Trivent Publishing

Available online at http://trivent-publishing.eu/

Evaluating the Performance of University Innovative Companies: The Management of Academic Spin-offs and Start-ups in Romania

Nicolae Bibu[1], Lavinia Mihali[2], Valentin Munteanu[3], Diana Sala[4]

[1] West University of Timisoara, România, nicolae.bibu@feaa.uvt.ro
[2] West University of Timisoara, România, lavinia.mihali@yahoo.com
[3] West University of Timisoara, România, valentin.munteanu@feaa.uvt.ro
[4] West University of Timisoara, România, diana.sala@feaa.uvt.ro

***Abstract**: The study is contributing to the development of the existing theory and practice in the field of innovative entrepreneurship through identifying the factors which influence the economic and financial performance and, implicitly, the survival rate of academic spin-off (ASO) and academic start-up (ASU) organizations.*
The importance of the research is given by the actuality of this subject and by the fact that in Romania it is still a controversial field, considering that there have been no studies about the factors that influence the survival of these two types of innovative organizations.
ASOs and ASUs are founded for exploiting the practical results of scientific research which is transferred from the academic environment into the industrial environment for the purpose of being commercialized.

***Keywords**: academic spin-offs and start-ups, performance, innovative entrepreneurship.*

Evaluating the Performance of University Innovative Companies: The Management of Academic Spin-offs and Start-ups in Romania

Nicolae Bibu, Lavinia Mihali,
Valentin Munteanu, Diana Sala
West University of Timisoara, Romania

I. Introduction

A research, unfolded on the national as well as the international level of the innovative companies of ASO and ASU type represents a stringent necessity, due to the precarious level of development of such type of companies in Romania.
Academic spin-off (ASO) is venture founded by employees of the university around a core technological innovation which had initially been developed at the university[1].

Academic start-ups within universities are innovative companies set up by students in the first three years after completing their studies or during their studies[2].

Academic spin-offs are special start-up companies that are set up by academic inventors, in order to exploit technological knowledge from a university environment in order to create products and services[3].

Bigliardi et al.,[4] studied the academic spin-offs (ASOs) in Italy and proposed the following factors which influenced the performance of an academic spin-off:

i. characteristics of the university: involvement of the university with a financial contribution in the company, and allowing access for acquiring the entrepreneurial knowledge;
ii. characteristics of the founders: the desire to be autonomous, the motivation of the founders, the reorientation in the career;
iii. characteristics of the external environment: characteristics of the industry, existing regional infrastructure, the geographical location, existing capital;
iv. technological characteristics: the degree of innovation, the development stage of the product / technology / service, the ability to patent and maintain the intellectual property right.

---

[1] A. Vohora, M. Wright, A. Lockett, "Critical junctures in the growth in university high-tech spinout companies," *Research Policy* 33(1) (2004): 147–175
[2] S. Blank, B. Dorf, *The Startup Owner's Manual* (K&S Ranch, 2012).
[3] B. Bigliardi, F. Galati, C. Verbano, "Evaluating Performance of University Spin-Off Companies: Lessons from Italy," *J. Technol. Manag. Innov.* 8(2) (2015).
[4] Ibidem.

In order to construct our own conceptual frame-work, which would allow us to approach the diversity of spin-offs, we have reviewed the works published starting with 1996.

After analysing all the definitions of the academic spin-off in the specialized literature, we have proposed the following definition for an **academic spin-off**[5] **(ASO)** "a new innovative company, set up by a researcher (professor, scientific researcher, student) or by a group of researchers from the staff of the university/institute/centre of research-development, who transfer(s) the result of a research (patent application, patent, doctoral thesis/ bachelor thesis/ master thesis, the result of a research project from a public program) to the newly founded company in order to earn profit by commercialization of the innovative product/service*"*.

From our perspective, **the academic start-up**[6] **(ASUS)** is defined as an innovative company created by an entrepreneur from the business environment, that uses the result of a scientific research such as: patent application, patent, doctoral thesis/ bachelor thesis/ master thesis, the result of a research project from a public program) from a university/ public institution of research, for the purpose of earning profit by commercialization of the innovative product/service.

For the current and future period of development and financing (2014-2020), European Union policy documents are emphasizing research-development activities and the integration of their results in production and in economy. Subsequently, a part of the European funds are being dedicated to support the accomplishment of these goals. Alternatively, for Romania, the analysis of the results already obtained is important, so that the possibility appears to ensure the efficient use of the available funds.

The results of the our research were focused on the identification of the factors which influence their rate of survival and the theorizing of viable solutions for the development of a successful model for increasing of the level of performance of ASOs and ASUs.

The study approaches as a topic the establishment of these kinds of organizations, especially in the academic environment, as a challenge in the present society of Romania, and their impact on the economic development at local, regional and national level. Romania was ranked 96th in the field of innovation, in 2017, according to the Report of Global Competitiveness.[7]

At international level, successful companies have increased their competitiveness and implicitly their productivity developing and using a number of new technologies and innovative products.

---

[5] N. Bibu, V. Muntean, D. Gligor, L. Cernescu, "Characteristics of university spin-offs. The Romanian situation," *Annals of the University of Oradea, Economic Science Series* 25(1) (2016): 852-870 http://anale.steconomiceuoradea.ro/volume/2016/AUOES-1-2016.pdf.

[6] L. M. Cernescu (Mihali), *The impact of the academic spin-off and start up type organizations' management on their economic and financial performances*, 2018, Doctoral Thesis.

[7] *The Global Competitiveness Index* 2017-2018 edition, http://www3.weforum.org/docs/GCR2017-2018/05FullReport/TheGlobalCompetitivenessReport2017–2018.pdf.

The universities and the public institutions/centres of research – development have a key role through their mission in what concerns the transfer of knowledge to the industry. In the Romanian context there is a limited cooperation of the public research – development units with the enterprises concerning the transfer of technology, innovation and knowledge.

Not the least worthy of mentioning, the suggested research topic is relevant for the growth of the survival rate and of the competitiveness for these companies in Romania.

II. Methodology

The purpose of the scientific research was to identify the factors which influence the performance and the life cycle of the academic spin-off and start-up type companies in Romania.

Taking into consideration the good practice achieved at international level in what concerns the management of ASOs and ASUs, we have intended to build a conceptual model of the factors which influence the economic performance of the innovative company, and a methodology which will allow in the future the growth of competitiveness in these types of companies.

The general objectives of the research were:

- The analysis of the economic and financial performance of Romanian ASOs and ASUs companies, financed through the Growth of Economic Competitiveness Operational Program (2007-2013);
- The analysis of the factors which influence the performance and evolution of ASOs and ASUs.

The research infrastructure is especially important and influences the industrial production, which is based on knowledge. In order to contribute to the growth of the country's competitiveness level, the scientific results of the researches in the universities and in the public organizations of research have to be marketed.

It is important to point out that certain changes occur at the moment when the transfer of the research's results from the academic environment in the industrial environment takes place. There are differences between the two environments from the point of view of the managerial approach, the system of human resources' motivation, the pursued purpose, the time and the form of collaboration.

Whereas the inventors and the professors in the research-development units are interested in prestige, publications, sharing of know-how, the private entrepreneurs are looking for the maximization of profit and the protection of the know-how. In the academic environment there is academic freedom, while in the industrial environment there is a hierarchic system. Inventors, professors and researchers may manifest a wish to contribute to the occupation of the workforce and the national economic development, but they usually do not have a drive for profit earning.

The contribution of the universities to the development and economic growth of a country has made it so that the main actors in the decisions (central government and its structures) are interested in the role played by the universities, as potential means of innovation and incentive for the creation of work places.

The conclusions of the WIPO 2011 Report show that Romania, as a country with a rather poorly developed economy, is confronted with several challenges: weakly developed R&D activity, a lack of competent researchers with competencies due to a large brain-drain towards developed economies; lack of quality in the public research system; lack of public policies which might support the development of academic start-ups[8].

We have analysed the Romanian situation beginning with the first program that was intended to stimulate the technology transfer from academic environment towards industrial environment through funding the process to establish and develop ASOs and ASUs. The Sectorial Growth of Economic Competitiveness Operational Program (POS CCE) for the period 2007-2013 intended the improvement of general performance in what concerns the R&D and Innovation, and the productivity of the ASOs ASUs companies, through the increase of the innovation rate and of the economic benefits induced by the commercialization of researches' results. One of the program's goals consisted of stimulating the technological transfer, focusing on the cooperation between the R&D institutions and the industry, on the increase of the innovation requests for new products and technologies from the industry, and on the support for the creation and development of new companies based on high level technologies.

The sample of the research has included 101 start-up type companies and 19 spin-offs financed through the Growth of Economic Competitiveness Operational Program (POSCCE) (2007-2013). Their identification data was gathered from the public reports of the Management Authority such as monitoring reports of the POS CCE program, public register information related to the grants approved and signed by the National Authority for Scientific Research).

Our purpose was to analyze the economic and financial performance of ASOs and ASUs, the identification of factors which determined their success or failure and their impact on the Romanian national and regional economy.

In this respect we have structured the research in two stages: first, the theoretical stage (conceptual-descriptive) and, second, the practical (empirical) stage, using mix of quantitative and qualitative research methods.

In order to reach the general objectives of our research, we have undertaken first, an analysis of the connections between the main economic and financial indicators, establishment of the factors which influence their dynamics; second, the we have drawn a list of qualities/ attributes/ characteristics/ features/ abilities of the entrepreneur manager, that we estimated to be useful for the management of ASO or ASU as types of innovative company in the Romanian context; and third, we have identified the main stimulating factors (internal and/or external) which have influenced their survival rate in the Romanian context, following the model of Bigliardi et al.[9]

[8] *World Intellectual Property Report The Changing Face of Innovation*, https://www.wipo.int/edocs/pubdocs/en/intproperty/944/wipo_pub_944_2011.pdf.

[9] B. Bigliardi, F. Galati, C. Verbano, "Evaluating Performance of University Spin-Off Companies: Lessons from Italy," *J. Technol. Manag. Innov.* 8(2) (2013).

We undertook the following steps:

- critical review of the international literature related to the support and promotion of entrepreneurial activity, including through the creation and development of innovative infrastructure;
- identification of the spin-off and start-up type companies in Romania over the period between 2006 and 2016;
- collection of data using the public data bases (Ministry of Finances) and instruments of my own creation (questionnaire, interview guide);
- statistical processing of the data for the purpose of analyzing the degree of development of the innovative academic spin-off and start-up type companies, formed during the period 2007-2013 through the Growth of Economic Competitiveness Operational Program POS CCE ;
- statistical processing of the data collected using instruments of our own creation;
- presentation and interpretation of the data, presentation of the identified relevant/significant cases.

We have analyzed for each company the following economic indicators (available from the public data base of the Public Finances Ministry): the annual net turnover; the average number of employees, per year; net profit/ net loss per year; fixed assets per year; current assets per year; forward expenses per year; total debts per year; total expenses per year, capital per year; total revenues per year.

It is important to mention that the companies were set up in different years and the data was collected for all the companies from the beginning of their operation until 31.12.2016. For this reason, the analysis was made on years of operation and not on calendar years. The companies have different operation periods (for example, maximum 11 years for the companies established in 2006, minimum a 4 years period for companies established in 2013).

Based on the available data, we have used the profitability of the assets ratio (or the economic performance), calculated as the ration between the net profit and the total assets per year, because it is one of the main profitability indicators of a company . We decided to use it because it measures the efficiency of the company's assets usage, from the point of view of the earned profit.

Second, we undertook the analysis of the factors influencing the performance and evolution of ASO and ASU companies, identifying general indicators for each factor, and developed a conceptual model which, following the processing of the research data, was validated and improved.

Bigliardi et al.[10] defines the academic spin-offs as being special start up type companies, which are set up by academic inventors, for the purpose of applying the technological knowledge from a university environment, in order to create products and services. Also Shane (2004) defines "spin-off" companies as a subset of start-

[10] B. Bigliardi, F. Galati, C. Verbano, "Evaluating Performance of University Spin-Off Companies: Lessons from Italy," *J. Technol. Manag. Innov.* 8(2) (2013).

ups, because they are economically very strong and they are part of the top innovative companies[11].

Starting from this view and taking into consideration the perception and the lack of clarity in defining the two terms of academic spin-off and academic start-up in the Romanian context, we have used all the characteristics identified by the specialized literature for the academic spin-offs (ASO) and we have tried to identify which of these factors also influence the academic start-ups (ASU).

The motivation of this approach can also be explained from the perspective of the fact that many founders of start-ups financed through the POS CCE program used to be university professors.

In this respect, the main used method of research was the survey based on interviews and questionnaires. The sample chosen for the distribution of the questionnaire was made up of 64 start-ups from a total of 101 ASUs existing in Romania.

Following the analysis of the information from the specialized literature, we devised the following synthetic conceptual model presented in Fig. 1.

It takes into consideration factors grouped in 4 categories: 1) characteristics of the founders/shareholders; 2) factors specific to the product/service/technology, which constituted the basis of the company's being established; 3) the relations of the company with its external environment; and 4) the managerial policy/strategy of the company.

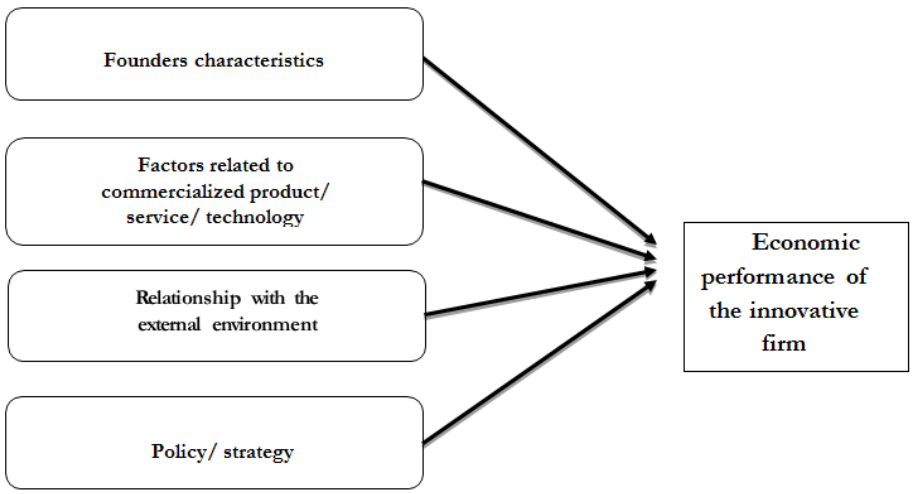


Fig. 1. The conceptual model of the research. Source: adapted after B. Bigliardi, F. Galati, C. Verbano, "Evaluating Performance of University Spin-Off Companies: Lessons from Italy," *J. Technol. Manag. Innov.* 8(2) (2013).

[11] S. Shane, *Academic entrepreneurship: University spin-off and wealth creation* (Northampton, MA: Edward Elgar Publishing, 2004).

III. Research results

This chapter is dedicated to the presentation of the results of the longitudinal study of the economic performance for the start-up and spin-off type companies. The sample under investigation consists of 120 innovative companies, of which there were 19 spin-offs and 101 start-ups, financed by the POS CCE 2006-2013, in Romania.

From the point of view of geographical location, most companies are found in the Ilfov Bucharest Region, followed by the North East Region of Romania. These companies are located in the developed areas of the country, with access to the research infrastructure and to the trained / skilled workforce. The distribution of innovative organizations (ASO) and ASU) by development regions is shown below (Fig. 2).

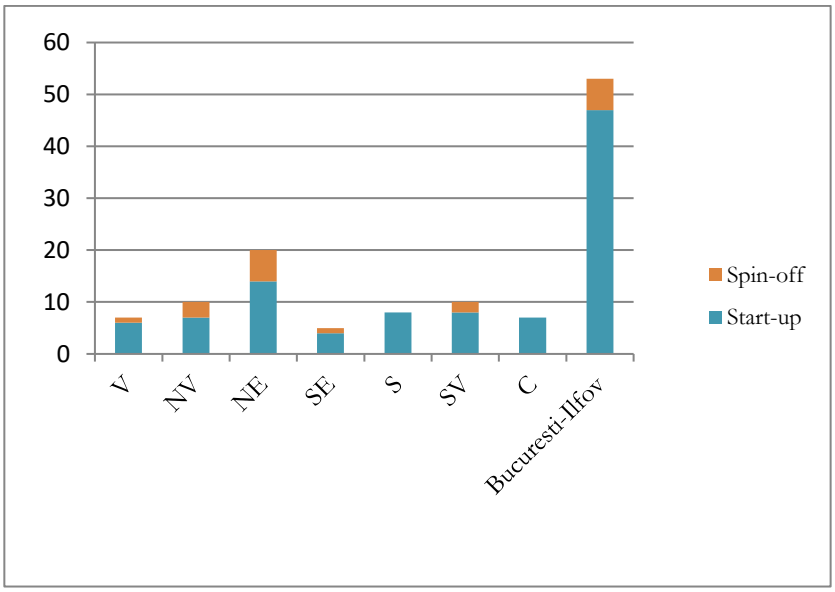
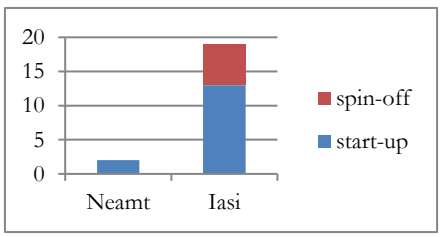
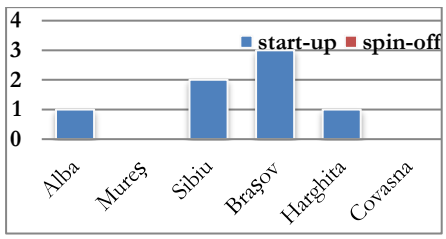


Fig.2. The distribution of innovative companies on regions



3a) North West Region

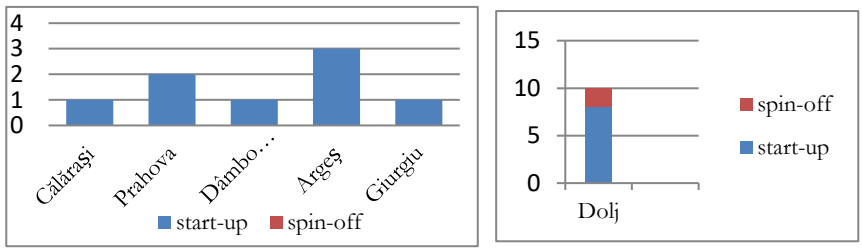


3b) Central Region

Fig. 3. Distribution of innovative companies on counties

Fig. 3 a) and b) presents the number of academic spin-offs and start-ups in the North East and Central Region. It can be seen that most academic spin-offs were

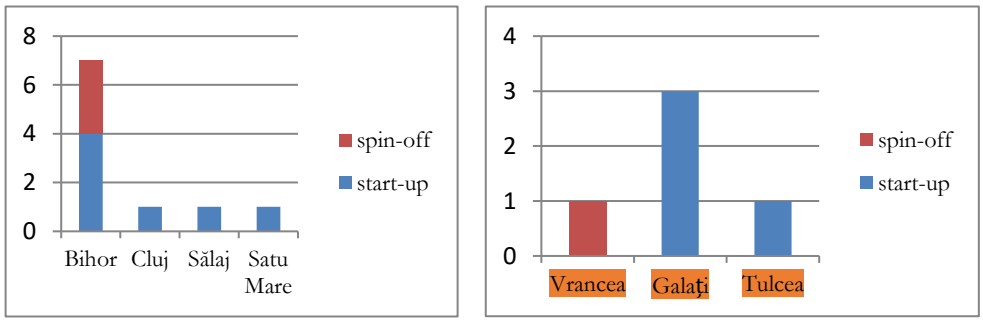
made in Iasi county, and most academic start-ups were set up in Brasov and Iasi county.



a)South Region **b) South West Region**

Fig. 4. Distribution of innovative companies on counties

Figure 4 a) and b) presents the number of academic spin-offs and start-ups in the South Region and South West Region. It can be seen that most spin-offs were made in Dolj county, and most start-ups were set up in Arges and Dolj counties.



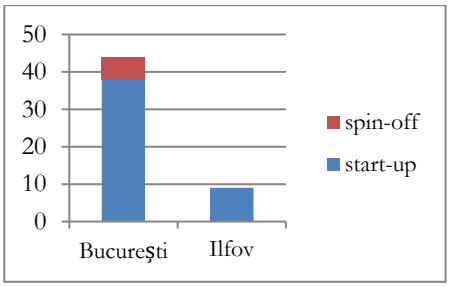
a) **North West Region** **b) South East Region**

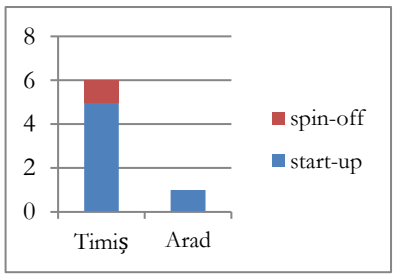
Fig. 5. Distribution of innovative companies on counties

Figure 5a) and b) presents the number of academic spin-offs and start-ups in the North West and South East Region. It can be seen that most spin-offs were made in Bihor and Vrancea counties, and most start-ups were set up in Bihor and Galati counties.

Figure 6 a) and b) presents the number of academic spin-offs and start-ups in the West and Bucharest Ilfov Region**.** It can be seen that most spin-offs were made in Timis county, and most start-ups were set up in Bucharest.

The explanation for this situation is related to the fact that the main public universities which are also important for research and development are situated in the main cities from this regions, such as Bucharest, Iasi, Cluj-Napoca, Timisoara, Sibiu, Oradea, Brasov, Targu Mures, and others. In the same approach, the main research national institutes and their regional/ local branches are concentrated also in these cities.





a)West Region **b) Bucharest Ilfov Region**

Fig. 6. Distribution of innovative companies on counties

Figure 7 presents the analysis of the profitability of the assets of spin-off companies, by years of operation. Given the fact that academic spin-off companies did not have the final purpose of selling the products / services (and obtaining profit), the acquired assets were intended to carry out the research activity in order to improve the product.

If we consider only the first 5 years of operation, for which we have a number of 13 companies, we observe that the return on assets is constantly negative, except for the year 3 when it reaches a rate of 3.38%. The average rate of return on assets for the first 5 years of operation of spin-off companies is -10.5%, that is a negative situation.

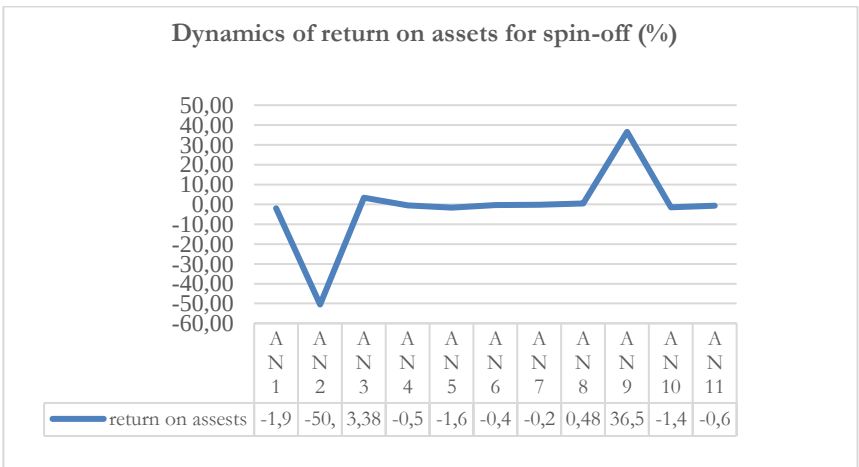


Fig. 7. The dynamics of the economic performance of academic spin-offs

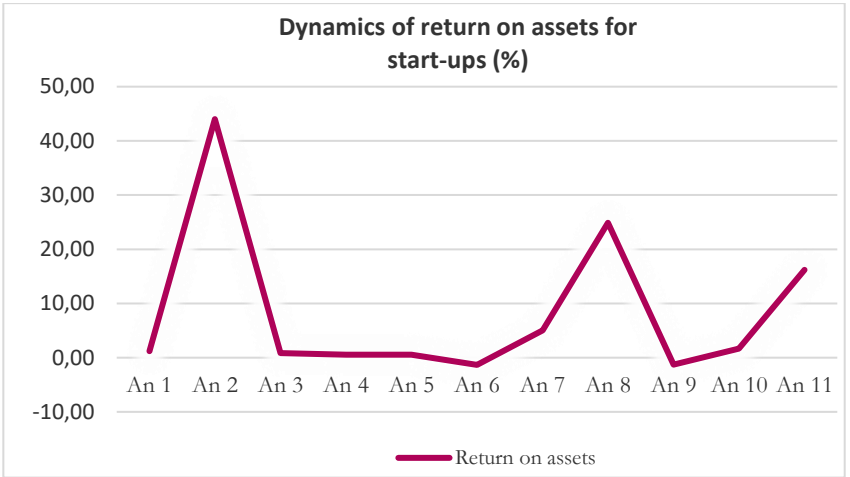


Fig. 8. The dynamics of the economic performance of academic start-ups

It can be observed that the yield of assets has a non-linear dynamics during the first two years of operation. If we consider year 2 of operation as the year in which the investment is made (acquisition of assets), we observe that for the next years (3-8) the dynamics of the assets remains relatively constant, but low, without significant improvements or decreases.

In what concerns the economic and financial performances of the ASOs and ASUs (financed through the Growth of Economic Competitiveness Operational Program during the period 2007-2013), we conclude that the results are contradictory and therefore the evolution of these companies does not correspond to what could be considered a normal economic life cycle .

Subsequently, ASU companies seem to fit into a development pattern with the following characteristics:

1. First step, the company is established and begins to implement the project using its own funds, following that the reimbursement of the expenses is being made after the purchasing of assets;
2. In order to perform the needed purchases, the company borrows money, usually from banks, and buys the assets; the purchased assets have a reduced profitability though, as the subsequent activity of the company will prove.
3. The company hires a number of employees according to the specifications of the approved project, without taking into account the real necessities of staff and (possibly) without the respective staff being competent or motivated enough to accomplish the sales (there is no correlation between the turnover and the number of employees). The granted salaries are also established without taking into account the results of the company's activity and represent a significant part of the total of expenses, as they are mandatorily preserved over the first 1-3 years of the company's operation. After this period, a slight decrease in the number of employees occurs.

4. The company succeeds in obtaining a small profit over the first 2-5 years of operation. After five years of operation, the company is in debt, even if it has increased their capital/ they have purchased assets. In the 6th year of operation, the companies accumulate new debts, in order to acquire new assets.

We have found that academic spin-off type companies (ASOs) followed a similar development pattern, with an important difference: their profitability is lower than ASUs. The characteristics foe ASOs are the following:

1. The ASOs financing is accomplished through loans which are contracted at the moment when the purchase of the assets is planned in the approved project (the second year of operation); the reimbursement of the loans by the programs management authority occurs very slowly, over the following two years of operation.
2. At the end of the project period (implementation and monitoring – five years) new loans are contracted, in order to ensure the continuance of the company's operation; the financing was performed based on the turnover achieved during the previous year(s).
3. The turnover increases slowly during the first two years of operation, and then the purchase of assets occurs; the assets have a much reduced profitability, even negative, over the first two years since the purchase, a period when the advancement of the product/technology is achieved. After this period, the turnover increases, due to the advancement of the product.
4. On the whole, during the analysed period, about 60% of the ASO companies made a profit. The contracted loans do not produce profit and the expenses constantly exceed the revenues. The employees do not seem to have an influence on the accomplished turnover, which indicates an inefficient human resource policy. Also, at the end of a 5 years' operation period, the companies contract new loans in order to be able to function.
5. The profitability of the assets is negative for the whole sample;
6. The survival rate of ASOs companies at the end of a five years' operation period (taking into consideration the number of companies which have obtained a turnover higher than 0 during the 6th year of operation, related to the companies initially analysed) is of 66.67%.

Therefore, we conclude ASO and ASU companies set up in Romania do not represent a model of success because the implementation of the new technologies does not lead to rapid making of profit, and the new technologies have a low profitability.

Moreover, we do not notice a constant growth of the profits, or at least of the revenues which would characterize financial success as a consequence of launching and marketing innovative products or technologies, or a constant cycle of growth which would result from the implementation of a technology improving an existent product or reducing its manufacture costs.

Following interviews with founders and the analysis of the data, we reached the conclusion that some companies that were forced to contract big loans in order to

be able to purchase assets; the assets were used so as to improve/advance/finalize the product or the technology the patent of which was at the basis of the company's being constituted. Such assets were not used efficiently, as their profitability was low or even negative.

An analysis of the dynamics of economic and financial indicators shows a chaotic development, by leaps, which does not seem to fit the pattern of a normal evolution. On the other hand, we have to consider the fact that these companies are a half-artificial construct, as they have been set up in the conditions imposed by the sponsor. We consider that these conditions may have imposed artificial limits and constraints which have led to a distorted operation manner of the companies of this type.

Thirdly, based on the above analysis, we have devised a more concise conceptual model resulted, which takes into account only the factors that were statistically validates to be relevant for the economic and financial performance of the company. The application of the Pearson correlation test led to the following results for statistical signicant correlations (for $p<0.05$ for an interval of 95%) presented in tabelul 1, mai jos. However, we have to mention that the number of companies for which the data collection was possible is small and we cannot talk about a statistically representative sample; therefore, these results and the compiled conclusions have to be considered just as a first step towards researching the phenomenon, knowing that more ample studies are necessary in order to accomplish a real image of it.

Table 1. Results of Pearson correlation test for ASUs

Variable	F-Ratio	P
Managers and/or shareholders of the ASU are academics	0,10	0,7550
The main motivation of establishing the ASU company was the wish of the majority stakeholder to commercialized his/her own research results	53,81	0,0000
The management team of the company had previous entrepreneurial experience to starting the ASU	7,80	0,0125
Difficulties in finding the needed workforce with the adequate job qualification	11,30	0,0037
Difficulties in finding the needed workforce with the adequate job qualification related to paying the desired wage level	42,67	0,0000
The level of development of the new product/ technology at the foundation moment of ASU	9,94	0,0058
Foreign capital contribution to ASU during its development	7,46	0,0142
The main goal of ASU in to make and/or improve the product/ technology that represented the basis of starting the company	4,44	0,0502

Variable	F-Ratio	P
Capacity to take risks by the managerial team influences the success of ASU	12,98	0,0022
The quality of research activity influences the success of ASU	3,00	0,1014
The competencies of the project team related to accessing non reimbursable grants influences the success of ASU	17,50	0,0006
Formal relations of ASU managers with the academic environment influences the success of ASU	1,71	0,2084
The market size was smaller than forecasted in the project	31,52	0,0000
The required technology for delivering the new product/service raised not anticipated challenges that led to cost increase	35,92	0,0000

Source: the authors

Thus, if we consider the dependent variable "the economic profitability" (calculated according to the formula: Profit/Total of assets) as an indicator of economic performance of a start-up type company, we may say that the factors (independent variables) which significantly and importantly influence such performance are:

a. Factors in the category "characteristics of the founders/shareholders":
   i. Previous entrepreneurial experience of the managerial team (positively affects the company's performance);
   ii. Foreign capital contribution to the company (positively affects the company's performance);
   iii. High capacity to take risks of the managerial team (Positive influence).
b. Factors specific to the commercialized product/technology:
   i. The advanced development degree of the product at the moment of the company's formation(Positive influence);
   ii. The necessary technology for the making of the product raised problems which had not been foreseen and increased the costs – this negatively influences the company's performance.
c. Factors related to the relation of the company with the external environment:
   i. Access to financing through non-refundable sums (Positive influence),
   ii. An increased competency of the implementation team (Positive influence);
   iii. Difficulties in finding the needed workforce with the adequate job qualification – (negative influence on the company's performance;
   iv. Difficulties in finding the needed workforce with the adequate job qualification related to pay their desired wage level– (negative influence on the company's performance.

d. Factors characteristic to the managerial policy/strategy of the company:
   i. The company's focusing on the advancement of the product/technology (negatively affects the company's performance).

IV. Conclusions

It is interesting to notice that a series of factors considered by the subjects as being important for the performance of the company were not confirmed. They are especially related to the aspects of research – development which are viewed as very important for the company's success but which prove to be rather an impediment: the more the company is focused on a research objective (the development of the product) the lower its economic performance is.

Also, other factors considered by numerous subjects as being important proved to not have a significant influence on the company's economic performance: collaborations with the academic environment, the managers' origin in the academic environment, the quality level of the product, the access to financing through non-refundable sums. The access to financing is especially worth mentioning because, although in interviews with founders/ managers of ASO and ASU the problem of the financing was raised often, our research proved that this aspect which did not decisively influence the companies' performance.

From the results obtained, it turns out that they all managed to solve the issue of financing (many times by loans in their own names which were used to finance the company) until receiving of the subsidy from European funds. An important aspect proved to be related to the implementation of the project and the competencies of the team who ensured the implementation, as this represented a specific characteristic for the types of companies that are analysed (financed through POS CCE).

We have tested the hypotheses based on the conceptual model was performed by using multiple linear regression. For processing of the data, the program Statgraphics Centurion XVII was used.

The studies also show that in spite of the fact that the number of academic spin-offs and start-ups has begun to increase, there is still not enough information with regard to the quality of their performance and the factors which influence their survival rate (Astebro et all., 2012; Djkovic&Souitari, 2008, cited in the survey called *Measuring the contribution of higher education to innovation capacity. Final report for the European Commission –Directorate, 2017).*

References

Bibu, N., Muntean, V., Gligor, D., Cernescu L. "Characteristics of university spin-offs. The romanian situation." *Annals of the University of Oradea, Economic Science Series* 25 (1) (2016): 852-870. http://anale.steconomiceuoradea.ro/volume/2016/AUOES-1-2016.pdf.

Bigliardi, B., Galati, F., and Verbano, C. "Evaluating Performance of University Spin-Off Companies: Lessons from Italy." *J. Technol. Manag. Innov.* 8(2) (2013): 178-188.

Blank, S., Dorf, B. *The Startup Owner's Manual.* Pescadero, Calif.: K&S Ranch, 2012.

Cernescu (Mihali), L. M. *The impact of the academic spin-off and start up type organizations' management on their economic and financial performances*. Doctoral Thesis, 2018.

Cernescu, L., Dungan, L. "Spin-off. Theoretical Approach Overview." *Procedia of Economics and Business Administration* (2015). ISSN: 2392-8174.

Cernescu, L., (Ciobanu) Bitea, C., Dungan, L. "The analysis of the Romanian global competitiveness international ranking. The impact of the IEC Program." *Procedia - Social and Behavioral Sciences* 238 (2018): 517-526, https://www.sciencedirect.com/science/article/pii/S1877042818300612.

Cernescu L. *Spin-offs. The vectors of innovation in the context of an economy based on knowledge*. Bucharest: Editura ASE Bucureşti, 2016.

Cernescu, L., Dungan, L. "The role of spin-offs in the Romanian economy. The impact of the European funds." International conference current economic trends in emerging and developing countries, May 19-20, 2017 TIMTED 2017, Timişoara, Romania http://www.timted.ro/wp-content/uploads/TIMTED2017-Programme-and-Conference-Abstracts.pdf.

Clarysse, B., Moray, N. "A process study of entrepreneurial team formation: the case of a research-based spin-off." *Journal of Business Venturing* 19(1) (2004): 55-79.

Dungan, L., Cernescu, L. M.Herman, F. Popescu. *Advising, an indispensable element in training students. Usefulness of POSDRU grants*. 2016, ISBN: 978-1-61804-369-6. http://www.wseas.us/e-library/conferences/2016/barcelona/EDBA/EDBA-07.pdf.

Cunningham, J., O'Reilly, P. "Macro, meso and micro perspectives of technology transfer." *J Technol Transf* 43 (2018): 545–557, http //doi.org/10.1007/s10961-018-9658-4.

Etzkowitz, H. "Entrepreneurial Scientists and Entrepreneurial Universities in American Academic Science." *Minerva* 21 (1983): 198-233.

Munteanu, V., Cernescu, L. "Exploring the roles of European funds in the life cycle of Romanian spin-offs." *Procedia - Social and Behavioral Sciences* 238 (2018): 562-571, https://www.sciencedirect.com/science/article/pii/S1877042818300661.

O'Shea, R., Chugh, H., Allen, T. "Determinants and consequences of university spin-off activity: a conceptual framework." *J Technol Transfer* 33 (2008): 653–666.

Rasmussen, E. *Facilitating University Spin-Off Ventures - An Entrepreneurship Process Perspective*. Bodø: Bodø Graduate School of Business, 2006.

Rasmussen, E., Borch, O. "University capabilities in facilitating entrepreneurship: A longitudinal study of spin-off ventures at mid-range universities." *Research Policy* 39 (2010): 602–612.

Rasmussen, E., Wright, M. "How can universities facilitate academic spin-offs? An entrepreneurial competency perspective." *J TechnolTransf* 40 (2015):782–799, DOI 10.1007/s10961-014-9386-3.

Rasmussen, E., Mosey, S., Wright, M. "The influence of university departments on the evolution ofentrepreneurial competencies in spin-off ventures." *Research Policy* 43 (2014): 92– 106.

Shane, S. "Prior knowledge and the discovery of entrepreneurial opportunities." *Organization Science* 11 (2000): 448–469.

Shane, S., Stuart T. "Organizational Endowments and the Performance ofUniversity Start-ups." *Management Science* 48(1) (2002): 154-170, doi: 10.1287/mnsc.48.1.154.14280.

Shane, S. *Academic entrepreneurship: University spin-off and wealth creation*. Northampton, MA: Edward Elgar Publishing, 2004.

Soetanto, D., Geenhuizen M. "Getting the right balance: University networks' influence on spin-offs attraction of funding for innovation." *Technovation* 36-37 (2015): 26–38.

Vohora, A., Wright, M., Lockett, A. "Critical junctures in the growth in university high-tech spinout companies." *Research Policy* 33(1) (2004): 147–175.

*** *Annual Implementation Report for 2011 of SOP Increase of Economic Competitiveness* www.fonduriue.ro/files/programe/COMPETITIVITATE/POSCCE/RAI_POS_CCE_2011.pdf.

*** *Annual Implementation Report for 2012 of SOP Increase of Economic Competitiveness* www.fonduriue.ro/files/programe/COMPETITIVITATE/POS CCE/RAI_POS_CCE_2012.pdf.

*** *Annual Implementation Report for 2013 of SOP Increase of Economic Competitiveness* www.fonduriue.ro/files/programe/COMPETITIVITATE/POS CCE/RAI_POS_CCE_2013.pdf.

*** *Annual Implementation Report for 2014 of SOP Increase of Economic Competitiveness* www.fonduriue.ro/files/programe/COMPETITIVITATE/POS CCE/RAI_POS_CCE_2014.pdf.

*** *Frascati Manual 2015, Guidelines for Collecting and Reporting Data on Research and Experimental Development*, https://read.oecd-ilibrary.org/science-and-technology/frascati-manual-2015_9789264239012-en#page11.

*** *Ghidul Solicitantului pentru operațiunea 2.3.1. Sprijin pentru start-up-uri și spin-off-uriinovative. Programul Operațional Creşterea Competitivității Economice*, http://old.fonduri ue.ro/res/filepicker_users/cd25a597fd62/Finantari/POSCCE/DMI_2.3_Acces%20la%20CDI/O231_Start-up_si_Spin%20off/Ghid_Start-up_si_Spin_off.pdf

*** https://lege5.ro/, accesatînperioadaianuarie 2016- octombrie 2016.

*** http://sar.org.ro/wp-content/uploads/2017/03/RAPORT-SAR-2017.pdf.

www.mfinante.ro.

*** https://www.romanian-companies.eu/search.as.

*** www.firme.info.

*** *The Global Competitiveness Index 2017-2018 edition*, http:/www3.weforum.org/docs/GCR2017-2018/05FullReport/TheGlobalCompetitivenessReport2017–2018.pdf

*** *World Intellectual Property Report the Changing Face of Innovation*, https://www.wipo.int/edocs/pubdocs/en/intproperty/944/wipo_pub_944_2011.pdf.