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INNOVATIONS' SURVIVAL

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Abstract

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Innovations currently represent a tool of maintaining the going concern of a business entity and its competitiveness. However, effects of innovations are not infinite and if an innovation should constantly preserve a life of business entity, it has to be a continual chain of innovations, i.e. continual process. Effective live of a single innovation is limited while the limitation is derived especially from industry.

The paper provides the results of research on innovations effects in the financial performance of small and medium-sized enterprises in the Czech Republic. Objective of this paper is to determine the length and intensity of the effects of technical innovations in company's financial performance. The economic effect of innovations has been measured at application of company's gross production power while the Deviation Analysis has been applied for three years' time series. Subsequently the Survival Analysis has been applied. The analyses are elaborated for three statistical samples of SMEs constructed in accordance to the industry. The results obtained show significant differences in innovations' survival within these three samples of enterprises then. The results are quite specific for the industries, and are confronted and discussed with the results of authors' former research on the issue.

Keywords: effect of innovations, financial performance, innovation, SMEs, survival analysis

INTRODUCTION AND THEORETICAL BACKGROUNDS

Currently, it is not a purpose to discuss or to justify a necessity of innovation processes itself. Importance of innovation processes is described by a wide range of authors, from Schumpeter (1934) to concurrent huge number of researchers. What is much more important in present, it is a problem of final effect of an innovation activity for individuals, companies or society as a whole. It is obvious that each user of results of innovation activities has different priorities, i.e. that it would be needed to establish different measurement of innovation effects to everyone.

As the look of society on innovation, their importance and contributions has been developing in a course of time, the methods assessing the effects of innovations on their users has been developing as well; since the beginning of society when the main innovations have consisted in the sphere of defence, through the time of industrial revolution when the innovation effect has been regarded mainly through novelty of products, through the second half of the 20th century tills the beginning of 21st century when non-financial (managerial) approaches to evaluation of innovations' effects have been developing.

Evaluation of innovation effectiveness can be regarded from different angles while approaches to assessment of effectiveness of innovation processes are principally divided into two basic directions which are non-financial approaches and financial approaches (for more see Tabas, Beranová & Polák, 2012). With regard to the fact that small and medium-sized enterprises are mostly marked as drivers of innovations activities, this paper is focused on measurement of innovations' financial effects in these companies. Most of the financial methods are first based on the same grounds as evaluation of investments, and second are applied ex post, i.e. after realization of innovation.

Generally, performance of a business entity is framed as an ability of enterprise to reach certain

results which are subsequently the object of comparison in time or in space. In relation to above mentioned widening, strengthening and global competition, performance of a business entity is often connected with its chance on survival on a market that inevitably joined just to innovations. In present, it is just about the innovations as about a critical process without that business entities are not able to maintain the place on a market. Then, business entities spend great amounts of their resources while it is expected that these investments would be gained back in the form of future profits. This way, maintenance of or respectively increase in performance of business entity is anticipated.

On the issue what is an innovation activity of company, and how company's innovativeness could be measured, a range of different studies already exists (see e.g. Bhaskaran, 2006; Avermaete *et al.*, 2003; Johannessan *et al.*, 2001; Kotabe & Swan, 1995; etc.). But another question is how the economic effect of innovation can be determined. In this sense, it is possible to find e.g. the measure of sales, respectively the share of sales of a new product in total sales (e.g. Dvořák, 2009; Hauschildt, 2004). Nevertheless, not every category of innovation could be joined with the sales, while it is clear that mutual relations between single categories of innovations exist, and any innovation is not possible to determine as a "pure" innovation of a sole type. Relations between the types (categories) of innovations are described e.g. by Gurkov (2005) who, among other, points out that product innovations very often leads necessarily to innovations in technologies, and requires also innovations to marketing or human resources management. Then, it is indispensable to determine other criteria of evaluation of innovation impact on the business entity economics. Here it is possible to meet approaches which are based on measurement of changes in market share, in profitability, in labour productivity etc. (Oksanen & Rilla, 2009). But all these aspect would always lead to occurrence of deviations from existing development of a business entity that can be modelled in the financial plan, and the economic effect of innovation could be defined as the difference (deviation) between the projected and real results reached at respecting the influence of economic cycle. For measurement of innovation effectiveness, various authors (e.g. Dvořák, 2009; Hauschildt, 2004; Acs & Audretch, 1992) suggest application of the methods which are ordinarily used in evaluation of investment effectiveness. Nevertheless, contrary to the real investments, evaluation of innovation effectiveness is characterized by a range of specifics while the basic one of them is immateriality that is typical for each innovation until a certain moment, i.e. it is typical for product innovations as well, and for some innovations, the materiality would never be reached.

Currently, it is possible to find a number of studies on innovations. But these studies are mainly focused on innovation environments, on the factors of innovation potential or innovation environment. In principal, authors of these studies operate especially with soft measures. But even if already Schumpeter (1934) has spoken about innovation profit, nobody focuses on what this innovation profit is, how long is the period of gaining innovation profit, or how bit this innovation profit is. Authors of this paper focused right on these issues.

This paper presents a new approach based on probability which can be applied on beforehand. Objective of this paper is to determine the length and intensity of the effects of technical innovations in company's financial performance, and to determine differences in the length of this effect of technical innovation depending on a branch of business activities. With regard to this objective, the authors set hypothesis as follows.

H0: Length of positive technical innovation effect (innovation profit) depends on the branch of business activities.

MATERIALS AND METHODS

In order to determine the effect of technical innovations in the financial performance of small and medium-sized enterprises, comprehensive research has been conducted. The statistical sample has consisted of 300 of small and medium-sized enterprises which are established and are doing their business activities in the Czech Republic, and have realized product-process (technical) innovation in the 2010 at latest. In accordance to kind of business activities, these companies are then divided into three sub-samples. These are:

- Production companies (51.3 %),
- Service companies (31.9 %),
- Trade companies (16.8 %).

In the statistical sample, trade companies represent the smallest sub-group. It is obvious because the product-process (technical) innovations are less usual in this type of business entities. Here, mainly marketing innovations are realized, nevertheless these innovations are not a subject of this paper.

Each business entity in the statistical sample is described witch defined variables, which are:

- Deviation of the gross production power (ROA = EBIT/A) from the industrial average in the five-years period, which is defined as t – 2 to t + 2, where the t represents the year when the technical innovation has been realized;
- Deviation of the rate of growth of sales from the industrial average, also in the five-years period of t – 2 to t + 2;
- Effect of innovation in sales, which is evaluate on the scale 1–5, where the value 1 means significant increase in sales and the value 5 represents significant decrease in sales, value 0 was used as well, and it is in cases when the effect is not possible to determine;

- Rate of growth of production cost, also in the five-years period of t – 2 to t + 2.

Evaluation of innovation's effect ex post is useful nevertheless, from the dynamic point of view of innovation processes management, it is not enough. For this purpose, it is desirable to add a predictive part to models of evaluation of innovation effectiveness. Objective of the predictive part of a model, presented in this paper, is to provide estimation whether the technical innovation would have a positive effect in financial performance of business entity or not. For this purpose the event history analysis has been applied while the survival functions are defined.

Previous researches of the authors and their outcome have already proved that technical innovation has an effect in company's financial per of different length in dependence on a branch of business activity. Then, the survival functions have been derived separately for every business branch. At observing the length of positive effect of innovation, i.e. period when the values of analysed variables have been higher than before innovation, the tree new variables are defined. These are:

- Length of innovation effect in deviation of gross production power;
- Length of innovation effect in deviation of rate of growth of sales;
- Length of innovation effect in production cost.

This way, the authors reflect and respect the goal of technical innovation, i.e. extension of production capacity with complex impact on gross production power, or a single growth of sales, or increasing efficiency of production processes in the sense of decrease in operational costs.

With regard to the length of period after innovation observed, these variables have discrete values 0 - 3, when 0 marks that positive effect of innovation was not observed in the value of financial variable at all, respectively the effect was negative. Value 3 represents a situation when financial performance measured with given variable was on higher level than before realization of technical innovation for the whole period observed. As the observed period is finished in the year t + 2, the main failing of this approach is that it does not reflect subsequent years. However, this has not an essential impact on results because as previous research of the authors proved (see e.g. Tabas *et al.*, 2012; Tabas & Beranová, 2013a; Tabas & Beranová, 2013b; Tabas & Beranová, 2014), positive effect of technical innovation, i.e. innovation profit, is time-limited, especially in service companies and trade companies. Probability of positive innovation effects which are longer than 3 years is very low in production companies as well. This failing of the model is also treated in the error of estimate which is screened as maximal in the ending values.

First, the event probabilities have been estimated while these events are defined as the end of positive effect of innovation in a given year. The estimates are conducted in accordance with (Hendl, 2012):

$$\hat{p}(t) = \frac{n_j - d_j}{n_i}$$

Where n_j is number of object in risk in the year *t*, d_j is number of events in the year *t*.

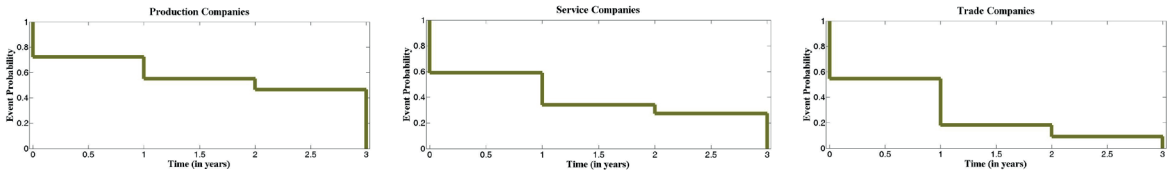
This is the estimation of conditional probability that the statistical unit which was not an object of event in the time tj-1 would be an object of this event in the time t neither. Because these probabilities are conditional probabilities, their sum does not equal to 1. Probability that the statistical unit will "survive" without an event, in this case it is with lasting positive effect of innovation, decreases in time. This verity is reflected also in the typical shape of the survival function. Values of the survival functions are estimated in accordance with (Hendl, 2012):

$$\hat{S}(t_j) = \hat{S}(t_{j-1})\left(1 - d_j / n_j\right)$$

RESULTS & DISCUSSION

Discrete survival functions for the innovation effect in the gross production power of a business entity are presented at the Fig. 1. The Fig. 1 clearly shows the differences among single sub-groups of business entities in dependence on their business activities. Value on the axis y in the time 0 represent the probability that technical innovation would have any positive effect in business entity. Then, it is visible that in service companies and trade companies these probabilities are quite close, it is 54.55 % in trade companies and 57.78 % at service companies. In production companies, the probability of positive innovation effect is 72.41 %. These differences persist also for following years. If the technical innovation has positive effect at the beginning in the production companies, the positive effect persist into the second period with the probability of 84.38 %. Because the probabilities are conditional, the result is multiple of simple probabilities. To the third period, a technical innovation would have positive effect in the production power of business entity with the probability of 45.10 %. Since the period 3 while this point on the axis x refers to the end of the year t + 2, the probability has the value of 0 because this point/period represents the end of observation.

In service companies, if the technical innovation is successful at the beginning that is with the probability of 57.78 %, its positive effect would persist in the second year with probability of 57.69 %. In simple probability it means that if the innovation has positive effect in the first year than this positive effect persists with the probability of 80 %. Coming out of this, in the year t + 2, a positive



1: *Survival functions for deviations of the gross production power*
Source: authors' elaboration

effect of technical innovation would occur only with 26.67 % probability.

In case of trade companies, if the technical innovation is successful, its positive effect persists the following period with the probability of 33.33 %. It means that if the effect of technical innovation in the gross production power would be positive in firs year after innovation realization, it is with the probability of 18.18 %. Consequently, in the second year after innovation realization, its positive effect persists in 50 % "surviving" trade companies. That means the total probability of persistence of the positive effect of technical innovation in the gross production power longer than one year after realization is 9.10 %.

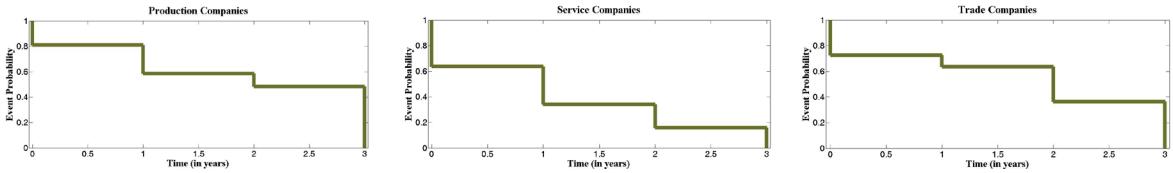
Verification of the statistical significance of differences in the survival functions for the positive effect of technical innovations in the deviations of gross production power in the three sub-groups of business entities is preceded by the Cox-Mantel test of survival functions conformity. This test is based on the similar principles as the Chi-square test. Thus, it is based on differences between expected and empirical values. In this case, the value of test criterion is 15.678. The test criterion is subjected to Pearson probability distribution and on the significance level α=0.05 at two degrees of freedom, the hypothesis about survival functions conformity is rejected. Thus, statistically significant difference exists among the tree survival functions, i.e. among the survival functions of positive effect of technical innovation in gross production power in the three different groups of business entities.

At application of the same procedure, the survival functions have been constructed for deviations in the sales rate of growth from the industry average as well. These functions for each sub-group of business entities in dependence on their business activities are presented at the Fig. 2 as follows.

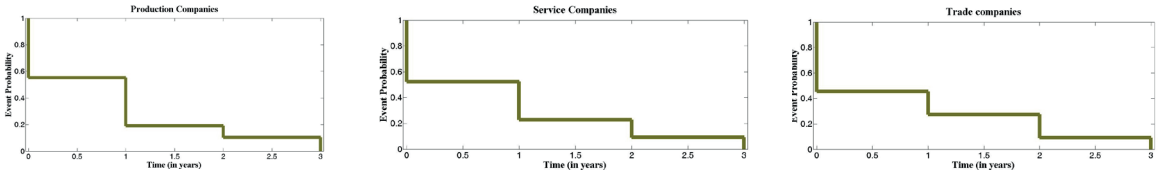
In production companies, the technical innovation would have the positive effect in sale with the probability of 81.03 % and then, in the first year after innovation realization, the positive effect of technical innovation lasts with the probability of 58.61 %, and in the second year with the probability of 48.27 %. Also here, the probability from the year 3, i.e. from the year t + 2 is zero because the observation is finished after. This fact is taken into account in the standard deviation of the estimate of course, as already mentioned above. In service companies, the realization of technical innovation would have immediate positive effect in sales with the probability of 62.22 %. This positive effect lasts in the first year after innovation with the probability of 33.33 % and in the second year with the probability of 15.56 %. In the sales rate of growth of trade companies, the positive effect would be started by a technical innovation with probability of 72.73 %, and it lasts for the first year after with the probability of 63.64 %, and for the second year after with the probability of 36.36 %.

In order to verify the statistical differences, also in this case the Cox-Mantel test has been applied. The Chi-square test criterion has the value of 24.785 here and the null hypothesis about survival functions conformity is rejected at the significance level α=0.05 and two degrees of freedom. It means that also in the rate of growth of sale, the sub-groups of business entities are statistically significantly different in dependence on their business activities.

Presented sets of survival functions for the deviations in gross production power, and in rate of growth of sales, again point out the fact that the positive effect of technical innovations is the longest in production companies. The interesting observation is that this is so in both, in the gross production power and in the sales growth as well. What is also interesting and what could not have



2: *Survival functions for deviations of the rate of growth of sales*
Source: authors' elaboration



3: *Survival functions for rate of growth of production costs*
Source: authors' elaboration

been covered by previous analyses is fact that the technical innovations would have longer positive effects in the sales growth in trade companies then in the service companies.

As a complement to these survival functions, the survival functions for rate of growth of production costs have been constructed. These functions are present at the Fig. 3, while these functions are supposed to be complementary because the analysis in this case does not work with the deviation from the industry averages which do not exist for this variable.

It is clearly visible in the production costs that the probabilities of the positive effect of technical innovations are not much differing among the sub-groups of business entities in dependence on their business activities. Also with regard to aims of technical innovations in production companies, the probability of decrease in production costs is significantly lower than in case of effect measurement by the gross production power and the sales growth. Here it is the initial probability of 55.17 %, the first year positive effect probability of 18.97 % only and the second year shows the probability of 10.35 %. This very fast decrease in probability of reductions of production cost is connected just with the most frequent aim of technical innovations in the production companies that is increase in production capacity. Higher production capacity usually means increase in production costs. In the first year after technical innovation realization, amortization of the new production capacity affects the production costs. Then, based on the results of previous analyses, it is possible to suppose, that calculated probabilities of 18.97 % and of 10.35 % match the stake of those production companies where the technical innovation is aimed at other objective than at production capacity extension.

In service companies, the technical innovation would have an effect in decrease in production cost with the probability of 53.33 % while the production costs decrease in next two years after with the probability of 24.44 %, and of 8.89 %. In the trade companies, technical innovation would affect the production costs in a positive way with the probability of 45.45 % only. In the first year after innovation realization, the effect would last with the probability of 27.27 %. In the year t + 2, the positive effect of technical innovation in production cost would exist with only 9.09 % probability.

Presented values of probabilities have also their logical background and build on results of previous analyses, because aside of the short-run effect of technical innovations in the service and trade companies, it is especially the aim of technical innovation what plays a substantial role. If the technical innovation is primarily aimed at increase in sales, it would also have an effect in the sense of increase in production costs because the cost of goods sold in trade companies, or in other cost items which are needed to be bought in service companies.

The Cox-Mantel test of these survival functions agreed the null hypothesis about the survival functions similarity with 95 % probability. The Chi-square test criterion has the value of 0.0266 only which means that the effect of technical innovation would not be significantly different in business entities regardless their business activities.

The survival analysis applied proved the previous results reached by the authors and presented in their previous papers (see e.g. Tabas *et al.*, 2012; Tabas & Beranová, 2013a; Tabas & Beranová, 2013b; Tabas & Beranová, 2014). Again, the most significant, here the longest, effect is observed in production companies where the technical innovations are focused mainly on production capacity extension in both, quantity and quality, and where the innovations are relatively also more difficult to be imitated by competitors. On the other hand, in service companies, the effect is also relatively high but it lasts for quite short time, especially because of the nature of technical innovation consisting mainly in the scope and manner of services provided. Content of technical innovation in the trade companies if quite difficult to be determined while the results are conform to this.

The authors agree that longer observation period would provide more precise, respectively sounder results. I would be also good for the research to compare the results reached with other studies on the issue, nevertheless no comparable study exists. The most studies on innovations' success are focused on soft factors influencing implementation of innovations. This way, the authors are conforming Schumpeter's theories of limited innovation profit only.

CONCLUSION

Objective of this paper was to determine the length and intensity of the effects of technical innovations in company's financial performance, and to determine differences in the length of this effect of technical innovation depending on a branch of business activities. The paper provides the results of research on innovations effects in the financial performance of small and medium-sized enterprises in the Czech Republic. The economic effect of innovations has been measured at application of company's gross production power while the Deviation Analysis has been applied for three years' time series. Subsequently the Survival Analysis has been applied. The analyses are elaborated for three statistical samples of SMEs constructed in accordance to the industry. The statistical sample has consisted of 300 of small and medium-sized enterprises which are established and are doing their business activities in the Czech Republic, and have realized product-process (technical) innovation in the 2010 at latest.

Main reason for such a determination was firstly the importance of small and medium-sized enterprises in the Czech economy and its competitiveness, and secondly a presumption of a lower financial power of these business entities and thus possible non-existence of complex intra-evaluation tools in these companies. Focus on the product-process innovations has come out, among others from the objectives of subsidies policy of the EU, operation program of Enterprise and Innovations for Competitiveness for the programming period of 2014-2020 (MPO ČR, 2014). Based on this, differences in the length of positive effects of technical innovations in the three dimensions have been determined in dependence on the field of business activities.

In order to reach the presented results, mainly the method of the Survival analysis has been applied. Relevance of the results has been tested by the Cox-Mantel test. Focused on the relevancy of the results, the authors have determined the three dimensions of technical innovations effects; these are the gross production power, rate of growth of sales and rate of growth of production costs.

In dependence on their business activities the statistical sample of small and medium-sized enterprises have been divided into three sub-groups, production companies (51.3 %), service companies (31.9 %), and trade companies (16.8 %). Highest probability of the positive effect of technical innovation in the three years period is observed in production companies for all of the three dimensions.

Knowledge about probability of the existence of positive effect of innovation and its length has high importance for a company. It could affect the activities of a business entity, especially development planning, R&D, marketing activities etc. and their timing. On the other hand, presented research itself has various limits. The biggest limit is that the survival functions are the same for every company in given group. This way, the results are quite general and the authors are developing their research in the sense of higher specification and narrowing of the proposed methodology in order to count with specifics of single business entity, especially its barriers to innovations. Nevertheless, the requirement is to not make the model too demanding for practical application. It means that this paper is a partial outcome of the complex work of the authors which is continuously developed.

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REFERENCES

ACS, Z. J., AUDRETCH, D. B. 1992. *Innovation durch kleine Unternehmen*. Berlin: Edition Sigma.

AVERMAETE, T. *et al.* 2003. Determinants of innovation in small food firms. *European Journal of Innovation Management*, 6(1): 8–17.

BHASKARAN, S. 2006. Incremental Innovation and Business Performance: Small and Medium-Size Food Enterprises in Concentrated Industry Environment. *Journal of Small Business Management*, 44(1): 64–80.

DVOŘÁK, J. 2009. Evaluace inovací, jejich bariéry a faktory úspěšnosti. In: *Podnikanie a konkurenceschopnost firiem 2009*. Bratislava. Vol. 1.

GURKOV, I. 2005. Innovations in Russian Industries: Conditions for Implementation and Impact on Competitiveness. *Journal for East European Management Studies*, 10(3): 218–246.

HAUSCHILDT, J. 2004. *Innovations management*. München: Vahlen.

HENDL, J. 2012. *Přehled statistických metod zpracování dat*. 1. vyd. Praha: Portál.

JOHANNESSAN, J. A. *et al.* 2001. Innovation as newness: What Is New, How New, and New to Whom? *European Journal of Innovation Management,* 4(1): 20–31.

KOTABE, M., SWAN, K. S. 1995. The Role of Strategic Alliance in High Technology New Product Development. *Strategic Management Journal,* 16(8): 621–636.

MINISTERSTVO PRŮMYSLU A OBCHODU ČR. c2005. *Benchmarkingový diagnostický systém finančních*

indikátorů INFA. [On-line]. Available at http://www.mpo.cz/cz/infa.html.

MINISTERSTVO PRŮMYSLU A OBCHODU ČR. 2006. *Operační program podnikání a inovace*. [On-line]. Available at: http://www.mpo.cz/dokument78086.html.

MINISTERSTVO PRŮMYSLU A OBCHODU ČR. 2012. *Zpráva o vývoji MSP a jeho podpoře v roce 2011*. [On-line]. Available at: http://www.komora.cz/pomahame-vasemu-podnikani/pripominkovani-legislativy-2/nove-materialy-k-pripominkam-1/nove-materialy-k-pripominkam/149-12-zprava-o-vyvoji-msp-a-jeho-podpore-v-roce-2011-t-13-6-2012.aspx.

MINISTERSTVO PRŮMYSLU A OBCHODU ČR. 2014. *Koncepce podpory MSP na období let 2014–2020*. [On-line]. Available at: http://www.mpo.cz/dokument119071.html.

OKSANEN, J., RILLA, N. 2009. Innovation and Entrepreneurship: New Innovations as Source for Competitiveness in Finnish SMEs. *International Journal of Entrepreneurship,* 13(Spec. Is.): 35–48.

SCHUMPETER, J. A. 1934. *Theory of Economic Development*. Cambridge: Harvard University Press, Mass.

SCHUMPETER, J. A., 1964: *Theorie der wirtschaftlichen Entwicklung*. Berlin: Duncker und Humboldt.

TABAS, J. 2013. Application of discriminant analysis in determining economic effects of technical innovations in the SMEs. *Journal of International Scientific Publication: Economy&Business*. 7(2): 26–35.

TABAS, J., BERANOVÁ, M., 2013a: Using a base of simplified financial plan for determination innovations' economic effect in small and medium-sized enterprises. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis*. 61(7): 2867–2873.

TABAS, J., BERANOVÁ, M. 2013b. Innovations effect on going concern of SMEs. In: *ICBE 2013 Business Challenges of Globalization for Sustainable Economic Development*. 1. vyd. Reykjavik, Iceland: UP Organizer and Publication Co. Ltd., 1–2.

TABAS, J., BERANOVÁ, M., MARTINOVIČOVÁ, D. 2012. Influence of Product Innovations on Financial Performance of Small and Medium-sized Enterprises in the Czech Republic. *Acta universitatis Agriculturae et Silviculturae Mendelianae Brunensis,* LX(7): 409–414.

TABAS, J., BERANOVÁ, M., POLÁK, J. 2010. Zhodnocení přístupů ke klasifikaci inovací. *Acta universitatis Agriculturae et Silviculturae Mendelianae Brunensis,* LVII(6): 563–570.

TABAS, J., BERANOVÁ, M., POLÁK, J. 2011. Classifications of Innovations: Approaches and Consequences. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis,* LIX(2): 399–406.

TABAS, J., BERANOVÁ, M., POLÁK, J. 2012. *Evaluation of innovation processes. Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis,* LX(2): 523–532.

TABAS, J., BERANOVÁ, M., VAVŘINA, J. 2011. Barriers to development of the Innovation potential in the small and medium-sized enterprises. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis,* LIX(7): 447–458.

TABAS, J., POLÁK, J., BERANOVÁ, M. 2010. *Evaluation of approaches to definition of innovations. Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis,* LVIII(6): 563–570.

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