	0,004	0,01	0,005	0,005
Total:	0,51	0,44	0,41	0,35	0,35

In 2019, out of the total budget for science of around 5 million euros only 1,5 million euros were dedicated to scientific research. The rest were intended for scientific institutes (which includes the salaries for employees without further recourse to funds for research and scientific work) and book translation projects (which took up 651,005 euros or 43% of the science budget). The total of 1,5 million euros available was allocated for covering everything from research projects, publications, organisation of conferences and meetings, participation of researchers in international conferences and meetings, as well as scholarships for postdoctoral and doctoral students for studies in domestic or foreign Universities. No funds have

[1]https://www.fakulteti.mk/news/19082020/kako-da-ne-ima-na-shangajskata-lista-so-ochaen-budzhet-za-nauchni-istrazhuvanja

been allocated for institutional access to international electronic libraries or databases such as the Web of Science and Scopus. Unsurprisingly, in this context marred by underfunding and lack of broader support for human scientific development, the country has been lagging far behind in international scientific rankings. In the Shanghai University Ranking 2019-2020, there is not a single Macedonian University ranked in the first 1000 positions. The Ss. Cyril and Methodius University in Skopje, ranked 1816, with a total score of 66.5, is the country's best ranked University.

Technology and Innovation

Although science and technology are strongly intertwined, with science acting as an anchor as well as a stimulant for technological adoption, advancement and development, this is not reflected in the formulation of the Macedonian public policy. Thus, while science is continuing to suffer from underfunding and structural neglect, attempts have started to be made in the field of technology and innovation. In 2013, the "Law for Innovation Activity" was introduced to regulate innovation activity, its principles and goals, as well as to organise technological research activity.[1] The law also assigns the Sector for Innovation and Entrepreneurship at the Ministry of Education of Science with the key role in formulating, developing and operationalising the country's strategy for innovation. Moreover, it defines the main subjects for providing infrastructure support for performing innovation activity to include: Business technology Accelerators, Science and Technology Parks and Technology Transfer Centers. Finally, the Law stipulated the creation of a Fund for Innovation and Technological Development.

In February 2019, 6 years after the passing of the Law, the first Business Technology Accelerator UKIM was opened at the premises of the Center for Transfer of Technologies and Innovations. It has been described as a business-technology accelerator established to identify and support the growth and competitiveness of the most promising technology entrepreneurs, startups, spin-offs and scale-ups in Macedonia. As the first of this kind in the country, the accelerator "will combine the expertise of the biggest university in Macedonia, an investment/lending firm, financial advisory organizations, and business support

[1] https://fitr.mk/wp-content/uploads/2020/05/Zakon-za-inovaciska-dejnost.pdf

institutions". According to the official description, the best business ideas will have access to investments in the form of equity and/or debt instruments. In addition to the funding, the Accelerator UKIM will actively support the funded startups with market development, networking, and fundraising for follow-on investments.

On the same day as the launch of the Accelerator, the first Science and Technology Park was also promoted. Located on the technical campus of the University of Ss. Cyril and Methodius, its goal will be to enable citizens to develop new skills, create new ideas and create important innovations and inventions in order to start their businesses.[1] Almost 2 years since the launch of the two initiatives, their concrete achievements are yet to be published and thus remain unknown to the public.

The Fund for Innovation and Technology Development was established in December 2013, with the aim of encouraging innovation by providing additional resources to finance innovation, in view of the need to build a competitive economy based on knowledge. The mission of the Fund is to encourage and support innovation activities in micro, small and medium-size enterprises (MSMEs) in order to achieve more dynamic technological development based on knowledge transfer, development research and on innovations that contribute to job creation, and to economic growth and development, while simultaneously improving the business environment for the development of competitive capabilities of companies. Its priorities and objectives include: improved access to financial support for innovation and technological development; promoting and encouraging innovation activities in the country. In 2020, the Fund amounts a total of around 18 million euros, drawn from a combination of funders including the State Budget, loans from the World Bank and self-financing activities.

In 2018, the Fund found itself at the center of public criticism following revelations that it had awarded grants to firms linked to Government officials. The scandal negatively affected the image of the Fund for Innovation and Technology, prompting concerns that its functioning and allocation of funding may also be affected by the pervasive societal corruption, political clientelism and nepotism.[2]

[1] https://accelerator.ukim.mk/official-opening-of-the-business-accelerator-ukim/

[2] https://denesen.mk/kompaniite-na-lokvenec-i-angjushev-gi-povlekoa-proekti-od-fondot-za-inovacii/

Success in science and technology depends on macroeconomic policies, state spending on education, research and development expenditures, the efficiency of domestic entrepreneurs, as well as the broader legislative and institutional environment. Whilst efforts taken since 2013 should be applauded, more should be done in order to advance scientific research and to support human scientific resources in the country, as a base on which to build and reward technological competency and innovativeness. Moreover, closer coordination between the relevant ministries and institutions is necessary to formulate and operationalise a comprehensive science and technology policy. The more rapidly science and technology public policy is able to be adapted and put to work in the economy, the more rapid will be its contribution to economic progress and development.

Science and Technology in Poland

Joanna Ciesielska-Klikowska

Digital revolution is nowadays penetrating daily work, changing business processes and setting new challenges for companies. The focus on the use of new technologies is clearly visible not only in the sector of fast-moving goods, but also in industry and energy. In the case of Poland, the technological revolution is a way to meet great European and global challenges, such as increased demand for energy, with the simultaneous need to reduce CO^2 emissions. Meeting these requirements is now possible thanks to the convergence of operational and information technologies accelerated by the development of the Internet of Things. The innovative, interconnected smart energy products allow enterprises to function better in the digital world. At the same time, solving various problems of societies, both local and global, and using new technologies has become a way for many companies to develop their business.

- **Research and development – data and numbers**

Gross domestic expenditure on research and development (R&D) activity increases in Poland every year, thus giving hope that the building of an information society focused on the use of the latest technologies will take place in a short time. According to the newest data from the Central Statistical Office, they amounted to PLN 25.6 billion in 2018 and increased by 24.6% compared to 2017. The number of entities involved in R&D activities amounted to 5779, which means an increase by 13.3% year to year. Yet, the ratio of gross domestic expenditure on R&D (GERD) to GDP is still quite small.

Table 1. Selected data in the field of R&D activity

	2014	2015	2016	2017	2018
Number of entities in R&D	3474	4427	4871	5102	5779
Gross domestic expenditure on R&D (GERD) in PLN million	16168	18061	17943	20578	25648
GERD in relation to GDP	0,94%	1,00%	0,96%	1,03%	1,21%

Source: Central Statistical Office, Research and development activity in Poland (30 October 2019).

Most of the internal expenditure on R&D - 79.5% - is the current expenditure, while 20.5% is allocated to capital expenditure. The highest internal expenditure on R&D (66.1%) is recorded in the enterprise sector - PLN 17 billion. Significantly, almost 1/3 of the total value of internal expenditure on R&D is attributed to the higher education sector, whose expenditure amounted to PLN 8.1 billion in 2018. In the case of the government sectors and private non-profit institutions, a sum of PLN 498.7 million and PLN 76.7 million are allocated to R&D respectively.

According to the figures, the main sources of financing for research and development projects carried out in Poland are the corporate and government sectors, whose funds account for 53.3% and 35.4% of GERD respectively. Internal funds of entities conducting R&D activity are responsible for financing more than half (54.9%) of internal expenditures on research and development works, while expenditures of the enterprise sector constitute 91.9% of all internal funds involved in financing R&D activities.

Majority of internal expenditure on R&D projects is allocated nowadays to development works - PLN 13.9 billion, 92.7% of which are the costs of development works in the enterprise sector. In 2019 funds in the amount of PLN 8.3 billion were allocated for basic research, and PLN 3.4 billion for conducting applied research. The highest share of research expenditure (basic and applied) in the amount of 62.3% was recorded in the higher education sector (PLN 7.3 billion).

According to the latest data, the highest expenditure is incurred by entities from the service sector. These outlays of PLN 18 billion (PLN 15 billion in 2017) account for 70.2% of the total internal expenditure on R&D. In this sector, the largest share of internal expenditure on R&D was attributed to professional, scientific and technical activities (33%). Among the entities specialized in research, expenditure on R&D was recorded in the amount of PLN 11.5 billion, of which more than half was spent by universities.

It is important that the staff in this sector currently reaches 266.300 people, and their number is still growing (by over 11.3% compared to last year). The largest part of the R&D employees come from the higher education sector (53% of R&D personnel in Poland, with every third of them having at least a doctoral degree).

What is interesting is the fact, that the largest part of internal expenditure on research and development activities falls on the Mazowieckie voivodeship (37%;

capital region), then Małopolskie (14.4%), and the smallest part falls on the Lubuskie voivodeship (0.9%). Yet, the largest share of financing R&D activities from the enterprise sector is recorded in the Podkarpackie and Pomorskie voivodships (68.9% and 68.7% respectively), and from the government sector - in the Lubelskie and Warminsko-Mazurskie voivodships (62.5% and 60%).

- **Strengths**

In general, Poland's economic development has been a huge success in recent years. According to the World Bank, Poland achieved the status of a high-income country in a record time. The increase in share of exports of goods and services in global exports recorded in 2004-18 was the highest in the entire EU (motor vehicles, food, rubber and plastic goods - increase by 15 points). However, in recent years, the importance of the research and development sector has also grown. The Polish technology sector has high potential. Polish companies use EU funding on an increasing scale. In this respect, there is no country in the EU that would maintain the pace of Poland's development. Yet, the starting point was very low.

In the face of the current technological trends, Poland has a real chance to become a leading player in the export of new technologies. Polish blockchain specialists are appreciated by international corporations and praised on the global market, and what is very important - they are quite cheap as employees (on average, the hourly labour costs in the market sector in Poland are 69% lower than the EU average).

The strength of Polish economy is therefore build on its competitiveness on international markets, yet it should be based on innovative, technologically advanced products. Only in that way it will be possible to move up the ladder of added value. However, to achieve this, financial support is needed, especially in innovations, which will result in visible economic growth. Stimulus driving the technology market and the consequent exchange of know-how, would be the increase in investments in the R&D sector - both the creation of own teams by the leaders of the Polish economy and the cooperation of these companies with start-ups.

As shown by the latest data, the situation in the R&D sector is changing for the better, but according to the newest European Innovation Scoreboard, Poland is

still one of the less developed countries in the EU in this respect (according to the European Commission Poland is a "Moderate Innovator")[1].

- **Weaknesses**

Thanks to European innovation support programs, funding for R&D is now available on an unprecedented level. In order to be able to use it, investments in R&D must be followed by specific business results. However, Poland lags far behind international statistics when it comes to efficiency (tangible results of investments in innovative projects). Good staff, new patents, growing R&D expenditures rarely translate into new products, sales growth, higher margins, gaining new markets and greater competitiveness of Polish companies. Therefore, in order to catch up with Europe, especially Polish SME's need more know-how in the field of innovation management and its commercialization. Poland needs more creativity and business organizations that absorb knowledge faster. Finally, Poland needs access to international markets and distribution channels to maximize the potential and profitability of an innovation once implemented. Acquiring this know-how should be supported by an open economy, stimulating international cooperation at the level of macro and micro-enterprises or research centers, and attracting foreign investments with high added value. The development of the local Polish capital market, including the venture capital industry, is also important for the transfer of knowledge.

Yet, the greatest problem is the unpredictability of law. Poland is a country in which the law has changed like a kaleidoscope in recent years - and the lack of certainty is the greatest damage to business. According to Grant Thornton's calculations, in the first half of 2019 alone, 11.800 manuscript pages of new legal acts were passed in Poland (i.e. laws, regulations and international agreements). This is disturbing data, because in the long run, changing laws and uncertainty always hurt business.

Still, some of these legal changes are paradoxically good news for the R&D industry, because companies and institutions must constantly update their systems or implement completely new solutions to meet regulatory requirements (i.e.

[1] https://ec.europa.eu/growth/industry/policy/innovation/scoreboards_en (accessed: 10 September 2020).

GDPR, the single control file, new regulations in the banking sector, freezing electricity prices in 2020).

Conclusions

Enhancing innovation is key building condition for long-term prosperity of Poland. Three areas should be distinguished in developing innovation though.

Firstly, attracting innovative international companies to locate R&D centers in Poland - development of research activities brings significant external effects, and therefore Polish economy and society will benefit from foreign investments. Secondly, stimulating domestic innovation and maintaining innovative start-ups - enhancing innovation is key building circumstance for long-term prosperity. Thirdly, supporting employees, especially young ones, who suffer from a growing brain drain and the need to go to work abroad.

In the present world, knowledge, intellectual capital and know-how constitute elements as important as financial capital, determining the development of companies and their globalization. And this directly translates into the (so far low) position of Poland in the global economy.

Science and Technology Innovation Mechanism of Romania

Oana Popovici

The science and technology innovation mechanism in Romania is planned and financed under the National research, development and innovation strategy developed by the Ministry of Education and Research in accordance with the EU objectives. The strategy is implemented through a number of instruments, but the most important one is the National Plan for Research, Technological Development and Innovation. Starting with the next year, several other strategies with impact on innovation and technological development are to be launched: the National Strategy for Smart Specialization and the National Strategy for Research, Development and Innovation. Romania remains connected to the EU priorities in the area of science and technology by taking part in the European partnerships for research and innovation.

In Romania, the Ministry of Education and Research is in charge with planning and monitoring of the research, development and innovation (RDI) activities, through the use of a RDI strategy, which is correlated with the EU objectives. The strategy is establishing the programmes that enhance the mechanisms for science and technology innovation, guiding the main areas of interests and therefore, the funding for the research projects.

Romania developed its first National research, development and innovation strategy for the period 2007-2013, which was mainly focused on the increase of the scientific production and domestic human capital in research. The strategy was based on a substantial rise in public allocations for research and technological development, investments for the modernization of specific infrastructures and supported internationalization by simplifying administrative procedures.

The actual RDI Strategy 2014-2020 is focused on a limited set of strategic priorities meant to allow the access to structural EU funds for financing the RDI activities. The major focus of the RDI Strategy 2014-2020 was on identifying the areas where Romania can have significant contributions and, at the same time, through which Romania's competitiveness can benefit from the results of science

and innovation. The areas of smart specialization for the 2014-2020 strategic cycle, identified on the basis of their scientific and commercial potential following an extensive consultation process, are: bioeconomics, information and communication technology, space and security, energy, environment and climate change, eco-nanotechnologies and advanced materials.

The strategy is implemented through a number of instruments, but the most important one is the National Plan for Research, Technological Development and Innovation 2014-2020, and through the Operational Program "Competitiveness", the priority axis "Research, technological development and innovation to support business and competitiveness". Therefore, financing for research has two sources: the state budget and the EU funds. The national research, development and innovation plan is the main instrument for implementing the national strategy in the field of research and innovation. It includes several sub-programs where financing is granted:

- The program for the Development of the national research-development system, aiming at the development of human resources, infrastructure and specialized institutions; increasing the efficiency of resource use in public organizations, by developing mechanisms for monitoring and evaluating the quality and relevance of RDI activities; increasing the attractiveness of the system and opening the research organizations to the international community; modernization of the public administration in the research sector.
- The program for Research in areas of strategic interest, aiming to support the participation of research institutions in Romania in international scientific institutions and programs for increasing the national research capacity in the fields of strategic interest; identification of research, technological and industrial niches at national, European and global level; promoting industrial innovation in sectors of strategic interest, developing and diversifying applications of research in industrial activities.

In addition, there were state aid schemes granted for several programs, such as the Development of the national research system; Increasing the competitiveness of the Romanian economy through research, development and innovation; European and international cooperation; Research, Development and Innovation for Space Technology and Advanced Research - STAR; Research, development and innovation for technologies in the field of ultra-high power lasers - ELI-RO;

Participation in international atomic and subatomic research bodies and programs; Research, development and innovation for river, delta, sea systems – Danubius.

During the last years, RDI policies and programs included measures for attracting researchers and supporting technology transfer, by encouraging competition on RDI projects for stimulating the creation of young teams of researchers, postdoctoral research, knowledge transfer, including those at the frontier of science and technology. As a result, under the umbrella of this strategy, financial support was provided for technology transfer projects, as well as promoting partnerships between RDI units and economic agents in science or industrial parks, in order to apply new technologies.

However, the efficiency of the RDI Strategies was low. Romania is among the countries facing the fragmentation of their research and innovation systems, with difficulties in properly integrating the European dimension of RDI into the national policies also due to a large gap as compared to Western countries, insufficient budgets and disproportionate migration of the research workforce, also known as the phenomenon of "brain drain". Unfortunately, for the financial year 2014-2020, Romania ranks last in terms of amounts obtained from the EU budget on research projects. Regarding the participation in Horizon 2020, EU's biggest research and innovation program, Romania's participation is modest, with EUR 214.8 million attracted from the Horizon 2020 budget and 787 signed contracts in which there are 1190 Romanian partners. This situation was mainly generated by the underfunding of research from public funds, but also by the difficulties in attracting private funds in research and innovation, and by the lack of effective national policies to stimulate RDI activity. Government financial allocations for RDI activities, after increasing to 0.26% of GDP in 2015, decreased to 0.18% in 2018 and 2019 and 0.13% in 2020, although according to the Europe 2020 Strategy, Romania had to allocate 1% of GDP to research and development. All these factors have produced negative effects in the Romanian RDI ecosystem. As a result, Romania is classified as a modest innovator (with more than 50% gap with the EU average), on the last place in the EU, according to the European Innovation Scoreboard 2019. The plans of the Minister of Education and Research are to launch a real reform of the national RDI system based on a transparent and impartial analysis of the factors that generated the decline of research and innovation in Romania.

In 2020, the priorities of the Ministry of Education and Research are to elaborate the National Strategy for Smart Specialization, as well as the National Strategy for Research, Development and Innovation and the next National Plan for Research, Development and Innovation. The strategic framework for supporting research and innovation at European and national level (2021-2027) is shaped by the EU Strategic Agenda for 2019-2024, the Cohesion Policy for 2021-2027 and a new RDI National Strategy in Romania.

It is expected that the new National Plan to behave in a similar manner like the previous strategy, employing specific research-development-innovation programs, whose launch and information package for accessing the funds are going to be detailed by the Ministry in charge with those funds and the subordinate structures. However, this year is challenging, as the Government has to substantiate the country priorities, both political and financial, for the next programming period 2021-2027. In the research area, Romania intends to follow the EU directions and to fill the gap in both infrastructure and the quality of research. The intention is to enhance European RDI Partnerships through which the European Commission, Member States and other investors, including from non-European countries, jointly carry out research and innovation programs on a pre-defined theme. Such mechanisms allow for the creation of unitary framework for the participation of all Member States in achieving objectives of common interest, which otherwise could not be accomplished, due to brain drain, lack of experience, lack of funds, etc. In addition, they represent the way through which the European Commission co-finances national RDI programs, with funding from the Horizon Europe Research and Innovation Framework Program 2021-2027. The Prime Minister expressed the intention of the Government to prepare a support mechanism for any potential beneficiary who wants to access the available funds, so that the submitted projects have a higher chance of obtaining funding for the next multiannual financial period.

In this respect, Romania has participated so far at the debate regarding the European partnerships for research and innovation. The European Partnerships are part of the future Framework Program and require political and financial commitment from each Member State. Topics covered include research applications in all areas: from health, transport, digitization, climate, energy, food, bioeconomy, agriculture and the environment to sustainable resource management. Romania is to express a point of view related to the participation in the European partnerships

proposed by the European Commission by October. To this end, the Ministry of Education and Research invited the ministries whose sectoral policies converge with the strategic research agenda of these European partnerships to contribute to the elaboration of Romania's position. The debate will focus on three topics: the role of research and innovation as an engine of industrial development; synergies between various categories of national and European funds; government measures to support private investment in the national RDI system.

Science and Technology Innovation Mechanism of CEE Countries: A Serbian Perspective

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CEE countries generally have weak to moderate technological-innovative systems. Serbia, as an average developed CEE country, has typical weaknesses for this region. These are limited interactions between the business sector, science and education, lack of influence on development, underinvestment and inefficient use of limited resources. The advantages, however, vary greatly between CE countries. In Serbia, the most positive aspects of techno-innovation mechanisms are a good business and regulatory environment. Several R&D activities have significant innovation results. Among them, according to the development potential, bio-technology stands out, with significant innovations in agriculture. Research and innovation in the field of new technologies (IT and new bio-technology) in agriculture can potentially be a new significant form of cooperation between China and Serbia.

Countries of Central and Eastern Europe (CEE), according to *European Innovation Scoreboard 2020* are classified as *Moderate* and *Modest Innovators* (lowest two of the four groups). Serbia belongs to the group Moderate innovators, countries where the *Summary Innovation Index* is at the level of 50-95% of the EU average.

In global terms, according to the *Global Innovation Index 2020* (GII) Serbia is ranked 53rd out of 131 countries. Other CEE countries hold a similar position. However, among the groups of indicators that make up composite GII, the *Knowledge & Technology Outputs* group is crucial, where Serbia occupies a relatively high 41 position in the world.

Like any index, these are average of numerous different indicators. Therefore, it is necessary to point out the specific weaknesses and strengths of Science and Technology Innovations (STI) in Serbia.

Weaknesses

1) Weakness of the system

The key weakness of STI in Serbia is the lack of developed national innovation system as an organized, connected and interactive network of all participants in innovation activities. The mechanisms of STI are insufficiently developed and inefficient, with non-functional or non-existent connections and interactions between their main parts: business sector, science and education. In particular, the scientific-research system is often without influence on economic and other development, focused on its own maintenance.

2) Underinvestment

An important weakness of STI is also very low investment. According to EIS (2020) they amount to 33.6% of the EU average in the business sector and 35.9% in the public sector. In the GII (2020) Serbia ranks lowest (101) in terms of *Market capitalization* indicator.

At the same time, research funding is almost entirely from the government's (rather limited) budget, which is quite the opposite than in innovation leaders-countries. In most Leaders innovation countries over 60% of Gross expenditure on R&D is financed by businesses. This is a natural and most efficient way to technologically improve the economy, because innovation should serve business. In Serbia this share is only 10%.

3) Inefficient use of resources

Therefore, a weakness is not only low investments, but also inefficient use of these limited resources. Given the lack of interest of business for R&D in Serbia, these investments largely do not serve to improve the economy, but to meet the form imposed by the political environment, primarily the EU.

State support for innovation is not only inefficiently used, but is often directed at projects that are harmful to the economy. For example, despite the mass emigration of educated personnel from Serbia, a large part of the budget is intended for innovations in the field of robotics and artificial intelligence. These technologies, by their nature, lead to a reduction in the number of jobs, especially those with higher education. In addition, advances in these technologies imply

radical innovations, i.e. technological breakthrough, which is unattainable for Serbian science at the existing level of development.

Strengths

Positive regulatory and business environment are significant advantages for STI in Serbia. This indicates the activity and readiness of society and, above all, the Government to achieve economic activities of a higher degree. This is probably the main driver of continuous progress in this area.

Namely, the dynamic progress on the relative scale of the innovation index is the second most important strengths in the Serbian STI. There are more and more examples of implementation of computer-controlled machines, development of local networks and their connecting to internet, development of databases for different purposes and the like. The results are visible in the mentioned international classifications, within which Serbia takes an ever better position every year.

In contrast to the absence of preconditions for radical innovations, Serbia has significant human and technical capacities for *incremental* innovation, which means minor technological advances and improvements. These capacities refer to the "desirable and possible development" of several areas, which are defined by the Serbian Academy of Sciences and Arts (SANU). Those are: energy technologies, new biotechnologies, nanotechnologies and information and communication technologies. Biotechnology stands out as the sector with the greatest techno-innovative potential. Several agro-institutes in Serbia have been achieving significant results in globally terms for decades. They are engaged in selection of strains, seed production and development of top hybrid varieties of cereals and vegetables, as well as in the field of other agro inputs. These institutes have certified laboratories, seed banks, their own land resources, experimental stations, etc.

Incremental innovations in biotechnology alone are not enough to raise Serbian agriculture to a significantly higher level of productivity and sustainability. In addition to these technologies, it is necessary to apply modern information technologies (IT) in agriculture. Their complementary development and implementation would significantly contribute to profitable and sustainable production and development.

The IT sector in Serbia also has significant development capacity, but its achievements in agriculture not at a high level. This is an area in which China would be a valuable partner.

Recommendations for intensifying cooperation between Serbia and China in the technology innovations

Opportunities for cooperation between Serbia and China in the field of technology are actually the least used. Numerous initiatives for improving cooperation in the field of innovation, technology and digitalization were the topic of the *Fourth China-CEEC (17+1) Conference on Innovation Cooperation*. Since that conference was held in October 2019, none of these initiatives not begun to be implemented. This otherwise relatively short period was marked by a number of challenges related to the Covid-19 pandemic.

One of the proposed joint projects in the field of innovation was the investment agreement for the industrial park, signed by the Serbian government and China Road and Bridge Corporation (CRBC). It was signed in April 2019 but for now there is no data on activities in the direction of its implementation.

Having in mind the stated strengths and weaknesses of innovation capacities of Serbia, the possibility of technological penetration of China into CEE through the transfer of new technologies to agriculture should be considered. In that cooperation, China is the dominant partner in the field of IT, while Serbia, as it was pointed out, has significant capacities in the field of biotechnology. Agricultural and food production in most CEE countries is already owned by European companies. This is not the case in Serbia, which opens up a lot of space for joint projects. China has made remarkable progress in the application of new technologies and information technologies in agriculture, from simple mobile applications to high-tech "digital farms", with focus on Internet of Things (IoT). Possibilities of IT in agriculture are tremendous. Some integrated systems include satellites, drones with spectral images possibility, sensors, agro-meteorological stations, and big data analytics. Most of these projects would potentially require a 5G network, but as a support of digital farms or other desirable outputs, it would not be in focus and would not attract as much negative publicity.

Joint research and investment would be of multiple benefits to both parties. China`s investment in the form of technology transfer would have remarkable

effects in the Serbian agricultural sector in terms of productivity, product quality and sustainability of agricultural production. On the other side, this is an easy and convenient way for more intensive technological penetration of China into the CEE region.

Conclusions

Given structural weaknesses, underinvestment and inefficient use of resources, the capacity of Serbian scientific-research system to participate in innovation creation is small and fragmented. These weaknesses make attempts at radical innovation in Serbia rather irrational. However, according to the dominant standards, the position of Serbia is no weaker than other CEE countries.

On the other hand, several strong factors, such as positive regulatory and business environment in Serbia, support the development of incremental (short-range) innovations, which in the 21st century are actually the largest number of innovations. Activities in which there are real opportunities, resources and capacities for such innovations are: energy technologies, biotechnologies, nanotechnologies and ICT.

The most technologically advanced sector is biotechnology with wide application in Serbian agriculture. What would lead to radical improvements in agriculture as a strategic sector would be the complementary implementation of bio-technologies and information technologies. As IT in agriculture is a field in which China has made remarkable progress, the areas and forms of cooperation between China and Serbia in technological innovations in agriculture are almost unlimited.

Science and Technology Innovation in Slovakia

Martin Grešš

Overview

Innovation enables countries to be more competitive, more adaptable to change and to support higher living standards. It provides the foundation for new businesses and new jobs and helps address pressing social and global challenges, such as health, climate change, and food and energy security (OECD, 2018). The rise of digital technologies, such as Artificial Intelligence or the Internet of Things, and their increasing convergence with the physical world has brought about rapid and deep changes in the way innovation is created and diffused, redefining entire industries (Correia et al., 2018). According to European Commission (2020), Slovakia is a moderate innovator and during the last decade, its performance increased relative to that of the EU in 2012. Based on the results, the strongest innovation dimensions where Slovakia performs above the EU average are Employment impacts and Sales impacts, especially in employment in fast-growing enterprises of innovative sectors, sales of new-to-market and new-to-firm product innovations, medium and high-tech product exports, and new doctorate graduates. On the weaker side, there are Finance and support and Innovators and Intellectual assets. Lowest indicators include venture capital expenditures, R&D expenditures in the business sector, lifelong learning, and opportunity-driven entrepreneurship (European Commission, 2020). Also, as Correia et al. (2018) points out, one of the crucial reasons for the low innovation performance in CESEE region (including Slovakia) is low investment in intangible assets, such as R&D. CESEE countries are not making sufficient strides to improve their R&D investment and continue to lag significantly behind.

Science and technology innovations in Slovakia are currently governed by these major documents: 1. Through knowledge towards prosperity – Research and innovation strategy for smart specialization of the Slovak Republic (also called "RIS3"), 2. Action plan for the implementation of the Research and innovation strategy for smart specialization of the Slovak Republic, and 3. Implementation plan for the Research and innovation strategy for smart specialization of the Slovak

Republic. The aim of RIS3 is to connect research, development and innovation with the immediate needs of practice, while the basic principle of this connection is the transition from a policy of dominant support of basic research to a state where the share of public resources allocated to basic research will be around 30% and the vast majority of public and private resources will be available in mutual combination respecting the criteria of demand from private enterprises and customer practice. To fulfill the structural change of the Slovak economy towards growth based on increasing innovation capacity and excellence in R&D to support sustainable growth of employment and quality of life of Slovak citizens, four strategic goals were set. In order to achieve these goals, three basic areas of specialization were identified and approved by the government of the Slovak Republic (Implementation plan, 2017):

- Areas of economic specialization, based on traditional anchored economic sectors, which have the potential to significantly influence the fulfillment of the strategic objectives of RIS3 (automotive and mechanical engineering, consumer electronics and electrical appliances, information and communication products and services, production and processing of iron and steel).
- Promising areas of specialization that are fast-growing and show a high potential for development for the economy (automation, robotics and digital technologies, processing and recovery of light metals and their alloys, production and processing of polymers and progressive chemicals (including smart fertilizations), creative industries).
- Areas of specialization in terms of available scientific and research capacities (materials research and nanotechnology, information and communication technologies, biotechnology and biomedicine, agriculture and the environment, including modern environmentally friendly chemical technologies, sustainable energy).

Organizations involved in research and innovation policies

Based on the above-mentioned documents focusing on the science and technology innovations in Slovakia, following table lists the most important institutions responsible for certain areas of science and technology innovations together with their main activities.

Table 1 List of organizations involved in innovation

Organization	Main activities
Innovation Fund of the Ministry of Economy of the Slovak Republic (Inovačný fond Ministerstva hospodárstva SR)	• promotion of sustainable development in science, research and development • accelerate innovation development • promotion of development and conceptual studies, setting out the main areas of use of scientific, research and development solutions
Ministry of Economy (Ministerstvo hospodárstva)	• central body of the state administration for selected economic activities: industry with the exception of food industry, construction products and manufacture of construction material, power engineering, manufacturing and supply of heat and gas, exploitation and treatment of raw materials, support to SMEs, policies related to creation of business environment and support to business environment, domestic and foreign trade, tourism and consumer protection and administration and privatization of the state property • key government body in field of innovation development
Ministry of Education, Science, Research and Sports (Ministerstvo školstva, vedy, výskumu a športu)	• central body of the state administration for education, lifelong learning, science • the most important government body in field of science and technology • supports basic and applied research via state budget allocations and competitive grants
Ministry of Finance (Ministerstvo financií)	• monitors efficient use, the fiscal consolidation and long-term sustainability of public finance within the eurozone, compliance with the rules of public funds spending, efficient implementation of EU financial instruments
Research and Development Agency (Agentúra na podporu výskumu a vývoja)	• support to domestic and international R&D projects developed by government research institutes, universities, private enterprises and non-profit organizations • provides sources to support projects developed in the Slovak Republic within international agreements on scientific and technical cooperation and projects within the international and the European programs and initiatives in area of R&D including preparation costs
Scientific Grant Agency	• joint advisory body of the Minister of Education and the Slovak Academy of Sciences

(Vedecká grantová agentúra)	• advisory body in field of financing basic research and evaluation of research projects • supports basic research in general and institutional finance in particular
Slovak Academy of Sciences (Slovenská Akadémia Vied)	• basic research in selected sciences on nature, technology and society • research teams also participate in the applied research projects • number of (internal) centers of excellence
Slovak Business Agency (previously Národná agentúra pre rozvoj malého a stredného podnikania)	• one of main managers of the Structural Funds projects on innovation and applied research in Slovakia • supports the development and growth of small and medium-sized enterprises (SMEs) to improve the competitiveness of the sector • manages national programs aimed at incubators for research-based spin-offs and fostering R&D activities in SMEs
Slovak Government Council for Science, Technology and Innovation (Rada vlády SR pre vedu, techniku a inovácie)	• expert, advisory, initiative and coordination body of the Slovak government • coordinates the cooperation of public and private sector organizations in ensuring the objectives of the science and technology and innovation policies • comprehensively assesses the materials of central state administration bodies in the field of science, technology and innovation
Slovak Guarantee and Development Bank (Slovenská záručná a rozvojová banka)	• specialized financial institution (joint-stock company) owned by the Ministry of Finance • supports small and medium-sized enterprises on the basis of partnership and cooperation with commercial banks and other institutions supporting this segment
Slovak Innovation and Energy Agency (Slovenská inovačná a energetická agentúra)	• information service for the Ministry of Economy with special focus on innovations and energy sector • gathers processes and disseminates information related to the increase of energy efficiency, using of renewable energy sources, and the development of innovation activities
Slovak Investment and Trade Development Agency	• government-funded allowance organization under supervision of the Ministry of Economy • designing and using stimuli to increase the influx of foreign investment

(Slovenská agentúra pre rozvoj investícií a obchodu)	• promoting Slovak companies in their effort to transform into high-performance subjects on a global level
Slovak Parliament (Národná rada Slovenskej Republiky)	• constitutional and legislative body of the Slovak Republic

Source: respective websites.

Note: Slovak name in parenthesis.

Conclusion

According to Correia et al. (2018), in order to sustain high levels of economic growth in the future, a shift will be required in the growth model of CESEE region countries to a new model that will be increasingly based on innovation. As Correia et al. (2018) stresses: "This innovation imperative will be crucial if rising prosperity is to be sustained and a fall into the middle-income trap is to be avoided. This is particularly important against the backdrop of rapid technological change driven by the rise of digital technologies and their convergence with the physical world that are posed to deeply transform our economies". We note that Slovakia lags significantly behind in low investment in intangible assets, such as R&D as also proposed by European Commission (2020) and Correia et al. (2018). Based on Baláž et al. (2018) assessment of the research and innovation system in Slovakia, the following challenges should be addressed to reflect the dynamic situation change in the world economy, as well as in Slovak economy:

• Improvement of the research and innovation governance – insufficient coordination and co-operation between ministries and their agencies and also fragmentation of resources for building research and innovation infrastructures are seen as major challenges for Slovakia.

• Improve the quality of the science base – Slovakia ranks among the modest R&D performers within the EU28 in terms of R&D expenditure, and commercial and non-commercial R&D outputs.

• Increase private innovation outputs and R&D investments – dual structure of the Slovak economy impacts patterns of productivity, innovation outputs and R&D spending.

• Strengthen synergies between science and industry – co-operation between the industry and academia is low and these two sectors still remain largely isolated.

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Slovenian Science and Technology Innovation Mechanism: How Excellent Is Slovenian Science

Tina Čok

Summary

The financial situation of science and technology in Slovenia depends largely on the funds that Slovenia receives from the European budget. While Slovenia's performance within the program Horizon 2020 is not bad, we are even the best of the EU13 countries in terms of size, Slovenian politicians do not understand the importance of these activities for the development of society in all areas, and largely see them as costs. Slovenian science, which receives only about 0.5 percent of GDP, is still at the lower end of the investment in science and research in the EU from the national budget. The corona crisis has also confirmed that only excellent knowledge leading to effective solutions can provide the most long-term and sustainable answers to the key challenges facing humanity. Research and innovation policy must therefore be strategically oriented and established as a platform for achieving the goals of all other policy areas, i.e. research and innovation must become an integral part of this policy.

The scientific breakthrough of Europe

The financial situation of science and technology in Slovenia depends largely on the funds Slovenia receives from the European budget.

When adopting the European budget for 2021 - 2027, European politicians have clearly forgotten the strategic importance of science and innovation for the development of the European Union. Once again, the sector that will be most responsible for the development of Europe - at a time when science is proving to be crucial to solving the Covid-19 pandemic crisis - has been seen as a cost, not an investment in the future.

The European Research and Innovation Framework Program, most recently Horizon 2020, provides funding for a number of programs that effectively address the problem of development in Europe.

Specific mechanisms also ensure that the gap in technological development and excellence in research and innovation between the developed part of Europe and the countries of the EU13 group, which also includes Slovenia, is narrowed. The program pays particular attention to the development of young people. Funding is provided for top scientific projects carried out by doctoral students in larger consortia. The European Research Area is enriched by European Research Fund projects which, by financing the best researchers, ensure that top-level research is carried out on European soil, regardless of where the researcher comes from. All this was supported with €77 billion under the Horizon 2020 program, which ran from 2014 to 2020.

Together with the EU, USA, Israel, Japan, South Korea and China are currently at the forefront of global research and innovation. Competition is intensifying and it was expected that the budget for the new Framework Program countries would increase. However, our representatives in Brussels decided otherwise, reducing the budget for the new Framework Program to only EUR 75.9 billion, with another EUR 5 billion or so coming from some redistributions. This means a total of around EUR 80 billion, which is practically the same budget as in the previous Framework Program, taking into account rising prices. For the first time in the history of the European Union, the budget for science has not been increased, moreover, the share of it in the European budget for science has fallen from 7.1% to 4.5%. This is despite the fact that Europe is more than ever exposed to fierce international competition and that new mechanisms have been created to develop the European economy more effectively than the aforementioned innovation sector.

Cuts will not be immediately felt in Europe, mainly because developed countries, even the most frugal ones, spend significantly more on science than they receive from the EU budget, where they are otherwise among the most successful.

The impact of EU funds on Slovenian science

Slovenia's performance within Horizon 2020 is not bad. We are even the best of the EU13 countries in terms of size. Slovenia has gained 306 million euros so far, Hungary 312 million, the Czech Republic 402 million and Poland 590 million - although these countries are much larger than Slovenia. We even surpassed some other more developed European countries. The main credit for such a successful

acquisition of projects goes to the applicants, but certainly part of the success is due to the good work of the National Contact Points at the Ministry of Education, Science and Sport, the efforts of the Slovenian Economic and Research Association, which operates in Brussels and was aiming for the highest possible budget for science in the next program, and the work of the project offices at Slovenian higher education institutions. Nevertheless, we are still lagging behind when it comes to obtaining the most competitive funding for excellent projects, such as the European Research Council programs.

The situation is certainly going to worsen now, and with the strong competition from institutions and research groups from all over Europe, the yield from calls for proposals will certainly be worse, and academic institutions and applicants will not be successful without a good support and internal organization.

National budget cuts in science funding

Unfortunately, scientists in Slovenia cannot be overly optimistic, as the history of funding in this area continues to show that Slovenian politics in general does not understand research, innovation, technology and higher education. It does not understand the importance of these activities for the development of society in all areas and largely understands them as costs. Slovenia, which allocates only around 0.5 percent of GDP to this area, is still at the end of the scale of investment in science and research from the national budget in the EU, despite sharp warnings from researchers.

Under the previous government, the situation began to improve only very slowly and we experienced a slight increase in the budget. However, the previous government did not manage to achieve any major breakthroughs. A good test of the new government's orientation in the areas of research and innovation will be the supplementary budget that is being prepared, which will immediately show what research and innovation really mean to the new government team. Even during the previous crisis, a government team led by some of the same actors has drastically reduced funding for research and development.

An important source for the development of research infrastructure are the funds of the Structural Funds, which countries can allocate at their discretion to projects to improve infrastructure and human resources. In Slovenia, the Government Office for Development and European Cohesion Policy plays a key

role here, and so far it has generally not done a good job. They are primarily concerned with priorities that neglect the area of research and innovation and the way this unit operates is reflected in the ossified absorption of funds.

Slovenia's revenue in the European budget is certainly very good. The key, of course, is how we will allocate and spend these funds.

The technology sector has been neglected too much for years and is completely understaffed, both in terms of personnel and finances. Researchers have repeatedly emphasized the need for a technological innovation agency, and correspondingly high levels of investment in the integration of science and industry, with various mechanisms to ensure the greatest possible transfer of knowledge. Experts pointed this out, among other things, at the last, 14th Summit of the Slovenian Economy in November last year, which was organized by the Slovenian Chamber of Commerce. At the summit it was also very clearly stated that of the 170 companies with annual revenues of more than USD 10 million that have achieved above-average growth in the last three years, we in Slovenia do not have a single high-tech company. In Austria there are 16 percent of such companies, in Italy 10 percent and in Croatia 7 percent.

Slovenian scientists have also joined global efforts to understand how the SARS- CoV-2 virus spreads and how we can protect ourselves against it. They have helped to develop protective equipment and therapeutic devices, and are involved in the development of vaccines. For all these efforts, which have not been small, we in Slovenia have not yet allocated funds (tenders with a total value of four million are underway)! We have neither improved our research infrastructure nor ensured that the most capable young people stay and work in Slovenia.

The last hope now remains for the Members of the European Parliament to decide on the budget and still make changes in the right direction. Opposition to such cuts for science has already been heard from MEPs, which gives some hope.

Conclusions

More than doubling EU funding for research, development, innovation, entrepreneurship, digitisation and the transition to a circular economy and society compared to the current period would bring Slovenia much closer to its estimated potential for accelerated growth. On the basis of higher public revenues, this could ensure not only the smooth repayment of loans for infrastructure, but also the

strengthening of our own financial capacity to invest in the necessary public services. Conversely, the likelihood of such a scenario would be much lower if we decided to focus the "appropriate balance" of available resources mainly on infrastructure, as Slovenian enterprises would not be successful enough in the transition to the fourth industrial revolution to reposition themselves equally successfully within global value chains due to insufficient innovation capacity and investment in knowledge, and the brain drain would most likely accelerate further. The decision may not be easy politically, but it is necessary and will have a significant impact on our future.