

Оригиналан научни рад

Примљено: 25. 5. 2015.

Ревидирана верзија: 21. 8. 2015.

Одобрено за штампу: 18. 9. 2015.

UDK 005.336.4-057.85(497.11)

## THE ROLE OF UNIVERSITY EDUCATED WORKERS IN IMPROVING INNOVATIVENESS OF LARGE COMPANIES IN SERBIA <sup>a</sup>

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### Abstract

The aim of this paper is to emphasize the importance of university educated workers in improving innovativeness of large companies in Serbia. Specifically, Serbia, as a country that has belatedly embarked on a process of economic transition, has lost its large companies. Large companies create over 65 % of gross domestic product in modern market economies. The backbone of the growth of large enterprises is made of innovation in respect of products, processes, organization, and marketing. The paper is based on the data obtained from a sample of 188 large companies in Serbia that implemented any innovative activity in 2012. Based on this data, we constructed a regression model in which the determinant of innovativeness was the percentage share of university educated employees, while the control variable was the data on the age of installed equipment. The constructed model was fully applicable to 56 % of large companies in the sample, and such a high coefficient of determination clearly shows that a high share of university educated employees fosters innovativeness, and thus growth and development of large companies in Serbia.

**Key words:** university educated employees, age of equipment, research and development, innovativeness, large companies

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<sup>a</sup> This paper was written as part of the Project No.47005 – Research and platform development in control and management of scientific and technological development in Serbia, and Project No.179066 – Improvement of public and private sectors competitiveness by competence networking in the process of European integrations of Serbia, financed by the Ministry of Education, Science and Technological Development of the Republic of Serbia.

## УЛОГА ВИСОКООБРАЗОВАНИХ РАДНИКА У УНАПРЕЂЕЊУ ИНОВАТИВНОСТИ ВЕЛИКИХ ПРЕДУЗЕЋА У СРБИЈИ

### Апстракт

Циљ рада јесте да се укаже на значај високообразованих радника за унапређење иновативности великих предузећа у Србији. Наиме, Србија као земља која је са закашњењем ушла у процес економске транзиције изгубила је своја велика предузећа. Велика предузећа креирају преко 65% бруто домаћег производа у савременим тржишним привредама. Окосницу раста великих предузећа чине иновације у производима, процесима, организацији и маркетингу. У раду се апострофира значај високообразованих радника за унапређење иновативности великих предузећа у Србији. Са тим у вези коришћени су подаци на узорку од 188 великих предузећа у Србији, која су реализовала неку иновативну активност током 2012. године. На бази ових података конструисан је регресиони модел у коме је детерминанта иновативности процентуално учешће запослених са високим образовањем, док је као контролна променљива коришћен податак о старости инсталиране опреме у њима. Конструисани модел апсолутно је применљив на 56% великих предузећа из узорка и са овако високим коефицијентом детерминације недвосмислено је показано да виши ниво учешћа упосленика са високим образовањем поспешује иновативност, а самим тим и раст и развој великих предузећа у Србији.

**Кључне речи:** високообразовани радници, старост опреме, истраживање и развој, иновативност, велика предузећа

### INTRODUCTION

Innovativeness has become the engine of national economies' prosperity, which causes many nations to compete for global innovation advantage. According to modern explanation, an innovation represents something new to companies, markets, and the entire world. Today, the significance of innovation has spread from purely scientific and technical focus to new business models and creation of new consumer experience, or approach to providing services. The consequence of such approach is the fact that companies that do not innovate must face a potential possibility of losing their market or being closed down. In a word, failure to innovate creates unsuccessful companies, loss of export competitiveness, redundancy, and, eventually, causes economic crisis. Therefore, it is essential for all companies to improve their innovativeness. As for Serbia, the innovativeness of large companies is of extraordinary significance.

The focus of this paper is on defining the determinants of innovativeness of large companies in Serbia, with the goal to improve their innovativeness. The focus on large companies is the consequence of the fact that the large companies have been the biggest losers during the previous transitional years. Definition of large companies in the EU and

Serbia is based on quantitative criteria. More precisely, a large company is a company that fulfills two out of three criteria: 1) average number of employed workers exceeds 250; 2) income exceeds €35 million in equivalent Serbian dinar value; and 3) average value of business assets exceed €17.5 million euros equivalent Serbian dinar value (calculated as an arithmetic mean at the beginning and the end of a business year).

We are the witnesses to the disappearance of industrial giants such as: Electronic and Machine industries in Niš, Jumko in Vranje, Srbijanka in Valjevo, etc. These large companies lost their markets and disappeared from the economic scene due to their non-innovativeness. In order to prevent the existing large companies in Serbia from experiencing that exact destiny, we analyzed the determinants of their innovativeness by applying mathematical and statistical methods. The initial assumption is that the share of university educated employees in the total number of employed workers and the age of installed equipment are the determinants of innovativeness in large companies in Serbia. In order to confirm the hypotheses, we conducted a research among 188 large companies that introduced at least some innovation in 2012. The section on the research itself is preceded by an overview of literature and empirical research that justifies the hypothesis.

#### *THEORETICAL GROUNDWORK OF THE IMPORTANCE OF INNOVATIVENESS AMONG ECONOMIC ENTITIES*

The role of innovations in economic prosperity has been the subject of research of economic theory for many years. In this theory, there are two main approaches to viewing innovations: traditional, neoclassical, and institutional or Schumpeterian approach. The basis of the standard, neoclassical, model is that economy gravitates towards balance, while knowledge and information are easily accessible. Innovations and research and development are viewed as examples of market failure, since an innovative company cannot make the most of the investment in innovating, which leads to insufficient investment in R&D activities, so they are at a lower level than socially optimal (Hoffman, Parejo, Bessant & Perren, 1998, pp. 39-55). The company is observed as a “black box”, where the innovation process has no significant effect on the production and operation of the company. The assumption about decreasing yields, which establishes the law of supply and demand, in fact guarantees that the growth will disappear in the end and that the economy will return to the previous state of balance.

Since the model was inconsistent with the real occurrences in economy (there had not been any long-term growth), Solow developed a new model of growth that enabled continuous growth (Souder, 1987). Solow’s major concept implies that the increased use of capital causes increased labor productivity. In this model, the impact of innovations is

treated as a part of the remaining Solow's residual, and thus as the key factor for economic progress and a long-term convergence (Solow, 1956, pp. 65-94). Arrow developed a new model of growth that introduced the concept of "learning-by-doing", where each new business activity causes the increase of the total knowledge in a company (Arrow, 1962). Romer continued to develop the model and he viewed knowledge as the third factor of production (Rothwell, 1994, pp. 7-31), which, according to Legge, allows the increased initial growth to slow down and, eventually, to attain a constant long-term rate (Legge, 1993). It means that knowledge, unlike labor and capital, is not affected by the law of diminishing returns, which accelerates the rate of growth over time due to increase of knowledge.

According to Schumpeter, innovations have a key role for the survival of new and already existing companies (Schumpeter, 1961), and they are the main feature of the market economy. Schumpeter emphasizes that innovation is a powerful means for new companies to successfully enter the market and threaten the position of the existing companies. In addition, innovations are important for the existing companies in order for them to retain the competitive position in the conditions of emergence of the new companies and the development of new "distracting" technology (Christensen, 1997). In his early work, Schumpeter underlined the importance of companies for innovation, and he thought that they were the most significant source of innovations (Schumpeter, 1939). Schumpeter indicated that innovations usually appear in new entrepreneurial companies, which begin to creatively operate beyond "the roundabout" of the existing production activities. The companies that successfully innovate become large and accumulate great fortune to their owners (Schumpeter, 1942). Schumpeter also indicated the need of the active entrepreneur to constantly move the boundaries and change the present organizational forms, which represents the main generator of innovations. Hodgkinson points out that if we observe the issue that way, the entrepreneur has the leading role in Schumpeter's theory, i.e. he is the main promoter of innovations and economic growth. Such approach views innovations and R&D as the result of a particular institutional structure of knowledge of each society (Hodgkinson, 1998). Schumpeter develops a thesis on creative destruction, according to which the introduction of new products, new methods of production, opening of new markets, discovery of new sources of supply, and organizational changes are the elements within the system that result in destruction of the existing economic structures and their substitution by the new ones.

However, in his later work, Schumpeter claimed that large companies, which operate in concentrated areas of economy, are the general source of innovations. This is because the development of innovations demands the accumulation of knowledge and finances, so the small entrepreneur can

no longer be the main driving force of innovation development. Due to imperfections on the capital market, large companies hold a certain degree of monopoly, which allows them to be the initiators of technological progress. The imperfections of the market permit the large companies to gain an advantage: they can provide financial means for risky R&D projects, because the size of a company is related to the accessibility and the stability of the resources. R&D activities are very expensive for small companies, which, unlike large companies, do not have the capital and the additional means, so for the small companies it is better to imitate the innovation activities of other companies, or participate in common innovation projects, than to independently develop innovations (Schumpeter, 1961). According to this theory, the companies that have not managed to sustain the sufficient degree of innovativeness become “trapped” between the price drop on the market and the fixed costs, which leads to their displacement from the market (Legge, 1993). Consequently, the number of companies diminishes, and the remaining companies become large and profitable, which establishes monopolistic behavior for longer periods. Accordingly, older activities tend to characterize large companies, while new activities are prevalent in small companies. However, progressive monopolization can be neutralized by “creative destruction”, where the innovative entrepreneur within a small company can introduce a premium product (with respect to quality and price) and thus jeopardize the existing monopolizing company.

The neoclassical approach is more oriented towards strict mathematical descriptions and models of the functioning of internal economy, while Schumpeter’s approach is more philosophical and descriptive, as it includes empirical evidence in order to explain the actual situation and give directions (Fagerberg & Verspagen, 2002, pp. 1291-1304).

Grossman and Helpman emphasize that many Schumpeter’s ideas have been accepted within new theories of development, even within new neoclassical models (Grossman, Gene & Helpman, 1994, pp. 23-44). For example, within the theory of evolution, the explanation of operation of an enterprise is based on the set of learned activities (routine) (Nelson & Sydney, 1982). The quality of the routine of a particular enterprise determines its position on the market, analogously to the positions of the species in the evolution chain. Of course, companies cannot permanently retain their competitive advantage through established routine alone. In order for them to preserve and improve the position of the company, innovations are necessary to develop new and improve the established routine, which is how the company conforms to constant changes on the market.

In the last few decades, due to the popularity of the theory of endogenous growth, economists claim that the differences in innovative capacities and potentials have been largely responsible for great differences in economic performances and the level of development of particular economies (Grossman & Helpman, 1991, pp. 46-51). The theory of

endogenous growth introduces simultaneousness in the relations between innovations and performances. In this model, economic growth determines the level of technology and innovations, which in turn depend on the funding for these activities. This theory also emphasizes the importance of the institutional frame for the stimulation of innovation, because the motivation for innovating depends on the possibility of an innovator to commercialize the innovations. The most significant representatives of this theory are Romer (1986, pp. 1002-1037) and Aghion and Howitt (1998).

Bessler and Bittelmeyer claim that innovations only allow companies a short-term competitive advantage and that the effects of innovations decline in the long run (Bessler & Bittelmeyer, 2008, pp. 323-356). This claim is in accordance with Schumpeter's concept of creative destruction. An innovation provides a competitive advantage for a limited period, after which the knowledge spreads throughout the market. As the new products emerge on the market, the competitive advantage of the existing companies decreases, their performance aggravate, and they get "squeezed out" of the market unless they develop better innovations.

The latest studies enable better understanding of relative advantages and disadvantages of small and medium-sized enterprises in respect of innovation, whereby they accept the specific features of SME innovation development that are reflected in their sector classification (production and services), age, or the stage of the company's life cycle, etc. On one hand, Burrone and others point out that the abilities and the innovative capacity of SMEs considerably vary, depending on the sector, size, orientation, resources, or business environment (Burrone & Jaiya, 2005). On the other hand, Becheikh and others claim that this issue especially draws attention in production sectors where innovation is a very complex process affected by a number of factors (Becheikh, Landry & Amara, 2006, pp. 644-64). This practically implies the acceptance of a great heterogeneity of SMEs and the complexity of the innovation process during the research of their innovativeness, as well as acceptance of different theoretical theses, the starting points in concrete researches.

In literature, a great number of articles explore the innovativeness of companies from different aspects. Particular articles explore the innovativeness of SMEs in respect of the following: development of R&D activities; the relationship between knowledge and innovativeness within a company; the effect of innovativeness on performances of large companies (productivity, profitability, employment, income, competitiveness, etc.); the effect of innovativeness on the development of a company, branch, or economy in general; the relationship of innovativeness and the size of a company; the effect of cooperation and company networking on the innovativeness of a company; the efficiency and effectiveness of innovation policy; the effect of technological innovations on the development of a company, where the heterogeneity of the companies is getting increasingly

acceptable; and the complex effect of their innovation activities on other partners in the economy.

As the basis for econometric and statistical research, we used the available statistical data (e.g. the data from the balance sheets of particular companies), as well as other available data. Intentionally collected statistical data on the innovativeness of companies are of immense importance, such as the data obtained from the Questionnaire on companies' innovativeness. Most studies in this field are based exactly on these data from the Questionnaire, because the method of data collection, the scope of observed units, and the obtained data enable different econometric and statistical analyses (Mairesse & Mohnen, 2010). Thus, we have an opportunity to explore the underlying assumptions and to establish different aspects of innovativeness of large companies in modern economy.

Based on the aforementioned theoretical foundations, and by applying appropriate statistical and econometric methods and techniques, we will explore the determinants of innovativeness of large companies in Serbia in the following section.

#### *METHODOLOGY AND PROPERTIES OF THE SAMPLE*

To confirm the claim that the innovativeness of economic entities is of paramount importance for their competitive advantage and the quality of macroeconomic performance of a country in which they operate, we decided to investigate the determinants of innovativeness of large companies in Serbia. The reason for such an approach lies in the fact that there are 500 large companies in Serbia in total. According to the data from the Statistical Office of the Republic of Serbia for 2013, large companies constitute 1.1 % of the total number of economic entities in Serbia, employ 37.4 % of the working population, and realize 34.5 % of the total sales in Serbia. In addition, no empirical data unequivocally show that the size of a company determines the level of its innovativeness.

In this paper, the research sample includes 188 large companies in Serbia, which, according to the Questionnaire on companies' innovativeness of the Statistical Office of the Republic of Serbia, undertook some form of innovation activities during 2012. It is composed of more than 1/5 of the total number of large companies in Serbia, which constitutes a representative sample. Special attention was also given to the geographical position and the type of activities of economic entities that constitute the sample. The structure of the sample is shown in the following figures:

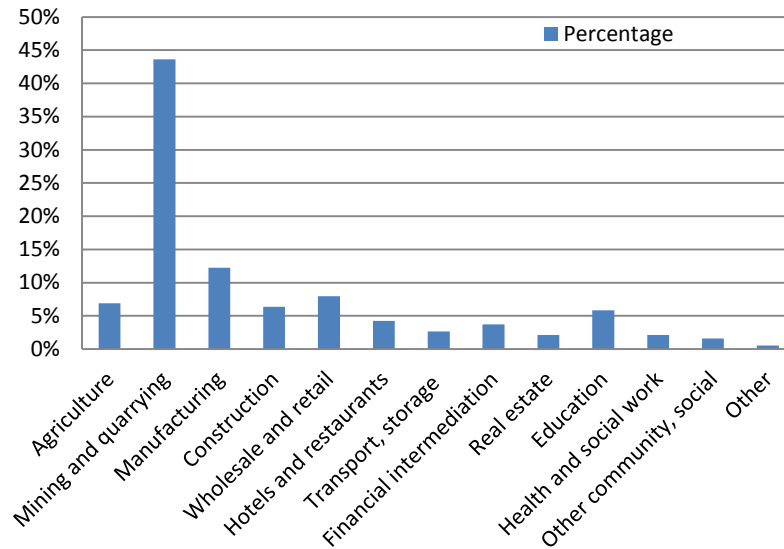


Figure 1. Structure of the sample by activities  
(authors, based on SORS database)

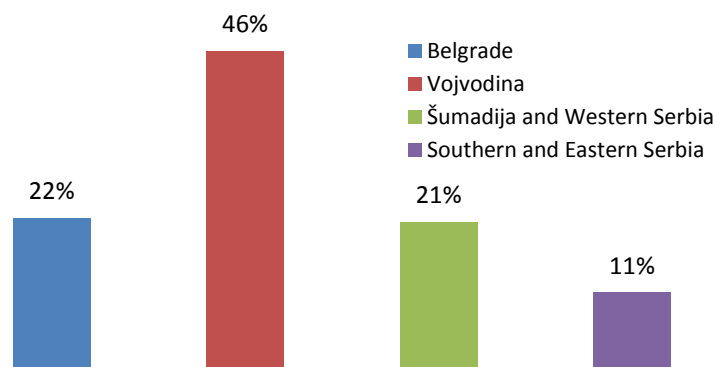


Figure 2. Structure of the sample by region  
(authors, based on SORS database)

For the purpose of our analysis, we will use a regression model. The independent variable will be companies' innovativeness measured by the costs of R&D per employee in 2012, while the independent variables will be potential determinants of innovativeness.



### RESULTS AND DISCUSSION

In accordance with the defined aim of research, the first determinant of large companies' innovativeness in Serbia is the share of university educated employees in the total number of employed workers, while the second determinant is the age of equipment. Thus, we formulate two hypotheses:

X1: The share of university educated employees in the total number of workers is a determinant of large companies' innovativeness in Serbia;

X2: The age of installed equipment is a determinant of large companies' innovativeness in Serbia.

Testing of the hypotheses is performed based on the results of the Questionnaire on the innovation activities of economic entities in 2012 conveyed by the Statistical Office of the Republic of Serbia. The analysis includes large companies that undertook any innovation activities in 2012, in terms of value expressed as costs of R&D.

Based on these data, we used a regression analysis in order to define the innovation determinants of large companies in Serbia. The dependent variable is the amount of costs of R&D per employee, while the independent variables are the share of university educated employees in the total number of employed workers and the age of equipment. Considering that the age of equipment varies, we selected the following categories of the age of equipment: up to one year old, one to three years old, and five to ten years old. For each of the specified category of the age of equipment, we calculated a percentage share of that category in the total of equipment in each company. The next step in order to confirm the hypotheses is to apply the regression analysis. The results of the regression analysis are shown in Table 1.

*Table 1. Results of regression analysis*

Source	SS	Df	MS	Number of ob	188
Model	159132.722	4	39783.1806	F (4, 183)	59.20
Residual	122988.71	183	672.069452	Prob >F	= 0.0000
Total	282121.432	187	1508.67076	R-squared	= 0.5641
				Adj R-squared	: 0.5545
				Root MSE	= 25.924

RiD_Investment_per_employ ee000	Coef.	Std. Err.	t	P > t	[95%	Conf. Int.
Share of university educated employees	881.3199	189.2057	4.66	0.000	508.0147	1254.62
Equipment aged 5 to 10 years	- 17.18291	10.44223	- 1.65	0.102	- 37.78555	3.41973
Equipment aged 1 to 3	- 57.35375	6.153348	- 9.32	0.000	- 69.49438	- 45.2131
Equipment aged up to 1 year	- 41.94066	27.60129	- 1.52	0.130	- 96.39833	12.5170
_cons	65.34832	8.400912	7.78	0.000	48.77322	81.9234

(Source: Calculations performed by the authors)

Based on the data from Table 1 we can conclude that out of four independent variables that we designated as innovation determinants of large companies in Serbia, only two of them have statistical significance. Specifically, the shares of equipment three to five years old and up to one year old are not an innovation determinant of the companies in the analyzed sample as their P-value exceeds 0.05.

Accordingly, by applying the regression analysis method, we tried to convey innovativeness modeling of large companies in 2012, but using only the determinants that have statistical significance. The regression analysis results are shown in Table 2.

*Table 2. Results of regression analysis*

Source	SS	Df	MS	Number of ob		188
Model	156034.708	2	78017.3538	F (2, 185)		114.47
Residual	126086.725	185	681.549862	Prob >F		= 0.0000
Total	282121.432	187	1508.67076	R-squared		= 0.5531
				Adj R-squared		: 0.5482
				Root MSE		= 26.107

RiD_Investment_per_employ ee000	Coef.	Std. Err.	t	P > t	[95%	Conf. Int.
Share of the university educated employees	849.26004	189.6719	4.48	0.000	475.0625	1223.45
Equipment aged 1 to 3 years	- 58.25613	6.176671	- 9.43	0.000	- 70.4419	- 46.0703
_cons	60.70282	8.174425	7.43	0.000	44.57574	76.829

(Source: Calculations performed by the authors)

Based on the data from Table 2 we can conclude that on the sample of 188 large companies in Serbia that conducted any R&D activities in 2012, the increase of the share of university educated employees in the total number of employed workers by 1 % causes the increase of R&D costs by 849.264 RSD per employee. This ascertainment relies on the ceteris paribus clause in 55.31 % of the examples with the level of statistical significance of more than 95 %. Thus, the regression analysis implies that the share of university educated employees in the total number of employed workers in large companies in Serbia is a determinant of their innovativeness. In other words, a higher percentage of the share of university educated employees in the total number of employed workers causes larger investments in R&D, which confirms the first hypothesis.

As regards the second hypothesis, according to the data from Table 2, we can conclude that it is only partially confirmed. However, the age of equipment is the innovation determinant of large companies in Serbia in 2012, but only the equipment aged one to three years. Furthermore, the data in Table 2 indicate that the increase of the share of the equipment aged one to three years causes the decrease of R&D costs by 1 % (58.256 RSD). In other words, the companies that possess the equipment that is on to three

years old will pay less for R&D. This ascertainment relies on the ceteris paribus clause in 55.31 % of analyzed examples with the level of statistical significance higher than 95 %.

Based on all the facts, it is generally possible to formulate a regression model that would include innovation determinants of large companies in Serbia that undertook any innovation activity in 2012:

$$Y=849.26\alpha - 58.25\beta+60.70,$$

where  $\alpha$  is the share of university educated employees in the total number of employed workers in a company,  $\beta$  is the share of equipment one to three years old, and  $Y$  is the cost of R&D in thousands of dinars per employee. We stress that the model is applicable in 55.31 % of analyzed examples, and it carries a high level of statistical significance.

### CONCLUSION

Innovations and entrepreneurship represent significant stimulators of economic growth and employment. We have reached this conclusion due to relevant literature that indicated that innovativeness in companies is a significant factor of their productivity growth. Productivity growth within companies entails increased salaries for employees and an increase in the standard of living. To answer what the most important innovation determinants for large companies in Serbia are, we conducted a research among 188 large companies that undertook any innovation activities in 2012. We ensured that the companies were equally represented in the sample according to their geographic location and specific business activity. Research results were sublimated into a constructed regression model. The model unequivocally showed that the bigger share of university educated employees in the total number of employed workers has a stimulating effect on the level of innovativeness of large companies in Serbia. Increased innovation activity results in higher R&D costs. However, rationalization of these costs is possible only in large companies that have a bigger share of equipment that is one to three years old. Such conclusion implies that more efficient investment in R&D is indeed possible, and so is the improvement of companies' innovativeness. All these indicators show that education is a significant factor of improvement of innovativeness, productivity, and the standard of living in Serbia.

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## УЛОГА ВИСОКООБРАЗОВАНИХ РАДНИКА У УНАПРЕЂЕЊУ ИНОВАТИВНОСТИ ВЕЛИКИХ ПРЕДУЗЕЋА У СРБИЈИ

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### Резиме

Србија, као земља закаснеле транзиције мора да јача и развија своја велика предузећа. Иновативност великих предузећа, у турбулентном и све конкурентнијем окружењу јесте есенцијални фактор њиховог раста и развоја, али и њиховог пуког опстанка. Уважајући ову чињеницу економским истраживачима се намеће питање које су то детерминанте унапређења иновативности ових привредних субјеката, као есенцијалној премиси њихове конкурентности. У овом раду, предмет истраживања јесу детерминанте иновативности великих предузећа у Србији, која су реализовала неку од иновационих активности у 2012. години. Постављене су две хипотезе. Прва, да учешће високообразованих радника јесте детерминанта иновативности и друга, да истовремено и старост опреме представља фактор иновативности великих предузећа у Србији. Са тим у вези, дали смо преглед економске литературе и обављених емпиријских истраживања која указују на значај иновативности за опстанак и раст великих предузећа и привредног просперитета земље у којој послују. Након тога, на бази узорка од 188 великих предузећа у Србији, креирали смо регресиони модел у коме независну променљиву представља годишњи износ улагања у истраживање и развој, мерен у хиљадама динара по запосленом раднику, док зависну променљиву представља учешће високообразованих радника у укупном броју ангажованих радника у привредном друштву. Као контролна променљива коришћен је податак о старости опреме у овим предузећима. Резултати истраживања у раду потврдили су постављене хипотезе. Наиме, недвомислено је доказано да је учешће високообразованих радника детерминанта нивоа улагања у истраживање и развој великих предузећа у Србији. Уз клаузулу *ceteris paribus* у конструисаном моделу доказали смо да повећање учешћа високообразованих радника у укупном броју ангажованих радника за 1%, утиче на повећање улагања у истраживање и развој на годишњем нивоу за 881.000 РСД по запосленом. Додатно, модел је потврдио да учешће опреме старости од једне до три године јесте статистички значајна детерминанта улагања у истраживање и развој у великим предузећима у Србији. Наиме, под клаузулом осталих непромењених околности, велика предузећа у Србији која повећају учешће опреме старости од једне до три године, у укупно инсталираној опреми, редуковаће улагања у истраживање и развој на годишњем нивоу за 56.000 РСД по запосленом. Значај конструисаног модела огледа се у чињеници да су идентификоване две врло значајне детерминанте улагања у истраживање и развој у великим предузећима у Србији, једне која повећава и друге која редукује овај износ. Адекватно управљање њима може да води унапређењу ефикасности иновативних улагања као чиниоцу раста и развоја великих предузећа у Србији.