



Available online at www.sciencedirect.com

ScienceDirect

Procedia Manufacturing 32 (2019) 1077–1084

Procedia
MANUFACTURING

www.elsevier.com/locate/procedia

The 12th International Conference Interdisciplinarity in Engineering

The Moderating Effect of Intellectual Property Rights on Relationship between Innovation and Company Performance in Manufacturing Sector

Andreea BARBU^{a,*}, Gheorghe MILITARU^a

^a *University POLITEHNICA of Bucharest, 313, Splaiul Independentei, 006042, Bucharest, Romania*

Abstract

This paper examines whether the intellectual property rights of manufacturing company moderate the relationships between innovation and company performance in manufacturing sector. We argue that technologically more advanced manufacturers rely on exploiting intellectual capital in their business. Thus, there is a growth of the use of formal intellectual property protection methods because protective rights are critical as it prevents replication by potential competitors. The objective of the study is to understand how intellectual property rights contribute as new ventures transform their innovation potential and creativity into market value, profit, productivity, new jobs, wages, and competitiveness. The multi-item constructs were tested by exploratory factor analysis (EFA) each set of scale items using the principal axis with the varimax method provided in SPSS. This procedure may help to reduce multi-collinearity or error variance correlations among indicators in the confirmatory factor analysis (CFA). The findings indicate a positive correlation between patenting and new ventures' growth, access to venture capital and new knowledge. This study provides empirical evidence that intellectual property is a set of valuable intangible assets and managing innovation better than its competitors is one of the main objectives of a manufacturing company.

© 2019 The Authors. Published by Elsevier Ltd.

This is an open access article under the CC BY-NC-ND license (<https://creativecommons.org/licenses/by-nc-nd/4.0/>)
Selection and peer-review under responsibility of the 12th International Conference Interdisciplinarity in Engineering.

Keywords: manufacturing companies; patents; copyrights; trademarks; intellectual property

* Corresponding author. Tel.: +4-0720-460-785

E-mail address: andreea.barbu2901@upb.ro

2351-9789 © 2019 The Authors. Published by Elsevier Ltd.

This is an open access article under the CC BY-NC-ND license (<https://creativecommons.org/licenses/by-nc-nd/4.0/>)
Selection and peer-review under responsibility of the 12th International Conference Interdisciplinarity in Engineering.

10.1016/j.promfg.2019.02.324

1. Introduction

Intellectual property rights (IPR) refer to the rights given to the inventor or creator to protect his invention for a certain period of time [1]. Basically, IPR is a system of legal rights that gives to a person or a company some exclusive rights over that work. Creativity and innovation are critical to the success of business when new products are protected through strong intellectual property jobs. Intellectual property (IP) includes patents, trademarks, copyrights, goodwill, know-how, industrial designs, trade secrets, and geographical indications. Thus, there is a set of valuable intangible assets owned and legally protected by a manufacturing company from outside use and include patents, copyrights, trademarks, trade secrets, utility models, and industrial design. Protective rights are critical as it prevents replication by potential competitors.

This paper advances a conceptual model for the interpretation of the IP rights in the business environment. The study develops hypotheses and tests them using survey data. This quantitative approach uses the perception of respondents. Using cross-section data from a sample which includes several small manufacturing businesses from Romania (such firms operate either in manufacturing or in high-tech industries), we empirically investigated the moderating effects of intellectual property rights on the relationship between innovation capability and business performance. The moderating effect of the variables from the conceptual model is captured by interactive terms between the key explanatory variable. The multi-item constructs were tested by exploratory factor analysis (EFA) each set of scale items using the principal axis with the varimax method provided in SPSS. This procedure may help to reduce multi-collinearity or error variance correlations among indicators in the confirmatory factor analysis (CFA). Based on the results of this study, the major findings have significant managerial implication. The findings indicate a positive correlation between patenting and new ventures' growth, access to venture capital and new knowledge. This study provides empirical evidence that intellectual property is a set of valuable intangible assets and managing innovation better than its competitors is one of the main objectives of small businesses from the manufacturing sector.

This study shows how intellectual property rights protection affect innovation and manufacturing performance, especially within small businesses. Entrepreneurs and business owners need to understand the basis of intellectual property to best protect their new product from the unfair competition. We discovered that many small businesses do not pay the necessary attention to the protection of intellectual property rights and brand identity. Today, intangible assets are growing relative to tangible assets everywhere and manufacturing companies need to adapt to these trends because intellectual property protection is a source of value for them. The remainder of the paper is structured as follows. First, we provide the theoretical framework and present the hypotheses before describing the sample and the research methodology. We then present the data analysis and results. Finally, we conclude by discussing implications, limitations, and directions for future research.

2. Theoretical background and hypotheses

2.1. Intellectual property rights

This section presents the literature related to IPR and how they can create value for customers and businesses. This section covers both empirical and theoretical contributions related to IPR and innovation in small businesses. Intellectual property rights create opportunities for stockholders and businesses to invest in research and development projects thus enabling them to benefit from their creative activities. Some innovators try to prevent the use of their discoveries by keeping them secret. The intellectual labor associated with the innovation and the need to protect the knowledge has become the most important strategy in encouraging business development and economic growth. IP is one of the key assets that firms may improve their competitiveness. Human capital has a limited economic value because human talent cannot be owned. Therefore a combination of intellectual property and human capital is the most important driver of business performance. These economic assets are created through the effort of the human mind and have no physical existence. They can be developed, owned, managed and commercialized to generate value. This value can be optimized by different protection policies. For example, a combination of patents and trademarks can sustain IP-based competitive advantage [2].

Many entrepreneurs, because of their lack of understanding of intellectual property, ignore the potential of intellectual property to improve the business performance by protecting the strategic assets. The primary driver for innovation is knowledge. IP rights have supported innovations by firms which have a large market and huge resources but for small business from the manufacturing sector were less investigated. The growth dynamics and competitiveness of markets directly depend on the incentives for intellectual property rights protection. New ways to protect IP can also create new opportunities to improve the process of protection of IPR, for example, smart contract. Global data networks and digital technologies, such as additive manufacturing and mass customization generate major difficulties to protect IPR in case of innovative products. Digital description of technologies or manufacturing process needs to be done to ensure the IP protection because more and more complex data needs to be analyzed. Innovation expenditure depends on the firm size [3]. Manufacturing firms demand IPR protection in order to safeguard their intangible assets, which are easy to copy and distribute at minimal marginal cost. The best-known IPR are patents, trademark, and copyright. Some rights such as secrets or know-how are not in law property rights but they are protected by other laws. A trademark is a distinctive sign that identifies certain goods or services like those provided by a firm to distinguish from those of other firms. Trademark can help customers to identify the quality of goods and services before they are purchased. Any sort of mark which a trader uses to distinguish its goods or services in the market is a trademark as long as the level of consumer recognition is sufficient.

2.2. Innovation

Some studies have investigated whether IPR protection is necessary to stimulate investment in innovation. The main findings show that firms do not, in general, regard IPR protection as very important to protect their competitive advantage [4]. Investments in knowledge creation and innovation can be promoted by establishing exclusive rights to use and sell technologies, goods, and services. Many studies have found that IPR are positively related to the level of R&D investment. IPR protection allows individuals and businesses to benefit from their innovative activities. Basic law of nature or mental processes cannot be protected by methods specific intellectual property rights [5].

Companies from the manufacturing sector are struggling to protect their investments. A part of them, especially small businesses said that their new product had been copied by rivals and they have suffered a violation of their IPR and have recorded significant financial losses. Strong IPR protections are particularly important to exporting small businesses. Manufacturing firms demand IPR protection in order to safeguard their intangible assets, which are easy to copy and distribute at the minimal marginal cost [6]. Large firms which operate in a concentrated market are the engines of technological progress [7]. Small firms are more innovative in competitive markets while large firms do better in more monopolistic markets [8]. In Romania, medium-tech manufacturing such as the automobile, chemical products or machinery and equipment are active in the fields of innovation. In the high-technology manufacturing sector the innovation investment increases with firm size [8]. However, the lack of ability to protect intellectual properties rights is seen as a lack of ability to capitalize on opportunities.

2.3. Hypotheses development

Many studies have examined the relationship between innovation and firm performance. However, prior research on IPR and the impact of this on companies' performance was scarce. Firms attempt to create sustainable competitive advantages by effectively utilizing their resources and capabilities [9]. Managers who ignore to protect IPR essentially discourage innovation effort. These approaches can influence a firm's decision and timing to collaborate on innovation-based projects. Some empirical studies estimate a business performance by the number of patents, innovation investment per employee or impact of innovation on firm sales [3]. There has been little empirical research into the impact of trade secrets on innovation or business performance. The expectation is that large firms will have higher innovation due to their larger set of resources and capabilities. Small firms have fewer patents due to lack of proper intellectual property rights and expenses of getting and managing patents [10]. Innovation is the key driver of business performance because it allows manufacturing firms to transform their dynamic capabilities to learn and exploit new ideas, skills, and competencies. Prior studies on innovation generally focus on the link between innovation capabilities and firm performance. Hence, there is still little clarity about the

exact mechanism by which IPR may affect the relationship between innovation potential and firm performance in a highly competitive marketplace [5].

Technological innovation is an intangible resource important for the sustainability of a firm's competitive advantage and it is divided into product and process innovation [11]. For example, the additive manufacturing or 3-D printing builds an object by adding ultrathin layers of material one by one. This technology uses less material than conventional techniques is faster and less expensive. Innovation capability is the ability of the firm to recognize the technical and economic value of new knowledge, assimilate, and use them to develop new products [12]. Sustainability is an innovative and transformational driver that creates value for customers. Technological innovation can help firms to achieve sustainable production and economic growth. Extending this logic to our context, we hypothesize that,

Hypothesis 1 (H1): *Innovation potential of small business from manufacturing industry has a positive influence on the business performance.*

The patent gives the owner a negative right because it prevents anyone else from making, using, or selling the innovation. It is also an invitation to be sued if there is any infringement. However, a strengthening of patent rights can delay the introduction of a new technology to the market [13]. Without protection, other companies could copy the innovation without incurring the R&D costs. Also, imitation can dissipate the gains to innovator firms and thereby can reduce the investment in innovation. Basically, the degree to which innovations are protected affects how firms profit from innovation investments [14]. Inventions are focused on the generation of new ideas, and innovation develops new products with commercial potential from creative ideas. Patents may provide protection for new products or technologies, the impact of patent rights on the relationship between innovation and firm performance is also investigated. For example, internal research capabilities are essential to enabling the manufacturing firms to generate creative ideas and develop new technologies and products. Because individual firms are the primary source of innovation, effective protection allows them to create a sustainable competitive advantage. Patent rights affect the technology transfer and imitation can erode competitive position and profitability. Therefore, we suggest that,

Hypothesis 2 (H2): *Patent rights will moderate the relationship between innovation potential and business performance.*

A firm should determine if the intellectual property is directly related to its competitive advantage. Many managers do not identify all their intellectual property, or they do not recognize the value of their intellectual property. All businesses want to be recognized by their potential consumers and use their names, logos, and other distinguishing features to enhance their visibility. Trademark protection provides many opportunities for firms to differentiate themselves from one another. Trademark is a distinctive sign used to distinguish the goods and services of a manufacturing firm from those of another. It provides legal protection to the owner by granting the exclusive right. Trademark can reduce consumers' search costs and it is a driver for manufacturing firms to invest in quality and reputation. Basically, the trademark is a mean to appropriate the benefit of innovation and an incentive to invest into R&D projects. Regarding the positive impact of trademark on firm performance, some authors argue that trademark is signaling elements used by firms to inform consumers about their new products [6]. Thus, we propose the following hypothesis:

Hypothesis 3 (H3): *Trademarks will moderate the relationship between innovation potential and business performance.*

A copyright grants the owner of a work of authorship the legal right to determine how the work is used and to obtain benefits from the work [15]. If something is not in a tangible form copyright law does not protect it [16]. Copyright law provides broad protection for authors and the creators of other types of work but copyright laws cannot protect ideas. To be protected, a work must be original. Copyright protects works that are expressed in print or electronic formats. For example, protection of computer programs (the source code, the on-screen layout or characters). Works protected by copyright may not be copied or exploited commercially by others without the prior permission of the right holder. Such exclusivity helps a firm to gain and maintain a sustainable competitive edge in the marketplace. For example, the key analysis of customers' purchasing habits and preferences, marketing strategies, and unique processes could contribute to improving the business performance. We, therefore, propose the following hypothesis:

Hypothesis 4 (H4): *Copyrights will moderate the relationship between innovation potential and business performance.*

A trade secret is any pattern, formula, physical device, process, idea or other information that provides the owner of the information. Confidential information that gives a manufacturer competitive edge can be considered a trade secret. Trade secrets are not limited in time and take immediate effect. Coca-Cola and Google’s algorithms are some examples of trade secrets and business innovation. Some manufacturers do not implement rules or policies to protect manufacturing equipment and processes. Protecting manufacturing trade secrets is essential to maintaining a competitive advantage. Protection of trade secrets begins with internal procedures. Trade secrets are used often to safeguard innovation in especially to protecting of manufacturing and innovation processes. For example, a technology transfer can be considered a trade secret at a company. Trade secrets do not require disclosure and cost relatively little. They extend beyond tangible assets including business ideas, internal business information, and customers’ lists. For these reasons, we propose the following hypothesis:

Hypothesis 5 (H5): *Trade secrets will moderate the relationship between innovation potential and business performance.*

After reviewing the literature and detailing the relationship between variables in the hypotheses with the moderating effects of IPR, we propose the hypothesized causal relationships illustrated in the research model in Figure 1.

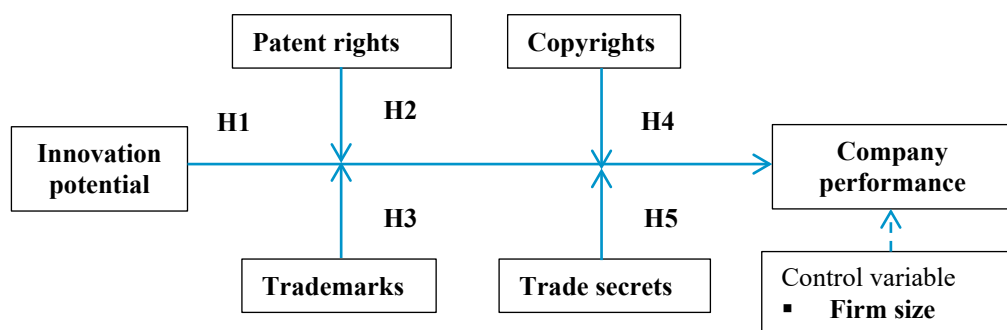


Fig. 1. Hypothesized research model.

3. Research methods

3.1. Sample

The use of a survey is chosen for this study because it allows us to assess a large set of variables and it is based on perceptions of respondents. Data were collected through a questionnaire that was administrated to students from the master programs who work in companies from the manufacturing sector. Everyone who participated in this study claimed that he/she had experience and has knowledge about IPR. Only students working in the manufacturing firms were surveyed. As shown in Table 1, the manufacturing firms varied in size. At the time of the survey, approximately 80% of the respondents had been in their current positions for more than two years. The final sample for our analysis consists of 38 respondents (an exploratory study). Based on their suggestions, some questions were eliminated or reformulated. A possible non-response bias was tested by divided the sample into two groups – early respondents and late respondents. Using a statistical test, we found out that the differences between the two groups and the non-responsive bias were not significant.

3.2. Measures and instrument development

When possible, construct measures were created based on the previously validated survey instrument. In addition, individual measures were averaged to obtain a simple value for each construct. The measures that are used in the operationalization of the constructs are briefly discussed below. Most of the variables involved in this study were measured with items using a seven-point Likert scale with anchors ranging from strongly disagree to strongly agree.

Table 1. Firm sample demographics

Sample characteristics	Number of respondents (firms)	% of firms
Number of employees in the firm		
up to 20	21	55
from 21 to 50	12	31.5
from 51 to 100	4	10.5
above 100	1	3
Revenues per year		
less than 0.5 million lei	13	34.2
up to 0.8 million lei	16	42.1
up to 1 million lei	6	15.8
upward of 1 million lei	3	7.9

In addition, individual measures were averaged to obtain a simple value for each construct. To measure the dependent variable – company performance (CP), respondents were asked to present their opinions about the following statements: “Do you consider that lately the innovation efforts of the firm you work for led to the sales growth (CP1)”, “Do you consider that lately the innovation efforts of the firm you work for led to a raise of the share market (CP2)”, “Do you consider that lately the innovation efforts of the firm you work for led to a profitability improvement (CP3)”, this scale was measured using 3 items. Innovation potential (IP) was measured using 3 items: “The rate of introduction of new goods has grown rapidly in the last two years (IP1)”, “Management actively seek innovative ideas (IP2)”; and “In comparison to its competitors, the manufacturing firm has become much more innovative (IP3)”. The operationalization of patent rights is based on the perception of the strength of patent rights. Higher index scores show stronger levels of protection. Patent rights (PR) were measured using 2 items: “Innovations are protected by the manufacturing firm through patents constantly (PR1)”; “Through patenting, the manufacturing firm contributes to improve its performance (PR2)”. Trademarks (TM) was measured using 2 items “Innovations are protected by the manufacturing firm through trademarks constantly (TM1)”; “Through trademarks, the manufacturing firm contributes to improve its performance (TM2)”. Copyrights (CPR) were measured using 2 items “Innovations are protected by the manufacturing firm through copyrights constantly (CPR1)”; “Through copyrights, the manufacturing firm contributes to improve its performance (CPR2)”. Trade secrets (TS) were measured using 2 items “Innovations are protected by the manufacturing firm through trade secrets constantly (TS1)”; “Through trade secrets, the manufacturing firm contributes to improve its performance (TS2)”. Control variable describes exogenous influences on the dependent variable.

4. Analysis and results

The data were subjected to factor analysis in order to validate the instruments. A principal components factor analysis was employed to identify constructs and to isolate a small number of factors for our prediction. All factors have eigenvalues equal to or greater than 1.00 [17]. We entered all items used in the questionnaire into an unrotated exploratory factor analysis. The first factor accounted for 41.32 % of the variance. Since a single factor did not emerge and one-factor did not account for most of the variance, suggested that common method bias was not a serious concern in our data set. The conceptual model was tested for reliability and validity. Data were analyzed with SPSS 20.0 software with maximum - likelihood estimation. Cronbach’s alpha was used to determine the internal consistency of items in each scale. Reliability of the factors was measured using Cronbach’s alpha for each construct and was found to be greater than the recommended minimum of 0.7 indicating high reliability [17]. For each latent variable, we calculate the composite reliability and average variance explained (AVE). Convergent validity is established by analyzing the average variance extract (AVE), whose value should exceed 0.5 and composite reliabilities 0.6. Convergent validity is strong because all latent variables have high loading score, higher than 0.7 [17]. A correlation matrix between latent variables with descriptive statistics (mean and standard deviation) for the

final constructs is shown in Table 2. We found that there were very low correlations between variables. Diagonal elements (in bold) represent the Cronbach’s α .

Table 2. Descriptive and correlation matrix

Constructs	Mean	S.D.	1	2	3	4	5	6	7
CP (1)	6.32	0.82	0.736						
IP (2)	5.43	0.77	0.045	0.802					
PR (3)	5.86	0.71	0.564**	-0.126	0.877				
CPR (4)	4.69	0.92	0.038	0.241*	-0.137	0.963			
TM (5)	5.66	1.08	0.344**	-0.189	0.021	-0.022	0.689		
TS (6)	4.55	0.67	0.266*	0.037	0.55**	-0.109	0.069	0.706	
FS (7)	0.74	0.42	-0.045	0.27*	0.088	0.103	0.265*	-0.034	1

N=38, ***p<0.001; **p<0.01; *p<0.05

Multiple regression methods are used to analyse the model. The conceptual model was analysed using hierarchical linear regression with company performance as the dependent variable and innovation potential, patent rights, copyrights, trademarks and trade secrets as independent variables. We have included in the model as control variable firm size. The results are shown in Table 3. In Model 1 was included only control variable against company performance, and no significance is shown.

Table 3. Hierarchical multiple regression (dependent variable – company performance (CP))

Explanatory variables	Model 1		Model 2		Model 3	
	β	t	β	t	β	t
Firm size	-0.198	-0.673	-0.09	-0.97	-0.18	-0.78
Innovation potential			0.826	5.045	0.694	4.756
Patents rights			0.672	3.805	0.388	3.44
Copyrights			0.023	0.667	0.059	0.881
Trademarks			0.762	4.283	0.559	2.997
Trade secrets			0.023	0.976	0.044	0.018
Innovation potential x Patent rights					0.267	1.995
Innovation potential x Copyrights					0.115	0.022
Innovation potential x Trademarks					0.266	2.113
Innovation potential x Trade secrets					-0.042	0.031
R2 / Adjusted R2	0.087 / 0.00		0.559 / 0.413		0.573 / 0.463	

N=38, ***p<0.001; **p<0.01; *p<0.05

Model 2 examines innovation potential, patents rights, copyrights, trademarks, and trade secrets as the independent variables. The adjusted R2 is 0.413, that is, this model explaining 41.3% of the variance of the dependent variable. The variables patents rights, copyrights, trademarks, and trade secrets have a key role in the explanation of company performance. The most appropriate model that was found significant is 3 because R2 is 0.573 and Adjust R2 is 0.463. As predicted, we found that innovation potential had a significant positive interaction with company performance ($\beta=0.694$, $p<0.01$). Also, patents rights protect had a significant positive interaction with company performance ($\beta=0.388$, $p<0.01$) and that trademarks had a significant effect on the company performance ($\beta=0.559$, $p<0.01$). These results support Hypotheses 1 and 2. Trademarks will moderate the relationship between innovation potential and business performance ($\beta=0.559$, $p<0.01$) and hypothesis 3 is supported. However, Hypothesis 3 and 4 were not supported because the coefficients for the interaction term were not significant and copyrights and trade secrets do not have a significant moderating effect.

5. Limitations and conclusions

This study investigates whether the intellectual property rights of manufacturing company moderate the relationships between innovation and company performance in the manufacturing sector. Patents rights and trademarks support hypotheses. However, some intellectual properties (copyrights and trade secrets) do not support hypotheses related. We found that the indirect effect of trade secrets was negatively influenced by company performance. This study contributes to the existing literature by providing empirical support for the IPR protection in manufacturing firms. This paper thus contributes to innovation literature by proposing and validating a measurement scale for product innovation performance. In interpreting the results of this research, certain limitations must be kept in mind. First, the limitations of our study include the relatively modest sample size for research model analysis. In this case, our findings should be generalized with caution. As regards the sample, a larger sample would reduce the influence of random variation. Future research using larger samples should aim to examine the robustness of our findings, preferably by simultaneously testing them. Second, we encourage researchers to engage in longitudinal research on the moderated effect of IPR on the relationship between innovation potential and company performance. Third, any theoretical model could be improved. Nonetheless, more variables can be added to our research model. Future studies look to refine this variable through further pilot testing with academics and practitioners, or by selecting a different set of items to represent this construct.

References

- [1] Bently, L., Sherman, B., *Intellectual Property Law*, Oxford, Oxford University Press (2001)
- [2] Hisrich, R., Peters, M., Shepherd, D., *Entrepreneurship*, Eight edition, McGraw – Hill, (2010)
- [3] Audretsch, D.B., Vivarelli, M., Firm size and R&D spillovers: Evidence from Italy. *Small Business Economics*, 8(3), (1996), 249-258
- [4] Levin, R.C., Klevorick, A.K., Nelson, R.R., Winter, S.G., Appropriating the returns from industrial research and development, *Brooking Paper on Economic Activity*, 3, (1987), 784-829
- [5] Raymond, L., St-Pierre, J., R&D as a determinant of innovation in manufacturing SMEs: An attempt at empirical clarification, *Technovation*, 30, (2010), 48-56.
- [6] Greenhalgh, C., Rogers, M., The value of intellectual property rights to firms and society. *Oxford Review of Economic Policy*, 23(4), (2007), 541-567
- [7] Schumpeter, J.A., *Capitalism, Socialism and Democracy*, Harper and Row, New York, (1942)
- [8] Acs, Z.J., Audretsch, D.B., Innovation, Market Structure, and Firm Size. *The Review of Economics and Statistics*, (1987), 567-574
- [9] Peteraf, M.A., The cornerstones of competitive advantage: a resource-based view. *Strategic Management Journal*, 14, (1993), 179-191.
- [10] Cetindemas, D., Ulusoy, G., Innovation performance and partnership in manufacturing firms in Turkey, *Journal of Manufacturing Technology Management*, 19(3), (2007), 332-345
- [11] Christensen, J.F., Asset profiles for technological innovation. *Research Policy*, 24, (1995), 727-745
- [12] Ray, G., Barney, J.B., Muhanna, W.A., Capabilities, business processes, and competitive advantage: choosing the dependent variable in empirical tests of the resource-based view. *Strategic Management Journal*, 24, (2004), 23-37.
- [13] Takalo, T., Kannianen, V., Do patents slow down technological progress? Real options in research, patenting, and market introductions. *International Journal of Industrial Organization* 18, (2000), 1105–1127.
- [14] Teece, D.J., Profiting from technological innovation: implications for integration, collaboration, licensing, and public policy, *Research Policy*, 15, (1986), 285-305
- [15] Bjornskov, C., Foss, N., How Strategic Entrepreneurship and the Institutional Context Drive Economic Growth. *Strategic Entrepreneurship Journal*, 7(1), (2013), 50-69
- [16] Barringer, B.R., Ireland, R.D., *Entrepreneurship. Successfully Launching New Ventures*. Fifth edition, Pearson, (2016)
- [17] Hair, J., Black, B., Anderson, R., Tatham, R., *Multivariate data analysis*. 6th Ed. Prentice-Hall, Upper Saddle River, (2006)