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SOURCES OF FUNDING FOR ACTIVITIES IN RESEARCH AND DEVELOPMENT IN THE SELECTED EUROPEN COUNTRIES

Abstract

One of basic indicators of a country's commitment to technological progress certainly includes the expenditures on research and development (R&D). The investments in R&D, i.e. the investment in research and commercial application of innovations are decisively significant for profitability of an enterprise and economic growth of the countries. In EU19, the total realisation of funding for R&D activities predominant is participation of business sector with 57%, followed by state sector with 21%. Contrary to this, public sector is a key source of funding for R&D activities in the Western Balkan countries, which is one of weaknesses of national innovation systems in these countries.

Key words: knowledge, research and development, innovations, sources of funding, EU, the Balkan countries

JEL classification: O32

ИЗВОРИ ФИНАНСИРАЊА АКТИВНОСТИ ИСТРАЖИВАЊА И РАЗВОЈА СЕЛЕКТОВАНИХ ЕВРОПСКИХ ЗЕМАЉА

Апстракт

Један од елементарних показатеља опредељености земље за технолошки напредак свакако су издаци за истраживање и развој (И&Р). Инвестиције у И&Р, односно шире улагања усмерена на истраживање и комерцијалну примену иновација су од пресудне важности за профитабилност предузећа и привредни раст земаља. У ЕУ19 у укупној реализацији средстава за И&Р активности доминира пословни сектор са учешћем од 57%, а следи га сектор државе са 21%. Супротно, у земљама Западног Балкана јавни сектор је кључни извор финансирања истраживачких и развојних актвнсти, што представља једну од слабости националних иновационих система ових земаља.

Къучне речи: знање, истраживање и развој, иновације, извори финансирања, ЕУ, Балканске земље

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Introduction

In contemporary conditions, it is possible to search for the answers to numerous complex and contradictory issues of funding for technological changes in various ways and within the context of various approaches. Besides, it is also possible to investigate the place and role of predominant forms and models of funding for technological changes, while considering importance of private and public sources of investment in continually increasing expenditures of research and development activities. The statement that this is an essentially significant aspect for the functioning of contemporary economy is confirmed by numerous data on participation of expenditures for research and development in gross domestic product in certain countries, together with the amounts of expenditures aimed at activities in research and development in leading world corporations (Cvetanović, Despotović, & Ribać, 2019).

Knowledge that is immanent to a human being has always been a driver of economic development. However, only in the last few decades knowledge was taken as a key driver of economic growth and development. In historical perspective of development of economic science, besides traditional factors of production that include labour, fund and natural resources, the effects of powerful factors of economic progress such as technology, innovations, intellectual capital and renewable sources of energy have been noticeable since the twentieth century. The applicable knowledge is a common denominator of all stated factors. Historically reviewing the role of knowledge in economy, we cannot say that it is an entirely new idea. On the contrary, historical context modified this, originally intangible phenomenon, whose outcomes included the products that were significant for human society. Bearing in mind the fact that the application of knowledge has always followed a man in his development with different "specific weight" for various periods and epochs, the topic of contemporary "society of knowledge" has become even more challenging.

Private and social benefits of commercialisation of knowledge in innovations

The term "society of knowledge" was first used by Peter Drucker in 1959 (Drucker, 2014; 2012). Drucker described the society of knowledge as a society of mobility, considering it the most competitive society in the history of humanity so far. Globalisation has intensified these processes (Greenhalgh, & Mark, 2012). Today, the society of knowledge and economy of knowledge have globally become recognisable and very popular terms (Pokrajac, 2002). After a series of occasional mentions of the economy based on knowledge, European Union pointed out in Lisbon Strategy (2000) that by 2010, it should become the most competitive and most dynamic world economy based on knowledge, capable of sustainable economic development with increased number of labour positions and better pay (Djurovic, 2012; De Bruijn, & Arnoud, 2005).

The importance of commercialisation of knowledge in innovations in economic processes has rapidly increased in recent years (Nijkamp, Iulia, & Donal, 2011). Namely, the growth of production during this period has been predominantly led by commercialisation of knowledge in innovations (Barro, & Sala-i-Martin, 2004). With the worries about the environment, the limitations for exploitation of natural resources has become increasingly evident (Caviglia-Harris, et al., 2009). To overcome this limitation it is necessary to increasingly apply knowledge, which provides development of new goods and services (Huggins, & Hiro, 2007; 2008). Both developed and developing economies are focused on

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innovations, thus globally competing in talents, resources and market shares. Information courses and networks are spreading over borders in the ways that could not have been imagined before the appearance of the Internet, global use of mobile phones and social networks and fast growth of broadband approach to the Internet (Nedić, & Ilić, 2013).

In the assessment of social benefits of new technologies, conceptual problems are pronounced. Innovations, especially radical, are effective in enterprises and many industries that can hardly be quantified precisely, especially in terms of total social benefits. The rate of social returns denotes the rate of returns on technological change in society as a whole. The rate of social returns on investment in new technology is important in the consideration of contribution of certain innovations, since it points to total effects of investment in the domain of research and technological development. High rate of social contribution illustrates the fact that the resources are effectively used in a society, and that such investment should be practiced more.

Practically, all considerations show that the average rate of private returns on research and development in industry is very high. The rate of social returns is also very high. The difference between the rates of private returns on the development of new technologies is very significant for theoretical explication of effects of investment in the development of new technologies. The reason why the state should support the investments in a new technology in various ways lies in the fact that certain research projects achieve significantly higher rate of social returns in comparison to the rate of private returns.

If an innovator is faced with very competitive environment, it is less possible that his results will provide large part of social benefit, otherwise, when he has monopolistic position or is a part of oligopoly, it is realistic to expect the rate of social returns at incomparably higher level. Normally, the measure to which the innovator is subject to competition may depend on the fact whether the innovation is protected by patent. The question is how expensive it would be for potential competitors to "avoid" patent protection, if it exists, and to purchase the equipment that is necessary for manufacturing a new product (or the use of new process). In a number of cases it is very difficult to speak of the possibility to imitate. In other cases, a potential competitor could either succeed in manufacturing certain product or use certain technological process at relatively low cost.

The question that is marked as significant for identification of difference between the rates of private and social returns is whether the technological change is big or small. According to some theories the degree of utilisation is probably smaller for greater technological inventions, because they can be imitated. Long ago, Kenneth Arrow shared similar viewpoint by saying that an inventor received whole social benefit for moderate innovation that reduced the expenditure, but not for radical technological changes (Arrow, 1971).

The enterprises in industry provide about two thirds of the amount of total costs of research and development activities, while the rest is funded by state. The industry invests in majority of research related to manufacturing new products, while the state mostly invests in fundamental research. Although a great part of state funds invested in research and development goes to the projects aimed at specific needs of public character, state investment in research and development of technology has enormous influence on economic growth because, looking from social perspective, the market failures result in insufficient investment of enterprises in research and development. The largest number of empirical studies, however, show that private sector invests considerably less than optimum in research and development. Insufficient investments are a result of the fact that enterprises cannot invest their whole profit in funding for research and development, partly because the imperfection of capital market can make funding for R&D more expensive, and incomparably more risky in comparison to other investments.

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From the perspective of enterprises, the issue of attractiveness of investments in the activity of research and development can be treated in the same way like all other forms of investments. The enterprise will invest as long as it expects the income of a research project at least to cover its expenditures. Average returns on research and development projects for an enterprise are 20-30%, but the returns for the society are even higher, often over 50%. These spillovers occur due to external use of research results, which thus expand in the directions that cannot often be devised by innovators. Those spillovers mean that the innovator made effective only a part of returns, realised on the basis of certain research and development project. As a result, the enterprises invest less in research and development activities than they would do in the case they could acquire total profit of their research. In other words, some research projects that could have positive net profit (i.e. the sum of private and social income, reduced for the project expenditures) are privately unprofitable since the investor logically does not effectuate social benefits. If, in this case, there were not certain interventions on the market, private sector would not do research projects, although they are to the best interest of society. If the enterprises in industry create certain knowledge, other companies may also use it without paying, in fact, the industry produces a certain product – bordering social benefit based on knowledge, which is not expressed in the stimuli for enterprises. Where those externalities (the benefits shared by other enterprises besides the one that produces them) are shown as significant, there is a good reason for subventions to industry. This reason is the same in both younger industries in less developed countries and developed countries. However, in developed countries this possibility gains significance simply for the reason of their industries based on continuous innovations where certain generation of knowledge is in fact the central aspect of an enterprise. In the high tech industries, the enterprises dedicate a great part of their resources to the improvement of technology by direct investment in research and development, or by being ready to endure initial losses due to placement of new products or introduction of new processes in order to gain necessary experience.

Although the investment in research and development is lower than the society would like, the enterprises invest even less than they wish in case they do not have appropriate assess to the budget necessary for funding to these activities. On capital market, possible problems may arise for the innovators in case they do not want, or are not capable of providing enough information to the investors, due to their fear of revealing too many details on the proposed idea, which could be practically assessed by investors related to cost-effectiveness of the research project. Mortgage cannot include the investments in research and development, as the investments in machines or buildings can be mortgaged. Thus it happens that enterprises are forced to pay higher interest for the loans intended to finance research and development, in comparison to the utilisation of loans for the realisation of other forms of investments, which can be on mortgage or have to rely upon internal sources of funding. Since the funds are fungible, the enterprises with sufficient internal cash flows normally use them for funding to research and development, while mortgage loans are allocated to funding for investments in buildings and equipment. In fact, many enterprises that deal with modern technologies would like to invest in research more than they could from their cash flows or mortgage loans. Schumpeter pointed to these limitations long ago (Shumpeter, 1968). The proofs of the influence of changes on cash flows in the resources directed towards research and development, however, have to be considered carefully, because the events that have limiting influence on cash flow can also have negative impact on net value of the enterprise and its ability to take over risks.

The fact that investment in research and development is globally insufficient certainly does not mean the absence of excessive investment in specific kinds of research. The most

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obvious example is allegedly pharmaceutical research that is conducted in order to innovate some already patented products. The aim of enterprises involved in such research is not to find better medication (although it may appear as a non-intended product) but to take over the monopole rent from the patent owner. Also, the rush for patents may lead to enormous expenditures where marginal contribution – the previously launched innovations on the market can be small in comparison to the average returns. This is a variant of problem of unity. A share of income is materialised in the patent of generally available knowledge.

In market economy, competition is taken as a basic factor of motivation of business entities in their expression of innovation activity. Conceptually, without denying this statement, it can be noticed that in contemporary manufacturing conditions, characterised by unwitnessed scientific and technological invasion of leading world corporations and countries, internal motivation is not the only significant factor of development of their innovation activity (in the case of the law on competition); they receive external stimulation, i.e. support of the state.

Basic sources of funding for research and development

Research and development have an immediate task to generate technological innovations. There is a direct connection between research and development potential and the realised innovation potential of enterprises and countries. It should be emphasized that most countries do not create larger part of knowledge, but the budget for research and development is directed towards the application of technological knowledge, which is the property of other subjects in domestic enterprises, not necessarily towards the creation of new technology.

The main failure of indicators related to investment in R&D is that their monetary expression decreases the possibility of relevant comparison between countries, because of the difference in price levels between countries at a given moment and in time. In order to overcome this shortcoming, it is recommended to observe the investments in R&D as a share in gross domestic product (GDP). Organisation of Economic Cooperation and Development (OECD) suggests that investments in R&D should be followed at the level of sector so the list of indicators which point to scientific and technological progress of a country should be grouped as follows:

- 1. Gross domestic expenditure on research and development GERD,
- 2. Business Enterprise Expenditure on R&D BER,
- 3. Higher Education Expenditure on R&D HERD
- 4. Government Expenditure on R&D PNERD,
- 5. Private non-profit Expenditure on R&D GOVERD
- 6. Government Budget Appropriations or Outlays for R&D − GBAORD.

Leading economies and scientific organisations invest enormous funds in investing increasingly demanding research and development activities (Cvetanović, Nedić, 2018, p.45-55). For illustration, global investment in R&D in current conditions is estimated to amount about 2,300 billion dollars. Concerning the countries that are R&D global leaders, the situation has not changed much, but the slight trend towards extruding European economies can be discussed. In 2009, top five countries with the greatest investments in R&D (by absolute values) were the USA, Japan, China, Germany and France. This year (2019) they are the USA, China, Japan, Germany and India. Their collective amount of investments for R&D reached

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the amount of 1,510 billion dollars in 2019, in comparison to 786 billion in 2009 (Government and Industry Continue to Grow Global R&D, n.d.). Figure 1 shows basic sources of funding for research and development activities.

Higher education sector Private non-profit sector Business enterprise sector Abroad Government sector Funded by sectors: Performed in Gross Expenditure on R&D GOVERD **BERD** GERD -**Business** Government Expenditure Expenditure on R&D on R&D **PNERD** HERD Private **Higher Education** non-profit Expenditure Expenditure on R&D

Figure 1: Sources of funding and sector of realizatons of R&D activities

Source: Author, according to EuroStat, n.d.

Sources of funding for the activities in research and development in the selected European countries

The sources of funding for R&D of the selected Europen countries in 2016 are given in Table 2 (no data are available for 2017). The data in the Table 5 show that in both EU28 and EU19 (Euro zone), business sector has a predominant role in investment in R&D activities, with the participation of 57%. Public sector invests about 30% in R&D activities, about 10% is from foreign sources while sectors of higher education and private non-profit sector participate in R&D activities with only 1% each.

Sector Coutry*	Abroad	Private non- profit sector	Higher education sector	Government sector	Business enterprise sector			
EU28	10%	1%	1%	31%	57%			
EU19 (Euro)	9%	1%	1%	32%	57%			
EU countries of the Balkan Peninsula								
Bulgaria	35%	0%	0%	22%	44%			
Greece	14%	0%	2%	43%	41%			
Croatia	10%	0%	5%	42%	43%			
Romania	10%	0%	2%	39%	49%			
Slovenia	10%	0%	0%	20%	69%			
Countries of the Western Balkans (Western Balkan countries)								

Table 2: Sources of funding for $R \not\sim D$ activities in the selected European countries in 2016

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5%

59%

30%

Montenegro

5%

0%

N. Macedonia	6%	0%	6%	59%	29%	
Serbia	13%	0%	32%	45%	10%	

Source: authors, based on Eurostat data, Database. EuroStat, n.d.

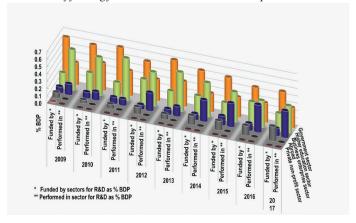
Table 3 shows the data on sector structure of investment in R&D, i.e. realisation of R&D activities of the selected European countries in 2017. Sector structure of investment in R&D activities shows relative advantages and shortcomings of innovation system of a country on the side of expenditure. The data in Table 6 show that in EU28 and EU 19, business sector predominantly participates with 66% in total realisation of investment in R&D activities, followed by higher education sector with 21% and 22% respectively. In European countries, public sector realised on average only 11% in R&D activities, while in Euro zone (EU19), it is somewhat higher (13%). Private non-profit sector participates in R&D activities with only 1% in EU28 and 0.5% in EU19.

Table 3: Structure of R&D investments realisation in the selected countries by sectors - 2016

Sector Coutry*	Private non-profit sector	Higher education sector	Government secto	Business enterprise sector				
EU28	1.0%	22%	11%	66%				
EU19(euro)	0.5%	21%	13%	66%				
EU countries of the Balkan peninsula								
Bulgaria	1.3%	5%	23%	71%				
Greece	0.9%	28%	22%	49%				
Croatia	0.0%	29%	22%	49%				
Romania	0.0%	10%	32%	58%				
Slovenia	0.5%	11%	14%	74%				
Country of the Western Balkans								
Montenegro	6.1%	58%	21%	15%				
N. Macedonia	2.8%	61%	11%	25%				
Serbia	1.0%	36%	27%	36%				

As it can be seen in Figures 7 and 8, Serbia had increasing investments in R&D in absolute amount during the observed period. However, GERD sources are predominantly based on public investments and the investment of higher education, which are in Serbia predominantly in the competence of the state.

Figure 8: Sources of funding for R&D activities in Serbia in the period 2009-17 as % of GDP



In the figure 8 a slight but very unfavourable fall of sources for R&D is noticed by public sector, which is not followed by adequate growth of sources generated from business sector. It per se shows insufficient strategic dedication of innovation policies and insufficient efficacy and effectiveness of Serbian national innovation system.

When the structure of sources and realisation of GERD in Serbia is shown relatively, as a percentage of total GERD, the relationship of its input and output components is more clearly perceived (Table 4, Figure 9).

Table 4: Structure of sources of funds versus their realisation for Serbian R&D in the period 2009-2017
expressed as % of GERD

Year	Abroad	Private non-profit sector		Higher education sector		Government sector		Business enterprise sector	
	F	F	P	F	P	F	P	F	P
2009	7.3%	1.2%	0.0%	20.7%	54.9%	62.2%	30.5%	8.5%	14.6%
2010	4.2%	0.0%	0.0%	28.2%	51.4%	59.2%	37.1%	8.5%	11.4%
2011	5.9%	0.0%	0.0%	22.1%	57.4%	63.2%	33.8%	8.8%	8.8%
2012	9.3%	0.0%	0.0%	33.7%	45.9%	51.2%	29.4%	5.8%	24.7%
2013	7.4%	0.0%	0.0%	25.0%	52.9%	60.3%	33.8%	7.4%	13.2%
2014	12.3%	0.0%	0.0%	26.0%	45.8%	53.4%	25.0%	8.2%	29.2%
2015	12.5%	0.0%	0.0%	23.8%	40.7%	51.3%	27.2%	12.5%	32.1%
2016	13.1%	0.0%	0.0%	32.1%	36.1%	45.2%	26.5%	9.5%	37.3%
2017	19.3%	0.0%	0.0%	23.9%	36.4%	46.6%	27.3%	10.2%	36.4%
F Funded by sectors for R&D P - Performed in sector for R&D									

In Serbia, Ministry of Science is responsible for the policy in the domain of science and research. In order to include scientific and research community in elaboration of strategic guidelines in science, the Council for Scientific and Research Activity was formed, aimed at supporting the Ministry in the promotion of scientific and research activities, analysis of conditions and achievements in science, preparing professional advice etc.

Strategy of Scientific and Technological Development of Serbia for the period 2016-2020 – Research for Innovations is a document which defines measures and programmes for promotion of excellence in science and targetable research for the development of economy and society as a whole (R. Serbia, 2016a). The vision of Strategy is to make science in Republic of Serbia based on the system that supports excellence of science and relevance for economic development, competitiveness of economy and the development of the society as a whole. The mission of Strategy is the establishment of effective national research and innovation system, integrated in European research area, which relies on partnership in the country and abroad and contributes the economic growth, social and cultural progress, rise of standard of citizens and quality life. Therefore, the document completely recognises the necessity of existence of effective R&D as a significant assumption on the European pathway of Republic of Serbia (R. Serbia, 2016b).

The Strategy represents national map of the road to integration in European research area, since it accepts and precisely defines measures for achieving priorities and aims defined by the map of roads in European research area. Basic novelty of the strategy is "research for innovations" in its core, in the function of economic and total social development of the country. Legally, the Strategy is in accordance with the Law on Scientific and Research Activity and the Law on Innovation Activity and sub-legal

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documents made according to these Laws, the Law on Higher Education and other effective laws and documents (R. Serbia, 2005; 2010; 2013).

The fact is, however, that independently of passing a large number of legal solutions in the domain of scientific and developmental research and the support to promotion of innovations, R&D in Serbia is still insufficiently developed and basically ineffective. There are many causes of inefficiency of innovation system in the Republic of Serbia, and they all can be marked as limiting factors on the European pathway of our country. They were described in detail by Serbian authors (Kutlača, & Semenčenko, 2015; Cvetanović, et al., 2015).

By elaborating appropriate strategic documents and shaping legal framework in this domain in the Republic of Serbia, further development and progress of scientific and research activity was made possible. The issues in the domain of science and research are defined by the Stabilisation and Association Agreement, Chapter 8 (Cooperation Policies), i.e. Article 112 (Cooperation in Research and Technological Development).

By signing Stabilisation and Association Agreement (SAA), Serbia is bound to cooperate with EU on stimulation of cooperation in civilian scientific research and technological development, based on mutual benefit, availability of funds and appropriate approach to their relevant programmes. The Agreement points out that the cooperation will especially include preferred domains related to acquisition in the domain of research and technological development (Delegacija EU u Republici Srbiji, n. d.).

Conclusion

The EU countries invest significant funds in the domain of research and development. Thus they try to promote significance of commercial valorisation of knowledge in innovations. The share of expenditures for R&D in GDP ranks about 20%. Nearly a half of the expenditures originate from private sector.

In the countries of the Balkan Peninsula that are the EU members, the investment in activities of research and development is significantly lower in comparison to EU average. Nearly a half of these expenditures originate from public sector, which can be characterised as pronounced weakness of national monetary systems in these countries.

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