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Venture Capital – Generator of Growth of SME Investment Activities

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Abstract: *The aim of the paper is to point out the importance and role of venture capital in creation of new values based on the knowledge economy. By reviewing relevant literature about venture capital, this paper presents the importance of the venture capital investments in innovative activities of SMEs that have an impact on economic growth. Pointing to the importance and quantifying the overall effects of venture capital investments, will be used the overview and trends in venture capital investments in the sectors of economy in Europe which generate a larger number of patents. According to data during the period of 2007 - 2015 will be defined venture capital investments and number of registered patents in the sectors of the knowledge economy. Empirical analysis indicated that the venture investments in the sectors of the knowledge economy generated more patents in those sectors. In addition, the paper analyzes the venture capital investment and innovation activities of SMEs, which are reflected in patent activities, where the result is a correlation between these activities in the European economies.*

Key words: *venture capital, creating new values, SMEs, knowledge economy, economic growth.*

Venture capital – generator rasta investicionih aktivnosti MSP

Apstrakt: *Osnovni cilj rada je da se ukaže na značaj i ulogu venture kapitala u stvaranju nove vrednosti zasnovane na ekonomiji znanja. Pregledom*

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relevantne literature o venture capitalu, ovaj rad predstavlja značaj ulaganja fondova rizičnog kapitala u inovativne aktivnosti MSP koji su od uticaja na privredni rast. U okviru značaja i kvantificiranja ukupnih efekata venture capital ulaganja, koristiće se pregled i trend ulaganja venture capitala u sektore ekonomije u Evropi koji generišu veći broj patenata. Prema podacima u periodu od 2007 - 2015. godine definisaće se projekcije ulaganja venture capitala u sektore ekonomije znanja kao i pregled broja registrovanih patenata u istim. Empirijska analiza je pokazala da sektori ekonomije znanja u koje venture capital investira generišu više patenata. Pored toga, u radu su analizirane venture capital investicije i inovacione aktivnosti MSP koje se ogledaju u patent aktivnostima, gde za rezultat imamo visoku korelisanost tih aktivnosti u evropskim ekonomijama.

Ključne reči: *venture capital, stvaranje nove vrednosti, MSP, ekonomija znanja, privredni rast.*

1. Introduction

The Venture Capital Funds or the risk capital funds refer to a type of private equity of an investment company offering participation in financing especially the innovative, risk-bearing or creative companies with a high growth potential in the medium and long term timeframe (5 years on average) and with clearly defined exit strategy. For the invested funds the Venture Capital Funds acquire certain number of shares or equity stake with potentially high return on invested funds. Certainly, such type of business bears a high risk, too. The venture capital investment also implies an active participation in management often including change in the business strategy, management, financing restructure (replacing equity with debt or vice versa), capital increase, etc. (Metrick and Yasuda, 2011).

The risk (venture) capital investors are characterized by:

- 1) Investment primarily in the startup, technologically oriented enterprises that cannot get the conventional loan - facility,
- 2) Funds are made available without time limit, where the capital investment is not aimed at dividend or interest, but at profit when equity stake or shares in the company are sold,
- 3) Participating in the form of capital investment carries a very high risk that could result in the entire loss of principle – at the same time, high investment profitability is possible,
- 4) Inexperienced entrepreneurs as well as small and medium-sized companies are also offered the managing know-how as an assistance in

making the investments as successful as possible, where the investor plays an active role in the entrepreneurial activities. (Da Rin, Hellmann and Puri, 2011).

Since the global financial crisis of 2008 the economic growth has become a central topic of the global economies. According to the latest agenda of the International Monetary Fund, a slow recovery of the European economy is envisaged (International Monetary Fund, 2013). Many companies, especially the small and medium-sized ones should be transformed, adjusted to new macroeconomic situation and their ways of appearance in markets expanded. The liquidity crisis has resulted in seeking for the new sources of financing, the situation in the market requires know-how and management expertise of small and medium-sized companies aimed at their better productivity, innovativeness and thus becoming more competitive. Venture Capital or Risk Capital Funds with an active participation in improving the SME's control activities is an alternative solution for the new market conditions.

In newly created challenging environment, in the paper authors shall analyze the impact of the venture capital investments in SME's innovative activities, which has an overall effect on the economic growth. The European Commission defines the private equity activities which support the activities influencing three key factors of economic growth: the innovative activities, productivity and competitiveness (European Commission's Europe 2020 Strategy, 2015). The risk capital funds' incentive for small and medium-sized companies in some sectors of economy provides innovation and support to implementation of new processes and launching new products in the market.

The positive outcome of the venture capital activities results from an impact of the improved management on promotion of a larger number of innovations. Venture capital supports innovativeness indirectly allocating larger amounts of funds for financing research and development of new products and processes in the companies the investments are made in, and directly through supporting the startup companies that tend to be more innovative than the average companies (EVCA, 2015).

2. Literature Review

Knowledge economy is a system that is based on knowledge, i.e. innovations resulting in high productivity and competitiveness so considerably influencing the economic growth in an economy. In this paper knowledge economy will cover the high tech sector of economy and also the other sectors that have generated a large number of innovations, i.e. patents. Knowledge economy that is based on innovations plays an increasingly important role in the long-term economic growth. The improved technology/function-based patents,

product and process patents are the key impetus for the economic growth. In the most developed countries, where it is more difficult to achieve economic growth and capital accumulation, innovations, discoveries, i.e. patents play an important role in stimulating the economic development because innovations provide better and more perfect utilization of current economic resources. As well, innovations stimulate and increase productivity and competitiveness of SMEs (OECD - Innovation Strategy, 2013).

The approved patents supported by the venture capital investments are estimated to reach the market value of over EUR 350 billion in 12 major European countries. Research has also indicated that in some knowledge economy sectors the venture capital financing can be up to nine times more efficient compared to alternative sources of financing the promotion of innovations measured by the number of approved patents (Popov and Roosenboom, 2009).

Research has shown that, through 495 LBO transactions, the companies supported by the venture capital investment have generated the economically more important patents worldwide (Lerner, 2011). According to data on the private capital investments and patent activities in the period of 1997 - 2004 for 21 European countries, Popov and Roosenboom concluded that 12% of overall innovations had resulted from private capital investments. Following the above mentioned logic about 116,000 guaranteed patents have resulted from the private capital investments (Mollica and Zingales, 2007). It should be emphasized that Private Equity is broader term than Venture Capital (risk capital) term. As a rule, Venture Capital refers to financing an enterprise in an early phase of development and in the phase of expansion, whereas Private Equity, as a broader term, includes both the Venture Capital investment and subsequent acquisition.

The Private equity funds and joint venture funds are institutional investors who are willing to invest funds in companies that do not have a long history of business. Their goal is to recognize a growth potential of company, to invest money in it, and to help company financial, marketing and technology develop. As this type of investor is included in the daily activities of the company, there is the presence of a stable economic and institutional environment. When deciding to invest in developing countries, they use different models for assessing the stability of the environment (Veselinović and Makojević, 2011). Most countries, particularly in Southeast Europe, have no alternative sources of financing such as financial markets and venture capital funds, so the banking sector is not motivated to develop long-term partnerships with entrepreneurs. The venture capital funds represent institutional investors who invest in business for which estimates that they will after active participation bring profits through different exit strategies (Makojević, 2011).

Some authors develop simultaneous models predicting the likelihood that firms attract VC financing, the likelihood that they patent, and the number of patents applied for and granted. Fully accounting for the endogeneity of investment, they find that the effect of VC on patenting is insignificant or negative, in contrast to the results generated by simpler models with independent equations. Researchers' findings show that venture capitalists follow patent signals to invest in companies with commercially viable know-how and suggest that they are more likely to rationalize, rather than increase, the patenting output of portfolio firms (Lahr and Mina, 2015).

Having in mind the above researches' conclusions, the objective of the paper is to point out the importance of risk capital investments in SME's innovative activities that produce an effect on the economic growth, where an overview and trend in venture capital investments in the Europe's sectors of economy, which generate patents, are used for quantifying the overall effects of venture capital. The research is based on analyses of venture capital investments in the knowledge economy sectors and also on the number of registered patents in Europe in the period of 2007 - 2015.

3. Research methodology

The study research sample includes and analyzes VC investment data, on the one hand, and the number of registered patents, on the other hand, covering the period from 2007 to 2015 collectively referring to all European economies.

The following reports have been used as the basis and the source of quantitative and partially qualitative data:

- EVCA (2015), *European private equity venture capital association* – annual report for 2015 and the report on private equity impact on economic growth in Europe.
- WIPO (2015), *World Intellectual Property Organization* – annual review of patents for 2015.
- Eurostat, (2015), *Statistic database*.

The research covers thirteen sectors of economy where the largest number of patents have been registered in the observed period, as follows: **1) Agriculture, 2) Business & Industrial Products and Services, 3) Chemicals & Materials, 4) Communications, 5) Computer & Consumer Electronics, 6) Construction, 7) Consumer Goods & Retail and Services, 8) Energy & Environment, 9) Financial Services, 10) Life Sciences, 11) Real Estate, 12) Transportation, 13) Unclassified**. The research also

includes the **HIGH-TECH** sector of economy covering high-tech of the state-of-the-art materials, production technology, biotechnology, nanotechnology, *aerospace* technology, microsystems, optics and electronics in the fields of car industry, process industry, energy industry, engineering, health and medical technologies and other IT sectors (A.T Kearney, 2013). High-Tech sector of economy should be differentiated from ICT sector of economy which includes all types of information and communications technologies exclusive of telecommunications service. The corresponding methodology is to test the research hypotheses.

The variable selection method (stepwise regression, backward, forward) is a combination of a method of gradual increasing and a method of gradual decreasing the model dimension. Its characteristic is that importance of each variable included in the model is tested at each step. Due to intercorrelations, some variables which presence is significant in the first step do not have to be significant in some of the coming steps. Decisions whether to eliminate or to include in the model are made based on F test. The variable selection is completed when neither new variable meets criteria for inclusion in the model and when neither variable can be eliminated from the model according to defined criteria for elimination from the model (Myers and Mullet, 2003).

The correlation methods, which indicate an effect of venture capital investments on the number of patents in some sectors of economy, have been created.

Dependence between two variables is analyzed in the paper: the value of venture capital investment and the number of registered patents in various economy sectors in Europe. Based on stepwise regression analysis, which shows correlation between dependent and independent variables, it was projected the value of dependent variable (number of patents) with certain values of independent variable (average value of venture capital investment). The least squares method has been used for estimation of the regression equation parameters (Biljan-August, Pivac, Štambuk, 2007.)

Pearson's correlation coefficient and matrix has also been used to measure the correlation between variables:

$$r = \frac{\sum_{i=1}^n XiYi - n \bar{X} \bar{Y}}{n\sigma_x\sigma_y} \quad (1)$$

σ_x, σ_y - standard deviations of variables

Essentially, the regression analysis objective is to sort out the analytic-mathematical expression of correlation between regressand (the number of registered patents) and regressor (average amount, i.e. value of venture capital investment), where the value of dependent variable can be estimated with certain values of independent variables.

Testing and analyzing an impact of venture capital investments on the number of generated patents through stepwise regression analysis and correlation matrix on the European market in the period from 2007 to 2015 provide not only qualitative information on the impact results, but differences among observed sectors of economy are also analyzed. In accordance with the research objectives, the authors have tested the following research hypotheses:

Main hypothesis H1: Applying stepwise regression analysis and Pearson's rank correlation coefficient (correlation matrix) enables successful testing the impacts of total venture capital investments on the total number of generated patents on the observed countries' markets.

Also, the additional (derived) hypotheses have been tested, as follows:

H2: There is a high correlativity between the total venture capital investments and the total number of generated patents with the statistical significance in the observed period.

H3: There is a statistically significant correlation between VC investments in HIGH-TECH sector and a number of generated patents in some sectors of economy.

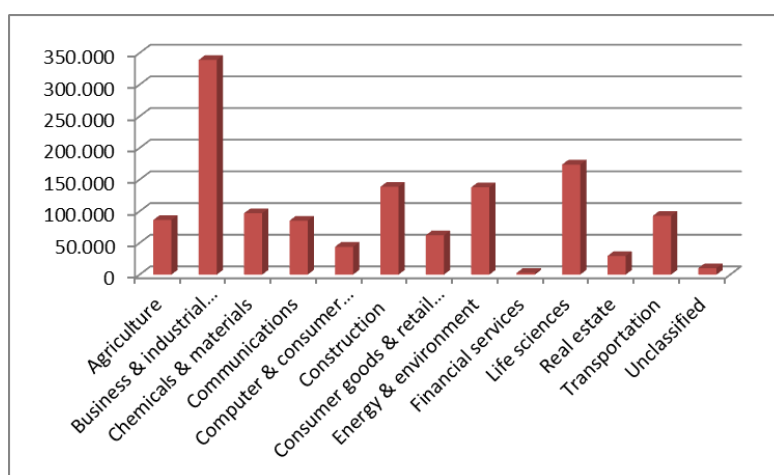
The hypotheses were tested using the stepwise regression, Spearman correlation coefficient and ANOVA through the software package SPSS 20.0.

4. Results and Discussion

Small and medium-sized enterprises financed by venture capital certainly have a leading role in the number of innovations. It is reasonable considering that the main objective of venture capital financing is financing the high potential SMEs with an idea, but lacking the alternative sources of financing. It is common to measure innovations by the number of patents registered by SMEs. In the economic research papers the correlation between the number of patents and the economic growth has not been still clearly defined, but

surely the new product or innovation on the market along with clearly defined strategy could generate high profit (Svenningsen, 2015).

Graph 1. Overview of economy sectors with the highest numbers of registered patents in Europe in the period 2007 - 2015



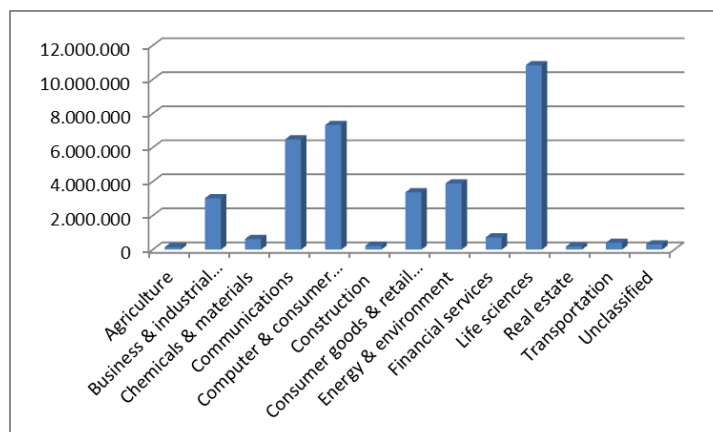
Source: WIPO- Annual review 2015, World Intellectual Property Organization

Based on the observed economy sector sample in the period of 2007 – 2015, graph 1 shows that 338,920 patents were registered in the sector of business and industrial products, 173,715 patents in the life science sector, 137,858 patents in the sector of energy and environments, 92,908 patents in the transportation sector, 43,887 patents in computer equipment and electronics sector, and 85,200 patents in telecommunications.

Using the same economy sector sample, Table 2 shows the amount of venture capital investments in Europe in the period of 2007 - 2015.

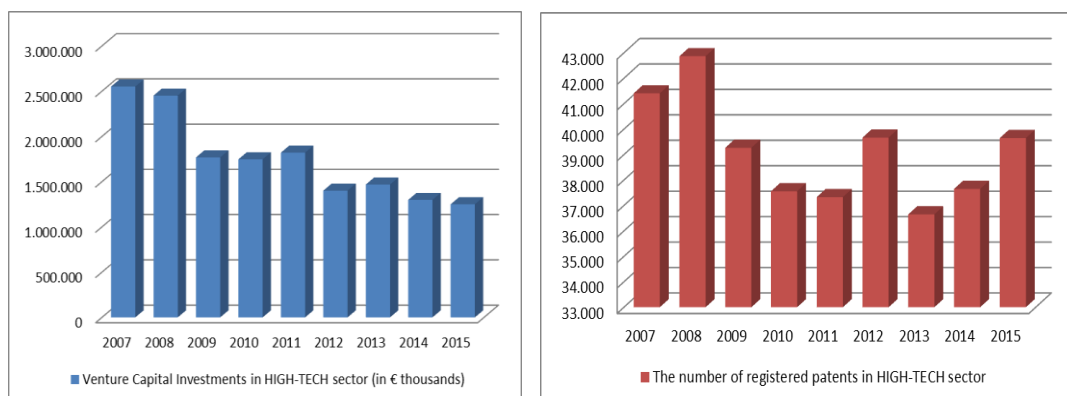
Based on the observed economy sector sample in the period of 2007 – 2015, graph 2 shows that the volume of venture capital investments in the life science sector totals to €10.8billion, in the sector of computer equipment and electronics €7.3billion, the telecommunications sector recorded €6.5billion, the sector of energy and environments €3.9billion, the sector of business and industrial products €3billion, and the transportation sector €407million.

Graph 2. Total volume of venture capital investments in Europe in the period 2007 - 2015 per economy sectors (in 000 €)



Source: EVCA- Annual review 2015, European private equity venture capital association

Graph 3. Comparative overview of venture capital investments and the number of registered patents in Europe in high-tech sector of economy in the period 2007 - 2015



Source: made by the authors based on comparative data from 2015 annual reviews, WIPO and EVCA

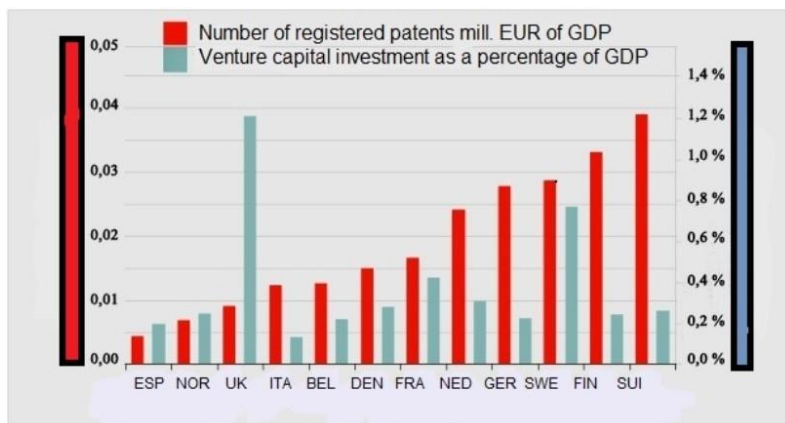
Graph 3 shows the comparative overview of venture capital investments (in 000 €) and the number of registered patents in the high-tech sector of European economy in the period of 2007 - 2015. The table shows that,

compared to 2007, the venture capital investments declined in the absolute value until 2015, however, according to the latest data, in 2013 compared to 2012 there was a slight increase by 4.08% in venture capital investments in the high-tech sector of economy. Such trend in venture capital investments is reasonable because the world faced the economic crisis followed by slow recovery of economy. The number of registered patents in the high-tech sector of economy recorded decline in the absolute value in 2015 compared to 2007 basic year, however, after 2011 there was an interannual growth of 6.26% in 2012, and 7.13% in 2015.

The values of venture capital investment and the number of patents do not record a linear upward trend in the observed period, and authors have tried to find a correlation between the variables. Accordingly, the research was based on the movement and the direction of movement of the venture capital investment level and the number of patents.

Further in this paper authors will explain a correlation between venture capital investments and the number of patents taking into account the most significant European economies through the value of GDP and authors shall also explain in which economy sectors there has been a strong correlation and the same direction of movement between the observed variables.

Graph 4 .Correlation between venture capital investments and the number of patents – overview of European countries



Source: EVCA/PEREP_Analytics 2014, WIPO, Eurostat.

Graph 4 shows, on the one hand, the number of registered patents expressed in EUR millions of gross domestic product value, and on the other hand, venture capital investments as a percentage of GDP of the European countries of the observed sample in the 2007 - 2013 period. The graph

containing the comparative data shows that countries with a higher share in venture capital investments generally produce a larger number of patents. Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Norway, Spain, Sweden, Switzerland and United Kingdom - these countries together represent 92% of all venture capital investment in Europe in the period from 2007 to 2014.

Table 1. The result of stepwise regression of total venture capital investment

Variables Entered/Removed^a

Model	Variables Entered	Variables Removed	Method
1	Computer-Consumer-Electronics	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	Energy-Environment	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: Total Investments

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.970 ^a	.941	.933	297226.55953
2	.993 ^b	.986	.982	154507.30522

a. Predictors: (Constant), Computer-Consumer Electronics

b. Predictors: (Constant), Computer-Consumer-Electronics, Energy-Environment

Correlation coefficient (0.970 and 0.993) shows that there is a very strong correlation between a dependent variable “Total Venture Capital Investments” and independent variables “Computer Consumer Electronics” and “Energy Environment”.

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	9870843663577.592	1	9870843663577.592	111.732	.000 ^b
	Residual	618405393816.629	7	88343627688.090		
	Total	10489249057394.220	8			
2	Regression	10346014013203.160	2	5173007006601.580	216.693	.000 ^c
	Residual	143235044191.060	6	23872507365.177		
	Total	10489249057394.220	8			

a. Dependent Variable: Total Investments

b. Predictors: (Constant), Computer-Consumer-Electronics

c. Predictors: (Constant), Computer-Consumer-Electronics, Energy-Environment

After analysis of the F test results it is concluded that each variable shows high statistical significance compared to dependent variable.

Coefficients^a

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
1 (Constant)	275399.881	381835.244		.721	.494
Computer_consumer_electronics	4.788	.453	.970	10.570	.000
2 (Constant)	554910.550	208142.048		2.666	.037
Computer_consumer_electronics	3.757	.330	.761	11.386	.000
Energy_environment	1.295	.290	.298	4.461	.004

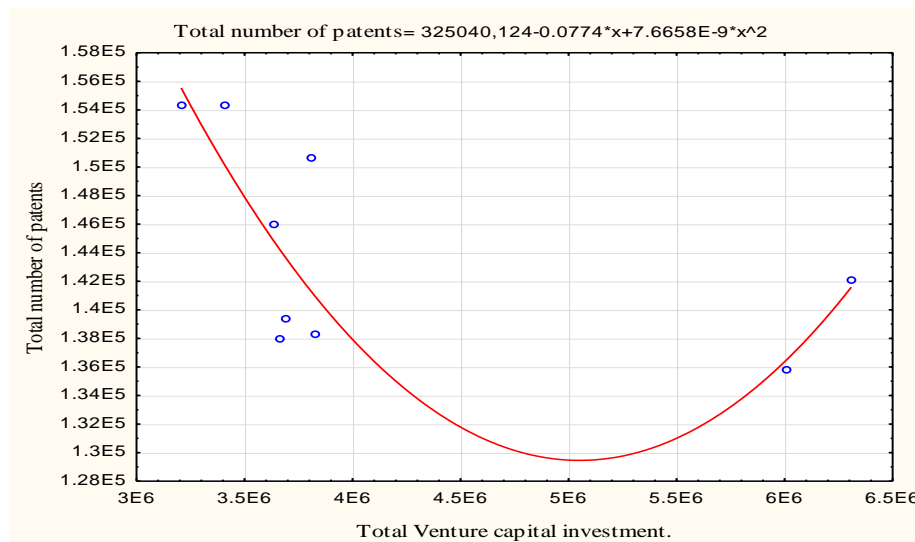
a. Dependent Variable: Total Investments

Source: Made by the authors based on EVCA and WIPO data

The stepwise regression model equation for dependence of the total investments on the impact of independent variables in the observed model is as follows:

$$Y = 554910.55 + (3.757 \times \text{Comp. Cons. Electronics}) + (1.295 \times \text{Energy Environment})$$

Graph 5. Scatter diagram between Total number of patents and Total Venture Capital Investments - Overview of economy sectors in Europe in the period 2007 – 2015



Source: Made by the authors based on EVCA and WIPO data

The scatter diagram shows that the points are grouped so that they can well fit the simple linear function of quadratic parabola form. At one moment it shows the dependent variable decline, which can be interpreted as entering the critical period, and a recovery of dependent variable in the later phase.

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.767	.588	.451	5376.304

The independent variable is Total Investments.

The correlation coefficient $R = 0.767$ shows a significant correlation between a dependent variable “the total number of patents” and an independent variable “Total Venture Capital Investments”.

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	247657043.999	2	123828522.000	4.284	.070
Residual	173427847.556	6	28904641.259		
Total	421084891.556	8			

The independent variable is Total Investments.

Coefficients

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Total_investments	-.077	.033	-.12223	-2.322	.059
Total_investments**2	7.666E-9	.000	11.741	.	.
(Constant)	325040.194	75475.932		4.307	.005

After analysis of the F test results it can be concluded that the independent variable does not show statistical significance compared to the dependent variable.

The equation of curve-fitting simple linear regression model for dependence of “the total number of patents” as a dependent variable on an independent variable “Total Venture Capital Investments” is as follows: $Y = 325040.194 - (0.077 \times \text{Total VC Investments}) + (7.666 \times 10^{-9} \times \text{Total Investments}^2)$.

The analysis of obtained Pearson’s rank correlation coefficients shows their correlation, which is statistically significant for the number of patents variables in Agriculture, Chemicals-Materials, Computer-Consumer-Electronics and Energy-Environment, to the variable of the total VC investments in HIGH

TECH sector, whereas other variables do not show any statistical significance.

5. Conclusion

The research results surely indicate significance of venture capital investments in some economy sectors, which further generate growth of small and medium-sized enterprises. In effect, the researchers have tested a role of the venture capital investments compared to innovativeness of the small and medium-sized enterprises which is reflected in the number of generated patents. The research findings have been tested on the sample of all European countries including a total of 13 economy sectors in the period 2007-2015. The research conclusions are especially interesting because some previous research findings have indicated insufficiently clear correlations and conclusions related to an impact of the venture capital investments on the number of generated patents.

Based on the analysis of the total venture capital investments in the observed period from 2007 to 2015 it has been concluded that the correlation coefficients (0.970 and 0.993) indicate extremely strong correlation between a dependent variable "total venture capital investments" and independent variables "computer consumer electronics" and "energy environment". The analysis of the F test results indicates that each variable shows a high statistical significance compared to dependent variable, which implies that the venture capital investments can be considered and presented as the most effective through the economy sectors of computer consumer electronics and energy environment.

Several hypotheses have been tested in the research process. The main hypothesis H1, which assumes an impact of the total venture capital investments on the total number of generated patents on the observed countries' markets in the period 2007-2015, has been proved true.

The hypothesis H2, which assumes strong correlation between the total venture capital investments and the total number of generated patents with the statistical significance in the observed period, has been partially proved true. It means that the result of $R = 0.767$ correlation coefficient research indicates a strong correlation between a dependent variable "the total number of patents" and an independent variable "the total venture capital investments", so partially proving the above mentioned hypothesis. However, the obtained F test results prove that an independent variable does not show any statistical significance compared to a dependent variable.

The hypothesis H3, which assumes statistically significant correlation between the VC investments in HIGH-TECH sector with the number of generated patents in some economy sectors in the observed period, has been proved true.

The analysis of obtained Pearson's rank correlation coefficients shows their correlation, which is statistically significant, to variables related to the number of patents generated in the sectors of agriculture, chemicals, computer and consumer electronics and energy environment, whereas other variables do not show any statistical significance.

Despite the above mentioned findings, this study has several limitations that provide a good basis for future research in this field. A limitation of this empirical research is time and space framework. The study analyses the practices of the venture capital investments and the number of registered patents during the nine-year period when the financial crisis occurred in Europe indicating some effects, which could be clarified by observation of sample over longer periods. Also, the comparative analysis of the innovative practice and the investment of risk capital in other countries of similar economic growth should be an open issue for future research.

Therefore, the future research in this field should be directed to creation of standardized models in transition and less developed countries, which would better define a correlation between the venture capital investments and innovativeness so promoting the innovative ways to run business and contributing to fast response to changes. An increased innovativeness will surely increase performances, probability of success and gaining the competitive advantage by transition and less developed countries. Accordingly, venture capital investments are aimed at creating a new value.

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Dželetović M. et al.: Venture Capital – Generator of Growth of SME Investment ...

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