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Personal Potentials of the Students in University of Defence on the Way of Professional Leadership

Eva Ambrozová[1], David Ullrich[1], František Milichovský [2]

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Abstract

Paper describes the application of X-tream method on an analysis of personal potentials for the development of professional leadership. There was employed pilot study as one of project output. The pilot study was focused on identification and comparison of marginal indices, connected to the condition of personal dimension in the group of students of army leadership. Gained results from the pilot study provides a view on the application of X-tream method, which should help to choose a relevant person for stressing environment such army or security area. The main objective of the paper is the application X-tream method in army context. The sample population was 46 successful participants of leadership course, which was realized at the end of 2017.

Keywords: professional leadership, connatural management approach, personal potential, X-tream methodology

Introduction

At present days, there are a lot of staff specifications, which organizations require on new managers and officers (no matter if an organization is a company, security, or army). The whole environment is still changing with all elements such as humans and human systems. Parameters such as dynamics, instability, and vicissitudes tend to new wants on their skills and abilities of cognition, decision making, negotiation, and leadership. These parameters represent psychology base of all managerial competencies.

All of the parameters mentioned above help to identify, develop and cultivate staff abilities and skills under the condition of cognitive management (Ambrozová et al., 2016). This concept considers leadership and management as different leading styles. Management is focused on rationality and hierarchical structure has clear conditions and evaluation. Vice versa, leadership is oriented on the intuition of staff, both network and

fluctuate structures, task meaningful, exploring activities, recognition, and reflection. In a professional environment there are arising situations, when is more requiring a manager's qualities instead of leaders. Therefore, cognitive management employs terms, such mental agility and cognitive continuum, which are the base for professional leadership definition (Ambrozová, et al., 2016; Koleňák, Pokorný and Ambrozová, 2013; Csíkszentmihályi, 2017).

Purpose of the paper is to present terms of connatural management with a focus on the individual personal potential in professional leadership (presented in the first part). In the second part, there is described research methods and obtained results of the research.

Connatural management (CM) is considered a concept of cognitive management (Ambrozová et al., 2016), which is focused on natural human potentials within their skills and abilities, useful for cognition processes, processes of decision making, or negotiating. This CM concept respects the natural qualities of human in various levels that are necessary for all potential situational contexts. These qualities are close to both tacit and implicate skills or meta-skills and they are connected with flow-effect aspects (Koleňák, Pokorný and Ambrozová, 2013; Csíkszentmihályi, 2017; Mindell, 2009).

The natural potential could be as biological, genetical and inborn, and are base of different skills, abilities, and functions, that are formed and developed by the impact of the external environment and own activities. All natural potentials are given and they are not based on reached abilities or by traditional education or training. Natural potentials have each person, but not each person develops these potentials or put them down by kind of education, the progress of society, and other professional environments (Robinson and Aronica, 2013).

These descriptions have become the main reasons, why they are accepted and pimple enter by Army of the Czech Republic. In general, the army requires the application of long-life education and long-time developing of competencies (Kubínyi and Veteška, 2018). Except for these requirements, in the professional army could be a focus on education process innovation of encumbrance (Saliger, Hodný and Macháčková, 2018), development of social competencies (Nekvapilová and Mikulka, 2016), or emotional intelligence and effective leadership (Kozáková, 2017).

Professional leadership is connected to commanding and management of people and human systems, organizing in an internal environment of an individual (Bogdanović, 2018). The purpose of the individual environment is internal state as proactive, receptive, listening and observing approach. The individual environment and its approaches help to find out order and structure on the way to define hidden qualities, relationship principals and other potentials. To develop and cultivate competencies of professional leadership is considered a process, by which is identified personal qualities for a leader (Ambrozová et al., 2016) and to model and setup preparing processes, education and personal development.

Methods and Data

Purpose of the research, on which base this paper was prepared, was an identification of personal potentials by quantification of individual indexes of personal dimension condition. For the research purpose, there was used results of psychodiagnostic data, gained from army course where X-tream method was applied. X-tream method is focused on the identification, evaluation, and development of skills, individual natural potentials in a hard environment. It helps to use principals of assessment job applicants and whole assessments centers. It creates conditions for the identification of personal level and mental dimensions in solving complex tasks. X-tream method represents multidisciplinary method with encumbrance variability and testing of both quality and quantity of individual performance level in the improvement process of their conditions (both physical and mental dimensions) during solving various tasks (Ambrozová et al., 2015).

The main objective of the paper is the application X-tream method in army context. To get relevant information there were used methods of personal analysis SPARO and GPOP. The sample population for the research was 46 participants of army leadership course, who are successfully passed this course with all individual parts including psychodiagnostic survey. The course was realized at the end of 2017.

Results

All results of SPARO and GPOP tests were employed as a base for the identification value of observed indices (Koleňák, Pokorný and Ambrozová, 2013). Variables, which are employed for these indices, acquire values in the range between 0 and 10. These values are divided into five groups, where:

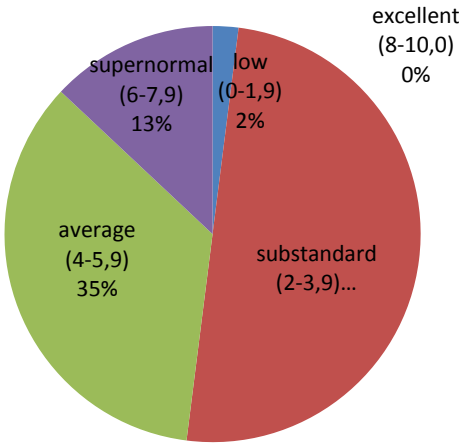
- values in range 0-1,9 are low,
- values in range 2-3,9 are substandard,
- values in range 4-5,9 are average,
- values in range 6-7,9 are supernormal,
- values in range 8-10 are excellent.

SPARO and GPOP tests were proved on the group of army-leadership students. On their answers in both tests, there were applied X-tream method, which provides a complex view on the evaluation of soldiers' competencies. According to the results of both tests, there were created charts, describing the significance of specific competencies.

Index cognitive and situational flexibility is focused on the situation, how people use intuition during perception and how they are open to various cognition models and ways. This situation is closely connected within orientation on changes, flexibility, spontaneity, and variability. Half students reach average values (in range 4-5,9) and higher. Only 13% reach an excellent group of flexibility in cognition (see Figure 1).

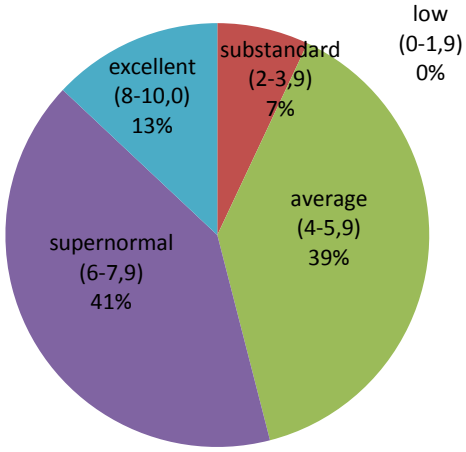
Index realistic deduction and decision-making impacts the relationship between preferred perceptions of reality preferred perceptions of decision-making, and lifestyle (such as orderliness, organization or planning). The connection shows cohesion and balance of skeptical approach in sensual perception, sensual perception, and orientation on present, factual and specific reality. All these parameters are applied during the decision-making process by fact objectivity, arguments' logic, and factual distance. The results show (see Figure 2), that the majority of students acquire average (39%) and supernormal groups (41%).

Figure 1: Values for index cognitive and situational flexibility



Source: Own work.

Figure 2: Values for index realistic deduction and decision-making



Source: Own work.

Index of positional spontaneity uses level of cognitive variability on the way to stabilize the human environment and high dynamics and versatility of intensive external impulses. This cognitive variability directs to processing of skill and abilities according to adjusting variability to define the future potential effect of decision-making process, activities and behavior. The biggest group (according to gained results) is group with supernormal value, where 50% of participants are located (see Figure 3).

Figure 3: Values for the index of positional spontaneity

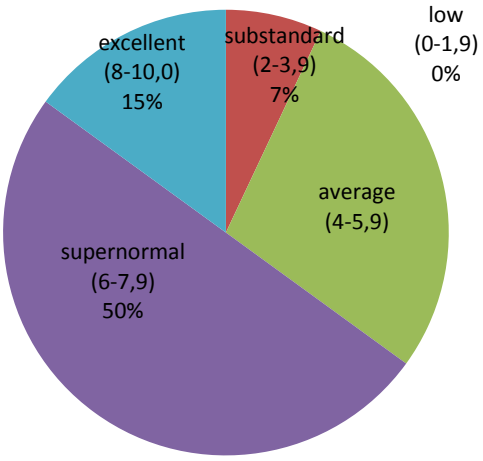


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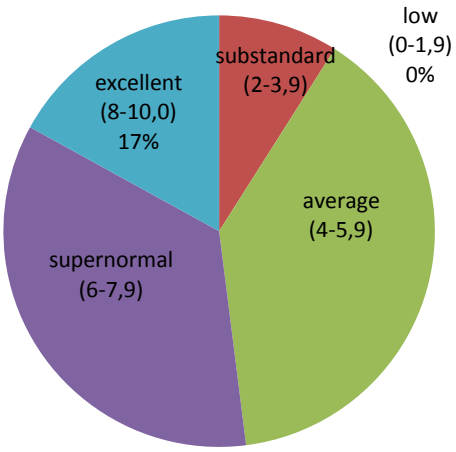
Figure 4: Values for the index of risk stimulation



Source: Own work.

Index of risk stimulation explains the connection of preference level of high dynamic interaction with the external environment, and preferences of stability, certainty, and resistance. On one hand, it is oriented on certainty as a tendency to be sure during decision-making, and choice decision with higher risk on the other hand. Kind of risk awareness shows 39% of participants in the average group, 35% in supernormal group, and 17% in excellent (see Figure 4).

Integrity index helps to understand links between the human resistance level of emotional influence of different situational context as the dominion of cognitive approach in task solving, and realistic and reasonable acting. Usage of critical thinking and keeping of complex personal integrity support application of individual skills and abilities by psychical, physical and mental capacity. Almost three-fourths of all participants have put into the average group or higher (see Figure 5).

Index of general stimulation represents linkage of stabile-form preference level on the human senses (such cognitional and experience fundamentals with various intensive content), and dynamic form preferences (plentiful content with cognitional and experience fundamentals). There is usually find motoric restlessness, which is connected with searching rivalry situation, excitement, adventure, and danger. In this index, all participants are divided equally into four groups except low one (see Figure 6).

Figure 5: Values for integrity index

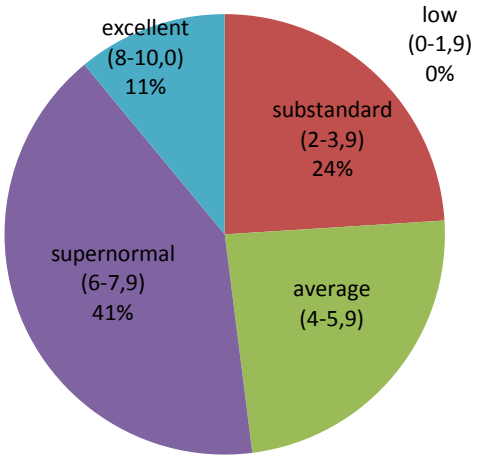


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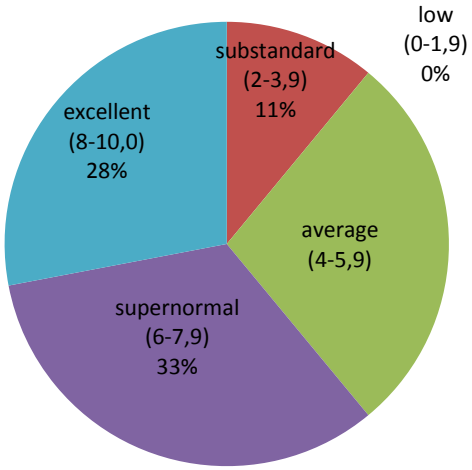
Figure 6: Values for the index of general stimulation



Source: Own work.

Discussion

Method X-tream was developed on long-time research, which was realized in the period 2010-2016 in the area of the security environment, who successfully passed extreme courses (Koleňák, Pokorný and Ambrozová, 2013). All of the gained values are results of the first application of the method for quality evaluation personal potentials for professional leadership in the army and security area to describe personal dimensions' conditions. Therefore, there is only a description of percentage values.

Values of individual indices could be analyzed in the context of the researched sample (students of army leadership) when is, an independent variable, age of participants (21-23 years). As the main factor, influencing the individual results is a personal experience with command practice. A potential challenge of X-tream method is verification reached values with a time offset (e.g. after passing special training programs of personal development of personal potential for professional leadership).

Conclusion

People's natural potential is a core issue that is addressed within Cognitive Management, specifically the Connatural Management approach, and extends significantly to the quality of professional leadership. In relation to the current security environment, its complexity and complexity, and unpredictability proves necessary to think of such qualities, skills, and the potential of the individual, their identification and subsequent development, allowing the individual to work through, respectively. to revive professional mastery, not only in the context of professional leadership. This is closely related to education, training

and personal development. That is the reason, why the University of Defense pays great attention to new forms, methods, and approaches that can improve the processes of education and training of students, future military professionals and leaders.

Connatural management is designed to support the development of natural potentials. This is related to processes, often referred to in psychology as self-knowledge, self-concept, and self-development. The question is, to what extent is the individual able and mainly willing to know himself and work consciously on development and cultivate their personality potentials and resources. It is not just a question of education, which is offered and implemented by external systems, but above all about internal work, personal intent, order, and a constant reflection of oneself, processes and the environment where the individual moves.

By applying the X-tream methodology, the personality potential can be identified and monitored in different situations and in different forms of stress on the individual. The partial research task, which was carried out within the framework of DZRO-K104 at the University of Defense in Brno, brought the first results of measurements of the fitness dimension indices of students of military leadership. These are six sub-indices that primarily address the potentials for cognitive, decision-making, decision-making, and human and human systems processes, specifically for the security environment.

The results showed lower values or the Realistic Reasoning and Decision Index and Integrity Index. This opens the door to focusing on student education and training towards decision-making, perception of factual reality, critical and realistic thinking. This can be supported, for example, by modeling the content of the contents of subjects of military leadership, or by focusing individual tasks within the courses with the applied X-tream methodology, which will, among other things, enable to monitor changes in indicators of personal fitness within the time range. Thanks to an individual reflection of one's own personal potentials and meaningful work of experts dealing with personal development, students, future military commanders and leaders for continuous education and self-development can be obtained.

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Water management in the Czech Republic: Transformation, restructuralization, and comparison of the current state of the branch with the state in 1993

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Abstract

The privatization process in the water industry is often a much discussed topic worldwide within the contexts of economic efficiency and social responsibility. As are the topics of organizing the market, transparency, private providers, and the nature of ownership of water infrastructure. The article describes the specific approach to transforming the water industry in the Czech Republic, its mechanisms, the role of the state, cities, and municipalities, and the private sector. A comparative analysis of the data describes the current state of key indicators of the industry and the state in 1993, such as number of owners and operators, connectivity to water infrastructure, consumer consumption, water losses, number of waste water plants etc. Article also describes the current condition of the market and affirms the significant development of Czech water industry since the beginning of the 1990s.

Keywords: water management, transformation, privatization

Introduction

The water industry, as a typical representative of network branches, is one of the key segments of the economy. Water was, is, and always will be an essential human need. The distribution of drinking water and the piping away of waste water via public pipes is nowadays considered as an automatic service by the society, without which we could not imagine everyday life. Since water is an essential human need, its reliable distribution is considered a duty of the public sector, since the market system could fail, and repairing potential damages could cost large sums of government funds and efforts. Over time, things change and move towards a revolutionary understanding of utilities and public goods (Mejstřík, 2004). Experiences with other network branches, such as the railway transportation or energy, also show that participating in the private sector has a number of benefits, such as higher effectivity and the level of provided services (Amos, 2004). The situation was similar after the entry of the private sector to the water industry in the Czech Republic during the 1990s, which provided the sector with dynamics and pressure to economic effectiveness (Hlaváč, 2006).

The transformation and privatization of the water industry is also the focus of a number of foreign studies whose conclusions vary significantly. In several cases, the participation of the private sector in the water industry is seen as only "picking out" the rentable elements of the market which in the end leads only to a price increase which does not correspond with the appropriate level of effectiveness and productivity (Memon and Butler, 2003). Partial privatization and participation of the private sector in developing countries can on the other hand lead to the branch receiving large capital investments that later raise the overall level of services and enable significant revitalization of infrastructure and improve the purity of water itself (Pangare et al., 2004). In most cases, the participation of the private sector is only partial – the ownership of the infrastructure remains in the hands of the public sector and the management of it is provided by the private partner via temporary lease. One of the few exceptions is the privatization of the water industry in the United Kingdom where the water infrastructure was sold to private operators. The entire branch is thereby solely private, of course under strict observation by the regulator. In this case the opinions differ about the development of effectiveness and productivity that the privatization brought. One side of the opinion spectrum states that the privatization significantly strengthened the technological facilities of the water industry but did not deliver the promised growth of productivity, thereby causing significant losses of overall effectiveness (Saal, Parker and Weyman-Jones, 2007). Another study however shows that the UK water industry experiences (thanks to the privatization) very quick technological development which leads to the constant decrease in operational costs (Bottasso and Conti, 2003).

The following part of the article will describe the process of transformation and the later privatization of Czech water market, its mechanisms, and the role of individual players. For an objective evaluation of the development of the market, there will be a comparative analysis of data that will compare the current state of key indicators of the water industry with the state in 1993. The data for the analysis was gathered from the publicly accessible database of the Czech Statistical Office, statistical yearbooks, and annual reports from the fields of water management and waste management published by the Ministry of Agriculture of the Czech Republic.

Transformation of the Czech Water Industry

The transformation of Czech water industry started in 1992. The entire preparation process for this extensive transformation was initiated primarily by the Resolution of the Government of the Czech Republic No. 222 adopted on 3 July 1991, on the principles of the reforms and transformation processes of the systems of providing drinking water, sewage systems, and waste-water treatment. In the same year, the Act No 92/1991 Coll. was established, on the transfer of property of the state to different persons which defined the course and form of privatization projects, thereby preparing all necessary institutional documents for the extensive transformation and restructuralization not only of the water industry. Besides the mentioned acts, the Ministry of Agriculture also worked

on a study called "Zásady pro privatizaci státních podniků oboru veřejných vodovodů a kanalizací" (Rules for Privatizing State-Owned Enterprises in the Area of Public Waterworks and Sewage Plants). The objective of the study was i.a. to introduce foreign experiences to the issue and their recommendations for a healthy development of the branch, as well as appropriate setting of regular mantinels for the functioning of the market environment. The study also stressed the advantages of bigger organizational structures that function more effectively and provide the users with high-quality services with appropriate tempo of price growth (Transparency International, 2009).

The specific process of transformation of the branch started in 1993, initiated by a gratuitous transfer of state-owned property of the water industry's infrastructure and operational property (via the Fund of National Property) to the self-government of cities and municipalities. In principle, every city or municipality became a sole owner of its water industry infrastructure and its operational property. All responsibility from these remained with the management of the municipalities. Until 1993, there existed overall 11 state-owned water industry enterprises (9 regional and 2 in Prague that provided the management, renewal, and development of water industry infrastructure). The implementation of privatization projects and the transformation lead to the fragmentation of these large wholes, in 1994 there were around 40 regional water industry enterprises and more than 1,200 additional small-scale operators. The privatization projects were at the same time constructed so that they secured the decisive influence of the cities and municipalities over the newly established water industry enterprise via having the majority of the shares in them. The beneficial interest of these enterprises (that the municipalities also received for free) was established by the value of their infrastructural property. Naturally, larger cities with a dense infrastructural network had a larger property share in the regional water industry enterprises than smaller municipalities with only several connections. Already at this stage, between 1992-1993, the state calculated the option of creating two different models of management:

- *Mixed model* – water industry enterprise owns and at the same manages the water infrastructure based on agreed upon norms and proper administration of the enterprise.
- *Separated model* – water industry enterprise only owns the water infrastructure and the management and connected services are provided by other natural or legal persons based on a contract (separation of ownership and management). Municipalities do not lose the oversight over the water and sewage prices.

To call the process until this point as a privatization process is completely false. It only came to the so-called deetatization – a transfer of the previously state-owned property (water industry and sewage infrastructure and connected operational property) to cities and municipalities. The original 11 water industry enterprises were by privatization projects fragmented into about 40 regional water industry enterprises whose new majority shareholders were the self-governments of cities and municipalities. Approximately 90% of all the shares of these newly established water industry

enterprises were owned by cities and municipalities. The state also within this process created certain safeguards that were supposed to even prevent a complete privatization of this industry as a monopole. Such a safeguard was e.g. an option of using the state administration's influence in water industry enterprises in the form of a "golden share". In such a case, the state could block any fundamental planned changes in the water industry enterprises for which a certain number of shares would be needed at the general meeting. The state also as a part of the privatization projects worked in limiting rules regarding the transfer and selling of shares. The intent of this was to keep the planned owner structure and prevent the selling of shares to the hands of private enterprises. Privatization (selling of share into private hands) would be a serious breach of not only the rules of the water industry enterprises but also of the rules of the Commercial Code. The remaining 10% of the market was provided by small operators created by cities and municipalities that decided to not invest their gained infrastructure and operational property into the ownership of regional water industry enterprises in which the municipality could have their representative, or participated in the ownership of such an enterprise via the purchase of a minority part of the shares (Transparency International, 2009).

At the end of the 1990s, the tendencies towards gradual actual privatization of the water industry enterprises commenced via a direct purchase of shares. In many divisions of owners of water industry infrastructure, it came to the transfer of ownership of separable (operational) property. E.g. in the South Bohemian Region in its water industry, already in 1998, the relation to the property changed this way in more than 90 cities and municipalities. The consequent privatization was joined by more than 45 regional water industry enterprises (MZe, 1999).

Tab. 1: Approach to privatization of water lines and sewerage systems until December 31, 1998

Privatized enterprises	45
Presented projects	162
Accepted projects	84
Privatized property	48,720,000,000 CZK
Implementation approach (of property privatization)	99.98%

Source: Ministerstvo zemědělství, 1999: Report on the state of the water industry of the Czech Republic, 1999.

The biggest interest of investors (mostly abroad) was in the shares of large cities that provided water to densely populated areas or in enterprises that provided the management of large areas. For example, the enterprise Pražské vodovody a kanalizace a.s. was privatized this way – by selling shares (it was established in 1998 via the decision

of the Fund of National Property and thereby separating property from management), which provided the provision, draining, and cleaning of water for the entirety of Prague and parts of the Central Bohemian Region. Ownership of the Prague water industry infrastructure remained (and remains until today) in the hands of the enterprise Pražská vodohospodářská společnost that is 100% owned by the Prague City. In the first stage, 66% of shares of the enterprise Pražské vodovody a kanalizace a.s. was sold off in a public tender, the remaining 34% were transferred with no additional costs within a privatization project to the ownership of the Prague City. The second stage happened within a few months and the remaining 34% of shares were sold to private hands, namely to a supranational water concern Veolia Voda (at that time Vivendi Water).

Similarly, privatization took place in other water industry enterprises that decided to separate their operational part from their ownership structure. They signed a contract between the operational enterprise and the city (or the alliance of cities and municipalities) lasting longer than 20 years. The sale of the operational parts of the enterprises meant that cities received sufficient amount of finances and the transfer of responsibility of the operations of infrastructure. Privatization of water industry enterprises also often happened via selling of shareholder rights (basically granting full powers to voting rights on shares), which allowed a relatively simple loophole of the rules of the water enterprises about the inability to directly transfer shares. The administration of cities and municipalities did not have experience with running infrastructure and often had problems. The arrival of private partners was therefore a natural reaction to missing market know-how and insufficient capital facilities.

Comparative analysis of data and comparison of the current state with the state in 1993

Since 1993, the Czech water industry came a long way. It went through a complicated change of property structure, as well as an extensive industry-wide transformation. Despite fundamental changes in the running of the entire industry, there has been significant development and the market environment has at least partially stabilized although the entire society still passionately debates the efficiency of private and public operators.

Thanks to the government's approach and the transformation and privatization plans, the current Czech water industry consists of 6,795 owners of infrastructure (almost the same number as the number of cities and municipalities in the Czech Republic) and 2,878 operators (Table 2). The Czech Republic is unique within Europe, especially due to the number of owners.

Tab. 2: Number of owners and operators

	1993	2017	Change
Owners	11	6,795	+6,784
Operators	11	2,878	+2,867

Source: Ministerstvo zemědělství, 1999, ČSÚ.

Water line infrastructure

Drinking water has become more accessible for Czech users. In 1993, there were 8.75 mil. people connected to water lines (see Table 3), which was 84.7% of the population. Until 2017, this number grew to 10.03 mil. inhabitants (94.7% of population). As of right now, almost all households in the Czech Republic have access to a drinking water line. The availability of basic human needs, to which access to drinking water definitely counts, is in close connection to the increasing living standard of the society.

Tab. 3: Number of inhabitants connected to the water line network

	1993	2017	Change
Number of inhabitants	8.75 mil.	10.03 mil.	+ 1.28 mil.
Share	84.7%	94.7%	+ 10%

Source: Ministerstvo zemědělství, 1999, ČSÚ.
To serve such a number of inhabitants, it was necessary to significantly broaden the water line infrastructure, as well as to revitalize the already existing water line network. The overall length of the water line infrastructure increased between 1993 and 2017 by approximately 33,000 km (Table 4). Each year, it has on average expanded by around 1,375 km (around 6.5 times the distance between Brno and Prague).

It is also important to mention that the development of infrastructure is capitally very difficult. According to the Ministry of Agriculture, the value of the water line infrastructure is more than 365 bil. KCZ which is ca. 4.6 mil. CZK per 1 km of water line.

Tab. 4: Length of water line infrastructure

	1993	2017	Change
Length (km)	45,579	78,584	+ 33,005

Source: Ministerstvo zemědělství, 1999, ČSÚ.

Gradual revitalization, significant increase of the state of water line infrastructure, and faster resolving of accidents reflects the significant decrease in water waste within the pipe network when distributing water. In 1993, the overall water loss in pipes was 310

mil. m^3 per year. Until 2017, the annual loss decreased by 212 mil. m^3 (Table 5). The overall share of lost water in the pipes was about a third of water in 1993. The resulting losses in 2017 constitute around a fifth of the overall distributed water amount.

Tab. 5: Water loss in pipe networks

	1993	**2017**	**Change**
Losses (mil. m^3/year)	310	98	-212
% from distributed water	28.9%	16.4%	-12.5%

Source: Ministerstvo zemědělství, 1999, ČSÚ.

Although the number of inhabitants connected to the water network has significantly increased since 1993, the overall yearly volume of invoiced water decreased by about 261 mil. m^3 of water (decrease of 35%, Table 6).

Tab. 6: Volume of invoiced water

	1993	**2017**	**Change**
Volume of invoiced water (mil. m^3/year)	743	482	-261

Source: Ministerstvo zemědělství, 1999, ČSÚ.

The explanation of the above stated decreasing trend in volume of invoiced water can be found primarily in the steadily decreasing consumption of water on average. In 1993, the average water consumption was 223 l per day and inhabitant, until 2017 this value decreased to around 132 l daily (Table 7). The average consumption of drinking water in households was 88.7 l per day and person in Czech households in 2017. This number decrease by half since the 1990s. The Czech Republic is in this instance one of the most economical in Europe. A lower average water consumption is only in Estonia and Slovakia. The trend is also influenced by the development of technologies that introduced much more economical appliances to Czech households.

Tab. 7: Average water consumption in the Czech Republic

	1993	**2017**	**Change**
Average overall water consumption (l/day)	223	132	-91

Source: Ministerstvo zemědělství, 1999, ČSÚ.

The following Table 8 shows an interesting comparison. It illustrates how the buyer power of an average wage developed over time. Meaning how many stated goods we could

purchase with an average wage. In 2017, we could purchase with an average wage 775 kWh of electricity and 634 liters of gas more than in 1993, but water got relatively expensive, and we could only purchase on average 212 m^3 less. Also due to the increased prices of water and sewage, Czech households behave more economically and the average consumption decreases.

Tab. 8: Buyer power of the average wage

	1993	**2017**	**Change**
Water (m^3)	553.85	341.03	-212.82
Gas (l)	338.53	972.5	+633.97
Electricity (kWh)	6,946	7,721	+775

Source: ČSÚ.

Waste infrastructure

The number of people connected to the sewage system also increased. In 1993, approximately 6.7 mil. inhabitants were connected to the network; this number grew to more than 9 mil. inhabitants in 2017 (Table 9). In 2017, more than 85% of the Czech population were connected to the sewage system. Sewage sinks in gardens have become only an unpleasantly smelling memory for a lot of Czech households.

Tab. 9: Number of inhabitants connected to the sewage system

	1993	**2017**	**Change**
Number	6.7	9.05	+2.35
Share	64.9%	85.5%	+20.6%

Source: Ministerstvo zemědělství, 1999, ČSÚ.

With the growing number of inhabitants connected to the sewage system, its length also increases. Since 1993, the length of the system grew by almost 31,000 km (Table 10). Each year, it grew on average by around 1,291 km. Same as the water system, the sewage system pipes are very costly. The overall value of the sewage system is more than 400 bil. CZK. Each kilometer of sewage infrastructure is worth almost 8.5 mil. CZK.

Tab. 10: Length of the sewage system (km)

	1993	**2017**	**Change**
Length of the sewage system (km)	17,493	48,491	+30,998

Source: Ministerstvo zemědělství, 1999, ČSÚ.

With a constantly decreasing amount of used water, the overall volume of invoiced water also decreases. Logically, the volume of water released into sewage also decreases. In 1993, the volume of released water was more than 690 mil. m^3 per year; this number decreased by 237 mil. m^3 by 2017 (Table 11).

Tab. 11: Volume of water released into the sewage system (mil. m^3/year)

	1993	**2017**	**Change**
Volume of water released into the sewage system (mil. m^3/year**)**	690.3	453.3	-237

Source: Ministerstvo zemědělství, 1999, ČSÚ.

In comparison with 1993, the Czech Republic now has more than four times more sewage treatment plants. In 1993, there were 677 plants, the network grew to 2,612 plants in 2017 (Table 12). These plants do not only clean waste water from households but also rain water which lands in the sewage system. Primarily rain water is nowadays being cleaned in larger volumes than in the 1990s and the plants are always busy even though the volume of waste water from households has decreased.

Tab. 12: Number of waste water plants

	1993	**2017**	**Change**
Number of waste water plants	677	2,612	+1,935

Source: Ministerstvo zemědělství, 1999, ČSÚ.

Thanks to the extensive network, a much larger share of waste water can be cleaned. In 1993, around 79% of waste water was cleaned; in 2017, the volume of cleaned waste water was 97.5% (Table 13). Almost all waste water is therefore cleaned effectively and can be reused.

Tab. 13: Share of cleaned waste water within the overall volume of waste water

	1993	2017	Change
Share of cleaned waste water	78.9%	97.5%	+18.6%

Source: Ministerstvo zemědělství, 1999, ČSÚ.

Conclusion

The Czech water industry has come a long way since the 1990s. The deciding factor for the future of this branch was the transformation process, during which the infrastructural property was transferred to cities and municipalities that were supposed to then decide how to manage the newly gained property. The implementation of privatization projects lead to the fragmentation of the original 11 water industry enterprises into more than 40 regional water industry enterprises to which the municipalities were able to voluntarily invest their infrastructural property and still decide on the questions of management together with other representatives of cities that decided on the same approach. As a part of the privatization projects, newly established regional water works were constructed so that they could secure the deciding influence of cities and municipalities via major share ownership. The beneficial interest of municipalities of these newly established water enterprises (that municipalities received free of charge) was determined by their infrastructural property that they invested in the enterprise. Although the statutes of these regional waterworks allowed direct sale of shares only between the current owners (primarily cities) – which was supposed to prevent privatization of enterprise – the extensive process of privatization started in 1998 when the market was opened to domestic and foreign investors.

The comparative analysis of the overall development of the market since 1993 seems very optimistic. In 1993, there were 84.7% of Czech inhabitants connected to the water network. This number grew to 94.7% in 2017. The sewage network grew by almost 31,000 km and by 2017, there were 20% more people connected to the system than in 1993. The density of the infrastructure almost doubled since the 1990s. The growing efficiency of the branch is evidenced by the number on water loss in pipes during distribution – this value decreased by 68% between 1993 and 2017. The number of sewage treatment plants also significantly increased – the Czech water industry manages to clean 97.5% of sewage water. Despite a larger share of connected inhabitants, the overall volume of invoiced water constantly decreases and Czech households on average are one of the most economical users of water in Europe. For enterprises to upkeep their profits, to develop and maintain the infrastructure, increase the quality of services, and to secure the corresponding quality of water, it is necessary for the price of water to also increase. In comparison with the prices of goods such as electricity or gas, the growth of the water price is much higher.

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Comparison of neural networks and regression time series on forecasting development of US imports from the PRC

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Abstract

The contribution deals primarily with the development and prediction of the PRC export to the USA, comparing traditional statistical methods in the form of regression analysis of time series and artificial neural networks, which are a very important prediction tools, and become an integral part of modelling and predicting certain development of time series based on the statistical data. The USA import from China can be defined based on the statistical, causal, and intuitive methods. In this case, the contribution deals primarily with comparing the statistical methods. The contribution provides only a possible framework of the monitored variable development. It is necessary to work also with the information about the future economic, political or legal environment. If it is possible to predict their development, it can then be reflected in the monitored variable. Optically, the best option from linear regression appears to the curve obtained by the least squares method by negative exponential smoothing. As for the neural networks, all retained structures appear to be applicable in practice. In terms of the correlation coefficient, only neural networks are applicable.

Keywords: regression time series, neural networks, prediction, import

Introduction

Import development and forecast may be determined based on statistical, causal and intuitive methods. In this case, the paper is focused on a specific comparison of statistical methods using the method of artificial neural networks, which has brought some promising results in similar applications recently. It consists in an artificial intelligence

approach that, based on historical data, is able to accurately model and predict certain development of a time series. Therefore, the main objective here is to compare the accuracy of time series alignment using regression analysis and neural networks in terms of US imports from the PRC. Such imports were selected due to the enormous influence of the two countries on the world economy. Accurate measurements and adequate import forecasts may have a major impact on the world economy.

International trade may be characterized as the exchange of goods, services and capital across international borders. It represents a substantial share of gross domestic product in most countries (Fürst and Pleschová, 2010). Bernard (2004) states that the international, social, economic and political importance of international trade has been increasing in recent centuries. Also, international trade is a more complex process than domestic trade.

Rowland and Vrbka (2016) claim that in order to forecast import development, it is possible to use, for instance, artificial neural networks or regression time series. According to Sanchéz and Melin (2015), neural networks are widely applied in a number of different areas. The main advantages include, e.g. their ability to work with large amounts of data, the accuracy of results, etc. (Vrbka and Rowland, 2017; Šuleř, 2017). Sayadi et al. (2012) argue that other advantages of neural network methods for forecasting key business indicators involve the ability to learn and generalize. Neural network models may also be used to approximate high-precision functions (Tealab, 2018; Pao, 2008). Falat and Pancitova (2015) combined various models of state-of-the-art artificial neural networks and introduced an alternative in developing accurate forecasts of various financial factors. The precision of their technique gave the impression that it was on a comparable scale with standard models. When using regression in forecasting, time series ought to be considered while trying to forecast the future (Sloboda, 2015). According to Horák and Krulický (2018), there may be certain issues with time series data. On using time series regression models, it is important to distinguish two different types of forecasts, i.e. ex-ante and ex-post. The former is carried out only with previously available information, while the latter is created using subsequent information on predictors.

Literature research

The regression time series method enables to forecast a future response that is based on the response history and transmission of dynamics from relevant predictors. Additionally, regression time series allows to understand and forecast the behaviour of dynamic systems from experimental or observational data and at present, it is commonly used to forecast and model biological, financial and economic systems (Pesaran and Smith, 2014).

Imports from China to the United States require a large number of units being synchronized, keeping the supply chain in motion, and including several basic guidelines.

The process also involves delivery of goods, payment for goods, transportation, ultimate distribution, etc. (Geng et al., 2017).

Ziyadin et al (2017) deal with China's current economic potential. China is one of the largest recipients of foreign direct investment in the world and plays a leading role in world trade.

Kourentzes (2013) designed a neural network methodology for forecasting intermittent time series used to provide dynamic demand forecasts not assuming a constant level of demand in the future and being able to capture interactions between non-zero demand and the rate of incoming demand. These neural networks have proven effective for intermittent demand applications.

According to Liu et al. (2009), CNY exchange rates may be considered as time series characterized by high uncertainty, non-linearity and time-varying behaviour. GBP-CNY and USD-CNY exchange rate forecasts were made with the use of RBF neural networks. A detailed design of RBF neural network architecture, transfer functions of hidden-layer nodes, input vectors and output vectors was put into practice by a number of tests. Experimental results showed that the performance of RBF neural networks for CNY exchange rate forecasts is acceptable and effective.

Dongdong and Wenhong (2011) note that financial time series is non-stationary, non-linear, and stochastic, which may prove to be difficult. The authors used a specific method based on wavelet analysis and artificial intelligence to forecast the A300 index in China and the NASDAQ index in the USA. Compared to the wavelet-ARIMA model and a simple BP neural network, their model shows superiority in performance forecasting. Results of different forecast lengths indicate that these methods are only suitable for short-term forecasts. The forecasting difference between the A300 and the NASDAQ suggests that the Chinese stock market is less efficient than the US one.

De Souza et al. (2010) introduced a new weight predictor of neural network time series that utilizes a virtual generalized Random Access Memory weight neural network to anticipate future returns of shares. The new predictor was evaluated on forecasting future weekly returns of 46 shares from the Brazilian stock market. Their results showed that the Random Access Memory weight neural network predictors are able to give forecasts of future returns with the same error levels and characteristics of basic predictors of autoregressive neural networks yet running 5000 times faster.

In January 2017, US imports from China rose from USD 39,381.80 billion to USD 41,376.30 billion, averaging USD 12,888.43 billion between 1980 and 2017 (with a record high of USD 45,700.60 million in September 2017 and a record low of USD 58.40 in March 1980) (Trading Economics, 2019). The highest import categories in 2017 were: electrical machines (USD 147 billion), machines (USD 110 billion), furniture and linen (USD 32 billion), toys and sports equipment (USD 26 billion), and plastics (USD 16 billion).

Methods and Data

The data for the analysis is available on the World Bank web pages, etc. The information about the import from China to the USA will be used for the purpose of analysis. The time interval covering the available data is a monthly balance, which starts in January 1985 and ends in August 2018. There are 404 input data. The unit is a billion of US dollars.

The descriptive data characteristics are shown in Table 1.

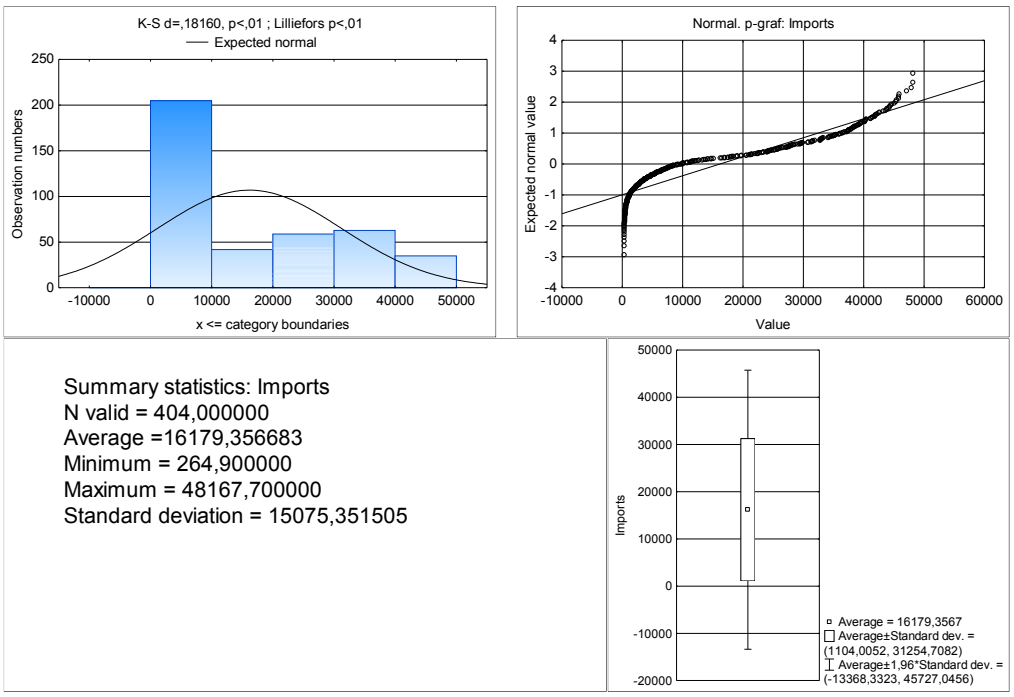
Tab. 1: The characteristics of data set

Samples	Month (Input prom.)	Imports (Output (aim)
Minimum (Training)	31,048.00	264.90
Maximum (Training)	43,313.00	48,167.70
Mean (Training)	37,316.95	16,718.52
Standard deviation (Training)	3,549.13	14,981.52
Minimum (Testing)	31,138.00	283.30
Maximum (Testing)	42,948.00	45,817.80
Mean (Testing)	36,651.48	14,618.18
Standard deviation (Testing)	3,758.45	16,187.18
Minimum (Validation)	31,199.00	348.70
Maximum (Validation)	42,979.00	45,429.70
Mean (Validation)	37,060.87	15,188.48
Standard deviation (Validation)	5,186.49	14,723.70
Minimum (Overall)	31,048.00	264.90
Maximum (Overall)	43,313.00	48,167.70
Mean (Overall)	37,180.08	16,179.36
Standard deviation (Overall)	3,554.16	15,075.35

Source: Own processing.

The development of import in a time perspective is obviously interesting. Therefore, the Figure 1 shows selected statistical characteristics in a graphic form; including the histogram of the input data.

Figure 1: Graph of basic statistical characteristics



Source: Own processing.

The data processing will be carried out by Statistica software version 12 of DELL Inc. The linear regression will be performed first, followed by the use of neural networks for the purpose of regression.

The linear regression will be performed on the examined data sample for the following functions:

- Linear,
- Polynomial,
- Logarithmic,
- Exponential,
- Distance weighting polynomial,
- Negative exponential smoothing polynomial.

First the correlation coefficient will be calculated, i.e. the time dependence of the USA import from China. Further we will deal with the significance level at 0.95.

After that the regression will be performed with the help of neural structures. We will generate the multi-layer perceptron networks and the neural networks of basic radial function. The independent variable will be time. The dependent variable is defined as the USA import from China. The time series will be divided into three sets, i.e. training, testing and validation. The first one includes 70% of input data. The neural structures will be generated on the base of the training data set. The two remaining sets will contain 15% of remaining information. Both sets will serve as a tool for the verification of the

discovered neural structure, i.e. the discovered model. The delay of the time series will be 1. We will generate 10,000 neural networks. Five of them which will have the best characteristics will be preserved1. There will be a minimum of two neurons in the hidden layer; however, the maximum will be 50. In case of radial basic function there will be at least 21 neurons and at the most 30 neurons in the hidden layer. The following distribution functions will be considered for a multiple perceptron network in both the hidden and output layers:

- Linear,
- Logistic,
- Atanh,
- Exponential,
- Sinus.

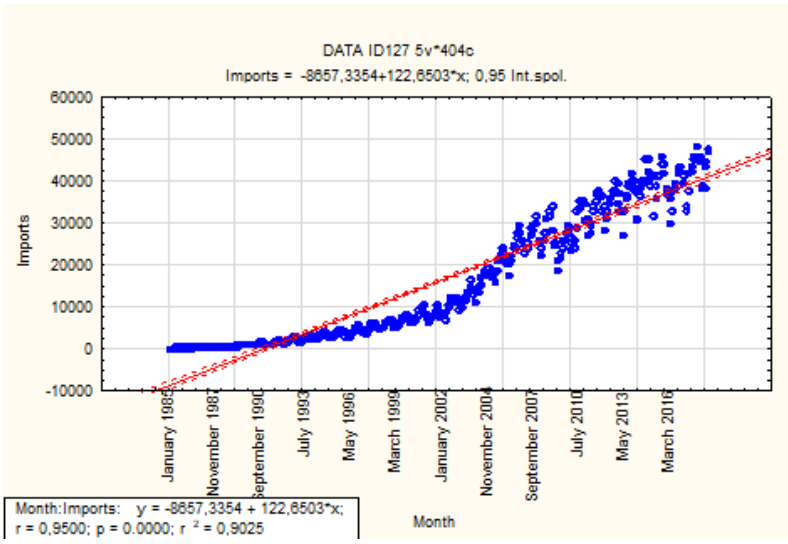
Results

Linear regression

The correlation coefficient equals to 0.95, which means a significant statistical direct dependence of the USA import from China on the time development. The coefficient of determination acquires the value of 0.9025.

A scatterplot has been formed (for more details, see Figure 2) in which the individual points were fitted with a regression curve; in this case linear. The parameters of the curve are clearly shown in the graph.

Figure 2: The scatterplot of the USA import from China with fitted regression curve – linear function

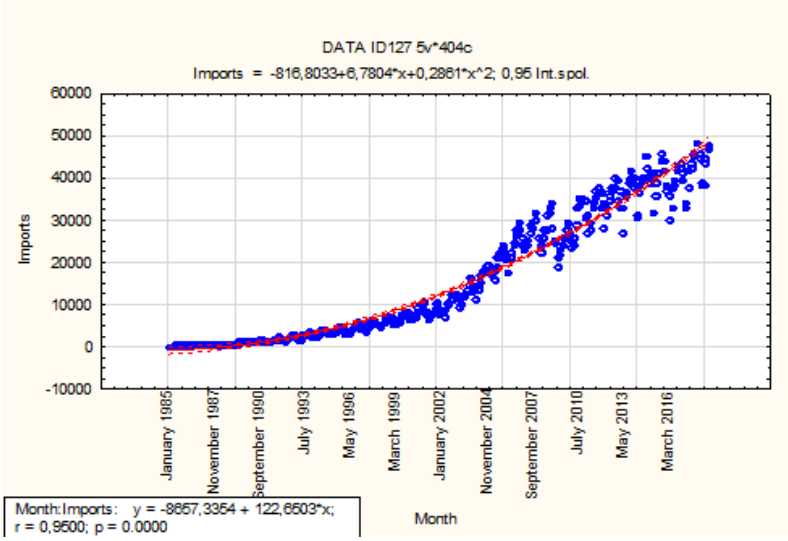


Source: Own processing.

We will use the least squares method. The generating of networks will be terminated unless there is an improvement, i.e. the reduction of the value of the aggregate of squares. Therefore, we will preserve such neural structures which will have the lowest aggregate of squares of residua in relation to the real development of the USA import from China, i.e. zero in an ideal manner.

The full line represents a regression function. The straight line does not balance the time series quite accurately. Figure 3 shows the scatterplot fitting with the polynomial function.

Figure 3: Scatterplot of the USA import from China with fitted regression curve – polynomial fiction

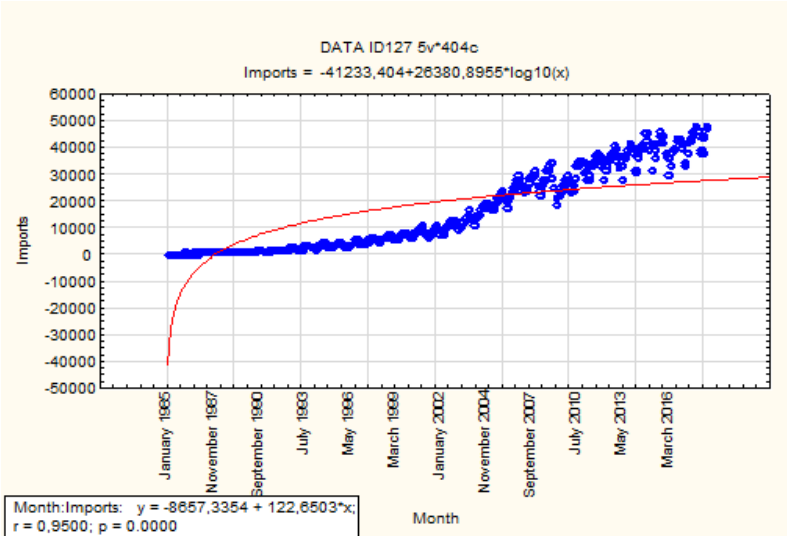


Source: Own processing.

It is immediately obvious that the polynomial function balances the time series markedly more accurately then the straight line of the linear function.

Figure 4 shows the scatterplot fitting with the logarithmic function.

Figure 4: Scatterplot of the USA import from China with fitted regression curve – logarithmic function

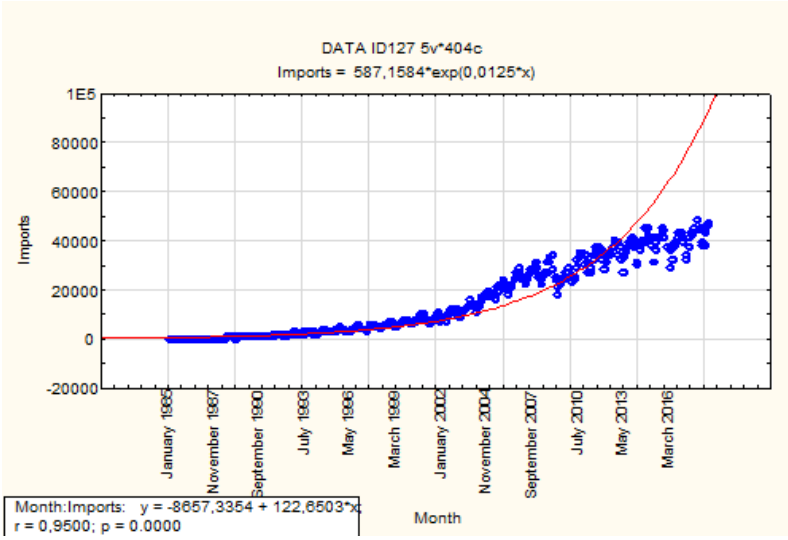


Source: Own processing.

The shape of hyperbola and the location of individual points in the graph clearly show that the logarithmic function is not suitable for a regression.

Figure 5 provides a scatterplot of the USA import from China which is interspaced with an exponential function.

Figure 5: The scatterplot of the USA import from China interspaced with the regression curve – exponential function

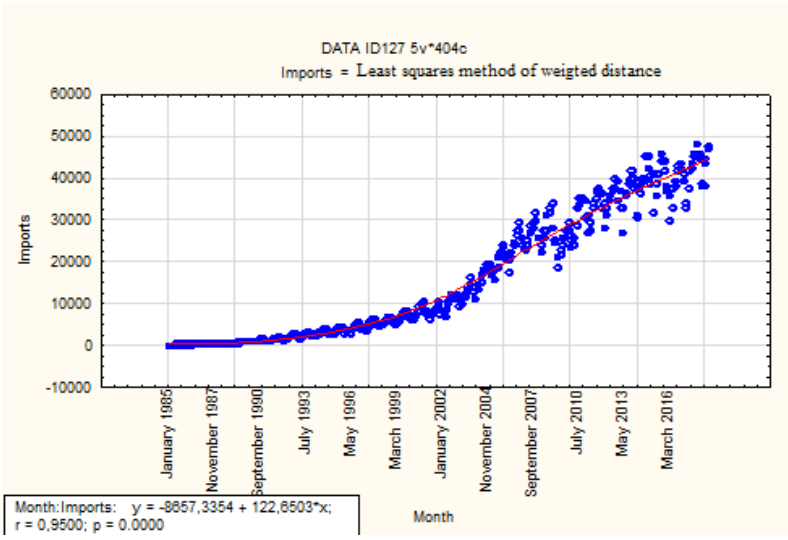


Source: Own processing.

The figure clearly shows that the curve has been gaining unreal values since 2013. Even this fitting of data of the USA import from China is not appropriate. Figure 6 presents a

scatterplot of the development of the USA import from China with fitted with function obtained by using the least squares method of distance weighting.

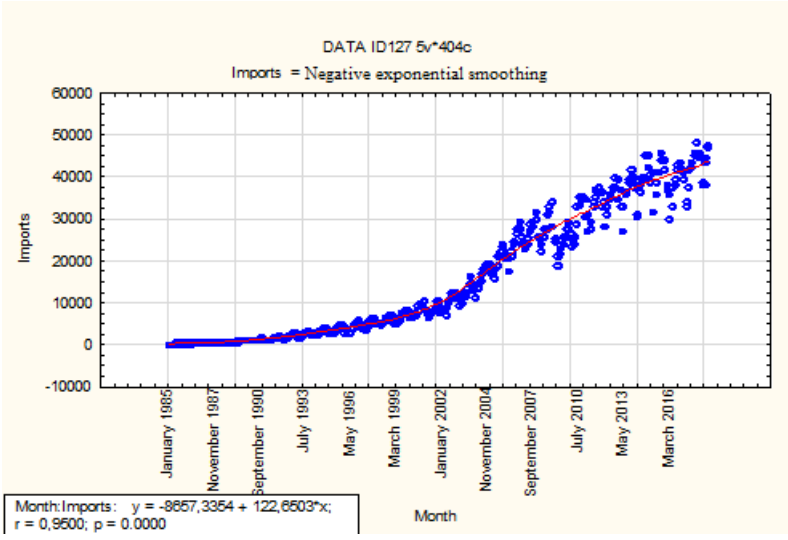
Figure 6: Scatterplot of the USA import from China with fitted regression curve – function MLS distance weighting



Source: Own processing.

The curve quite appropriately copies the development of the USA import from China in its total interval. Figure 7 presents the fitting with a function. It has been obtained with the help of the least squares method in a negative manner, i.e. exponential smoothing.

Figure 7: Scatterplot of the USA import from China with fitted regression curve – function MLS negative exponential smoothing



Source: Own processing.

Even this curve seems interesting and appropriate for an eventual prediction.

As mentioned above, the correlation coefficient at 0.95 indicates a significant statistical indirect dependence of the targeted variable on the time development. If we considered the results merely by an optical comparison of the development of the USA import from China and by a shape of regression curve and if we considered a simple linear regression at the same time, we could definitely conclude that the curves obtained by the method of least squares - negative-exponential smoothing and by the method of the least squares of weighting distances correspond with the development the most. The polynomial function would certainly hold the third imaginary position. All the three functions follow the basic development of the USA import from China.

Neural structures

There have been generated 10.000 neural networks on the base of the defined procedure. Five of them that have the best parameters have been preserved. They are presented in Table 2.

Tab. 2: The list of retained neural networks

Index	Network designation	Training perform.	Testing perform.	Valid. perform.	Training. error	Testing error	Valid. error	Training algorithm	Error function	Activation hidden layer	Output activat. function
1	RBF 1-28-1	0.985565	0.993687	0.988204	3199247	2234000	2510302	RBFT	Sum of squares	Gauss	Identity
2	RBF 1-24-1	0.981934	0.994521	0.988715	3985467	2272140	2446088	RBFT	Sum of squares	Gauss	Identity
3	RBF 1-25-1	0.974559	0.988826	0.988329	5593698	2897250	2473482	RBFT	Sum of squares	Gauss	Identity
4	RBF 1-30-1	0.988410	0.992897	0.988280	2564933	2679733	2424616	RBFT	Sum of squares	Gauss	Identity
5	RBF 1-28-1	0.979283	0.989343	0.987745	4565578	3029347	2526599	RBFT	Sum of squares	Gauss	Identity

Source: Own processing.

There are only the neural networks of basic radial function. There is one variable in the entrance layer, i.e. time. The neural networks contain from 24 to 28 neurons in the hidden layer. Consequently, there is a single neuron and a single output variable in the output layer, i.e. the USA import from China. The training RBFT algorithm was applied in case of all the networks. Moreover, all the neural structures used the same function for the activation of the hidden layers of neurons, Gauss curve in particular. Similarly, the same function is used for the activation of the external layer of neurons, i.e. the identity function (see Table 2).

The training, testing and validation performances are definitely interesting. In general, we look for such a network that has an identical performance in the same data sets, i.e. ideally. Let us remind of the fact that the distribution into the sets was coincidental. The error ought to be the smallest possible.

The performance of individual data sets is defined in the form of correlation coefficient. The values of individual data sets based on the individual neural networks are shown in Table 3.

Tab. 3: Correlation coefficients of individual data sets

Network	Imports (Training)	Imports (Testing)	Imports (Validation)
1.RBF 1-28-1	0.985565	0.993687	0.988204
2.RBF 1-24-1	0.981934	0.994521	0.988715
3.RBF 1-25-1	0.974559	0.988826	0.988329
4.RBF 1-30-1	0.988410	0.992897	0.988280
5.RBF 1-28-1	0.979283	0.989343	0.987745

Source: Own processing.

The conclusion, based on the table, is that the performance of all the neural structures is roughly identical. The insignificant differences bear no influence on the performance of individual networks. The value of the correlation coefficient of all the training sets is in the interval from more than 0.974 to 0.988. The value of the correlation coefficient of testing data sets acquires more than 0.988 in case of all the neural networks. The correlation coefficient of validation data set of all the neural networks is above the level of 0.987. We need to carry out the more detailed analysis in order to select the most appropriate neural structure. Table 4 shows the basic statistical characteristics of the individual data sets for all the neural structures.

Tab. 4: The statistics of individual data sets according to the retained neural networks

Statistics	1.RBF 1-28-1	2.RBF 1-24-1	3.RBF 1-25-1	4.RBF 1-30-1	5.RBF 1-28-1
Minimal prediction (Training)	-105.81	580.89	121.1	-246.8	-297.8
Maximal prediction (Training)	45.281.06	46.726.83	46.002.4	44.572.1	44.832.3
Minimal prediction (Testing)	-17.55	875.04	204.9	-236.1	-66.6
Maximal prediction (Testing)	43.523.94	43.272.06	45.755.1	41.867.8	44.650.5
Minimal prediction (Validation)	-115.73	782.33	664.4	-228.6	-361.7
Maximal prediction (Validation)	43.676.46	43.430.95	45.447.6	41.848.5	44.800.2
Minimal residua (Training)	-9.388.83	-9.090.02	-12.440.4	-11.451.6	-10.678.7
Maximal residua (Training)	9.830.06	11.453.48	13.102.8	8460.7	10.527.1
Minimal residua (Testing)	-29.29.57	-4.211.16	-4.982.3	-3.175.6	-6.051.8
Maximal residua (Testing)	85.48.44	8.099.91	9.591.5	7.255.6	9.059.8
Minimal residua (Validation)	-84.38.26	-7.010.75	-6.153.3	-8.573.7	-6.018.4
Maximal residua (Validation)	4.860.34	3.833.17	7.097.7	6.317.5	6.693.0
Minimal standard residua (Training)	-5.25	-4.55	-5.3	-7.2	-5.0
Maximal standard residua (Training)	5.50	5.74	5.5	5.3	4.9
Minimal standard residua (Testing)	-1.96	-2.79	-2.9	-1.9	-3.5
Maximal standard residua (Testing)	5.72	5.37	5.6	4.4	5.2
Minimal standard residua (Validation)	-5.33	-4.48	-3.9	-5.5	-3.8
Maximal standard residua (Validation)	3.07	2.45	4.5	4.1	4.2

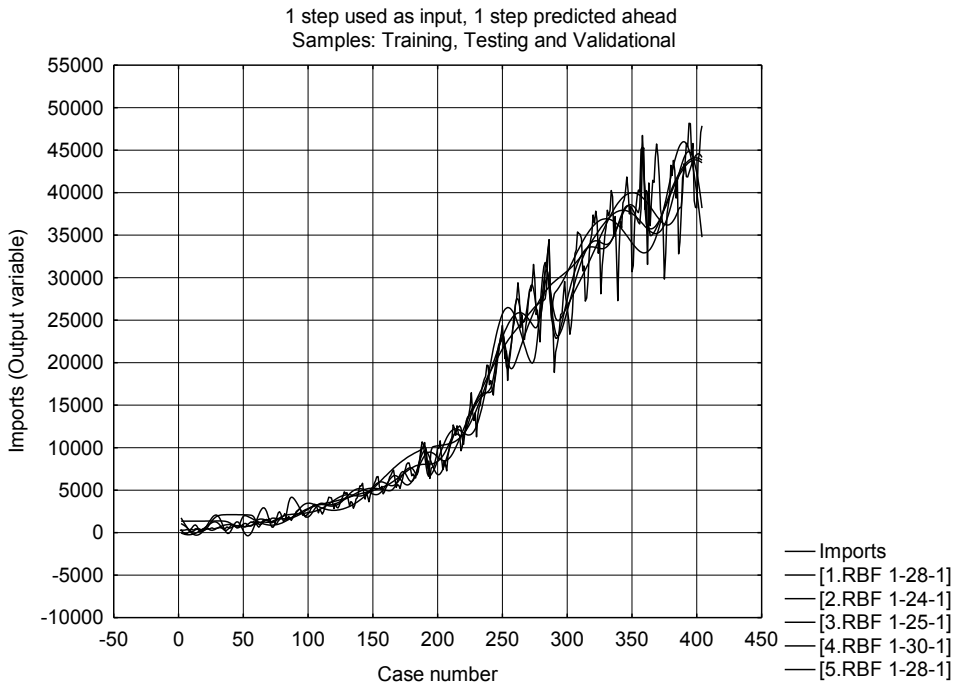
Source: Own processing.

The individual statistics of a neural network are in an overall cross-sectional consensus in all the sets, i.e. minima, maxima, residua; in an ideal case. In case of balanced time series, however, the differences are minimal. There are more significant differences in case of residua. Nevertheless, we are not able to clearly identify the neural network with the most appropriate results.

Figure 8 presents a line chart which displays a real development of the USA import from China and the development of the individual predictions with the tool of individual, generated and retained networks.

The graph clearly shows that all the neural networks predict a development of the USA import from China in the individual intervals with subtle differences. The similarity of the predictions of individual networks is not important but it is the similarity, i.e. the degree of consensus, with the real development of the USA import from China that matters. It is appropriate to claim that all the preserved neural networks seem very interesting at first sight. They respect the curve directions and tend to, although not quite accurately, take into account the extremes of the curve.

Figure 8: Line chart – the development of the USA import from China predicted by the neural networks in comparison with the real development of import in the monitored period



Source: Own processing.

Conclusion

The aim of the paper was to compare the accuracy of the equalizing time series by means of regression analysis and the neural networks on the example of the USA import from China.

In general, every prediction is determined by a degree of probability, which causes its fulfilment. When we predict a future development of any variable, we attempt to estimate the future development of the variable on the basis of the past data. Although we are able to integrate the majority of factors which influence the targeted value into the model, it is always the case of the simplification of reality and we always deal with a certain degree of probability that some predicted scenario will take place. In both cases of the linear regression and the regression with the use of neural networks there is a simplification, which is quite substantial. We deal with two quantities, i.e. the input (time) and the output (the USA import from China). Thus we utterly ignore certain input quantities which often bear a substantial significance on the USA import from China, i.e. the international political situation, taxation in both countries, price of production factors, state support for export, life standard of inhabitants in both countries, and many others). Despite this fact or because of this fact that there are a great number of factors influencing the USA import from China, it is necessary to reconsider, whether the use of time series causes an excessive simplification of the targeted variable or, on the contrary, the other variables are so insignificant that the input variable, i.e. time, and the output variable, i.e. the USA import from China, are entirely sufficient. The purpose of the calculation is thus crucial. It is valid that the aggregated variables are estimated better than the partial variables.

Concurrently we may claim that the significant simplification of reality results in the impossibility of the prediction of extraordinary events and their influence on the USA import from China. Perhaps it is possible in the short time perspective but certainly not in the long term. The ideal prediction would be in the matter of days. However, it is not currently possible to acquire data for such a short prediction.

The USA import from China can be defined on the basis of statistical, causal and intuitive methods. We have dealt with the comparison of statistical methods in this case. They have provided just a mere possible framework of the development of monitored variable. It is necessary to subsequently work with information about the future development of economic, political or legal environment. If we are able to predict its development, we can subsequently project it into the monitored variable. Concurrently the personality of evaluator, i.e. economist, comes into sight. He or she corrects the price, which is defined by the statistical methods and specified on the basis of causal links, on the basis of his or her expertise and experience.

The objective of the paper has been fulfilled.

The best curve out of linear regression, from the optical view, seems the one acquired by the least squares method – negative exponential smoothing and the curve acquired by the least squares method of weighting distances. All the preserved structures of neural

networks have proved to be useful in practice. If we view the performance from the perspective of correlation coefficient, only the neural networks remain to be used and there is hardly any difference between them from the practical point of view.

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Effectiveness of the companies participating in international strategic alliances: methodological and analytical aspects

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Abstract

The article deals with the theoretical, methodological and analytical issues of the development of international strategic alliances that are becoming of increasing importance in the development of global markets and determine the general trends of technological and socio-economic business development. Identification of the content characteristics of the concept international strategic alliance allows outlining the functional areas of analysing their effectiveness. In accordance with the stages of forming the information and analytical support for managerial decisions regarding international strategic alliances, the author suggests the algorithm for analysing the effectiveness of their activities, as well as formulates the task of each stage systematize a set of indicators. The algorithm for calculating synergistic effects is proposed in the article and their qualitative characteristics from the standpoint of internal and external-oriented analysis are presented taking into account the potential of international strategic alliances for synergy. The practical issues of the development of international strategic alliances are presented in the example of Renault-Nissan-Mitsubishi Alliance, which gives an opportunity to outline both the issues of cooperation of participants and strategic guidelines. Discussion issues include the grouping of the advantages and disadvantages of the functioning of international strategic alliances. The results of the study suggest the principles of managing strategic alliances in the modern economy.

Keywords: international strategic alliances, methodological approaches, synergistic effects, advantages, principles of management

Introduction

The process of integration, the result of which at the micro level is the formation, including international strategic alliances (ISA), is one of the key factors in the development of the economy at the present.

The worsening competition in world markets, the high dynamics of technological development and the growth of the cost of innovation is far from a complete list of challenges facing modern, even global companies. International strategic alliances is the very form of association used by separate enterprises to accelerate the dynamics of development, strengthening of competitive positions, etc.

The most significant in the world include the following strategic alliances: IBM and Apple (1991) (in total, IBM has consolidated nearly 1000 strategic alliances), Toyota and BMW (2011), Microsoft and Nokia (2011), Coca Cola and Endomondo (2012), GM and PSA Peugeot Citroen (2012), Mazda and Toyota (2017), Mahindra Group and Ford Motor Company (2017), others. In general, Fortune 500 companies (Global 500, 2018) have an average of 50–70 alliances each. These facts indicate the spread of integration processes at the micro level and their strategic importance for the further development of participants, and therefore their research is important at all stages of development.

The development of international strategic alliances has been actively explored by scientists since the mid-1990s, when the integration and globalization processes intensified.

Thus, the theoretical positions of the development of international strategic alliances, namely, the content characteristics of the concept, forms and stages of development are presented in Bohachev (2009), Hamel. (1991), Holmberg (2009), Kanter (1994), Kauser and Shaw (2004), Vyas, Shelburn and Rogers (1995), Wohlsletter, Smith and Malloy (2005). The development of international strategic alliances from the point of view of the resource theory and the theory of strategic management is disclosed in the writings of Aaker (2002), Das and Teng (2000), Khanna (2010), Lin and Cheng (2010), Mowla (2012), Pellicelli (2003), Zamir, Sahar and Zafar (2014). The issue of the effectiveness of the activities of international strategic alliances in the context of determining the main factors of the forming the competitive advantages becomes the subject of research in the works of Hamel (1991), Holmberg and Cummings (2009), Kasych (2011), Mowla (2012), Schreiner, Kale and Corsten (2009).

Considerably less attention is paid to the issue of the methodological provision of the processes for analysing the performance of international strategic alliances, which needs to be streamlined and integrated. It is often an issue of analysing the feasibility of creating an ISA, but the effectiveness of managing ISA activities depends on the availability of comprehensive information at all stages of creating and operating an ISA.

Methods and Data

The purpose of this article is to develop methodological provisions for analysing the effectiveness of the activities of the international strategic alliance and its participants, formed based on integrating effects in different functional areas. The aim is achieved due to:

- studying the theoretical positions of the processes of developing the international strategic alliances,
- systematizing the existing methods of analysis and justifying the directions of their improvement,
- conducting research on the effectiveness of the functioning of international strategic alliances and their participants on concrete examples,
- formulating general tendencies of developing the international strategic alliances,
- substantiating the principles of effective strategic management of the activities of international strategic alliances.

It is expedient to use the following main methodological approaches to solve the tasks: the integrated and the system approach, the resource and the functional or structural-functional approach and the strategic approach.

The integrated approach determines the need to explore not separate aspects of the ISA and its participants, but all subsystems and all aspects of its operation. The processes of creating ISA and their subsequent developing result in the rapid consolidation, complication of the research object, and therefore there is a need to explore the new aspects and scope of the ISA and its participants.

The system approach to the analysis of the ISA activity determines the necessity of studying the entire system of interconnections between the subsystems of the participating enterprises, whose composition is increasing, as well as their dependence on the impacts of the complex and dynamic external environment. Expanding the scope of the ISA causes its dependence on those factors that did not have a significant impact on the previous stages of development.

The resource approach lies in the fact that each organization has a unique set of resources that distinguish it from other industry enterprises. In addition, while the classical analysis is aimed at analysing the use of productive resources, the strategic one aims at studying the whole complex of the enterprise resources. Accordingly, the task of strategic analysis is to ensure that the enterprise receives, distributes and uses a unique set of resources to provide an effective response to the challenges of the external environment in order to provide competitive advantages.

The functional or structural-functional approach lies in the need for a quantitative assessment of the structural changes that are carried out by participants in order to ensure the effective performance of the ISA functions. Each system performs certain functions, and a system such as ISA has a wider list and more complex operational conditions. The process of developing a strategy at participating companies provides for their coordination within the ISA framework.

The strategic approach defines the understanding of the strategic importance of management decisions for the ISA creation, and therefore, the methodology for analysing the processes of ISA forming and operating should: provide a combination of internal (actually complex) and external (aimed at determining the position in the external

environment) analysis; anticipate the use of modern methods developed by leading scientists and advisory groups.

The complexity of the analysing the ISA effectiveness is caused by certain circumstances, which are considered necessary in the process of developing a methodology:

1. When assessing the effectiveness of the strategic alliance, experts also use indicators that cannot be measured quantitatively. In general, the following should be used: quantitative assessment methods, quality assessment systems and combined (mixed) assessment methods.
2. The method of analysing the ISA should be distinguished by a multi-level approach that is to be reflected as a comprehensive assessment of the strategic positions of the enterprise compared with competitors, and provide a detailed description of the individual components of the strategic potential.
3. The analysis should combine the retrospective, operational and perspective aspects of the study. The laconic wording of the success criteria of a strategic alliance proposed by American experts, Blake and Ernst (1995), should be indicated in connection with the foregoing. In their opinion, the strategic alliance, in the course of which the planned strategic objectives of each of the partners are achieved and all the costs incurred are paid off, should be considered successful. However, it should be clarified that not only the goals of each of the partners, but also the common goals that must be established at the signing of the strategic agreement, must be fulfilled.

As a type of combined assessment, one can consider the ballistic approach offered by (Alliance Operation Effectiveness Assessment, 2009), which specializes in providing consulting services in the formation of strategic alliances. When doing such an assessment, it is necessary to conduct a survey of leading employees of the partner companies and involved experts. They should set an estimate from 0 to 10 for each of the fifteen criteria developed and divided by (Alliance Operation Effectiveness Assessment, 2009) into nine groups: quality of collaboration, information sharing, resource utilization, management, trust and transparency, commercial success, relationships, reputation.

However, universal methods have not been developed. Moreover, given the dynamics and scale of the studied processes, the search for new approaches to their analysis is not stopped.

Results

The history of successful strategic alliances is a decade of successful activity, even when they have not had the characteristics of the strategic ones yet.

Strategic alliances between companies from different countries are becoming more widespread. At present, there are several thousands of them. The goals of such strategic alliances are different, but more often, it is a combination the scientific potential of

corporations, production co-operation and the division of risks mainly without mutual absorption.

The economic encyclopaedia defines an alliance (from French Alliance – Union) as "a union, association of several organizations, enterprises on a contractual basis" (The economic encyclopaedia, 2000, p. 34). The concept of strategic alliances and international strategic alliances is used in the science and practice of management. Definitions that allow us to establish the key essential characteristics of the concept of "international strategic alliance" are presented in Table. 1.

Tab. 1. The economic essence of the concept of "international strategic alliance"

Author	Essence	Base characteristic
Pellicelli (2003)	CAs are agreements between companies (partners) to achieve goals of common interest.	Target orientation of activity
Bohachev (2009)	An international strategic alliance is a formal or informal alliance of companies located in different countries, created to combine resources to address reorganization tasks, increase market efficiency or achieve a "scale effect".	Combining resources, achieving scale effects
Mykhailova (2007)	The international strategic alliance (ISA) is a relatively long inter-organizational cooperation agreement that involves sharing resources and (or) management structures for two or more independent firms from several countries to meet the challenges associated with the mission of each of them.	Duration of cooperation
Pivovarov (2009)	The international strategic alliance (ISA) is a functional agreement (for example, joint research and development, production development, product development, consortia, etc.), asset participation agreements, such as the creation of a new organization (for example, joint ventures), and without the formation of a new organization (mutual exchange of shares, acquisition of a small share of participation).	Functional basis of interaction
Kozachenko and Shulzhenko (2014)	Strategic alliance is a system of partnership and hierarchical relations of various organizational and legal forms between economic entities that preserve a certain autonomy and autonomy of activity, which is built indefinitely for a long time on the property and non-property basis in order to effectively use material and intangible resources, to achieve of common goals during a certain time span, the pursuit of strategic and current shared interests, risk sharing, control and the results of joint activities between the members of the alliance.	Preservation of autonomy and autonomy of activity
Aaker (2002)	SA is the cooperation between two or more organizations, in which participants use their strengths to achieve a common strategic goal.	Use of strengths

Source*:* Systematized by the author.

In general, ***international strategic alliances*** are a business concept for enterprise development, implementation of which involves the formation of stable relationships and ensuring effective interaction between individual enterprises in order to create greater value and develop competitive advantages compared with other market players.

The identification of the content characteristics of the ISA concept allows outlining those aspects of the functioning of alliances, which should be taken into account in the process of analysing the effectiveness of their activities.
1. Target orientation of the ISA activity determines the need to study the content of the strategies of participating companies in the context of their alignment and additions.

2. ISA gives participants the opportunity *to combine their resources*, cooperate in any area of interests, provide significant flexibility to their joint activities, sharing all the risks among themselves, which is in line with their common interests, hence an important area of analysis, is the analysis of resource support activities.
3. The duration of the ISA existence the determines the time horizon for the analysis and the need to calculate forecast indicators on a variant basis, depending on the forms of interaction and development goals.
4. Interaction of the ISA participants may take place within one or more functional areas of activity, respectively, during the study of the ISA effectiveness it is necessary to carry out a meaningful analysis of the functions that are or will occur in the interaction.
5. ISA is aimed at using and strengthening the strengths of the participants. Accordingly, the study should monitor the strengths and weaknesses of not only the ISA and participants, but also in comparison with competitors.
In the world of practice, both large and small companies, unite efforts to succeed on the market and to achieve the goal. That is why the need to develop a methodology for analysing the prerequisites, expediency and implications of ISA is of great importance.

According to the research by international organizations (McKinsey&Company, 2010), the main driving forces for the formation of alliances are: a decrease in the value of products and the possibility of entering new markets in the pharmaceutical sector; the unification of efforts to develop new global products and communications systems standards in the field of communications; the combination of financial and technological efforts to develop more environmentally friendly vehicles and engines, as well as to achieve saving due to the production scales and to enter new markets in the automotive sector; reducing costs in developing common booking and ticket sales systems, customer service in the field of air transportation, etc.

Making a decision on the company's entry into an international alliance and its existence is a complicated process. Since the role of the results of the analysis is decisive for making managerial decisions and for creating and operating the ISA, we will present the analysis methodology in accordance with the objectives of the enterprise management system.

The proposed algorithm for analysing the ISA is presented in Table 2.

Tab. 2. Stages of forming informational and analytical support of managerial decisions concerning international strategic alliances

Stages	Goal	Key quantitative indicators	Key qualitative characteristics
I. Justifying the feasibility of ISA creating			
Stage 1 Researching the main results of financial and economic activity of the enterprises to participate in ISA	Identifying the main economic preconditions for joining the alliance	- dynamics of production volume; - sales dynamics including exports; - dynamics of the number of employees; - dynamics of financial results and financial condition of the enterprise; - dynamics of capital investments and in R&D; - market value of the company and stock prices	- competitiveness of products; - image of the enterprise; - corporate culture; - quality of management
Stage 2 Determining of the economic conditions of forming the alliance	Exploring the optimal balance of participants in the alliance	- percentage ratio of alliance members; - costs that the participants are able to direct to finance joint projects and processes	- kind of alliance; - form of interaction; - list of functions that are consistent
Stage 3 Analysing the resources which are consolidated in the process of creating an alliance	Setting the role of the alliance in the business processes of participating companies	- value of investments aimed at the projects of the alliance; - amount of research funding; - number of staff	- list of activities that are agreed within the alliance;
II. Determining the effectiveness of the ISA operation and the development strategy			
Stage 4 Determining the effect of interaction between participating companies	Determining the effectiveness of the alliance creation agreement and the synergy effect from engagement.	- increase in the number of jobs; - growth of production volumes; - reduction of production cost; - R&D investment and expenditures - increase in production and sales; - increase in the value of shares and enterprises	- personnel training; - formation of the image of the alliance as a whole; - improvement of the system and management structure
Stage 5 Developing an alliance development strategy.	Forming the strategic guidelines for the activities of participating companies in	- volume of production; - R&D expenses; - investments in the development of sales markets;	- technological innovations; - expansion of interaction platforms;

	accordance with the strategy of ISA development	- synergistic effect;	- environmental efficiency.

Source: Formed by the author according to Wallace (2005), Butler (2012), Kasych and Vochozka (2019).

The first stage includes the study on the preconditions and possible benefits of the ISA creation. In order to compete effectively in the global market, the company must intensify technological development and ensure the high level of competitiveness of the products it produces and markets. That is why, the situation in the markets regarding the main parameters of competitive struggle is an important object of analysis, and that is, it is necessary to conduct both internal analysis and the external one.

At the second stage, the options for the ISA creation are summarized, their estimation is done in a cut. This stage should be based on the analysis of the internal capacity of participating companies in terms of compatibility and complementarity. The experience of international alliances confirms that the alliance has a better chance of success if its participants have mutually complementary experience and resources.

At the third stage, harmonization of the terms of cooperation is carried out, and therefore, for each functional area of activity of the participating enterprises, forms and methods of interaction, as well as the resources necessary for ensuring cooperation are determined.

The fourth stage defines the results of the interaction of participating enterprises in terms of functional areas of activity and in general. Using common sales channels, harmonizing the directions of scientific and technical development, combining innovation potential, expanding the potential for the scale effect and other results of the ISA creation form the basis for obtaining a synergistic effect.

The fifth stage involves using the results obtained at the previous stage as the basis for improving the organization and management of ISA, developing a long-term strategy, etc. After a strategic alliance has been formed, it is necessary to continuously monitor the effectiveness of the cooperation and the positive consequences for its companies. In other words, it is necessary to evaluate its efficiency. This is required, on the one hand, to determine the strategic guidelines for the further development of alliances.

The proposed algorithm will enable:

- **first**, to determine the preconditions, course and results of the processes crating and functioning of international strategic alliances,
- **second**, to form the necessary amount of information for making management decisions on the development of alliances at any stage of their functioning,
- **third**, to determine the directions of improving the business model both for participants and for the alliance as a whole.

Most of the overlapping stages of analysis have a sufficiently high level of methodological support. Therefore, it is necessary to further focus on those issues that do not have established methodological approaches, which include, firstly, the study of the interaction scale between participating companies within the ISA framework and the analysis of synergistic effects.

The first important moment that forms the basis for the functioning and development of ISA is the mutual penetration of assets. One company member, while retaining control over their assets, sells some part them to other partners. Since integration into full M&A is not foreseen, it is important to analyse the level of mutual integration. To do this, it is proposed to calculate the integration coefficient of the ISA. Let us take for example the ISA, which consists of three participants: Enterprise A, Enterprise B and Enterprise C. The integration rate of the ISA will be calculated as:

$$K_{I(MSA)} = (K_{I(A)} + K_{I(B)} + K_{I(C)})/3, \quad (1)$$

The deeper is the level of integration, that is, the interaction is closer, the greater synergy effect is expected.

Partial coefficients that reflect the level of integration of individual participating enterprises of ISA:

$$K_{I(A)} = R_{A(B)} + R_{A(C)} \quad (2)$$

$K_{I(A)}$ – coefficient of integration of enterprise A;

$R_{A(B)}, R_{A(C)}$ – share of assets of enterprise A belonging to enterprises B and C.

In our opinion, an expanded integration model allows tracking the economic basis of interaction and can be represented as follows:

$$\begin{gathered} As_A + As_B + As_C = R_A * As_A + R_B * As_B + R_C * As_C + \\ (R_{A(B)} + R_{A(C)}) * As_A + (R_{B(A)} + R_{B(C)}) * As_B + (R_{C(A)} + R_{C(B)}) * As_C \end{gathered} \quad (3)$$

where As – the value of assets of enterprises;
A, B, C – the indices of the ISA participating companies;
R_A, R_B, R_C – share of assets of enterprises A, B, C, which they own;
$R_{A(B)}$, $R_{A(C)}$ – share of assets of enterprise A belonging to enterprises B and C.

As the integration processes evolve between the participating companies, the importance of the analysis of effectiveness and synergy effects is increasing.

Direct synergistic effects that arise in the process of merger and absorption are investigated in the works (The 2018 M&A Report, 2019, Perspectives on merger integration, 2010). Synergistic effects are complex and cannot always be measured by quantitative indicators. Nevertheless, their assessment should be carried out, both at the stage of ISA

creation, and in the process of functioning, in order to understand the correctness of the decision on the ISA creation and determine the directions for further development. The general rule of synergy is as follows: 2+2=5 and more. However, in the process of ISA creation, there is no complete merger of assets, and therefore the definition of synergistic effects is a more complex and multifaceted process, since the combination of participants is partial and combinatorial. The list of potential synergistic effects in the context of the functional areas of activity, which may not have quantitative expression, is presented in the table 3.

Tab. 3. Sources for obtaining synergistic effects of ISA

Functional spheres	**Synergistic effects**
Marketing and sales markets	- expansion of channels of sales (reduction of expenses for realization); - information on the situation on certain markets (reducing the cost of marketing research).
Production sphere	- growth of production volumes; - use of new production sites.
Technologies	- acceleration of technological development in separate directions (reduction of the cost of individual developments and access to their greater quantity); - reduction of the time for organizing new production and reduction of the cost of developing new technologies
Financial sector	- ability to concentrate significantly more investments to implement strategically significant projects for all participants in the ISA (expansion of investment opportunities); - optimization of taxes and the usage of transfer prices.
Management	- dissemination of best practices in decision-making (reducing administrative costs).
Corporate culture	- focus on meeting the integrated goals of sustainable development.
Image	- a combination of image characteristics of companies and the establishment of brands in all markets.

Source: Formed by the author.

Receiving synergistic effects is possible in different functional areas, for example, marketing, investment and innovation activity of the enterprise, etc. Synergistic effect is expedient to determine by using the effective indicators, in particular, the volume of production, the level of profit. That is why the synergistic effect of creating the ISA should be considered as an integral result, which is based on the increase in the indicators characterizing different functional zones of the enterprise and its individual results.

One can talk about the synergy effect on the indicators of income or sales volumes if, at a particular time, each of the participants of the ISA receive not only an increase in the indicator, but an increase that will exceed the average increment of the given indicators for a certain period (offered for the last 5 years), or an increase that will exceed the growth of major competitor companies.

That is, the synergistic effect of ISA is the ability of MSA participating companies to have a better dynamic of key performance indicators compared to the period before the ISA creation or in comparison with industry trends.

To calculate the synergistic effect for the total results (revenue), the following formula is proposed:

$$SYN_R = \Delta R_t - \int_{t-5}^{t-1} f(R)dt / Q[t-5; t-1] \quad (4)$$

SYN_R – synergistic effect received by the enterprise on the indicator of sales revenue;

ΔR_t – growth of revenues from the sale of the enterprise in the year t;

$f(R)dt$ – function of the enterprise revenue in the interval t;

$Q[t-5; t-1]$ – number of years taken for the analysis of the indicator on the interval from t-5 to t-1, that is, the period of 5 years preceding the research year t is taken.

Since in modern conditions, the competitive advantages of enterprises, especially in high-tech industries, are formed due to, primarily, the innovation and investment component of an increase in these costs under a similar scheme will enable the determination of partial synergistic effects, the receiving of which will ensure the development of the potential for obtaining an effective synergistic effect.

Another important aspect of manifesting the synergistic effect in the external environment is the growth of market capitalization of the enterprise and the value of shares. Certainly, the ISA creation and the participation of individual enterprises herein is accompanied by strengthening the image of the company not only among consumers, but also in the stock market. A larger increase in the value of shares that the participating companies will receive compared to the previous period or in comparison with the value of shares of competitor companies can also be attributed to a synergistic effect.

To understand the complexity of using existing and proposed methodological approaches to analysing the performance of the ISA, we will focus on researching such an alliance as Renault-Nissan-Mitsubishi Alliance.

Strategic alliances involving Western European TNCs and US play an important role in international economic relations. According to the OECD and UNCTAD, the transnational corporations of the EU states, on average, make up 35-40% of all strategic alliances in the world. Strategic alliances of TNCs have a significant impact on the development of the world automotive, pharmaceutical and biotechnology industries, as well as play a significant role in the global ICT sector.

The study of the ISA functioning should be conducted in the context of the historical aspects of the creation, analysis of common indicators to identify development rends; analysis of the effectiveness of the functioning of the participants and their associations, including in the context of assessing the probable synergy effect. Such a study will give an opportunity to generalize foreign experience, to identify the advantages and disadvantages of the functioning of such structures of the international economy.

Renault-Nissan-Mitsubishi Alliance is a Franco-Japanese strategic partnership between the Renault automakers, based in Boulogne-Billancourt, France; Nissan, based in Yokohama, Japan, and Mitsubishi Motors, located in Tokyo, Japan, which together sell more than 1 out of 10 cars around the world.

At the beginning of 2019, Renault owns 43% of Nissan shares; Nissan owns 15% of Renault's shares and 34% of Mitsubishi shares. In this case, the review of Nissan's cooperation with Fiat Chrysler is underway, despite the fact that Renault and Nissan can merge into one company.

The main competitors of Renault-Nissan-Mitsubishi Alliance are Volkswagen, Toyota, and General Motors, the main indicators of which are shown in Table 4.

Tab. 4. Key performance indicators for leading automotive manufacturers in the world, 2017

Enterprises	**Place in Global 500**	**Sales volume, units**	**Net Sales, € million**	**Net income, € million**	**Number of employees**	**Capital expenditure, € million**	**R&D costs, € million**
Toyota	5	8,971	231,908	15,387	364,445	10,200	8,700
Volkswagen	6	10,741	230,682	4,353	626,715	13,200	13,600
General Motors	18	9,600	132,355	(3,512)	225,000	8,5	7,4
Nissan	44	5,770	93,369	6,123	137,250	3,792	3,873
Mitsubishi Motors	145	1,001	17,125	4,063	77,164	0.780	0.801
Renault	157	3,761	58,770	3,780	124,849	3,362	2,958
Alliance	–	**10,532**	**169,264**	**13,966**	**339,263**	**7,934**	**7,632**

Source: Formed by the author according to Official sites of Toyota, Volkswagen, General Motors, Nissan, Mitsubishi Motors, Renault, Alliance.

As the figures show, none of the alliance members can independently ensure the achievement of the level of development of global leaders by key indicators of production volumes, investment and innovation costs. They rise to a high level of competition and become a key player in the world market only in the alliance. So, in 2018, the Alliance Renault-Nissan in terms of sales (10.76) exceeded Volkswagen (10.62) and became the largest automaker in the world. It should not be forgotten that there are other powerful players in the global automotive market, including Volkswagen and General Motors, as the participants of the ISA and even the integrated structures.

Tab. 5. The performance indicators of Renault-Nissan-Mitsubishi Alliance

Indicators	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Nissan, € *Million*						
Sales volume	4,914	5,188	5,318	5,423	5,626	5,770
Net Sales	90,845	78,228	82,429	92,345	93,760	93,369
Operating income	4,939	3,719	4,272	6,010	5,938	4,491
Net income	3,230	2,903	3,316	3,968	5,308	5,835
Capital expenditure	4,948	4,002	3,356	3,629	3,754	3,792
% of Revenues	5.45	5.12	4.07	3.93	4.00	4.06
R&D costs	4,433	3,736	3,667	4,030	3,923	3,873
% of Revenues	4.88	4.78	4.45	4.36	4.18	4.15
Number of employees	143,455	142,925	149,388	152,421	137,250	138,910
Mitsubishi-motors, € *Million*						
Sales volume	987	1,047	1,090	1,050	926	1,101
Net Sales	17,123	15,619	15,797	17,174	15,248	17,125
Net income	0.358	0.781	0.857	0.550	-1.588	0.841
Capital expenditure	0.485	0.539	0.493	0.523	0.465	0.780
% of Revenues	2.83	3.45	3.12	3.05	3.05	4.55
R&D costs	0.565	0.504	0.541	0.596	0.712	0.801
% of Revenues	3.30	3.23	3.42	3.47	4.67	4.68
Number of employees	30,330	30,200	29,800	29,555	29,604	30,507
Renault, € *Million*						
Sales volume	2,548	2,628	2,712	2,801	3,468	3,761
Net Sales	41,270	40,932	41,055	45,327	51,243	58,770
Net income	1,735	695	1890	2.823	3,543	5,210
Capital expenditure	2,665	2,551	2,416	2,729	3,047	3,362

% of Revenues	6.46	6.23	5.88	6.02	5.95	5.72
R&D costs	1,863	1,793	1,890	2,243	2,530	2,958
% of Revenues	4.51	4.38	4.60	4.95	4.94	5.03
Number of employees	127,086	121,807	117,395	120,136	124,849	181,344

Source: Formed by the author according to Official sites of Nissan, Mitsubishi Motors, Renault, Alliance.

The alliance creation for participating enterprises, as evidenced by the figures presented, in fact means:

First, the possibility of reaching all continents and ensuring the presence in an increasing number of countries, which is important both for market research and for the promotion of its products.

Second, the change in the competitive position in the market, since the participating companies try to be active competitors on the scale of the global economy, but the existing potential does not allow them to achieve their goals. In the Alliance, they provide production of more than 10 million cars. At the expense of joint efforts, the Alliance actively develops a production site for electric cars and has already joined the world leaders;

Third, the combination of efforts in the field of innovation and investment activity by increasing the volume of financing of scientific and technical projects and the delineation of scientific research. Even taking into account the aggregate effort, the Alliance is lagging behind the world leaders in terms of Capital expenditure and R&D costs. Hence, this is the direction by which only in the conditions of the alliance it is possible to provide the dynamics of innovation development of participating companies.

The basis of the synergistic effect of ISA is the ability of participants to achieve leadership positions in selected technology areas.

Mitsubishi Motors will benefit from synergies in the areas of joint purchasing and plant utilization, deeper localization, sharing of common platforms and automotive technologies, and expansion into new markets. In turn, Alliance partners Nissan and Renault will benefit from Mitsubishi expertise and leadership in areas such as kei cars, plug-in hybrid technology, SUVs and four-wheel drive vehicles, as well as its strengths in the ASEAN region. We will continue to identify new synergies as the Alliance evolves.

Despite the fact that this kind of Alliance has existed for several years, as well as the unstable dynamics of key indicators of Alliance member companies, they state the Alliance generated €4.3 billion in synergies in 2015, one year earlier than anticipated, and 5 billion in 2016. In 2017, Renault-Nissan-Mitsubishi reported a 14% increase in annualized synergies to €5.7 billion.

Discussion

In general, participation in international strategic alliances should be considered as an important mechanism for solving many problems of the development of enterprises that do not have sufficient capacity for their own development. Moreover, despite the fact that in the overwhelming majority, the process of consolidating the enterprises is logical and objective, it has its advantages and disadvantages, the identification of which is debatable. The goals, forms of cooperation, the timing of the interaction and the effectiveness of the functioning of alliances depends on whether participants can enjoy the benefits that characterize the competition in the market of certain types of products. The main advantages that companies are trying to achieve through participation in strategic alliances (Table 6).

Tab. 6. Advantages and disadvantages of functioning of strategic alliances

Advantages	**Disadvantages (problem zones)**
the confrontation of competition, which moves to a higher level precisely at the expense of more dynamic development	problems in defining goals, i.e. the inability to agree specific targets, in particular, return on investment, market share, etc.
the establishment of new global standards, for example, in the field of technology	difficulties of effective organization of project management
overcoming protectionist barriers	blocking the implementation of the strategic goals of the Alliance development
distribution of risks	transfer of strategically significant information
economies of scale by distributing constant costs of production	impossibility of ensuring the implementation of the agreement due to the dynamic changes in the conditions
access to the market segment, which access is difficult	degree of cultural compatibility of the participants
access to technology, i.e. convergence among technologies is the origin of many alliances	mistakes in selecting partners
pooling forces in the process of financing individual projects that have high costs for managing by one company	loss of partner trust throughout the cooperation time
breaking the gap if the company does not have the resources or capabilities needed to develop a specific strategy	loss of control over the basic strategies of the Alliance development in connection with changes in the strategic objectives of the participants
"game prediction", i.e. the company, which is the first on the curve of experience to gain market benefits.	unexpected high costs associated with transition and coordination

Source*:* Formed by the author.

The list of benefits expected by alliance members is a very powerful tool for finding partners for engagement. However, alliances always have problem areas that need to be addressed in the management process. Some of the drawbacks may become an insurmountable problem, which will put an end to the alliance. That is why the process of forming and functioning of international strategic alliances requires introduction of modern methods of management and their continuous improvement based on a powerful analytical process.

The proposed methodological approaches to the analysis of the effectiveness of the ISA operation should be the basis for integrated and comprehensive monitoring. The isolation and calculation of synergistic effects from the ISA creation is the most complex. Synergy, as a complex manifestation of the multifaceted performance of the MCA, can and should be evaluated, but not only in the cost measure. To understand of the nature of the synergistic results of the MCA more clearly, it is advisable to take into account the sectorial features: development trends, technical standards and key vectors of innovation perspectives, which may not be fully technically counted. These directions presented in the article are debatable and require further research.

Conclusion

The joint coordination of strategic planning and management of the participants of activity is carried out within the framework of international strategic alliances, which allows them to agree on long-term partnership relations with the benefit to each participant. Strategic alliances are mobile, free for partners, more focused on the future, reduce ambiguity and uncertainty in partner relationships, increase stability in resource provision and distribution of products and services.

In general, it should be noted:

- participation in strategic alliances becomes a necessity of functioning of enterprises in many markets of industrial products, as there has been a significant increase in their number in order to ensure technological leadership in these industries,
- global leaders have several alliances and try to penetrate into industries that have not been previously characteristic of them,
- strategic alliances become the basis for more dynamic creation of new types of products, introduction of new technologies.

All of the above changes the competition conditions and the composition of the competitiveness actors turning strategic alliances into a real mechanism of developing competitive advantages of an individual enterprise.

The researches of the features of functioning of Renault-Nissan-Mitsubishi Alliance allow formulating the following principles of management of strategic alliances in the modern economy, observance of which allows to achieve a positive result when creating associations of this type:

- focus on solving long-term perspective problems and tasks,
- equality of the alliance parties based on the fair assessment of their available resources, opportunities, organizational competences, other important assets for joint activity and registration by providing this equal relationship with a clear legal status,
- formation of a clear and effective management system that allows to carry out both high-level tasks (strategic planning), as well as the tasks of the lower operating levels (staging tactical goals, allocating resources) quickly and efficiently,
- constant search for new ways of interaction and increasing the effectiveness of cooperation in order to maximize the synergistic effect by combining the strengths of all participating companies,
- autonomy of the partners entering the alliance,
- deep respect for the corporate values and individuality of the brand of each of the partners while maintaining their independence,
- mutual exchange of accumulated experience and developments.

Such basic principles should be guided by the conclusion of agreements on the establishment of a strategic alliance in the modern world economy. These principles, as well as the experience of Renault-Nissan-Mitsubishi Motors and other strategic alliances created by automakers will be used in the future to develop the effective model of the strategic alliance management.

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Analysis of trading companies on the basis of Kohonen networks

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Abstract

The contribution deals with the analysis of trade companies using artificial neural networks, more specifically Kohonen networks, where the basis for the analysis is primarily the data from evaluating economic performance of a business entity, where each entity strives for increasing its market value. This contribution also estimates the development of trade companies. For the analysis, the data of 11,604 companies in the given sector in the Czech Republic were used. Cluster analysis is carried out using neural networks. From the clusters, those with the highest number of companies were chosen. Subsequently, the analysis of absolute values of selected financial statements items is carried out. From the owners´ point of view, the situation is not positive, as the rate of deposits appreciation is even lower than the risk-free appreciation of 10-year state bonds. In the conclusion, recommendations for trade companies are given.

Keywords: Kohonen networks, neural networks, economic performance of company, trade, cluster analysis

Introduction

Evaluating economic performance of a given business entity in the best possible manner is the wish of every owner (or investor). From their perspective, it is particularly important to find out whether their enterprise is able to increase its value and hence to gain early return on investment (Kisel'akova et al., 2018). According to Onuferová and Čabinová (2018), there is a question, however, of how to measure such enterprise performance. They further add that monitoring financial performance of a particular

organization is undoubtedly the most important measure. Narkuniene and Ulbinaite (2018) state that there is practically a wide range of company evaluation approaches, and their use is based on the current market situation as development of markets brings about shifts in performance measures. Also, as Malichová, Ďurišová and Tokarčíková (2017) remark, there is a current shift in the area of indicators that are capable of measuring performance of business entities.

Vochozka et al. (2017) state that, for instance, to evaluate trading companies, which this contribution addresses, Czech entrepreneurs focus mainly on monitoring traditional indicators of financial analysis, i.e. indicators of indebtedness, activity, liquidity, profitability, etc. Due to over-criticism of some regular indicators, new approaches to evaluation of trading companies have gradually developed in business practice. Nowadays, the most common methods include Benchmarking, creditworthy and bankruptcy models, EVA, MVA, Balanced Scorecard, and the increasingly popular method of artificial neural networks.

As part of a specific analysis carried out in this contribution, importance of the trade sector within the Czech economy shall be briefly discussed. According to the MPO (2015), the above sector is the second largest employer as well as contributor to GDP (or GVA), with the sector itself representing more than 10% of the Czech economy's GDP. In 2014, for instance, trade accounted for 14% of total employment (and with the category of entrepreneurs – self-employed individuals included as well, the total even reached 18%, which means that the number of people working in the trade sector is estimated at around 700,000).

Equally significant in this respect is even the volume of investment in the business network development, which has reached over CZK 600 billion since the 1990s. Apart from that, the Czech Republic holds one of the largest ratios of sales area per capita (1.5 m^2).

Additionally, retail in the Czech Republic is one of the most advanced in Europe as it uses modern technologies and introduces many new trends. There is a great deal of competition among individual traders as well, which is mainly beneficial to consumers being ultimately able to choose the most reasonable price.

Another positive trend is that household consumption expenditures (as one of the main factors of economic growth) have risen slightly in recent years. The year-on-year increase in household consumption in terms of retail trade is almost 2%.

An average four-person household spends more than CZK 24,000 per month in the retail sector, which is more than CZK 120,000 per person on average annual spending.

Recently, there have also been notable changes in the manner of selling products, with a major increase being in Internet sales. In 2014, revenues of e-shops were 2.5 times higher than in 2008 and accounted for 7.1% of total revenues.

Artificial neural networks – Kohonen maps

An artificial neural network is currently a well-known term representing an algorithm inspired by knowledge of neurons and neural networks of living organisms and their abilities – to learn, generalize, solve complex nonlinear problems, etc. (Rowland and Vrbka, 2016). Vochozka and Machová (2018) claim that artificial neural networks are relatively easy to use and are mainly applied to predictions and complex problems. Owing to a number of advantages, artificial neural networks are used in various areas (Sánchéz and Melin, 2015). Weinlichová and Fejfar (2010) add that their use is being explored, for instance, in all areas of business (whether it's for business risk assessment, marketing, management or other financial aspects, etc.).

Ahmad and Yusof (2016) observe that SOMs – Self organizing maps – are increasingly being used for business studies. At present, they are the basic and most popular kind of neural networks widely known as Kohonen maps (Bodyanskiy, Deineko and Eze, 2018). Wehrens and Kruisselbrink (2018) view Kohonen maps as popular tools for grouping and visualizing of data in many areas of science.

According to Trafialek, Laskowski and Kolanowski (2015), this kind of networks is classified as the so-called non-teacher learning networks which do not need ideal patterns to set up. Juszczyk and Zima (2017) further add that they are single-layered networks with full unit-to-input linking between their inputs and competitive layer, i.e. each neuron has information about the value of each input.

Pasa, Costa and Medeiros (2017) state that thanks to their ability to self-organize and cluster objects with similar characteristics into groups, Kohonen maps are predestined for decision-making, identifying and classifying objects, signals, etc. There are a number of options regarding the use of Kohonen maps, and even some experts quite rightly say: “If you don't know which algorithm to use, use Kohonen maps” (Haimoudi et al., 2016).

In addition, Šuleř (2017) used Kohonen maps in his study on examining possibilities of their use to identify businesses likely to go bankrupt. On the basis of three conducted analyses of a sample of construction companies operating in the South Bohemian Region between 2006 and 2015, he found that Kohonen networks are not suitable to be used as a tool for predicting possible bankruptcy of companies. However, it is possible that, in combination with other tools, more significant results could be achieved.

The main objective of this contribution is to analyse trading companies operating in the Czech Republic through Kohonen networks and subsequently predict their development.

Methods and Data

For the purpose of the contribution, a data set will be created, which will include complete data of financial statements of 11,604 companies trading in the Czech Republic in 2016. They are the subjects, the prevailing business of which is classified in section G of CZ-

NACE classification of economic activities. The set of companies will be generated from the Albertina database of Bisnode company.

The data will be recorded in a table in the format of Excel Application. Every row will contain a financial statement of a particular company, which will be identified by its name and identification number. The companies which did not perform their main business activities during the whole monitored period will be removed from the set. They are the companies which were closed (and did not significantly influence the direction of national economy) in this period, and the companies the business activities of which were commenced (and likewise did not significantly influence the direction of national economy in the Czech Republic). The case of the companies which commenced their activities on 1 January 2016 and those which terminated their activities on 31 December 2016 could be discussed. However, it does not have a significant impact on fulfilling the objective of this contribution. Furthermore, the columns which do not provide a dispersion will also be excluded.

The set will subsequently undergo a cluster analysis using Kohonen networks. Dell´s Statistica software, version 12 will be used for the cluster analysis. Data mining module will be applied as a specific tool of neural network. At this point we will select self-learning neural networks, i.e. Kohonen networks. We will specify the data for the analysis, i.e. we will select a table with the data set from the Excel application. They are continuous predictors in all of the cases. The set will be divided into three parts:

1. Training data set: it includes 70% of companies from the set. This data set will serve for the purpose of creation of Kohonen network.
2. Testing data set: this includes 15% of the companies of the original set. We will verify the parameters of the Kohonen network with the help of this data set.
3. Validation data set: this will include 15% of the companies of the original set as well. We will verify the obtained Kohonen network with the help of this data set in order to determine whether it is applicable or not.

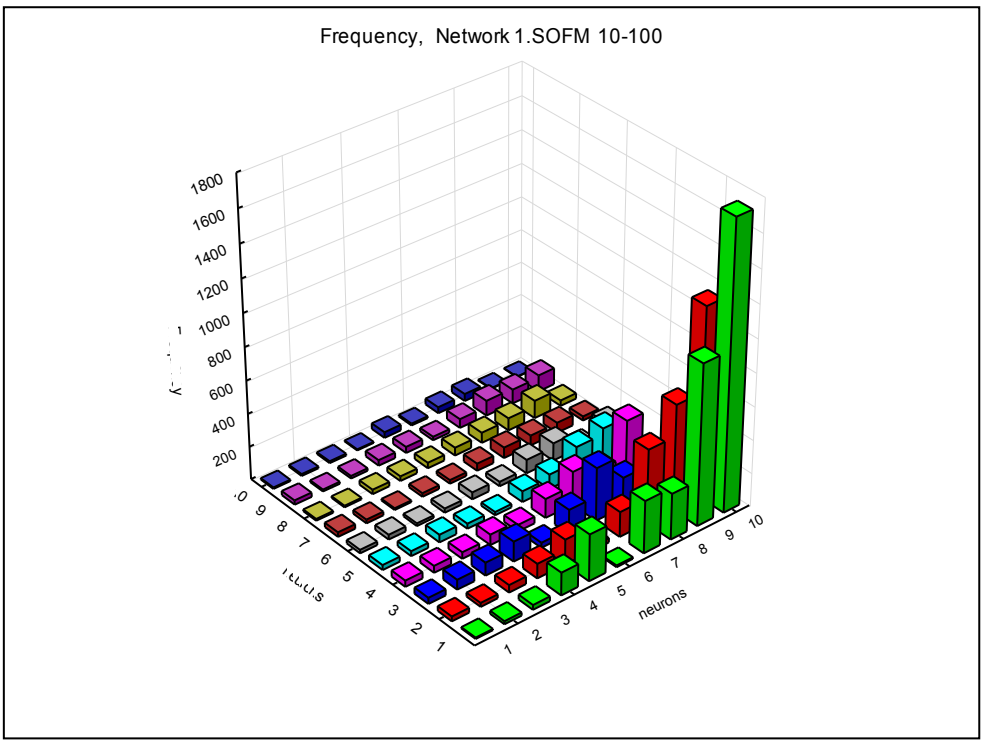
Both the topological length and the topological width will be defined as 10. The number of iteration will be defined as 100,000. Nevertheless, it is important to remind the reader of the fact, that the error level is crucial. If there is not an improvement of the parameters of Kohonen network when following iteration takes place, the training will be terminated before the 100,000th iteration occurs. In case that network parameters improve when 100,000th iteration takes place, the whole process must be repeated and a higher value of required parameters must be defined in order to be certain that the achieved result is the best possible one. The learning speed will initially be defined at 0.1 and subsequently at 0.02.

The results (the division of 100 individual companies into clusters) will be transported into a table in Excel application. Subsequently the individual clusters will undergo an analysis of absolute and selected ratio indicators, i.e. their mean values, arithmetic means, and the results will be interpreted.

Results

Clusters were created on the base of applied methodology. The division of quantities of companies in individual clusters is shown in picture No. 1.

Figure 1: Division of companies in individual clusters of Kohonen map



Source: Own processing.

Figure 1 shows a three dimensional Kohonen map of the quantity of companies in individual clusters. It is obvious that the biggest number of companies is in cluster (1, 10). The following cluster is (2, 10). The third position is cluster (1, 9). Furthermore, it is possible to observe a slightly bigger proportion of clusters (2, 9), (2, 8), (4, 9), (3, 7) and (1, 7). The other clusters contain a significantly lower proportion of companies.

Table 1 shows specific values presented for the purpose of making a detailed example of the proportion of companies in individual clusters.

Tab. 1: Proportion of companies in individual clusters of Kohonen map

	Network: 1.SOFM 10-100 Samples: Training, Testing, Validation									
	1	2	3	4	5	6	7	8	9	10
1	8	19	29	137	281	10	316	278	969	1726
2	29	24	45	88	150	26	151	446	636	1138
3	37	60	78	121	31	148	320	181	97	283
4	38	42	40	64	40	116	201	137	354	60
5	30	30	46	31	20	66	88	178	214	1
6	21	30	16	25	43	28	83	107	15	79
7	28	23	10	22	22	44	65	61	63	25
8	10	10	27	29	34	48	63	75	108	34
9	26	12	16	34	37	22	55	93	87	101
10	9	11	11	6	35	11	37	44	4	3

Source: Own processing.

The table clearly shows that only the clusters highlighted in red always include more than 100 companies. The clusters highlighted in yellow contain more than 500 companies. The other clusters always contain less than 100 companies. Further analysis only includes the following clusters (1, 10), (2, 10), (1, 9), (2, 9), (2, 8), (4, 9), (3, 7) a (1, 7). They consist of 5.905 companies and are represented by 8 clusters out of 100 existing clusters, i.e. 50% of companies in the set. Moreover, one particular cluster (1, 10) includes 1,726 companies, which is nearly 15% of the whole set. Therefore, it is appropriate to conclude that the analysis will be a valuable representation of the potential of entire Czech trade.

Mean values of the data set as a whole and selected cluster in assets are given in Table 2.

Tab. 1: Selected variables mean values of clusters

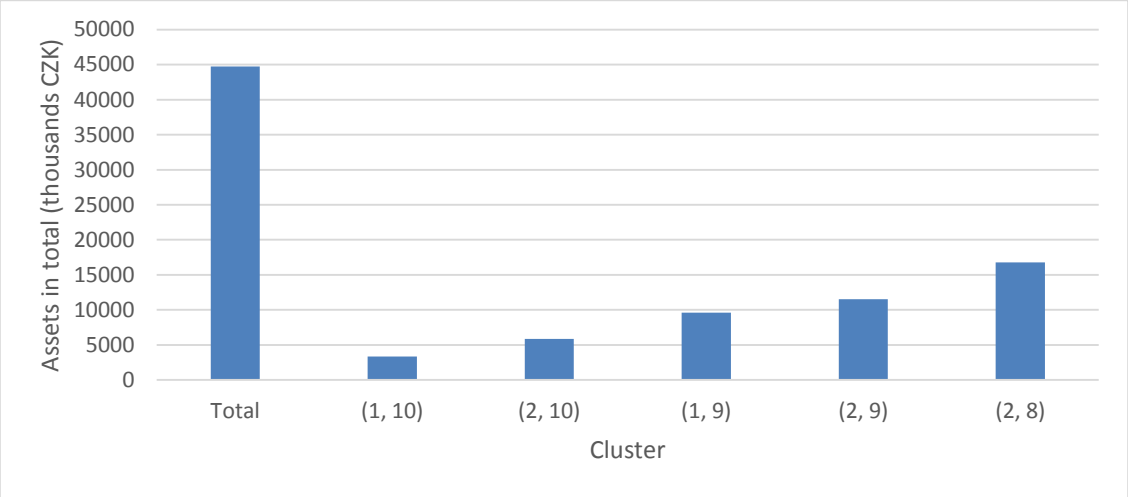
Captions	Total	(1, 10)	(1, 7)	(1, 9)	(2, 10)	(2, 8)	(2, 9)	(3, 7)	(4, 9)
Assets in total	44717.82	3325.669	16670.41	9602.85	5860.159	16798.03	11509.6	18589.83	20900.69
Fixed assets	11366.46	549.3592	10437.77	1229.674	1199.341	1819.722	1616.296	2389.859	2863.356
Current assets	32848.42	2726.213	6094.823	8214.43	4579.923	14691.88	9779.395	16073.06	17789.22
Equity	20126.67	680.7039	6276.092	3208.833	2226.957	2241.868	6564.502	14005.87	14402.73
Liabilities	24269.38	2619.081	10310.61	6289.757	3587.876	14325.94	4861.075	4501.038	6301.085
Performances	3108.327	119.4983	346.0823	106.2714	302.4745	401.1413	306.3695	45.32813	719.6695
Value added	10266.52	642.6715	2230.896	509.7152	3222.928	2086.081	4344.454	19.05625	6188.963
Operating earnings	3315.922	101.5122	396.9462	117.3209	857.6204	456.213	1556.689	148.325	2695.297
Earnings before interest and tax	55.0904	1.325608	7.664557	2.412797	17.93673	8.069507	34.64623	-0.575	59.12429

Note: The amounts are given in thousands CZK.
Source: Own processing.

The table clearly shows the difference between the values in terms of the whole trade sector and the individual clusters. Mean values of the whole trade sector are significantly higher than mean values of the clusters with the highest number of companies. This can mean that the selected clusters significantly reflected the size of companies as one of

parameters (this necessarily did not have to be a primary parameter; it could have happened inadvertently). The most important assets values are given in the individual graphs below. Figure 1 shows a comparison of mean asset values for trade as a whole and for individual selected clusters.

Figure 1: Mean assets values for trade sector and for selected clusters

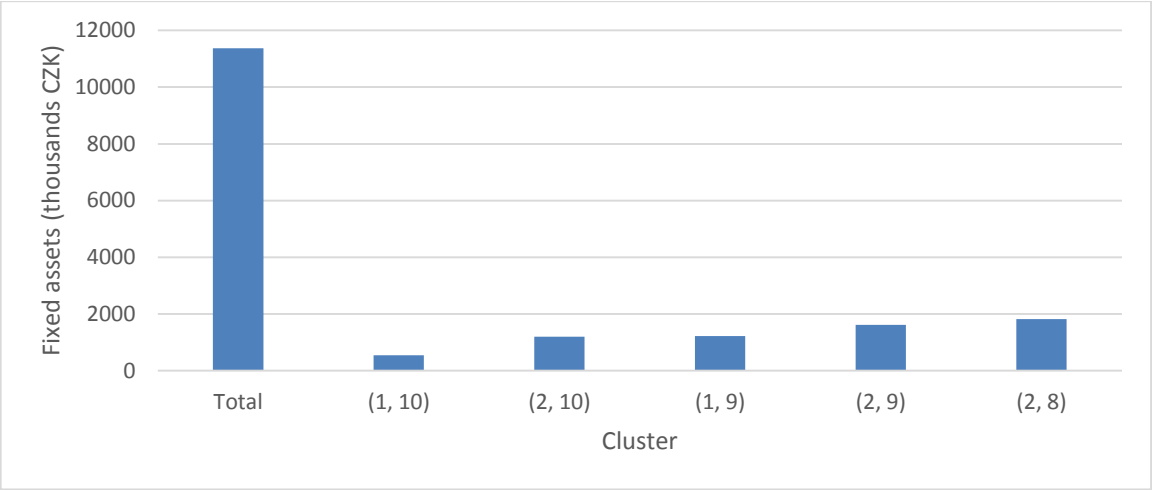


Source: Own processing.

The average balance sheet, that is, the value of assets for the trade sector is almost CZK 45 million per company. Cluster (1, 10) achieves the average assets value of CZK 3.3 million. Only two of the clusters from the graph achieve the average total assets value of more than CZK 10 million. The companies of the (2, 8) cluster have assets in the average value of nearly CZK 17 million. Another cluster exceeding CZK 10 million is the cluster (2, 9) with the average value of more than CZK 11.5 million. The cluster (1, 9) with the average value of CZK 9.6 million is also close to the limit.

An equally interesting indicator that distinguishes companies in individual clusters in the trade sector is the amount of fixed assets (for more details, see Figure 3).

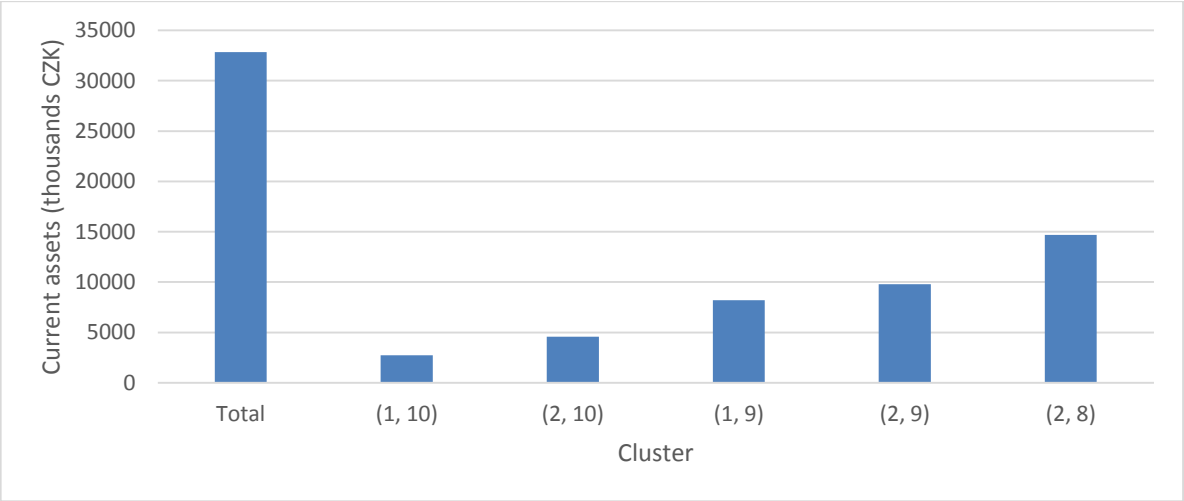
Figure 2: Mean values of fixed assets for trade sector and for selected clusters



Source: Own processing.

Trade is essentially a very specific sector of the national economy. It itself does not create a value. However, traders are able to mediate the exchange of tangible goods produced by manufacturing companies or service companies with customers producing a demand. Mediating trade itself carries the value added (either directly or through additional service – distribution, promotion, etc.). A lot of resources are concentrated in trade. Depending on the subject of trade, a large volume of current assets or receivables can be expected, as well as a large amount of liabilities. The marginal rate of capital substitution for labour force does not work well in trade (except for sales through vending machines). The level of automation is relatively low in trade. Trade as a whole is above the fixed assets value of CZK 11 million per one company. The companies in the examined clusters use the fixed assets significantly less. The best is the cluster (2, 8), reaching the value higher than CZK 1.8 million. The cluster with the highest number of companies (1, 10) reach the value of nearly CZK 0.55 million per company. The cluster with the second highest number of companies (2, 8) achieves CZK 1.2 million per company. The remaining two clusters reach the value of CZK 1.2 million, namely it is CZK 1.2 million for the cluster (1, 9) and CZK 1.6 million for the cluster (2, 9). Assuming that the rate of fixed assets involvement increases with the size of companies, it can be concluded that the examined clusters do not include large or extremely large companies operating in the trade sector of the Czech Republic. Other variable examined is current assets. For more details, see Figure 4.

Figure 3: Mean current assets values for trade sector and for selected clusters

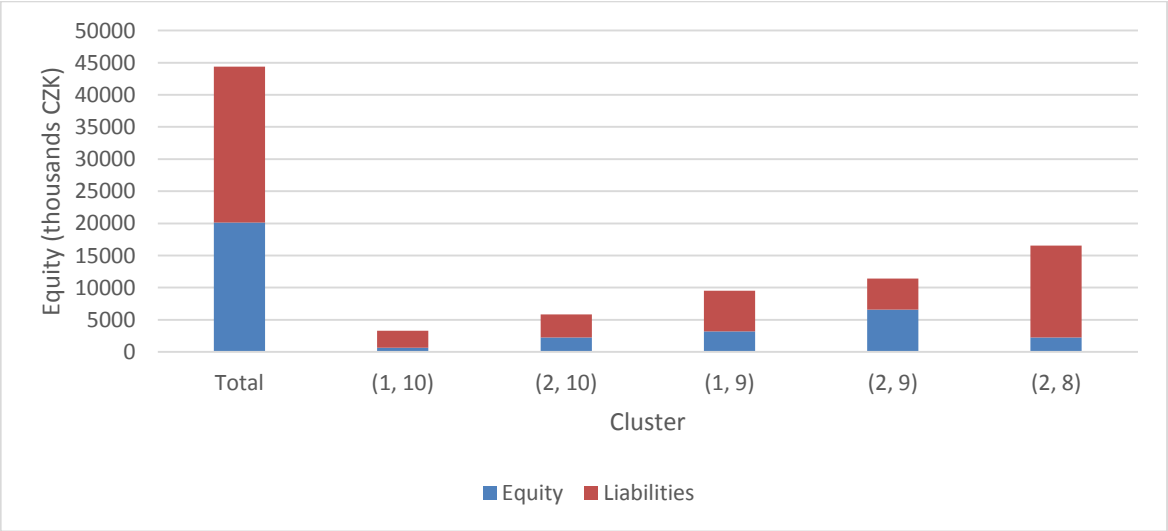


Source: Own processing.

Current asset (although it is not the same as working capital) is a very important of every company, especially a commercial company. It represents the basic purpose of its existence, that is, the volume of goods the company trades in. It thus includes inventory, mainly goods, receivables and financial assets. Mostly these are retail companies, where payments are in cash or online by credit cards; the receivables therefore are not high. The highest mean value of current assets shows trade as a whole, nearly CZK 33 million. The companies in the cluster (1, 10) have the average current assets value of CZK 2.7 million. In the case of the clusters (2, 10), (1, 9) and (2, 10), it is less than CZK 10 million. The companies in the remaining cluster (2, 8) own the current assets of the average value of nearly CZK 15 million.

Not surprisingly, equally interesting values are for the assets financing sources, capital. The structure of commercial companies financing is shown in Figure 6.

Figure 4: Mean values of equity and liabilities for trade sector and for selected clusters

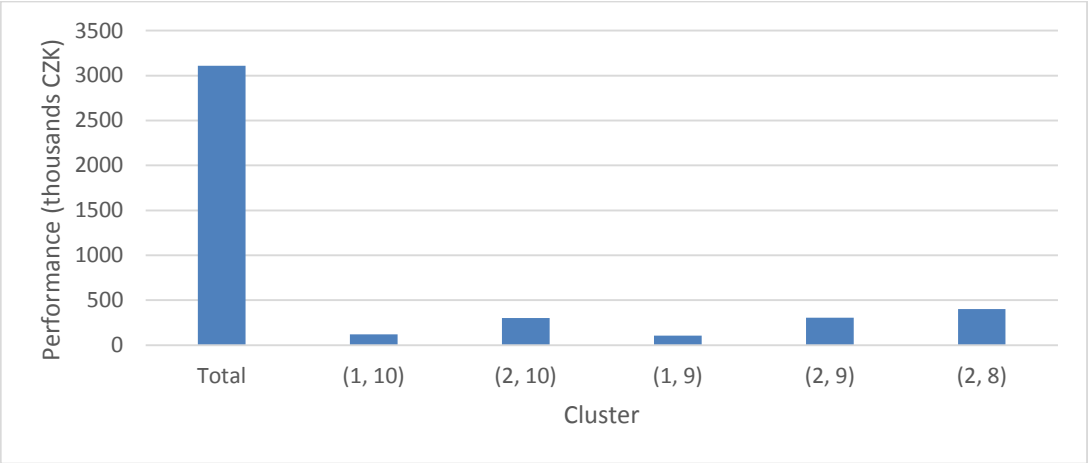


Source: Own processing.

Figure 6 shows the ratio of equity and liabilities for selected clusters and for the whole trade sector. The figure indicates that the share of liabilities in the trade sector is nearly 55% on average. In the case of the whole data set, the equity as well as the liabilities is at CZK 45 million. The highest capitalized cluster in the monitored data set is the cluster (2, 8). Its sources are CZK 16.5 million. However, in the case of this cluster, the liabilities prevail significantly. The average indebtedness of this cluster is nearly 86.5%, which exceeds significantly the values recommended. Even in the remaining clusters, the liabilities are predominant. The only exception is the cluster (2, 9).

Due to the extent of the contribution, it is only possible to focus on several selected items in the earnings and loss account, the comparison of average performance in the trade sector being the first of them (see Figure 7).

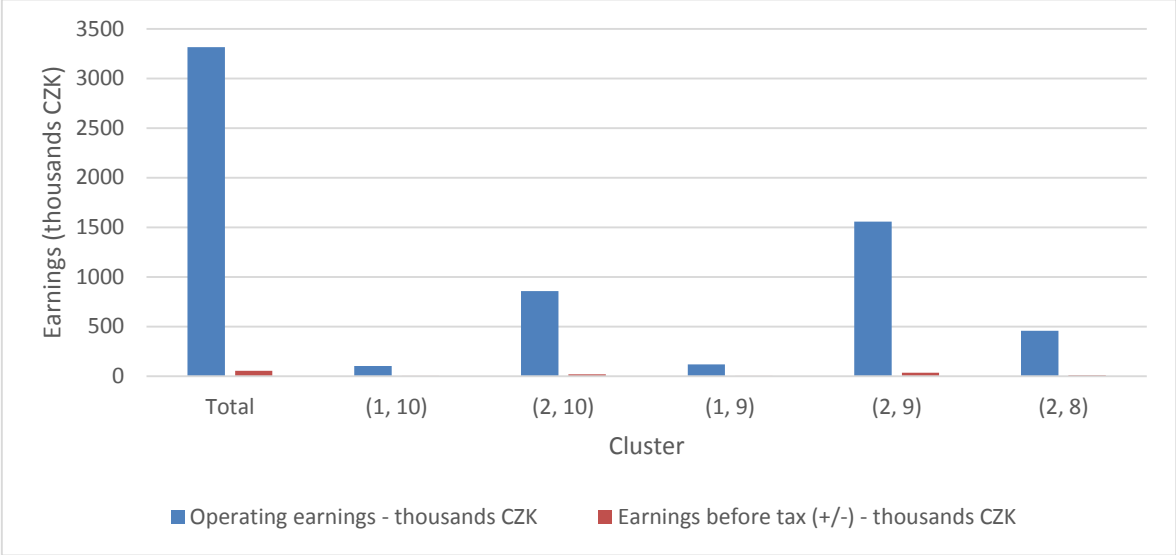
Figure 5: Average performance values for trade sector and selected clusters



Source: Own processing.

An average trading company´s performance is more than CZK 3.1 million. Just for comparison, an average trading company´s performance is over CZK 30 million. From the clusters examined, the highest value is for the cluster (2, 8). An average value of a company in this cluster is nearly CZK 0.46 million. The cluster with the highest number of companies (1, 10) generates an average performance of CZK 0.1 million. Figure 8 shows a comparison of the earnings achieved. In particular, it deals with the operating earnings and earnings before tax.

Figure 6: Average values of earnings for trade sector and for selected clusters

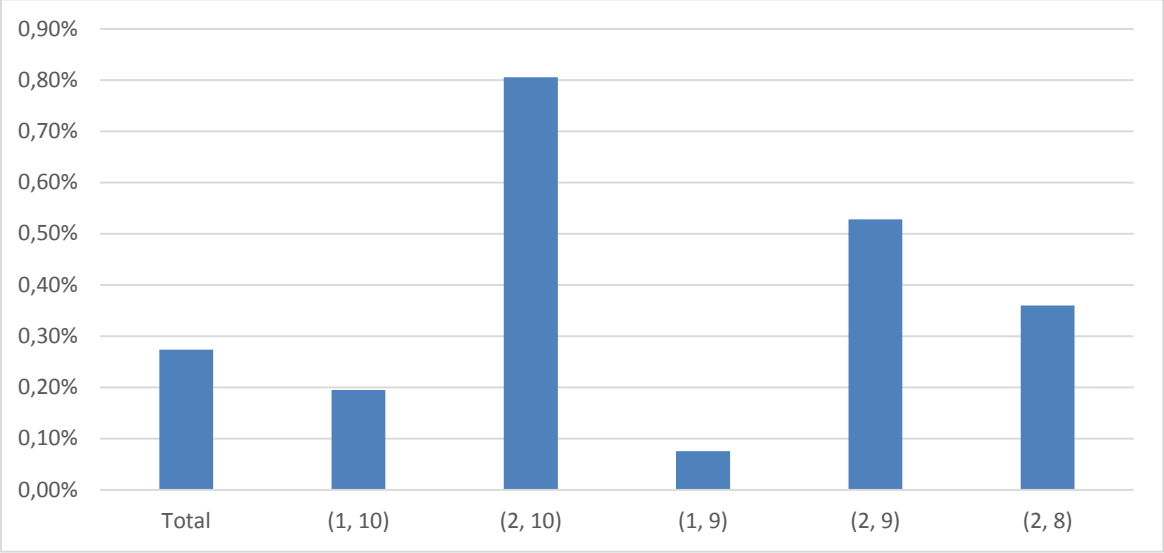


Source: Own processing.

The most important earnings for a company is the operating earnings, which represents the results of the company activities, or the activities for which the company was founded. The highest value of both operating earnings and earnings before tax are achieved by the trading companies as a whole. The mean value of the operating earnings is approx. CZK 3.3 million. However, the value of the earnings before tax is only CZK 55,000. Such a big difference between the value of the operating earnings and earnings before tax is evident in all examined clusters. This means that the financial and extraordinary result must be significantly negative in total. Similarly, the clusters (2, 10), (2, 9) and (2, 8) achieve a significant amount of operating earnings. However, even in this case, the earnings before tax is minimal.

So far we could assume that companies of different size were compared, which intensified their clustering. For better illustration, a relative indicator will be added, namely return on equity. This is an interesting indicator, since it is able to assess the fulfilment of the basic company objective, which is the appreciation of the owners´ investment. It is an indicator of ratio comparing earnings after tax to equity capital. Specific values for the trade sector and the selected clusters are shown in Figure 9.

Figure 7: ROE Indicator of mean values for trade sector and selected clusters



Source: Own processing.

It follows from the figure that neither the trade sector nor the individual clusters achieve high values. Taking into account the value of risk free investment (i.e. ten-year government bond interest) as of 31 December 2016, the results appear to be completely unsatisfactory. Risk free rate as of the aforementioned date was 0.53%. In 2016, this value was achieved by the companies in the cluster (2, 9) and exceeded by the companies in the cluster (2, 10). Other companies, including the average of the trade sector did not even reach this rate of owners´ investment. Moreover, when considering that the rate of investment appreciation is compared with risk free return, the resulting ROE of the cluster (2, 10) is also insufficient. If the situation persisted in the following years, the owners should consider investment in other sectors of the national economy.

Conclusion

The objective of the contribution was the analysis of companies operating in trade in the Czech Republic by means of Kohonen networks and prediction of their development.

The objective of the contribution was fulfilled. A cluster analysis was performed. From the clusters those with the highest number of companies were selected. Subsequently, the analysis of absolute values of the selected financial statements items was carried out. As a typical representative of a cluster, the mean in cluster examined was determined.

Overall, it can be stated that trading companies show relatively bad values – minimum assets, high debt and minimum earnings before tax. Perhaps the only positive value is the operating earnings which is in certain contrast with the earning before tax. This allows assuming long life of trading companies. However, from the owners´ point of view the situation is not good. The rate of their investment appreciation is even lower than the risk-free 10-year government bonds. The owners are thus faced with the decision whether to

keep investing in trading companies or whether to transfer their investment into companies operating in other sectors of the national economy.

As for the individual clusters results, it can be summarized as follows:

1. Five clusters with the highest number of companies represent more than 50% of companies operating in the trade sector.
2. The clusters examined showed lower, sometimes significantly lower values of the selected financial statements items (balance sheet, fixed assets, earnings, etc.).
3. It follows that the examined 50% of the companies generate 50% of the trade sector performance.
4. It follows that the remaining 50% of the companies play a more significant role in the trade sector performance than that one corresponding to 50%.

It can thus be concluded that the remaining 50% should be examined thoroughly in order to identify which companies (or clusters) positively influence the results of the entire trade sector. This would enable to predict the future development of the whole institutional sector of the national economy.

In conclusion trading companies are recommended to:

1. Consider whether they work only with the operationally necessary assets.
2. Reduce their indebtedness.
3. Try to increase the trading margin (even at the price of offering other services related to selling goods, know-how, etc.).
4. Focus on the optimization of the earnings.

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Industry 4.0 and its impact on employees' age

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Abstract

Development of industrial environment and changes in technologies always brings negative influence on companies and employees, because of the fundamental skills and abilities. The main objective of the paper is to discover potential relations between the age of workers and (1) knowledge of 4.0 industry concept, (2) threats of new technologies and (3) future expectation of technology changes. There were defined three hypotheses, focused on connection between defined variables. To verify these hypotheses there was used questionnaire survey, distributed in engineering companies in Czech Republic, Germany and Canada. Gained data was put under statistical evaluation by Pearson's chi-square test of independence. According to processed data there was confirmed only one dependence between age of workers and foreknowledge of industry 4.0 (significance is 0,001, intensity of the dependence is 0,630).

Keywords: Industry 4.0, industrialization and automatization, unemployment, circular economy

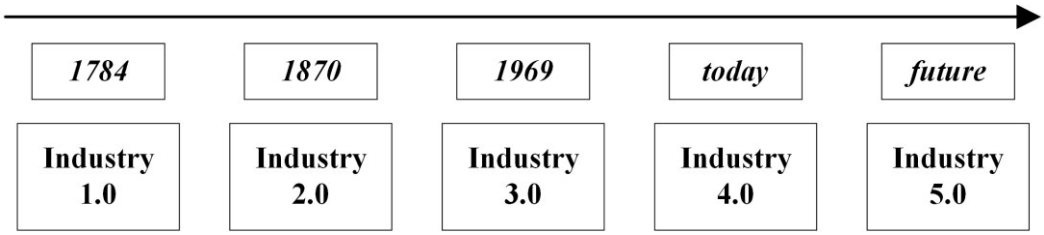
Introduction

Industrial environment and all including companies have to adapt their approaches, technologies, and strategies according to industrial changes, which are provided by industrial revolutions (IR) as a kind of answer to actual industrial production. In the present time, there is already concept Industry 4.0 which requires high digitalization of all processes in company and organization in connection to the implementation of automatization into production. All past IRs and IR 4.0 required changes in employees' minds because of the technology changes.

Cline (2017) mentioned, that one-third of companies plan to adapt their corporate environment components of IR 4.0 by process digitalization for effective production.

During the development of industry, there were four steps till now, how companies and industries adapted their production systems (see Pic. 1). IR 1.0 changed occasional production into mass production by the employment of machinery (approx. since 1784). IR 1.0 was established by finishing a steam machine and its production. As IR 0 there was applied only hand-made production within hand-tools. At the moment, when companies started with mass production and assembling lines, which replaced simple machinery, we can define IR 2.0 (approx. since 1870). Lean philosophy as Kanban production, Just-in-time transportation prepared the situation for IR 3.0 (since 1969). During IR 3.0 there were implemented computers, corporate networks, and internet as a kind of support of production on the way to digital transformation and outsourcing of specialized process and production. During all industrial stages, there were required skills, abilities and experiences of workers. IR 4.0 moves companies to massive digitalization and automatization of the production systems, which lead to clouding and virtual process (future IR 5.0).

Figure. 1: Industrial revolution in time



Source: Own work according to Cline (2017).

Concept IR 4.0 provides smart factory creation because of the requirements of the market. The basic essence of the smart factory is strong integration, automatization and continuous optimization of the working environment in linking to production facilities and equipment within cyber-space and cyber systems. Development of innovative solutions, followed by the implementation into corporate lines requires intensive investments, which help to stabilize time-consuming projects on the way of creation long-time competitiveness of Czech industrial companies. Producers of equipment, software, and industrial companies need a specific platform, which provide development, function verification and compatibility of new solutions in semi-industrial conditions and in interaction within actual technologies (Fettig et al., 2018; Ematinger, 2017; Koren and Shpitalni, 2010; Nayak, Dürr and Rothermel, 2015).

IR 4.0 consists of a mix of technologies, which help to make flexible production systems (e.g. robotic manipulation, cutting, additive production or smart conveyors. Due to both of flexible connections of universal production devices and sophisticated driving systems, there is possible to use the same equipment in different operations, which are planned in optimal ways according to specific needs. For the production of new products, there could be employed simulation processes and virtual environment, in which companies could eliminate potential threats as kind of optimization before starting new production line

and launching a new product on the market. Whole simulation process provides a reduction of waste time and support cost-effectiveness before launching. A lot of companies use cloud services as a kind of support both of data collecting and data processing of whole production, which help to improve individual areas in company as quality management, equipment maintenance, usually marked as crucial part of industry 4.0 for modern and future production (Český institut informatiky, robotiky a kybernetiky, 2018).

The main essence of IR 4.0 is designed on the base of the German initiative, which was focused on the way of cooperation creation of academics and practitioners in companies in the production process as answer for performance claims (Bundesministerium für Wirtschaft und Energie, 2017). Czech Ministry of Industry and Trade (2015) implemented a philosophy of IR 4.0, which includes principles of the German initiative as well as Industrie du future (France), Fabrica Intelligente (Italy), Industrial Internet (USA). All of these concepts describe processes in the implementation of digital technologies into production equipment in connection within the internet. At the same time, there is required new thinking and mind setup of the staff because of their skills and abilities. From a general point of view, IR 4.0 combine both rational and irrational thinking of staff, who provides a specific value for building self-confidence of target customers as well as enquiring and more judicial to offering (Hecklau et al., 2016; Tomek and Vávrová, 2017, p. 10-13).

Gatullo et al. (2019) describe IR 4.0 from point of view, how it influences different management approaches. These approaches are as follow:

1. Staff time capacity (time data collection in real time, providing fast reaction to potential falls and risks, and its connection to key documents because of real-time updates).
2. Orientation on services (orientation is assessed for a future base, how to create products, which meet customer's requirements, solving their problem in the combination of virtual space, humans, services, and internet offer product composition).
3. Virtual production (creation of virtual production environment support management of physical flows, using GPS systems and eliminate potential risks).
4. Decentralization (material's requirements in the company are decentralized to lower levels; if is make a failure, there is applied centralization to higher levels to help to solve the failure).
5. Modularity (modular approach maintains prompt reaction in case of changing product setup; production documentation must be modular to integrate new procedures, technologies, and other required items).
6. Interoperability (it provides communication between individual elements of a virtual world such as human, production units and systems which could be marked as crucial).

All of these elements reflect a strategy of the company, reacting to the current situation in different fields such specification of used business model, innovation's context, employment's needs or technology development.

Description of IR 4.0 implementation is usually sensed as a kind of challenge, what has to be reached in the context of corporate strategy, vision, and mission. In this way, it leads to corporate autonomy in production and supports the development of staff skills on the pathway to making opportunities, strengthening competitiveness and improve staff working-life balance (Fettig et al., 2018; Reischauer, Schober and Obermaier, 2016).

Due the virtualization as one of key part of IR 4.0 workers can find critical elements in production system and state product solution to prevent or minimize these critical elements, which leads to elimination of staff injuries and develop safety of working environment (Winge et al., 2019; Reissová, Šimsová and Hášová, 2017). As implementation of IR 4.0 is improved situation of staff safety and working environment advancement as key processes leading to higher productivity and satisfied employees (Lundberg, Rollenhagen and Hollnagel, 2009; Lindberg, Hansson and Rollenhagen, 2010; Reichel, De Schoenmakere and Gillabel, 2016).

All areas of IR 4.0 line up to staff opinion about the situation after implementation. This opinion is impacted by doubt of claim of a wide audience for eco-friendly production, reusing or repairing old technologies for new purposes. This approach is based in the so-called circular economy, which intensifies in corporate practices with no regards to industry or country.

Circular economy helps to discover new availing of used products, generated waste or used materials on the way of creating new products. Because of raw-material shortage, there is important to get a new form of source materials for the advancement of companies, industries, regions and of course whole countries (Benton, Hazell and Hill, 2015).

Circular economy brings in connection to industry 4.0 new potential values for all stakeholders' group on the way to connect them whit high responsibility for people, nature and other environments (Reichel, De Schoenmakere and Gillabel, 2016; Reike, Vermeulen and Witjes, 2018).

Circular economy considers all kinds of waste such ground to reuse and redesign these wastes. Specific vigilance interrogates long-term products, for which have to find new alternate usage against to landfilling or burning. By potential utilization of waste instead of new sources, there is increasing requirements on relevant workers and their knowledge, abilities and other skills in connection to their profession (Kiørboe, Sramkova and Krarup, 2015; Ingebrigtsen and Jakobsen, 2007).

Methods and Data

The main objective of the paper is to discover potential relations between the age of workers and (1) knowledge of 4.0 industry concept, (2) threats of new technologies and (3) future expectation of technology changes.

There was realized questionnaire survey between workers in engineering companies in the Czech Republic and Germany. These companies operate in Brno and Stuttgart. The purpose of the research was to verify if workers have awareness of industry 4.0 and potential changes in this industry revolution. For this survey, there were asked 350 workers, from which decided to participate 110 workers from engineering companies (return rate was 31.43%). To processing, there were used only 95 questionnaires forms, which were completely fulfilled.

Gained data were processed by IBM SPSS Statistics 25. Then, there was applied calculation of dependency between two nominal variables by means of contingency tables and Pearson's chi‑squared test. Pearson's chi-square test for independence of variables provides a basic view on the relationship between variables and help to show the specific intensity of the dependency.

Results

There was employed Pearson's chi-square test of independence between chosen variables, which afford to define potential influence. During analysis, there was an applied test of dependency with the paucity of external influence. On the base of the described theory, there is an assigned hypothesis, which had to be transformed into a statistical hypothesis. These statistical hypotheses are designed of the null form (as follow). In case of acceptation of the alternative hypothesis, there is a change in explanation from "there is no dependence" to "there exists dependence", which could be considered as statistical hypotheses (and could be put under statistical evaluation):

- $H1_0$: age of workers does not influence the foreknowledge of industry 4.0.
- $H2_0$: age of workers does not provoke potential future threat in 10 years.
- $H3_0$: age of workers does not impact new technology implementation of industry 4.0.

The main problem of Industry 4.0 concept is that it is still unknown by the industrial environment, managers of manufacturing companies and as well by appropriate employees. In case they know this concept, they usually have a kind of myth in their minds. Therefore, authors want to answer if working experiences, theoretical knowledge can impress potential acceptation of the concept in individual corporate fields (with no reference to the kind of industry).

There were participated 95 employees, which are employed in three locations, in German (Stuttgart area) and in the Czech Republic (Brno area) and in Canada (Windsor area, Ontario). These locations were chosen on connection to their focus in the heavy-

machinery industry. For the purpose of the research were asked their employees, from which coincide to participate and deliver fulfill questionnaire only 95 persons. Their answers were categorized and put under evaluation by chosen statistical methods.

Table 1 shows relations between factors of threat expectation in the future and consciousness of industry 4.0 as a concept. It is obvious that employees consider their working positions as substantial for the company and they don't feel any potential threat because of the implementing of automatization.

Tab. 1: Pivot table of variables in linkage to the age of the workers

			20-29	30-39	40-49	50-59	60-70	Total	
H1	foreknowledge of industry 4.0	nothing important / naturalness	8	3	10	4	1	26	95
		no impact on my person	1	4	1	3	2	11	
		changes in employment	7	10	5	6	5	33	
		changes with possible adaptation	6	6	6	4	3	25	
H2	New technologies	threat	4	5	7	6	8	30	95
		opportunity	18	18	15	11	3	65	
H3	comprehension of industry 4.0	fiction	1	2	2	3	0	8	95
		behind us	1	2	2	1	1	7	
		computer coming	1	6	1	3	6	17	
		robots	5	3	5	1	2	16	
		digitalization	14	10	12	9	2	47	
Total			22	23	22	17	11		

Source: Own work by authors.

According to premises, there is a kind of limitation because some cells have zero value, which usually requires merging of separated answers. All of these values were put into a determination of proposed affinities and evaluation by Pearson's chi-square test for variable independence.

From the realized test of independence, there was employed Pearson's chi-square test for independence. Due to the processing of the data, there was important to reach the significance level of 95%. This level could be described as the situation, in which exist 5% fault in case of choosing an alternative hypothesis. This error value is recall as significance, regarded as a level of reliability. If the value of significance is less than 0,05 than is possible to accept the alternate hypothesis and is possible to conclude the existence of dependence between chosen variables.

In Table 2 there are situated results of the Pearson chi-square test of independence, which are connected to defined hypotheses H1-H3. From these results, there is found just one dependence on 95% significance level (it is given by significance value under 0.05). According to previous note there, only one dependence was found: Age of workers and foreknowledge of industry 4.0 (H1), where significance is 0.001. The power of the dependence is given by the contingency coefficient, which circulates in range ⟨0; 1⟩. Values by zero are considered as weak, Vice versa, values close to 1 represent strong power. The intensity of observed dependence reaches the value 0.630, which is quite strong. Therefore, hypothesis $H1_0$ is declined and is chosen alternate hypothesis $H1_1$.

Hypotheses H2 and H3 have high significance values, which provide no statistical validation of dependence between variables. For H2 was significance at 0.873; for H3 significance value was 0.284.

Tab. 2: Gained values of the processed test of independence

	Pearson value	**Significance**	**Intensity**
H1: Age of workers and foreknowledge of industry 4.0	44.655	0.001	0.630
H2: Age of workers and new technologies	1.231	0.873	0.136
H3: Age of workers and comprehension of industry 4.0	18.704	0.284	0.467

Source: Own work by authors.

The main problem of the industry 4.0 concept is that a lot of managers and employees don't know the specification and relevant definition, which help them to improve their work setup and single work. From the point of view of the country of the company, it is obvious that industry 4.0 would be well known mainly in Europe. Arntz, Gregory and Zierahn (2016) mention that workers in OECD countries fear of the automatization, which replaces them in production. Therefore, it is necessary to rebut apprehension and destroy myths, connected to industry 4.0. This situation confirms the work of Krzywdzinski, Jürgens and Pfeiffer (2015).

Discussion

The main objective of the paper is to discover potential relations between the age of workers and (1) knowledge of 4.0 industry concept, (2) threats of new technologies and (3) future expectation of technology changes. These relationships significantly support the future development of the company in the context of IR 4.0 implementation. By this development, there is a strengthening of realized business activities as a process of producing all requested product solution (both tangible and intangible). For that, there is important to have professional knowledge about industrial environment and fields such engineering, electrotechnology, building industry, or chemistry, which held a specific quantity of employees (Černíková, 2018; Ambrozová, Koleňák and Pokorný, 2016).

Technology development attacks on staff minds, where appear fear of job loss. This fear is usually the due implementation of smart factory concept, including phases such as automatization, robotization and digitalization, and their adoption by production system in the company and all other affinitive fields. In case of implementation claim of IR 4.0 concept into a company, there is providing a lot of suitable amount of information, how IR 4.0works, what it needs for quick and regular adaptation into production, technical aspects, and potential of technological progress (Rojko, 2017).

Regardless of the fear and low complex knowledge, companies esteem concept IR 4.0 as a huge opportunity for own development. Because of IR 4.0 knowledge broadcast among managers, they already see the necessity of staff education and increasing their qualification, especially in working professions. That necessity leads to threats of staff dismiss (Malý, 2017; Telukdarie et al., 2018).

Conclusion

There exist a huge problem in companies in the implementation process of new technologies and requirements' changes for staff qualification. In both business and marketing activities, there will be work variations, when is revolve reduction of pre-set business offers, and all staff will start with creative work (Malý, 2017). From point of HR view, all potential changes will not be radical, because companies still must care about their employees, train them, support their motivation and stimulate them (Malý, 2017; Armstrong, 2007). By this long-time care would be reached positive influence of staff expectations about planned changes (Kohnová, Papula and Salajová, 2019).

According to the defined objective, there were stated three hypotheses. These hypotheses were evaluated by Pearson's chi-square test of independence. In results, there was found only one dependence between the age of workers and foreknowledge of industry 4.0 (H1), where significance reaches 0.001 and intensity is 0.630. Other hypotheses (H2, H3) did not match significance value and there is not possible to declare statistical dependence.

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Application of Porter's five forces model to the Czech dairy industry after the abolition of milk quota

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Abstract

One of the important factors for successful management is the knowledge of the competitive environment in which the business operates and the ability to adequately respond to changes. The article describes the creation of Porter's five forces model for the Czech dairy industry after the abolition of milk quota. As part of a comprehensive analysis, the forces to determine the intensity of competition in dairy industry and its profitability level of milk producers and processors in the Czech Republic are identified and described in detail. Their significance for the affected subjects is quantitatively evaluated. The results show that in the case of milk producers, the most significant competition appears to be current competition in the industry and the bargaining power of the customers, followed by suppliers' bargaining power. In contrast, existing competition in the sector and the bargaining power of customers have the greatest importance for milk processors. The model can be applied to the situation of specific businesses operating in this area.

Keywords: Porters´s five forces model, milk, milk quotas, Czech dairy industry

Introduction

At the turn of the 1970s and 1980s, Western Europe had overproduction of milk. The problem was dealt with by subsidizing its export, which had a global impact on its price (Hrdličková and Mikulka, 2015). For this reason, milk quotas with the aim of stabilizing the market and purchase price were introduced in 1984 (Andersson and Lingheimer, 2015). Each EU country had domestic wholesale and direct sales quotas, any exceeding was sanctioned. In 2008, the European Commission published specific legislative proposals to remove the quotas and the system of milk quotas was abolished in the European Union on 31 March 2015 in accordance with Regulation (EU) No. 1308/2013 of

the European Parliament and of the Council of 17 December 2013 (Andersson and Lingheimer, 2015). As of that day, every producer can produce any amounts of milk, which may affect significantly the entire industry (Hrdličková and Mikulka, 2015). By abolishing the quotas after more than thirty years, the European Union made the market more liberal, which is the reason why European countries of so-called "milk belt" (the Netherlands, Germany, etc.) have been preparing for this situation from the moment when the change was first proposed and they are able to increase their production promptly by tens of percents (Hrdličková and Mikulka, 2015). A gradual growth in the production in other countries is expected, especially in Poland and Hungary, by contrast, producers who do not adapt to the new conditions will be forced to exit the dairy industry (Bosková, 2013). The situation in the market is impacted by the EU embargo on Russia (Petříček and Vlková, 2015), a promising region where increased dairy production could be exported are Asian countries (Hrdličková and Mikulka, 2015). With respect to the number of factors, the particular impacts of quota abolition may differ across EU countries; the objective of this paper is to describe systematically possible impacts of this legislative change on Czech producers and processors by applying Porter's five forces model.

Methods and Data

Porter's model of five competitive forces

The model was created in the 1980s as a tool of exploring competition (Porter, 1994). The idea is that the attractiveness of market and its overall profitability can mainly be defined by the market structure. According to the model, the degree of competition in an industry is conditioned by five basic forces that affect companies in the industry, while their joint influence determines the intensity of the competitiveness of the environment (Eskildson, 2010; Narayanan and Fahey, 2005). According to Porter, the "awareness of these forces can help a company stake out a position in its industry that is less vulnerable to attack" (Porter, 1979). The greater influence of forces affecting a company, the lower profitability of investment can be expected (Ormanidhi and Stringa, 2008). The basic competitive forces are: industry rivalry, bargaining power of buyers, bargaining power of suppliers, threat of new entrants and threat of substitutes (Shevchuk, 2007).

Rivals in an industry compete on a constant basis (Martínková, 2008). A company tries to achieve a competitive advantage (Eskildson, 2010) by employing tools such as technological innovations and advertising (Shalloo, 2007). Intensity of rivalry is subsequently demonstrated as a consequence of several interlinked structural factors (Shevchuk, 2007), the most important one being the type of market competition, cost items (Ormanidhi and Stringa, 2008), industry growth and its dynamics (Grundy, 2006), differentiation of goods and services as well as rival differentiation (Shevchuk, 2007), increase resulting from expanding capacities and intensity of strategic effort (Jiříček, 2007) and costs linked with the company's entry to the market and exit costs (Eskildson, 2010).

Buyers can influence profitability of the industry by exerting downward pressure on prices or product quality (Martínková, 2008). It can be said that with an increasing dependence of a producer on one buyer increases such buyer's bargaining power and more intense competition in the industry can be expected. That is why it is a good idea to define clearly supplier-buyer relationships when setting up a business strategy (Shevchuk, 2007). Bargaining power of buyers can be assessed using criteria such as the number, importance and profitability of customers (Eskildson, 2010), the importance of goods or services for customers, threat of backward integration (Jiříček, 2007) and costs of customer switching (Narayanan and Fahey, 2005).

Similarly to buyers, also suppliers can influence the profitability in an industry (Martínková, 2008). If they exercise their dominance over other participants when bargaining and they enhance it with threat of increasing prices or decreasing quality of the goods and services they provide, they can achieve more favourable conditions, complicating the conditions for companies buying from them (Shevchuk, 2007). Bargaining power of suppliers can be assessed using criteria such as the number and importance of suppliers (Eskildson, 2010), threat of new entrants (Narayanan and Fahey, 2005), importance of buyers for the supplier (Shevchuk, 2007), existence of substitutes and their threat to the supplier (Narayanan and Fahey, 2005) and arrangement of labour in the industry (Jiříček, 2007).

The seriousness of threat of new entrants to existing markets depends primarily on the extent of barriers to entry and exit (Jiříček, 2007). New entrants bring to the industry new production capacity often together with sources while trying to seize the largest market share possible. Further development of the situation is also conditioned by the response of the existing participants (Shevchuk, 2007). The higher the barriers to entry and exit, the more attractive a segment is for a participant, while the threat of new entrants is relatively small since overcoming such barriers requires considerable effort and means (Jiříček, 2007). The main sources of barriers include economies of scale (Narayanan and Fahey, 2005), investment exigency and access to distribution channels (Eskildson, 2010), product differentiation, customer loyalty and government policy (Martínková, 2008), need for know-how, patent, licence or special technology, access to materials, power supplies, labour (Jiříček, 2007), cost disadvantage independent of scale, improvement of services provided by existing market participants (Shevchuk, 2007).

Last but not least, it is necessary to mention substitutes. The greater the pressure on the product from the part of substitutive products and the lower the pressure from the part of complementary products, the tougher the competition in the industry observed (Shevchuk, 2007), since the easier it is to replace a product with a substitute, the less attractive the industry is becoming (Martínková, 2008), which is due to a price decrease and thus lower company profits (Jiříček, 2007). Achieving technological innovation in a substitute sphere has the same effect. Threat of substitutes can be assessed using criteria such as number of substitutes and complements in the market (Grundy, 2006), possibility of substitutes entering the market in the future (Martínková, 2008), competition in a

substitute sphere (Narayanan and Fahey, 2005), development of substitute prices and their utility features (Jiříček, 2007).

Porter's model once had significant influence on the development of strategic management (Ormanidhi and Stringa, 2008), later it was criticised particularly for its static view of competition operating with fixed industry boundaries, excessive accentuation of profit at the expense of other important factors, insufficient elaboration of the model on the micro-level and for suppressing the concept of collaboration among companies in the market (Downes, 1997; Grundy, 2006).

In order to create Porter's model, it was first necessary to identify the forces in the dairy industry in the Czech Republic following the theoretic framework. Subsequently, the factor intensity was evaluated using expert assessment. The outcome is two models: a model of a Czech producer and a model of a Czech processor.

Results and Discussion

Porter's model of a Czech producer

Rivalry among existing competitors – due to globalization, it is currently complicated to define boundaries of the market (Mann, 1994); for the purpose of this article, all milk producers registered in the Czech Republic represent the relevant market. In the previous six months before milk quotas were abolished, Czech producers produced 1.486 million litres of milk (Brož, 2015). Milk from producers associated under various interest groups (Bosková, 2013), especially marketing cooperatives (there are over thirty such cooperatives in the Czech Republic) (Pecinová, 2010) accounted for approximately 67% of the total volume, same as in the previous years.

The producers are most significantly influenced by the Agrarian Chamber of the Czech Republic which, however, it promotes interests of producers from different industries. The biggest specialized interest group is the Mlecoop marketing cooperative that associates several marketing cooperatives on the regional level including (Pecinová, 2010). Besides Mlecoop, there are several interest groups whose share in the total milk production in the Czech Republic is below 1-2% (Bosková, 2013). The share of producers who are not part of any interest group is negligent (Havel, 2003). With respect to the number of milk producers in the Czech Republic, it can be said that rivalry among them is rather strong, with no company being so dominant so that it could determine prices.

After the removal of milk quotas, some producers experienced an increase in milk production, although there is no demand for such an increased production due to the embargo on Russia and competition among producers is getting tougher (Mikulka, 2015). What is becoming crucial are contracts with big dairies, as milk production exceeds local consumption (Brož, 2015). Small or less efficient farmers (there is a quite a larger number of them in the Czech Republic) (Petříček and Vlková, 2015), can either terminate producing milk or start processing milk themselves which, however, requires significant investments and entrepreneurial spirit (Beneš, 2015). Another factor are foreign

producers who can deliver milk to Czech dairies for lower prices because of subsidies they receive from their governments (Šrámková, 2015), thus exerting further downward pressure on prices (Hrdličková and Šenk, 2015). Therefore, it is very important for producers to meet their buyers' requirements in order to decrease likelihood of terminating collaboration, which can be safeguarded more easily as long as their production is efficient (Jobson, 2013). The solution lies in investing in modern technologies, endeavour to minimize costs (McCoy, 2000) and possibly in an innovative approach (Bosková, 2013). In case of a farmer exiting the market, it cannot be presumed that such a person would ever return to production with respect how demanding it is to run a business in this industry (Beneš, 2015).

The above stated clearly shows that competition among milk producers after the abolition of quotas is one of the most significant forces in the Porter's model, which is why it was assigned five points on a five-point scale, meaning it is most significant.

Bargaining power of buyers – the most significant milk buyers are dairies, from whom a group of key players is established (Antonyová, 2010). With respect to surplus of milk produced in the Czech Republic (Brož, 2015) these buyers, regardless of their importance and size, have huge bargaining power. The simplest way for producers to ensure sales are long-terms with dairies (Ryan, 2007), which is a certain assurance of income (Králová, 2013). Losing a contract with a dairy may prove to be liquidating for some producers, which allows dairies to exert downward pressure on prices and to achieve their decrease eventually (Hrdličková and Šenk, 2015; Hrdličková, 2015).

Another option is export. Historically, the greatest buyers are dairies in Germany, Austria, Italy and France (Králová, 2013). However, after the quota abolition, the production of Dutch and German (Hrdličková and Mikulka, 2015) as well as some other producers, e.g., in Poland and Hungary rose, which – together with Russian ban on dairy product import (Petříček and Vlková, 2015) decreased the demand for Czech milk. This is the reason why producers try to find other selling channels (e.g. milk vending machines, European programme "Milk for Schools", producers processing milk themselves, etc.).

Taking into consideration the volumes of milk produced, it can be concluded that there are not enough buyers (Hanžlová, 2015), their switching costs are not very high, and the price or quality of the production is not compromised (Hrdličková and Šenk, 2015) with the end consumer hardly noticing any change. This is the reason why dairies have no reason to stick to their habits (Šrámková, 2015) and they are capable of responding to a more advantageous offer from other producers quite flexibly.

In consequence of quota abolition, we can thus see an increase in bargaining power of buyers, which is why it was assigned five points on the five-point scale – most significant.

Bargaining power of suppliers – suppliers of milk producers include encompass suppliers of power, fuel, various devices, technology and equipment, employees who take care of the entire process and farmers supplying feed in case the producer does not have own sources. In some cases, we can even include landowners of fields where cattle are

kept (Ryan, 2007). All suppliers have impact on the final price of the milk produced. Most of the suppliers are dependent on the development of global prices of materials that influence the price of their goods, which means that production costs of milk producers are – to a great extent – also dependent on the global economy (Petříček and Vlková, 2015). The item with the highest price variability is fodder mixtures, their price depending not only on economic trend, but also on the weather (Beneš, 2015). An alternative is import from other parts of the world that remained unaffected by adverse climatic conditions (Uhlíř, 2015).

As to a change in this bargaining power in Porter's model after milk quotas were removed, it is evident that there has been no transformation. Still, it is necessary to consider milk producers an important force, which is why it has been assigned four points on the five-point scale – rather significant.

Threat of new entrants – possibilities of new producers entering the industry have improved after the abolition of milk quotas (Hrdličková and Mikulka, 2015), on the other hand, there has been an increase in the volume of the milk produced by producers who had been restricted by the quotas, which raised the global production to levels that it cannot be sold under the current conditions (Vöneki et al., 2015; Hrdličková and Šenk, 2015). It is generally true that producers increasing production are the most efficient ones who are able to sell their production, by which they push out of the market the less efficient ones, which in turn increases the competition in the industry and conditions for new entrants are becoming more difficult (Hrdličková and Mikulka, 2015; Hrdličková and Šenk, 2015). Other barriers to entry are, e.g., purchase of cattle, technologies and special equipment (Ondersteijn et al., 2006), establishing a customer network (Antonyová, 2010) and searching for reliable suppliers (Eskildson, 2010).

This force was assigned two points on the five-point scale – rather insignificant, since it can be expected that market situation will be influenced by current producers, especially foreign ones, rather than by new entrants (Hrdličková and Mikulka, 2015).

Threat of substitutes – milk substitutes are any kind of food that have similar use to milk, but their nutrition values differ from cow milk (Rodná, 2015). The closest substitutes are sheep and goat milk and various drinks made of almonds, soy, rice, coconut, other nuts and cereals. The reason for their consumption may be health issues caused by cow milk consumption (Fuchs, 2015) as well as by new dietary trends (Marketing & Media, 2014).

The force of milk substitutes has not changed in any way whatsoever as compared with the situation before the abolition of quotas, which is why it was assigned three points, meaning medium significant, which is linked particularly with the modern lifestyle that concerns more and more consumers (Čermák, 2013).

Porter's model of a Czech processor

Abolition of quotas has undeniably affected also Czech milk processers (Mikulka, 2015), which is why a Porter's model was created also for this sphere of milk industry, attention being paid particularly to factors that are subject to change due to deregulation.

Rivalry among existing competitors – market participants are, for the purpose of this model, all processors registered in the Czech Republic. It proved convenient to classify them by their turnover as small ones (with local reach), mid-sized (with regional reach) and large ones with a turnover of more than one billion CZK – they offer a wide product assortment with distribution in the entire Czech Republic (Zábojník, 2009). Furthermore, a group of key players who set trends in the market can be found in the last category (Antonyová, 2010). The model is conceived from their perspective.

Competitiveness in the market among current rivals has been very tough recently (Antonyová, 2010), for the Czech market is rather saturated with dairy products. Great pressure is exerted on processors in terms of product quality, innovation, new forms and flavours (Balšínková, 2009), they are forced to pay increased attention to promotion and pricing. There are enough processors in the market (Ondersteijn et al., 2006), none of them being dominant in pricing. Due to low customer loyalty, everyone needs to conform to the current situation (Mikulka, 2015).

Dairy farming is a rather dynamically growing industry (Christiansen, 2014) that only offers growth opportunities for processors who can keep pace with trends. The situation is complicated by sanctions on Russia, which is one of the main reasons of dairy product surplus in the Czech market and decrease of their prices. This also concerns other EU countries, particularly former Visegrád Group states (Hanžlová, 2015). Another factor affecting the situation in the Czech market is the increasing production of some foreign processors after the quota abolition in April 2015, expansion efforts are anticipated (Hanžlová, 2015). In this particular situation, the Czech market is a suitable location for export, since transport costs will not increase the product price much and the production will remain competitive when compared with Czech production (Hrdličková and Mikulka, 2015). This will further increase competition in the processor market due to tough battle for key buyers. A solution for existing Czech processors to staying in the market is to focus on other business activities, not merely on milk processing (Shalloo and Horan, 2007) while striving for maximum production efficiency, focusing on cost minimization and achieving economies of scale and – last but no least – on investing in new technologies (McCoy, 2000).

Existing rivals are the most significant force in Porter's model, which is why this force has been assigned five points on the five-point scale – the most significant one. Therefore, processors should watch closely what is going on in their industry (Christiansen, 2014) in order to avoid neglecting an important factor in their tough competitive environment, which could result in devastating consequences for them (Shalloo and Horan, 2007).

Bargaining power of buyers – the most important buyers buying from processors are, with respect to the volume of the production bought, retail chains, which are part of food sale network, the main group of buyers being retailers (Zábojník, 2009). The Czech market has a very low concentration of such buyers, while it has a very dense and diversified network, which is unique in Europe (Nevyhoštěný, 2012). According to experts, we can expect several big players to exit the industry in the years to come,

however, bargaining power of buyers with respect to processors is already considerable, with great downward pressure on reducing prices as low as possible (Vejvodová, 2014). It is apparent that quota abolition increased the bargaining power of buyers. The situation could be changed with a government intervention in the form of subsidies or buying certain products for state material reserves (Šrámková, 2015; Mikulka, 2015). However, such interventions may damage the industry over the long term (Holman, 2005).

This force was assigned four points on the five-point scale – rather significant. It will be hard for processors to find new customers if they lose an important one.

Bargaining power of suppliers – suppliers are all producers who supply milk processors with milk to be processed. Their classification was sketched in the text above. They are predominantly national and local suppliers, however, it is necessary to take into account also foreign suppliers (Beneš, 2015). Larger suppliers, and/or possibly suppliers guaranteeing constantly high quality of milk supplied (Antonyová, 2010), who usually demand higher prices and longer term contracts may have stronger bargaining power (Ryan, 2007). It is necessary to mention other suppliers such as power, technology, chemical, food and other companies who are not affected by the quota abolition, which is why they are no longer taken into consideration.

It is apparent that after removal of quotas the bargaining power of suppliers dropped even more, on a five-point scale it was assigned two points – rather insignificant.

Threat of new entrants – milk processing is a rather complicated procedure that is subject to legislative regulation, which affects the total costs of the procedure. Also, the technology needed for dairy production is typically single-purpose, unit costs can be decreased particularly by distributing fixed costs among the highest number of products; they are not sufficiently differentiated among producers though (Zábojník, 2009). It is the reason why a new competitor entering the industry is very exigent in terms of capital (Ondersteijn et al., 2006) as well as building a distribution network (Antonyová, 2010). Experience and knowledge of technology are not an important aspect, since the industry is not, with some exceptions, protected by patents (Zábojník, 2009). A new processor would struggle trying to find new suppliers who do not require too high prices and can deliver high quality milk on a constant basis (Zábojník, 2009). Well-established brands play an important role here and unknown brands can hardly compete with them (Balšínková, 2009).

After the abolishing of quotas, there is an opportunity for some suppliers to increase their production. There is a certain room for buying milk for a lower from Czech producers as well as from abroad. This means that the most efficient producers will probably push out of the market competitors who cannot produce milk at sufficiently low costs.

A new rival entering the industry is not very likely, which is why this force was assigned two points on the five-point scale – rather insignificant. The situation on the market can be influenced by the current players in the years to come, while we can anticipate some

of them being forced to exit the market (Bosková, 2013), rather than a massive entry of new rivals in the industry (Šrámková, 2015).

Threat of substitutes – substitutes of milk and dairy products are all types of food replacing milk made of sunflower, rape, olives, nuts, soy, buckwheat, rice and other plants. Another alternative are products made of milk other than cow milk, although they are not very popular with Czech consumers (Kučera, 2008). Especially thanks to intense promotion of a "healthy lifestyle", the position of substitutes in the market has been reinforced over the long term (Rodná, 2015), which affects negatively the demand for dairy products. The more developed a society is, the more significant determinant of human decision making a healthy lifestyle becomes (Čermák, 2013).

From the perspective of quota abolition, dairy product substitutes are not a significant threat, but what cannot be ignored is the growing media pressure on the population, which is enhanced by measures taken by various institutions that, e.g., in case of life insurance favour individuals leading a healthy lifestyle that is linked, although questionably, with substitutes (Mašek, 2014).

The abovementioned factors are not much affected by the quota abolition, which is why this force was assigned three points, same as before these legislative measures, meaning it is still medium significant.

Conclusion

The article presents an analysis of Porter's forces in the dairy industry after the removal of milk quotas on two entities: a producer and a processor from the Czech Republic.

Results are shown in Table 1.

Tab. 1: Porter's five forces model

	Producers	**Manufacturers**
Rivalry among existing competitors	5	5
Bargaining power of buyers	5	4
Bargaining power of suppliers	4	2
Threat of new entrants	2	2
Threat of substitute products	3	3

Source: Authors.

As concerns milk producers, it was found that two forces have the greatest significance and they were assigned five points on a five-point scale. One of them is the existing competition in the industry which has increased after the abolition of milk quotas in combination with an embargo on Russia, which is why it is important for producers to

focus particularly on production efficiency. The other one is the bargaining power of buyers. Their position has also gained significance due to a greater volume of global milk production. A slightly less important was the bargaining power of suppliers that was assigned four points. Suppliers in many cases influence significantly producers' costs, while costs are crucial for producers to stay in a highly competitive market. Threat of substitutes is of medium significance with three points: it is influenced, in particular, by modern lifestyle linked with massive promotion of vegetable products and growing number of food allergies. The least significant force was the threat of new entrants in the industry with two points: its influence is currently considered less significant in the Czech market.

As for milk producers, it was found that the existing industry rivalry, assigned with five points, is of the greatest significance, which is why it is necessary for processors to keep watching their competitors and adapting to the changing situation in the market. The second most significant force is the bargaining power of buyers with four points: if a milk producer loses some of its important buyers, it can only hardly sell its production on the existing market. What we found of medium significance was the threat of substitutes with three points, significantly influenced, as the case is with substitutes concerning milk producers, by a modern lifestyle and consumers' health issues. Two forces were assessed to have rather insignificant influence, i.e. they were assigned with two points. One of them is the threat of new entrants when a prospective competitor would have to be able to face very high costs linked with entering the industry, the second one being the bargaining power of suppliers who find it hard to sell their production.

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Discussion of theoretical-practical aspects of squeeze out

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Abstract

The presented article has mainly a nature of theoretical discussion on the issue of squeeze out. The squeeze out entitles a majority shareholder to exercise his rights to buy out remaining shares of an offeree company. It a specific transaction mechanism with an impact on shareholders, offeree company, procedural regulation of the transfer of ownership rights arising from shares, methodological aspects of determining a squeeze out price of shares of minority shareholders, efficiency of capital markets etc. In case of Slovakia, the squeeze out has been used for more than one decade, however the number of such kind transactions is low. The main objective of the article is to point on specifics of that transaction and methodological aspects of determination of a general value of shares as a criterion of a fair price relying on basic attributes of procedural regulation of squeeze out in Slovakia, synthesis of knowledge from empirical studies, existing legal and financial theory as well practical experience one of the authors.

Keywords: consideration, fair price**,** general value, share, squeeze out

Introduction

Determining the value of a company (business valuation), parts of a company, its assets or other property is not a new instrument from the view of the Slovak (or Czechoslovak) economy. Its existence was already evident at a time when our economy had the feature of central planned economy. However, since its transformation into the market economy that was related (except other) to the process of changing ownership structure of state-owned enterprises, emergence of new (private) enterprises, new legal forms of business etc., the view on a business valuation and reasons for valuating have changed. In connection with the forensic engineering, a business valuation is related to the determination of a general value that is considered objective. The essence of the process of valuation, regardless of the subject of valuation, is to objectify a source value to a final – general value. *A general value* is an expert estimate of a most probable price of a

company under assessment or its parts (on the valuation date, at given place and time) that would be accepted by the both sides of transaction, provided there is a free competition, fair trading, demand and supply side act with an appropriate awareness, caution, and assumption that the price is not affected by a disproportional motive. Concerning the purpose of business valuation, the general nature of a company´s value may be identified with different types of value e.g. with investment value, liquidation value, fair market value, inherent value and other types depending on the legal or other act that raises any need to determine the value, including squeeze out (Sedláková, 2006).

The squeeze out is a specific transaction of a forced nature. It is not a result from an arm´s-length negotiation and thereby an aspect of voluntary is questionable in the context of general value. The valuing usually falls within the remit of an independent expert (determined by the national legislation), who should determine a fair value of shares in the context of understanding the legal implications of squeeze out, but without examining compliance with procedural acts legally. Such a way determined value – redemption price should be acceptable for participants of squeeze out transactions.

Primary attributes of squeeze out

For the purpose of the article, *"squeeze out"* is a legal mean to push out minority shareholders from an offeree company by a majority (controlling) shareholder. On the one hand, it establishes the right of a majority shareholder, who is interested in transferring the entire company to his person without economic liquidation of an offeree company, to buy, on the other it obliges a minority shareholder to sell. The legitimacy of the right is conditional – a majority shareholder must keep in hands a certain threshold of an offeree company´s shares and votes, and offer to the minority an adequate *"equivalent"* for shares. If a majority shareholder exercises the right, majority shareholder is obliged to sell.

Obviously, in case of the squeeze out, the rights and obligations of a majority and minority shareholder are affected in a specific way, which results from the very nature of a joint stock company. The share capital of a joint stock company is allocated to a certain number of shares with a given par value that are in a property of more natural persons or legal entities (the number is not legally restricted). De facto, a managing of a company may be a potential interest of all shareholders. The rights of shareholders are "materialize" into the ownership of shares, while the specificity of the rights is a matter of the legislation of individual countries. The general nature of shareholder´s rights express that all shareholders have the right to ask a company to treat all of them equally and under the same conditions. In addition, no shareholder may exercise own right at the expense of other shareholders' rights and interests. The primary economic goal of the existence of a joint stock company is the same as in case of other legal forms of businesses – to be profitable and contribute to a market appreciation of a share capital. However, the potentially existing high fragmentation of a shareholder base may be (and in many cases, the practice has proved that is) an obstacle to effective corporate governance and lead

through a complicated process of compromises in the enforcement of important decisions. The fragmentation may be a source of agency problems and costs[1], information asymmetric etc. that creates a difference in the value of the same company, provided *"unanimous decision-making"* and provided *"fragmented decision-making"*. As well, it is important to highlight the presence of business risk and different preferences related to the dividend policy. The business risk is considered higher in case of a majority shareholder than in case of a minority shareholder, in other words it is proportional to the size of their investment (Pokorná, 2003). The disproportion in the area of dividend policy includes a conflict of long-term goals and short-term goals concerning an earnings distribution.

It is obvious that the squeeze out is rather a means of protecting interests of a majority shareholder. As a mechanism for concentrating fragmented ownership structure of companies to rationalize their financial, economic and strategic governance, it firstly appeared in the 1930s in the United Kingdom (Havel and Pihera, 2008) Hečková and Chapčáková (2009) state that the squeeze out is a legal means of "purifying" the ownership structure from minority shareholders by a "strong" majority shareholder, who is interested in developing a company´s business according to own ideas. Incentives for the squeeze out are mainly a need to increase a company's competitiveness, reducing administrative and governance costs and burdens[2], and restructuring a company by going private (Hečková and Chapčáková, 2009; Mařík, 2008). The concentrated structure may be a positive impulse for investments, which otherwise a majority shareholder would not undertake (Uzsák, 2007), generally said a majority shareholder cannot fully exploit synergies, while not fully owning an offeree company (Bergstorm et al., 1994; Chen et al., 2018). Damodaran (1997) emphasizes that the squeeze out is able to bring benefits not only for a company itself but also for the society. Van der Elst and Van den Steen (2006) in their comparative analysis note benefits of the squeeze out in connection with the public interest, too. Miliutis (2013) deals with it in connection with disparities in the legislatives governing its process. Despite the identified disparities, he states that rationales for going private are the same – avoidance of agency costs and compliance with listing-related reporting, economies of scales, constant under-pricing of listed shares, improved D/E ratio, tax mitigation etc. The squeeze out legislation emphasizes economic efficiency and benefits to the society at the expense of non-controlling shareholders (Kainsanlahti, 2002). In connection with the legislative, there is a discussion about shareholders´ wealth, allocative efficiency, means of protection of minority shareholders, as well chosen valuation approaches (e.g. Chen et al., 2018; Enriques, 2014; Saastamoinen and Savolainen, 2019).

The squeeze out affects all rights of minority shareholders that is obvious. As regards a possibility to participate in the decision-making and management of a company, a

[1] We assume agency problems and agency costs of the second type. See e.g. A. Shleifer & R. E. Vishy (1986)

[2] In the meaning of simplifying and rationalization of a company´s management system mainly due to minimization of abusing legitimate rights that belong to minority shareholders in order to protect them from the consequences of various company decisions (solving a free ride problem), information duty etc.

minority shareholder is usually in such a position that he cannot enforce own managerial interests (if such an interest exists at all). The practice, therefore mainly points to a moot of property rights. By a forced sale, a minority shareholder loses forever an entitlement to dividends and potential gain in a form of an increase of the market price of shares and so allows to a majority shareholder to acquire 100% stake in an offeree company and benefit from associated effects. The protection of minority shareholders (depending on the legislation of that country) is therefore ensured by legislative quantitative and qualitative requirements that the squeeze out transaction must meet to minimize interference with minority rights, mainly property ones.

Quantitative criteria stipulate a minimal level of the capital carrying voting rights and voting rights of an offeree company that allows to a majority shareholder to exercise the right of squeeze out (so-called a personal condition of the existence of a majority shareholder). The threshold differs country to country. E.g., the Directive 2004/25/EC of the European Parliament and of the Council of 21 April 2004 on takeover bid (hereinafter *"Directive"*), general directive on take-over bids in the EU, sets a threshold at 90%. However, the Directive allows to the member states to be stricter and apply a higher threshold, but no higher than 95% (Article 15, paragraph 2 a) – b) of the Directive). As a rule, the quantitative criterion also usually includes a time criterion determining the time limit or the moment when a majority shareholder can exercise the squeeze out right. *Qualitative criteria* stipulate in which companies the squeeze out can be undertaken[3] and define a legislative process of this transaction, including the appointment of a supervisory authority. Except that, criteria include determining a value of compensation for shares of minority shareholders with a requirement to consider all relevant quantitative and qualitative aspects that may determine a fair price. In most countries, the consideration paid to minority shareholders must be supported by an independent opinion. The criterion also defines the institutions of protection of minority shareholders' rights.

Theoretical aspects of fair value determination (fair squeeze out price)

On the theoretical level, it is possible to identify several valuation approaches, whose aim is to determine a fair price. The most preferred are methods based on discounted cash flows of different nature, in general, based on the principle of present value of expected benefits generated by any asset. By deductive approach applied in the issue of business valuation, the value of a share determined for an investor´s need will be at the level of the present value of future incomes that a share is expected to generate. From the point of view of the squeeze out and consideration for the forced sale of shares, minority shareholders should be compensated such a way that the consideration takes into account all value-forming factors, which are inherent for an offeree company and which minority shareholders lose. If minority shareholders do not get an appropriate return on their

[3] Generally, the principle of squeezing can be applied in any company with a fragmented structure. From the legislative point of view, the squeeze out right is regulated and connected mainly with public joint stock companies. In some countries, the right is possible to apply also in other legal forms of business.

shares when are being squeezing out of a company, they will never get a second chance to gain a return again (Croci et al., 2013). Concerns associated with minority shareholders welfare in the squeeze out have frequently garnered the attention because the pricing of minority shares does not emerge from an arm´s-length negotiation and reflect a conflict inherent with disparate ownership interests. (Bates et al., 2006) A majority shareholder aims to minimize own costs in gaining full control of a company, whereas a minority shareholder seeks to maximum exit value for his stake. In connection with this Maliutis (2013) identified three basic standards of a fair price in the squeeze out – market value, going concern value, and third-party sale value. As many other authors point, each of suggested standard is case specific with own application restrictions (Dukes et al., 1996; Steinmeyer and Hägar, 2002; Herz et al., 2007; Anderson, 2009; Hamernesh and Wachter, 2009; Ventoruzzo, 2010; Saastamoinen and Savolainen, 2019 etc.). In the practice, each standard is probably applicable only in the scope of legislation governing the squeeze out and valuation process in particular countries. It is mostly applied that the squeeze out price is given by more standards of value or other quantitative criteria at the same time, as the squeeze out is a legislative forced sale and not a voluntary one. For instance, the Slovak Republic accepts previous transaction prices in a company´s stock as one but not the only legally determined criteria of an adequacy of the consideration in case of the squeeze out. The legislative accepts a going concern approach, too since an expert in charge of determining a general value of an offeree company is required to apply this approach within both required valuation methods in the squeeze out transaction. Regarding a third-party sale value, this approach is being applied within in case of valuating securities for determining their general value[4], however the Slovak legislation its usage in case of the squeeze out does not admit.

Formal-procedural side of squeeze out in Slovakia (legal framework)

With regard to Slovakia, the introduction of the squeeze out is a systematic step toward the harmonization of the Slovak legal system with the community law of the EU (Hečková and Chapčáková, 2009). Previously mentioned Directive of the EU was intended to promote the integration of the European capital markets, provides for an efficient market for corporate control, and harmonize take-over regulations (Enriques et al., 2014). Into our legal system, the squeeze out through the Directive was incorporated as *"buy-out right"* by the approval of the Act No. 644/2006 Coll. that amends and supplements the Act No. 483/2001 Coll. on banks as amended and by the Act. No 209/2007 Coll. that amends the Act No. 566/2001 Coll. on securities and investment services as amended (hereinafter *"SA"*) with effect from 1 January 2007. The legal introduction of the squeeze out has had a direct or indirect impact on other legal norms, e. g. Act No. 513/1991 Coll. on commercial code as amended, Act No. 431/2002 Coll. on Accounting as amended, Act No. 747/2004 Coll. on financial market supervision as amended, Decree of the Ministry of Justice No.

[4] Appendix No. 7 *"Determination of a general value of securities"* of the Decree of the Ministry of Justice No. 492/2004 Coll. on determination of general assets value.

492/2004 Coll. on determination of general assets value (hereinafter *"Decree"*), and other statutory norms. With effect from 1 January 2019, the SA was amended by the Act No. 373/2018 Coll. that amends and supplements the Act No. 371/2014 Coll. on resolution in the financial market as amended, which has changed the procedural side of squeeze out in Slovakia[5].

According to the Slovak law, *squeeze out* is the right of a majority shareholder to require all minority shareholders to pass on him all remaining shares of an offeree company at a fair price (Article, 118i, paragraph 1 of the SA). *An offeree company* is a joint stock company whose shares are the subject of a take-over bid (Article 114, paragraph 2 of the SA), while shares must be admitted on a regulated market in Slovakia (Bratislava Stock Exchange) or on other regulated market in other member states of the EU (Article 114, paragraph 1-4 of the SA). A majority shareholder is *an offeror*, who has carried out a take-over bid (before exercising the buy-out right) and holds at least of 95% of a company´s shares and votes. *A take-over bid* is a public offer to conclude a contract under the terms of the Commercial Code (Article 114, paragraph 1 of the SA; Article 276-279 of the Commercial Code). Its subject is a purchase of shares of an offeree company or exchange them for other securities. A public offer, which was neither partial (it only concerns a designed part of remaining shares) nor conditional (it concerns a minimum number of shares that an offeror wants to acquire), is made on a mandatory basis (following the acquisition of control[6] of an offeree company), or voluntary basis (its objective is acquisition of control of an offeree company). The buy-out right must be exercised not later than 3 months after the validity period of a take-over bid period. The validity period is precluded. An offeror may exercises his squeeze out right only in case of the approval of the National Bank of Slovakia (hereinafter *"NBS"*), *a supervising authority* (Article 118i, paragraph 4 of the SA). The NBS is eligible to examine the application related to the exercise of the right; after that the application approves, rejects or requests an offeror to revise it. Before an offeror submits the application to the NBS, it must deposit a cash necessary to provide the full consideration to minority shareholders to the hands of *authorized person* (Article 118i, paragraph 12 the SA). An authorized person ensures a centralized payment of a consideration belonging to minority shareholders for their shares. It may be a bank, broker, central depository, or a foreign person authorized to carry out similar activities in the territory of Slovakia like previously mentioned subjects (Article 118i, paragraph 11 of the SA). If a majority shareholder meets the mentioned conditions, may ask a board of director of an offeree company to convene *a general meeting to take a decision on the transfer of all remaining shares* to a majority shareholder

[5] From the procedural point of view, a majority shareholder is no longer obliged to send to each shareholder a contract proposal for the purchase of shares, or proposal for exchange of shares for other securities. The transfer of ownership rights of shares does not relate any more to the consensus of minority shareholders´ will and neither it is not needed to be replaced by the court order (in case of the disagreement of minority shareholder). This was replaced by a decision of a general meeting with a requirement to register the transfer of share resolution in the Business Register and by the establishment of the institute of an authorized person.

[6] For the purposes of the SA, control means a share of at least 33% of the voting rights attached to shares in an offeree company (Article 114, paragraph 2 of the SA).

(Article 118i, paragraph 5 of the SA). The general meeting approves the transfer of shares only if the resolution is accepted at least by 95% of all votes of all shareholders. By expressing favourable opinion of a general meeting, a majority shareholder's squeeze out right is considered to be exercised (Article 118i, paragraph 6 of the SA). After 30 days since the registration of approval on the transfer resolution in the Commercial Register, shares of minority shareholders are transferred to a majority shareholder who becomes their owner (Article 118i, paragraph 6 of the SA). The *transfer of the ownership of shares*, a legal matter, is registered in the statutory register of securities (in favour of a majority shareholder´s account and debited to minority shareholders´ accounts) on the date of transfer of shares based on the order given by an offeree company. An authorized person pays the consideration to minority shareholders within 3 days of the transfer of shares. It is responsible and obliged, on behalf of an offeror, to publish in the Commercial Bulleting a notice of consideration payment for shares. The notice must inter-alia inform about the date of transferring of shares in favour of a majority shareholder, amount of the consideration per share, and due date of the consideration. The legal means of protection of minority shareholders in case of the squeeze out – the right to file a petition on the validity of decision of the general meeting on the transfer resolution and right to object that the consideration is not adequate are governed by Article 118i, paragraph 15-16 of the SA.[7]

Methodological aspects of business valuation in case of legal act of determining general value of shares for purpose of determining adequacy of consideration in squeeze out

Legal criteria of adequacy of consideration for shares of minority shareholders

Determining a fair price is a crucial element in the success of squeeze out transaction. We build on the already mentioned statement that a property fragmentation of shares and corresponding voting rights do not allow minority shareholders to participate effectively in managing in terms of promoting their own interests, so property settlement remains the priority disputed task. The property interests of a minority shareholder whose shares are subject to *"expropriation"* have been incorporated through the term of adequacy into the legislation regulating the methodology of share valuation in order to determine a fair price of the consideration. We emphasize that *a fair price* we deem as a price that a majority shareholder will pay for shares of minority shareholders and that is adequate from the legal point of view. The SA is currently set up in such a way that the rights of minority shareholders are protected by meeting the aforementioned quantitative and qualitative criteria. The guarantee of meeting conditions of adequate consideration is

[7] The use of legal means of protection of minority shareholder is case of the squeeze out does not restrict the legal power of a majority shareholder to become an owner of a minority stake. However, in case of the first mean, his disposition rights will be restricted – given shares cannot be used as a collateral or to be transferred to other persons unless the court takes a decision. In the second case, only the question of consideration will be questionable without contesting ownership rights of a majority shareholder.

given by a requirement that the consideration shall be established by *an expert opinion*. Determination of an expert in the field of Economics and Business Management, the business valuation sector falls within only the competence of the NBS. The consideration under the squeeze out may be offered in cash, securities or combination (Article 118i, paragraph 9-10 of the SA) and must be equitable concerning the value of shares of an offeree company.

The consideration if the squeeze out is preceded by a mandatory take-over bid shall not be lower than the consideration in that take-over bid. It must be evidenced by an expert opinion (Article 118g, paragraph 7 of the SA). According to the Slovak legislation governing the forensic engineering, only an expert – a legal entity (specialized team of experts – natural persons), is competent to prepare an expert opinion. The price, at which an offeror or persons acting in concert with him acquire shares of remaining shareholders, shall meet all the conditions of adequacy at the same time (Article 118g, paragraph 6 of the SA):

- *Is not lower than the highest price, which an offeror (or persons acting in concert) has paid for shares in the period of 12 months before a take-over bid became mandatory.*
- *Is not lower than the average market price of shares quoted on the stock exchange over the period of 12 months before a take-over bid became mandatory.*
- *Is not lower than a general value of share stipulated by an expert opinion that is calculated as a general value of an offeree company divided by the number of shares while taking into account their par value* (Appendix No. 16 of the Decree); an expert is obliged to identify a general value of a company for the purpose of squeeze out by applying two valuation methods – asset-based method and business method; *the adequacy of consideration determined by an expert is always in accordance with the higher general value* (Article 118g, paragraph 5 of the SA)[8].
- *Is not lower than net value of a company´s assets per share, including the value of intangible assets according to the most recent financial statements audited before a take-over bid became mandatory*.

If a voluntary take-over bid precedes the squeeze out, an offeror may use the same price in both cases, if the price is adequate. *A legal fiction of a fair price is defined by a requirement that through a take-over bid, an offeror acquired at least 90% of capital carrying voting rights of an offeree company comprised in a voluntary bid.* If an offeror was able to acquire the necessary number of shares and voting rights, the price is considered attractive and acceptable for the rest of minority shareholders. Otherwise, an offeror is requested to determine a fair price in accordance with the procedure of a mandatory take-over bid.

Business valuation in case of legal act of determining general value of shares for purpose of determining adequacy of consideration in squeeze out

[8] Note: An offeror for the purpose of the squeeze out and determination if the consideration is adequate may use an expert opinion prepared prior to the obligation to declare a mandatory take-over bid.

The buy-out right was incorporated in the methodology of business valuation through the Act No. 626/2007 Coll. that amends and supplements the Decree of the Ministry of Justice No. 492/2004 Coll. on determination of General Assets Value. The Decree requires an expert to comply with the substance principle – to consider all company´s specificities as an open system with all its effects on the external environment and vice versa when determining a general value of a share. From the practice point of view, the principle comprises a detailed understanding of the squeeze out as a legal action and application of a principally unified methodological approach. The Appendix No. 16 *"Determination of general value in order to find out adequate consideration for shares under Act No. 566/2001 Coll. on securities and investment services as amendment"* of the Decree rules methodology of valuation only for the purpose of squeeze out. The methodology is designed is such a way that the consideration has a nature of *"absolute"* indemnity for an investment of a minority shareholder, who loses it due to a squeeze out, while *"opens a way"* for an opposite party to get 100% ownership of an offeree company. It does not take into account only the importance of investment that a minority is losing (could be identified with a price at which a majority shareholder would receive a similar risk-oriented investment with a similar return), but also the importance of investment, which a majority shareholder is acquiring.

The Act No. 382/2004 Coll. on experts, interpreters and translators as amendment and the Decree of the Ministry of Justice of the Slovak Republic No. 228/2018 Coll. govern the structure of an expert opinion, which is the same for all legal acts of business valuation. The squeeze out is not an exception, however in an expert opinion must be included all relevant specifics of an offeree company and take-over bid that precedes the squeeze out. It must include an ex-post financial and economic analysis of an offeree company as well as a business plan submitted by a majority shareholder and verifying of its feasibility, while an expert takes full criminal responsibility for a general value quantified in an expert opinion. The determined general values of shares by the assed-based method and business method are provided at the end of an expert opinion.

Use of asset-based method to determine general value of company and general value of shares for purpose of squeeze out

According to the Appendix No. 16 of the Decree and applying the asset-based method, a general value of an offeree company is the sum of general values of all components of company´s assets reduced by the general value of liabilities and accruals on the valuation date. It is based on the accounting of an offeree company and documents providing the existence of assets and liabilities. A general value of assets is determined by experts in required expert fields depending on a type of assets. The general value of liabilities is determined in accordance with the Appendix No. 12 *"Determination of general value of liabilities"* of the Decree. The date on which the general value of a company is determined, is decisive and unified for all assets and liabilities.

Use of business method to determine general value of company and general value of shares for purpose of determining an adequacy of squeeze out

According to the Appendix No. 16 of the Decree, the business method determines a general value of an offeree company through the capitalization of drainable resources during the evaluation period. It is a 2-component value category – it is the sum of the present value of drainable resources for the evaluation period and continuing value. For the purpose of determining the general value of shares for the squeeze out (*netto value*), the general value of a company calculated in this way (*brutto value*) is adjusted by a general value of needless assets from operational point of view (*plus*) and general value of interest-bearing debts on the valuation date (*minus*). A general value of needless assets is determined by experts in required expert fields depending on a type of assets. A general value of interest-bearing debts is determined based on accounting information and other documentation in accordance with the Appendix No. 12 of the Decree. According the Appendix No. 16, an expert shall apply different approaches to the calculation of general value of drainable resources depending on a kind of an offeree company. It is needed to distinguish between a business and a financial institution.

A drainable resource is a monetary value of benefits generated, in particular, from a profit, revenues or cash flows that are generated from business activities of a company or its parts, or company´s assets, which depends on a company's past, market position and anticipated development (Article 2, paragraph 1 k) of the Decree). *In case of the squeeze out, an expert determines a drainable resource in accordance with the theoretical quantification of FCFF*. An expert shall take into account all benefits gained by a company´s own activity that is financed by the interest-bearing capital whether implicitly or explicitly.

A discount rate is the weight average cost of capital *("WACC")*. It considers the capital structure of an offeree company (equity and interest-bearing debts), cost of forms of financing and their risk that ensures that the theoretical assumption of symmetry of valuation of invested capital is met. *Cost of equity* (implicitly interest-bearing capital) is given by the average return on a risk-free investment, which is equal to an average return on a government bond with the longest maturity in the bond market in Slovakia on the date of valuation. *Cost of debt* is calculated as a ratio of interest expenses to interest-bearing debts converted on an annual basis.

*A sustainable growth rate of drainable resource*s is derived from the historical and projected returns indicated in a business plan. If the growth rate cannot be reliably identified (taking into account historical and expected development), it shall be replaced by the average growth of an industry concerned in which an offeree company belongs to, for the previous period usually of 5 years based on the findings of the Statistical Office of the Slovak Republic. The sustainable growth rate found in this way shall also be used if the growth rate derived from a business plan is higher than the applied discounted rate. If any of previous approaches cannot be used, the sustainable growth rate of drainable resources will be equal to the expected inflation rate found on the valuation date.

Discussion

The squeeze out as a legal mean of a majority shareholder to acquire remaining shares of an offeree company has been used in Slovakia more than a decade. The right belongs to the Slovak and to a foreign majority shareholder of an offeree company, whose shares are admitted to trading on the Bratislava Stock Exchange or on other regulated market in other member states of the EU. The Slovak legislation governing the squeeze out is conditional and more pro-minority oriented since it stipulates the limit of ownership interest and corresponding voting rights enabling a majority shareholder to exercise the right clearly more strictly than the EU Directive. At the time when the squeeze out was implemented into the Slovak law, questions were been arising, whether its existence will not detract the trading on the already dysfunctional and less liquid Slovak capital market. This fact has not been confirmed since only six companies has been exercised the squeeze out right so far in Slovakia.

Tab. 1: Squeeze out transactions in Slovakia (2007-2018)

Business name or name of person who has consent of NBS	Business name of offeree company	Par value / consideration per share (in EUR, for give ISIN)	Average value / highest value since listing on stock exchange (in EUR)	Date of approving by NBS	Consideration compared to par value / average value / highest value (in %)	Period for exercising right (from – to)
Ing. Alžbeta Janusová	MINERÁLNE VODY a.s., Prešov	33.1934 / 78.650	9.582 / 9.582	19.12.2018	136.94 / 720.81 / 720.81	21/10/18-21/01/19
SC FOOD, AGRO&INDUSTRIAL a.s. (Czech Republic)	Polnonákup HONT a.s., Hontianske Nemce	33.190 / 29.400	4.156 / 5.809	19.9.2014	(-)11.419 / 607.41 / 406.11	09/07/14-08/10/14
COLAS SA (France)	Inžinierske stavby a.s., Košice	33.194 / 1.500[1]	16.279 / 85.640	31.1.2012	(-)95.48 / (-)63.91 / (-)98.25	31/12/11-30/03/12
Achmea B.V. (Netherlands)	Union poisťovňa a.s., Bratislava	33.200 / 71.270	6.845 / 12.000	26.1.2012	114.67 / 941.20 / 493.92	03/12/11-03/03/12
BONGRAIN EUROPE S.A.S., Barendrecht (Netherlands)	Liptovská mliekareň, a.s., Liptovský Mikuláš	33.194 / 53.020	5.509 / 7.867	25.11.2008	59.73 / 862.43 / 573.95	16/09/08-15/12/08
Sudop International B.V., Barendrecht (Netherlands)	DOPRAVOPROJEKT, a.s., Bratislava	33.194 / 286.030[2]	87.413 / 219.080	20.11.2007	761.69 / 227.22 / 30.56	27/10/07-26/01/08
[1] A bid price in a voluntary take-over was EUR 1.00.			[2] A bid price in a voluntary take-over was EUR 213.10.			

Source: By authors based on statistics of trading of Bratislava Stock Exchange and NBS.

We think that this situation was mainly related to the formal-procedural side of the transfer of ownership rights and its time-consuming nature. This also was the main reason for the already mentioned amendment of the SA with effect from 1 January 2019. Its aim is to simplify and speed up the process of exercising a squeeze out right and related transfer of ownership rights of minority shareholders to a majority shareholder and therefore we assume that the number of squeeze out transactions may increase in Slovakia. Potential litigation we do not exclude, since the means of protection of minority shareholders for the purpose of squeeze out the law admits. However, despite the minimal number of squeeze out transactions, as follows from the Table 1, we can state that the consideration paid to minority shareholders in most cases exceeded not only the par value of shares, but also the average value of the market price since listing the shares on the

Bratislava Stock Exchange. If we took into account just the results of this simple analysis, we state that the squeeze out price included also the premium for the gained control.

As regards the discussion about a fair price, the condition to determine a general value of shares of an offeree company by an independent expert according to the Decree is one of the legislative requirements that the consideration is adequate. *We state that the nature of squeeze out as a legal act has been clearly reflected in the methodology of an expert opinion as an expert is obliged to determine a general value of a company by using of two valuation methods simultaneously*. We consider relevant that the criterion of adequacy of consideration for shares is identified with a higher general value. The methodical procedure determining a general value of an offeree company, then a general value of shares is relatively exact. Nevertheless, practical experience has shown disputed areas, which arises a question whether the valuation methodology for the purpose of squeeze out is really the most relevant procedure. Taking about a *business valuation method*, the legal nature of squeeze out affects the valuation methodology such a way that the legislation obliges an expert:

- *Apply going concern principle that ensures an expert takes into account future returns, which minority shareholders are losing by squeezing them out.*
- *Impartially assess the relevance of a business plan, make a relevant corrections if they are needed.*
- *Identify and properly use all economic categories need for a general value calculation – sustainable growth rate of drainable resources, discounted rate, cost of explicitly and implicitly interest-bearing capital.*
- *Relevantly determine the value of needless assets from the operational point of view; a general value is determined by experts in relevant fields of expertise and added to a general value of an offeree company; the assets and reasons why they are needless is determined by an offeror; such approach is logical, since the needless assets should not be taken into account in the prediction of company´s drainable resources.*
- *Reduce a general value of an offeree company by a general value of interest-bearing debts on the date of the valuation.*

A general value of an offeree company identified in such a way is primarily depended on a submitted business plan that points to a company's revenue potential for the period of 5 years. We consider the period optimal, because it is sufficient in terms of reducing the risk of unrealistic estimation of predicted development. It is a source document for quantifying future drainable resources, as well as a sustainable growth rate. It is required a business plan shall contain relevant and true information that make it possible to investigate its feasibility in terms of its creation and amount of drainable resources in the context of past and future periods, including starting points of their creation and parameters. It shall be in coexistence with a financial health of a business. An expert is not able a business plan clearly objectify because the legislation does not precisely determine the process and methodology of a plan´s creation. Moreover, a majority shareholder submits it himself. The fact that the legislation requires a majority shareholder to provide all the requisites for an expert to review it is not a 100% guarantee of its objective content. The practical experience have shown that a quality financial analysis undertaken by an

independent expert is a prerequisite of his ability to assess a business plan. The real problem is mainly that the projected revenue potential is not in coexistence with opportunities generated in the past or in current period and the set direction of an offeree company.

The general problem is that the discount rate used to calculate the present value of drainable resources, takes into account capital structure of an offeree company and cost of capital on the valuation date. It is rather ex-post discount rate however. In case of the squeeze out, an expert works with the assumption that the discount rate is constant for all projected cash flows in each period, de facto even with the assumption of fixed capital structure for forecast periods (Mařík et al., 2011), which is contrary to the reality. In accordance with the legislative methodology of quantification of the cost of equity (see in the following text), it is at least desirable the business plan to provide information that in the context of projected drainable resources will also point to the need of capital sources. In practice, this would mean that an expert would work with more discounted rates determined analytically or iteratively that could contribute to objectifying a general value of an offeree company. This problem is partly treated in case of the cost of equity because it is taken into account the government bond with the longest maturity on the bond market. Regarding the cost of debt, in the nature of the transaction as a squeeze out is, we do not consider the *"general"* way of determining it under the Decree sufficient even with regard to the specificity of an offeree company. This way should be confronted with the cost of interest-bearing debts found by analysing credit conditions under which the capital was borrowed. These are facts that can be documented, are specific to an offeree company, so the assumption of their different valuation by experts on the same date is minimized. From the methodology of the calculation of cost of equity for the purpose of squeeze out it follows that a general value of an offeree company may be seen over-valued from the perspective of minority shareholders. It is fact that the methodology does not reflect the existence of any risk premiums and so it is a fact that the methodology is lagging behind existing and commonly used financial theories[9]. In practice, this would mean that if shareholders participate in the future benefits of a company (that is the fact in the general value calculation), they should also be involved in the riskiness of those benefits (Bartošová and Klieštik, 2018). E.g. Hečková and Chapčákova (2009) argue in their study that the method of determining the cost of equity according to the Appendix No. 16 of the Decree should be only used as a reference risk-free interest rate and not the rate of the total cost of equity. However, on the other hand of the issue is the nature of squeeze out that should not be forgotten – squeeze out is a forced sale and definitive unwanted loss of a minority shareholder´s investment. Therefore, we consider the identification of the cost

[9] Note: E.g. CAPM, Fama French 3-factor model, arbitrage pricing model, dividend capitalization model, average profitability method, build-up models, deriving the cost of equity from the cost of debts etc. The use of chosen method shall be in correspondence in particular, with the specifics of a company in terms of availability and relevance of the data used in the context of the requirements of individual methods of quantifying of the cost of equity (Michálková and Kramárová, 2017).

of equity only with the yield of government bonds to be a clearly compensation of expropriation of minority shareholders in case of squeeze out transactions.

The Decree defines more possibilities of calculating the sustainable growth rate of drainable resources and thereby experts may gain different results in the process of valuation. The priority is given to the rate derived from historical and projected revenues; the influence of extraordinary and extreme values should be excluded. Such a way determined growth rate would be inherent for an offeree company. However, the methodology does not exactly identify what kind of revenues "is bearing" the potential of sustainable growth. Even it does not identify the length of time-series of historical and projected revenues that should be taken into account in the process of rate quantification. We reiterate that the sustainable growth rate identified in this way is highly dependent on the objectivity of a business plan and, in the long run, should not exceed the pace of economic growth in the sector concerned. We are of the opinion that the choice of this approach falls only within the competence of an expert and his theoretical and practical knowledge with regard the specifics of an offeree company to justify the relevance of the choice. However, only a more detailed specification of category of "revenues" would contribute to minimizing potential litigation, as it would eliminate the presumption that an expert acts subjective. In our opinion, a relevant category could be sales revenues for merchandise, products, and services or the category of added value, a parameter that moreover considers the cost of purchased inputs.[10] We see both indicators to be the ones of the main generators of the value of a company. The Decree also does not specify which methodological procedure to use to derive a sustainable growth rate of drainable resources. It is therefore up to an expert to decide which methodological procedure will be applied. It is clear that an expert most likely will follow the procedure of the "general" business valuation method that is set out in the Decree in the Appendix No. 1 *"Basic procedures to laid down the general value of a company and its parts"*. The other two options for determining the sustainable growth of rate of drainable resources that the Decree governs we seen as marginal, as they do not take into account the specificities of an offeree company.

In case of the asset-based valuation and in connection with the squeeze out, the valuation has a multidisciplinary feature, as it requires experts from different expert fields to cooperate closely, thereby it is extremely robust, time-consuming, and demanding in terms of finances. Whereas the accounting data is the starting point for this method, the method offers rather a static view on an offeree company however without considering its income potential. The method requires considering technical and economic usage of all assets, and determining their real useful life with respect to their physical and moral depreciation or other usage. The practice draws attention to the weaknesses related to the valuation of assets in close relation to debts and liens, if they are related, weaknesses in valuing of intangible assets, double considering of assets in a process of acquisition,

[10] Note: The added value in the meaning of the value that is added to purchased inputs, whether from commercial or manufacturing activity.

investments in progress etc. Despite this, the valuation of assets and liabilities must comply with accounting and valuation standards. In relation to the consideration to minority shareholders under the SA, particular emphasize shall be placed on attachments of an expert opinion. They are irreplaceable for an expert due to a large scope of the valuation subject and methodological procedures that are needed to apply in valuating all single parts of company´s assets and liabilities.

Conclusion

The squeeze out is really a specific transaction mechanism that is mirrored in the existing legislative. Companies in Slovakia do not used it frequently, although the Slovak capital market still *"offers"* such kind of companies that could "reap" from it, mainly companies created thanks to the voucher privatization in the 90´s of the last century. Some of them used other *"alternative"* ways of squeezing the minority out. The legal aspect of squeeze out as a forced sale, without violating property rights in the sense of the Constitution in Slovakia, has an impact on the business valuation methodology. The business valuation for the purpose of squeeze out, unlike some other countries, is only in the competence of an independent expert appointed by the NBS. By analysing the Slovak law and valuation methodology, we state that is more strictly than e.g. the Directive of the EU especially in terms of protecting the interests of minority shareholders. In the process of valuation, an expert is obliged to apply asset-based valuation method and business method. The use of two valuation methods at the same time creates a scope for objectifying a general value of a share and adequacy of the consideration, and that reflects legal and economic specifics of the squeeze out. The use of both methods is justified because a squeeze out cannot be seen as a normal transaction driven by supply and demand side. The use of both methods is also relevant to the anticipated cycle in which an offeree company is located[11]. Existing practical experience shows that despite the fact that the Appendix No. 16 of the Decree is relatively more precisely determined than the Appendix No. 1, regarding the squeeze out, still there are "sources" that lead to disparities in a general value. It would be desirable in this context to more precisely defined at least the approach to a business plan construction including determination of relevant sources generating drainable sources, *"revenues"* that are used to derivate the sustainable growth rate of drainable sources. The way of determining other economic categories is disputable also in purely theoretical level.

[11] Note: Other valuation methods of shares given in the Decree (Appendix No. 7. „Determination of general value of securities") – liquidation method, combined method, and comparative method are not allowed to use in case of the squeeze out in Slovakia.

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Analysing structure of employed and unemployed population of Czech Republic as part of human capital on labour market

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Abstract

The article analyses the historical course of quarterly time series of employed and unemployed population of the Czech Republic at the age of 15 years and more for the period 1993-2018. The objective of the contribution is to describe the statistical distribution of the number of employed and unemployed persons, characterise time course of relevant time series and subsequently propose at least two optimal forecasting models and compare their statistical properties and their accuracy. The contribution deals with forecasting macroeconomic variables of the number of employed and unemployed persons. For forecasting, Brown's linear exponential smoothing, and Winters smoothing model are used. The accuracy of final forecasts is characterised by Mean Squared Error (MSE) and Mean Absolute Error (MAE). The results are interpreted only in the Czech context, not on the European level. The analysis is based on decomposition, seasonal adjustment, determination of empirical seasonal index and determination of optimal point and interval forecasts for the period 2019-2021. Since the null hypothesis of the series independence on the quarter was rejected, both time series had to be seen as seasonal.

Key words: employment, unemployment, Brown's linear exponential smoothing, Winters model of smoothing

Introduction

The contribution submitted deals with two macroeconomic indicators – employment and unemployment of the population in the Czech Republic. The main macroeconomic indicators of a state include unemployment. With gross value added, inflation, monetary stability, and other indicators, it expresses the economic and social level of a given country. Statistical surveys, measuring and analysing employment and unemployment is

based on the division of population into economically active and economically inactive and their further classification by various criteria (Macek et al., 2008).

Unemployment together with other indicators measures the economic and social level of a given country. The Czech Republic invests resources in taking preventive measures in the labour market, in combating unemployment (Hančlová and Šimek, 2014). The position of the state to labour market includes all policies, institutes, and legal standards aimed at the economically active population. In terms of political economy, labour market can be analyses also as a market of investments in human capital (Bonoli, 2010). Vokoun et al. (2017) define unemployment as a situation on the labour market when a certain group of the population refuses to find a paid job.

By economic activity, the population is divided into the following categories: economically active population (employed and unemployed) and economically inactive population (Helísek, 2002). In the Czech Republic, the category of economically active population includes people at the age of 15 and more, that could be included in the subcategories of employed and unemployed population in the country. Employed people are those who have an employment relationship or any other formal link to employment and are paid by an employer or are employed in their own business (this includes also members of production cooperatives). One of the authors dealing with unemployment is Mareš (2002) who introduced the definition of unemployment accepted in the European Union. According to this definition, the unemployed population includes the persons who do not have an employment relationship, who are registered as unemployed at the Employment service, who are actively seeking a job and who are able to start work immediately. On the other hand, the economically inactive population includes other inhabitants, whose economical inactivity can have both objective and subjective causes.

Unemployment is a problem for all market economies; therefore, a wide range of analysts pay attention to its analysing. The results related to unemployment (e.g. the current values of the unemployment rate) are expected with great interest of state authorities, economic subjects, as well as the general public (Čabla and Malá, 2017). Similarly, a problem as important as the number of unemployed people, or the unemployment rate, is also a period of time for which the unemployed have been looking for a new job. Unemployment longer than one year is referred to as long-term unemployment. Long-term unemployment rate is an important indicator of the situation on the labour market and also the economy as a whole (Krueger, Cramer and Cho, 2014).

The number of the unemployed and their structure, the number of vacancies and the length of unemployment are affected by many various factors (Hunt, 1995). To identify these factors, to describe and quantify their influence or subsequently formulate and implement measures to diminish negative influence and enhance positive influence is a permanent task of all bodies responsible for economic development (Røed, Jensen and Thursie 2008). The system, amount and time of payment of unemployment benefits (Jurajda and Tannery 2003), the tax system and the existence and amount of minimum wage (Bover, Arellano and Bentolila, 2002) also play a significant role. The chance to get

a job in the labour market is positively influenced by good health and the absence of other health limitation; unemployment (especially long-term unemployment) negatively affects the health of the unemployed (Korpi, 2001; Krueger et al., 2011), thus reducing their chances in the labour market.

Mass unemployment is an urgent issue in almost all developer countries. Unemployment is a situation in which a person actively seeking work cannot find a job. This phenomenon is sometimes used as an indicator of economic health. Currently, a serious problem is not only natural unemployment but also weak demand for workers, and structural or regional unemployment. Prolonged unemployment represents a risk that many unemployed people lose their skills and will become discouraged from finding a job, which increases permanent unemployment. Unemployment affects the entire population of a country, not only the unemployed and their families (Krueger et al., 2011).

Unemployment can be defined as a situation of imbalance between the supply and demand of work, i.e. the supply is higher than the demand. This phenomenon can be measured by macroeconomic indicator of the unemployment rate. Using this indicator, it is possible to evaluate the current situation on the labour market. However, it shall be noted that this indicator shall be perceived in a wider context. In other words, to evaluate the labour market performance it is necessary to examine not only the level of unemployment rate but also to divide unemployment into several groups by its duration, qualifications of the unemployed and also the regional dimension shall be taken into account (Tvrdoň, 2014).

The view of employment service workers in regional labour markets: The results indicate that the active employment policy tools and passive political instruments are seen as ineffective and inappropriate. The unemployed usually do not have any previous work experience, they mostly only completed primary education and are not willing to travel for work. An urgent problem appears to be the quality of secondary education, the problem of access to „poverty trap“ of the unemployed and generous social benefits without a „treat“, which makes the employment policy ineffective (Novák et al., 2016a).

The dependence of the minimum wage on the wage decile index was confirmed in the case of the unemployed, who usually receive these wages in the least qualified professions. This dependence is based on the assumption that such least qualified professions are disappearing and are partly or fully replaced by robotization in many forms (AI, RPA, ML ...). Due to the increase in the minimum wage, for companies, it is cheaper to deploy e.g. 10 robotic system controlled by one or two workers. This was already happening in the period 1998-2013 when robotization only took forms of automation and control of systems. This relation will probably be confirmed in the last five years thanks to supporting robotization and digitalization of companies (Vokoun and Straková, 2016).

Palíšková (2014) considered structural unemployment as a serious problem in the Czech labour market. She sees its causes in inappropriately established state employment policy. Due to high social benefits compared to minimum wage, great part of the unemployed was not interested in finding a job.

By analysing the labour market, Vokoun (2013) concluded that the active employment policy instruments are only effective for a short time, i fat all. Their impact on the state markets (Vokoun et al., 2017) is zero in many cases, and sometimes even negative (Novák et al., 2016b).

Židek (2006) refers to the young, unskilled workers, graduates, women after maternity leave and the disabled as problem groups on the labour market. In his work, he states that as for the above-mentioned groups, university graduates had the highest chances to get a job.

A special and also problematic group on the labour market are the Roma, who are generally associated with a worse attitude towards employment. The Roma minority is also associated with a high unemployment rate and discrimination on the legal labour market (Kajanová and Kmecová, 2018a). The authors in their study focus on the perspective of companies employing the Roma and the specifics of working with this group. The authors addressed the companies in the South Bohemian Region and the Vysočina Region, who employ educated and qualified Roma. Within the analysis of the obtained data, the following categories were identified: Employment positives, Employment negatives, and Specific approaches to employing Roma employees. The authors assumed that there would be a difference in employing Roma with different qualification and education level. However, the assumption was not confirmed by the results.

Hajská and Poduška (2006) state that the Roma are in a very low position in the labour market. The Roma often participate in the illegal labour market. One of the reasons is the discrimination and prejudice from the side of the employers. The prejudice and stereotypes related to the Roma are different, but most employers believe that the Roma do not want to work and that they abuse state social benefits (Gabal, Čada and Snopek, 2008). The Roma participating in the labour market often have only short-term jobs of seasonal character (Davidová et al., 2010). Černušáková (2017) mentions the „invisibility" of Roma work. The reason is that a large proportion of the Roma minority work without having an employment contract, and in the informal labour market they usually do highly unstable, socially insecure, and often physically dangerous work.

In their study, Kajanová and Kmecová (2018b) point out that a number of authors address the causes of the Roma unemployment. According to them, it is a combination of factors such as discrimination on the labour market and in public discourse in general (Gabal, Čada and Snopek, 2008), and a small number of jobs for low-skilled workers (Mareš, Sirovátka and Vyhlídal, 2003), and the related low education or qualifications in the Roma population (O'Higgins and Ivanov, 2006). Šajgalíková and Copuš (2017); Swietek (2013) et al. see the main problem in intergenerational employment. If there are no work patterns within a family, it results in the situation that a child sees this as normal, a standard. However, the main cause of low employment is in high indebtedness and the related salary deductions, which is demotivating. The Roma thus switch to the illegal

labour market that provides fast and secure earnings. Fuzesi et al. (2008) see poor health as the main cause.

Kajanová and Kmecová (2018b) analyse the unemployment rate of the Roma minority in selected European countries. The results showed that in most European countries there the data on the target place are not accessible, except for the post-communist countries. The unemployment of the Roma minority has no relation to general unemployment; i tis always many times higher and is primarily related to the exclusion of the Roma minority. It appears that the main causes of their unemployment consist mainly in their social exclusion, not in the ethnicity per se.

Methods and Data

The objective of the contribution is to describe a statistical distribution of the number of employed and unemployed population of the Czech Republic at the age of 15 and more, to characterize the time course of relevant time series, to propose at least two optimal prediction models and to compare their statistical properties and accuracy.

The contribution deals with the description and the analysis of the historical course, point and interval predictions of quarterly time series on the number of employed and unemployed inhabitants of the Czech Republic at the age of 15 and more for the period 1993-2018. Firstly, the basic numerical characteristics of both time series are determined and analysed, and the values are shown by means of a boxplot. Subsequently, the analyses of first the time series of the employed and then the unemployed are carried out. The course of the time series is shown in a graph. By analysis of variance (ANOVA) the seasonality of the time series is verified (a significant dependence of the values on the seasonality is proven). Therefore, their decomposition into trend, seasonal, and random component is carried out by means of the multiplicative method, then their seasonal adjustment is performed and empirical seasonal indices are determined. Then there are determined the optimal point and interval predictions for the years 2019-2021 of seasonally adjusted time series using Brown´s linear method.) are determined, and after the multiplication of these trend predictions by a seasonal factor, also predictions of the original time series. Forecasts are obtained also in a simpler way using the Winters method. The results of both methods are then compared and evaluated. The adequacy of these methods for the data used (i.e. for statistical properties of estimations) is evaluated and their accuracy is verified by the calculation of the Mean Square Error (MSE) and Mean Absolute Error (MAE) indicators. The data was obtained from the Czech Statistical Office online survey.

Cipra (1986 and 2013), Stuchlý (1999 and 2004) describe all forecasting methods used. Winters forecasting method for seasonal time series was introduced by Winters (1960).

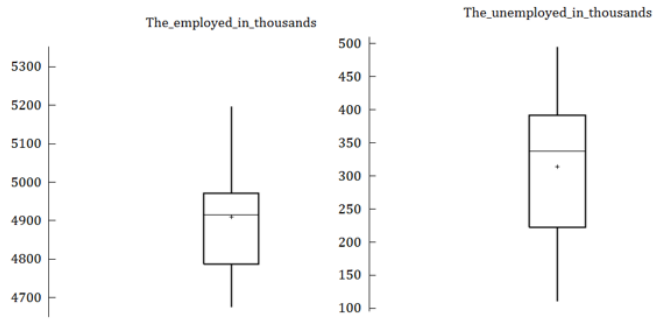
The results were obtained by means of the programmes Excel, R (descriptive characteristics and classification of variables) and Statgraphics Plus for Windows, version 1 (analysis of time series and their point and interval predictions). The application of

Statgraphics is described in the manual for Stratgraphics Plus, Time-series Analysis (1997). Statgraphics enables to choose various forecasting methods, to determine optimal values of their smoothing coefficients, and to determine and show point and interval predictions by means of graph, to evaluate their statistical quality using residual analysis, and to calculate the accuracy indicators of such forecasts (MAE, MSE, etc.). It also enables to compare the quality of up to 5 forecasting models. The statistical quality is evaluated by the graphs of residuals and autocorrelation function. For the purposes of the residual analysis, the results of 5 tests are given (randomness, level, variability, and autocorrelation of the residuals values – Box-Pierse Test). This detailed analysis, performed for the purposes of various forecasting methods, is not described in the text in order to keep an adequate extent of the text. It was only used for choosing the optimal forecasting methods appropriate for the data used.

Results and Discussion

Firstly, some methods of descriptive statistics are applied on the variables of the number of employed and unemployed methods. Graph 1 shows box plots and the basic numerical characteristics are calculated.

Graph 1: Box plot of the number of employed and unemployed persons in CR



Source: Czech Statistical Office, own processing.

From the calculation based on the Excel or R data, it results that the median of the number of employed persons at the age of 15 and more is 4,916,100, while for the unemployed population the median is 337,300. The average numbers for the whole period are 4,910,400 in the case of employed persons and 313,500 in the case of unemployed persons. The maximum number of the employed was achieved at the end of the period (5,326,330), while it is 494,380 in the case of the unemployed, which was achieved in the first quarter of 2000. On the other hand, the minimum numbers were 4 675,900 in the case of the employed (achieved in the first quarter of 2004) and 111,040 in the case of the unemployed (at the end of the period). Moreover, the 25% quantile of the employed is 4,786,800, while for the unemployed it is 221,950. 75% quantile of the employed at the age of 15 and more is 4,970,800, while in the case of the unemployed it is 391,020. The quartile deviation of the employed is 89,160 and in the case of the unemployed, it is

83,470. Relative variability is significantly higher in the group of the unemployed which will reflect in the forecast error in forecasting models.

The average absolute increase in the time series of the employed persons aged 15 and more per quarter from the whole period is 4,863,300 and the average growth coefficient of this time series is 0.096%., while this average absolute increase in the time series of the unemployed persons aged 15 and more is -1.1460 thousand and the average growth coefficient of the examined time series is -0.701%. By extrapolation the average increases for the individual quarters of 2019 it is possible to get approximate forecasts of the number of employed persons in thousands (5,263.1, 5,294.1, 5,306.2, 5,331.2) and the number of unemployed persons in thousands (128.6, 117.1, 126.3, 109.9). In this case, the seasonality of the time series used is not considered.

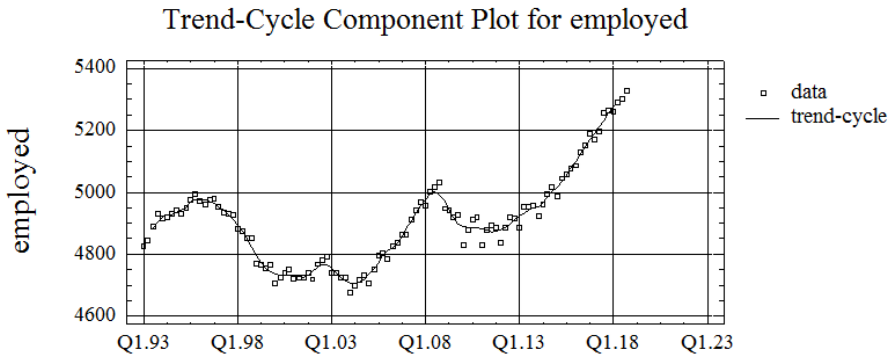
Graph 2 shows that the number of the employed grew between 1993 and 1995 (from 4,825,400 to 4,994,900), then it decreased between 1996 and 2001 (from 4,961,300 to 4,721,000) and mostly increased between 2001 and 2018 (from 4,721,000 to 5,326,300).

Furthermore, it was found that the number of the unemployed between 1993 and 1996 decreased (from 229,100 to 192,700), then it grew between 1996 and 2001 (from 192,700 to 436,700) and mostly decreased between 2001 and 2018 (from 436,700 to 111,000). It follows that the development in terms of employment rate in the Czech Republic from 2001 to the present can be considered favourable.

It was found that both time series have a seasonal character. By means of analysis of variance, it can be tested whether the number of persons in both time series depends significantly on the individual annual quarters. For the employed time series, the analysis of variance result is F = 93.93, p-value = 0 and for the unemployed time series, the result is F = 5.27, p-value = 0.0024. In the case of both time series, the null hypothesis of the series independence on the quarter factor was rejected. Therefore, both series shall be considered seasonal.

First of all, the time series of employed persons will be analysed. From advanced forecasting models, the model based on the decomposition of time series will be used. The multiplicative method of empirical seasonal indices will be applied. This method is the most widely used and numerically relatively simple.

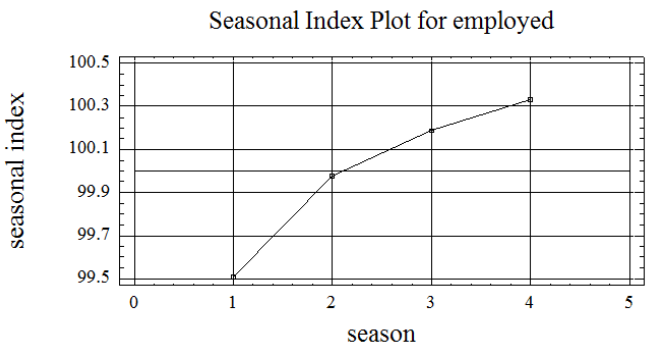
Graph 2: Time series of the employed – smoothing by primary trend



Source: Czech Statistical Office, own processing.

Empirical seasonal indices for the individual seasons in % achieve the following values: 99.5073; 99.9742; 100.187; 100.331 (see Graph 3). It means that on average, the highest number of the employed persons was in the 4th quarter, while the lowest number was in the 1st quarter.

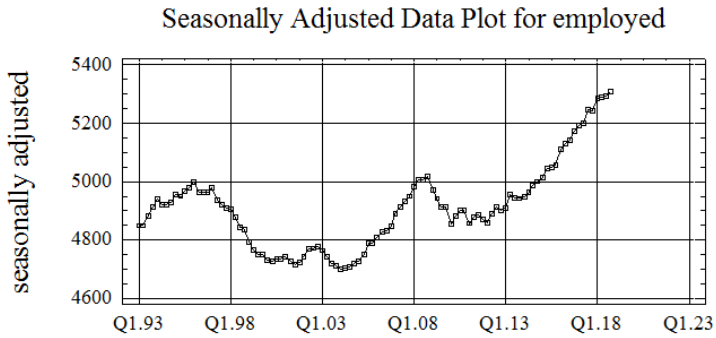
Graph 3: Empirical seasonal indices for time series of employed persons



Source: Czech Statistical Office, own processing.

Seasonally adjusted time series is shown in Graph 4.

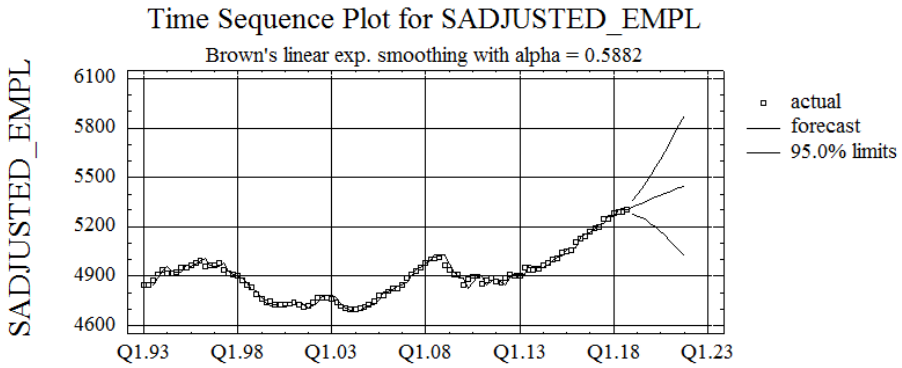
Graph 4: Seasonally adjusted time series – time series for employed persons



Source: Czech Statistical Office, own processing.

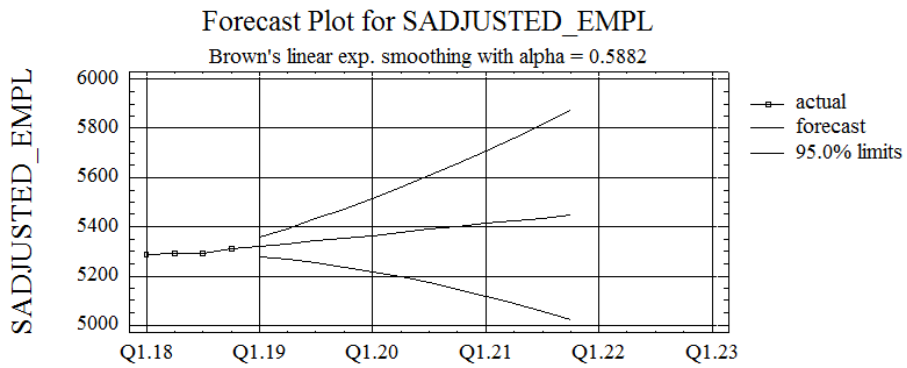
Seasonally adjusted data are subsequently used for a more adequate forecast of trend function in the period 2019-2021. For forecasting model, Brown's linear exponential smoothing with alpha = 0.5882 is used. The accuracy of these forecasts is characterised by MSE = 445.376, MAE = 16.672.

Graph 5: Smoothed values and forecasts of seasonally adjusted time series of employed persons.



Source: Czech Statistical Office, own processing.

Graph 6: Forecasts of seasonally adjusted time series of employed persons



Source: Czech Statistical Office, own processing.

Tab. 1: Point and 95% interval forecasts of adjusted time series trend and resulting values of the time series of the employed persons in thousands

Period	**Trend Forecast**	**Low. Limit**	**Up. Limit**	**Seasonal Index**	**Time Ser. Forecast**	**Low. Limit**	**Up. Limit**
Q1.19	5,318.63	5,277.47	5,359.79	0.9951	5,292.43	5,251.47	5,333.38
Q2.19	5,330.45	5,266.9	5,394,01	0.9997	5,329.07	5,265.54	5,392,62
Q3.19	5,342,28	5,253.03	5,431.52	1.1870	6,341.29	6,235.35	6,447.21
Q4.19	5,354.1	5,236.29	5,471.91	1.3310	7,126.31	6,969.50	7,283.11
Q1.20	5,365.92	5,216.98	5,514.87	0.9951	5,339.48	5,191.28	5,487.70
Q2.20	5,377.75	5,195.29	5,560.21	0.9997	5,376.36	5,193.95	5,558.78
Q3.20	5,389.57	5,171.39	5,607.75	1.1870	6,397.42	6,138.44	6,656.40
Q4.20	5,401.39	5,145.42	5,657.36	1.3310	7,189.25	6,848.55	7,529.95
Q1.21	5,413.22	5,117.49	5,708.94	0.9951	5,386.55	5,092,28	5,680.81
Q2.21	5,425.04	5,087.68	5,762.40	0.9997	5,423.64	5,086.37	5,760.91
Q3.21	5,436.86	5,056.08	5,817.64	1.1870	6,453.55	6,001.57	6,905.54
Q4.21	5,448.69	5,022.77	5,874.60	1.3310	7,252.21	6,685.31	7,819.09

Source: Czech Statistical Office, own processing.

To compare the accuracy of the individual seasonal time series forecasts, Winters smoothing model is used. In this contribution the authors refer to the following computer outputs only.

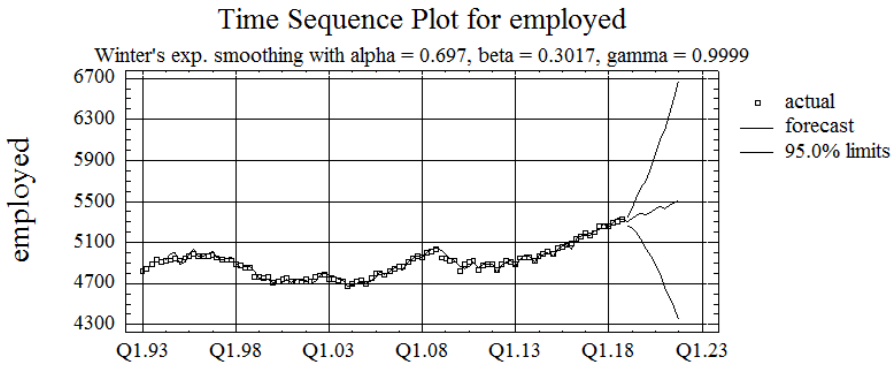
The accuracy of the resulting forecasts is characterised by MSE = 550.369 and MAE = 17.682. The smoothed values, as well as point and interval forecasts are shown in Table 2 and Graphs 7 and 8.

Tab. 2: Forecasts of employed persons in thousands obtained by means of Winters exponential smoothing with alpha = 0.697, beta = 0.3017, gamma = 0.9999

Season	Employed	Forecast	Upper limit	Lower limit
Q1.18	5258.2	5248.40		
Q2.18	5289.2	5295.27		
Q3.18	5301.4	5334.11		
Q4.18	5326.3	5320.48		
Q1.19		5308.01	5353.14	5262.88
Q2.19		5336.46	5437.61	5235.3
Q3.19		5365.90	5535.6	5196.19
Q4.19		5388.04	5636.77	5139.31
Q1.20		5369.36	5704.01	5034.7
Q2.20		5397.96	5829.48	4966.44
Q3.20		5427.56	5964.2	4890.92
Q4.20		5449.78	6098.38	4801.18
Q1.21		5430.71	6192.49	4668.93
Q2.21		5459.46	6347.04	4571.89
Q3.21		5489.22	6509.43	4469.02
Q4.21		5511.52	6669.26	4353.78

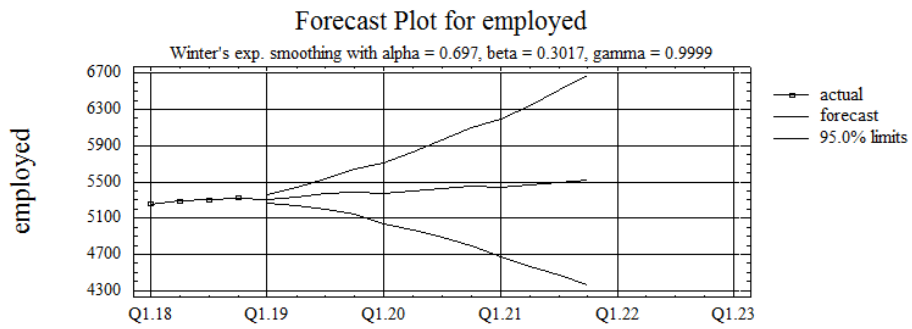
Source: Czech Statistical Office, own processing.

Graph 7: Smoothed values and forecasts of seasonal time series of employed persons obtained by means of Winters method.



Source: Czech Statistical Office, own processing.

Graph 8: Forecasts of seasonal time series of employed persons obtained by means of Winters method

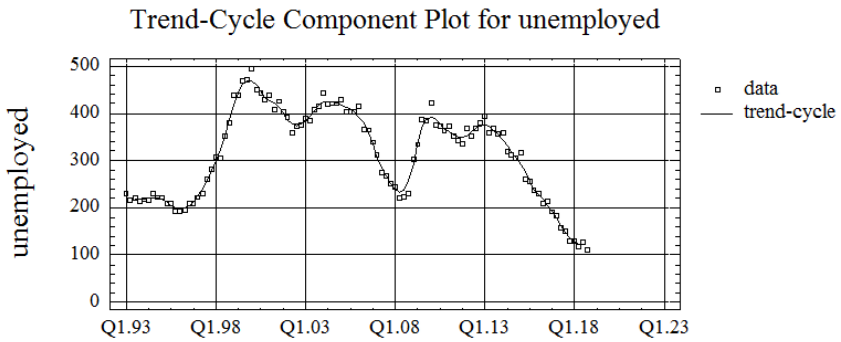


Source: Czech Statistical Office, own processing.

Both methods used provide quality forecasts. Relevant statistical tests show that they also have good statistical properties. The accuracy measures show that the method based on the decomposition of the time series and Brown's linear exponential smoothing with alpha = 0.5882 provide more precise results.

The following part will deal with proposing advanced models of the time series of unemployed persons. This time series must also be considered seasonal. First, the multiplicative model of empirical seasonal indices is used. The results obtained are shown below.

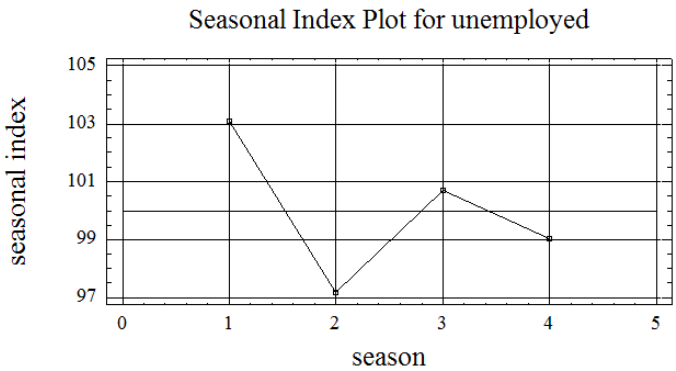
Graph 9: Time series of unemployed persons – smoothing by primary trend



Source: Czech Statistical Office, own processing.

Empirical seasonal indices for the individual seasons in % achieve the following values: 103.097; 97.155; 100.707; 99.040 (see Graph 10). This indicates that on average, the highest number of unemployed persons is in the 1st quarter, while the lowest number of unemployed persons is in the 2nd quarter.

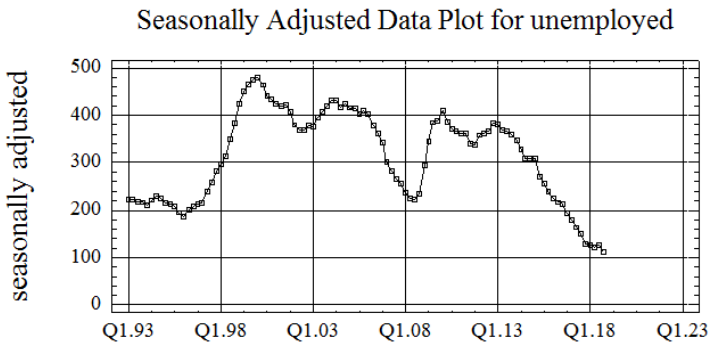
Graph 10: Empirical seasonal indices for time series of unemployed persons.



Source: Czech Statistical Office, own processing.

Graph 11 shows seasonally adjusted time series of unemployed persons.

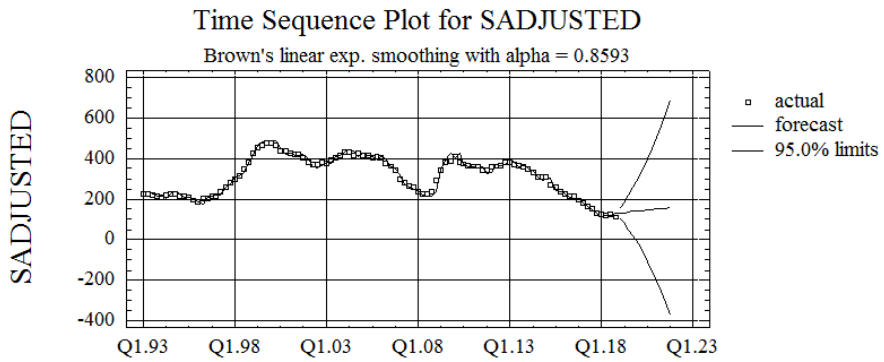
Graph 11: Seasonally adjusted time series for unemployed persons



Source: Czech Statistical Office, own processing.

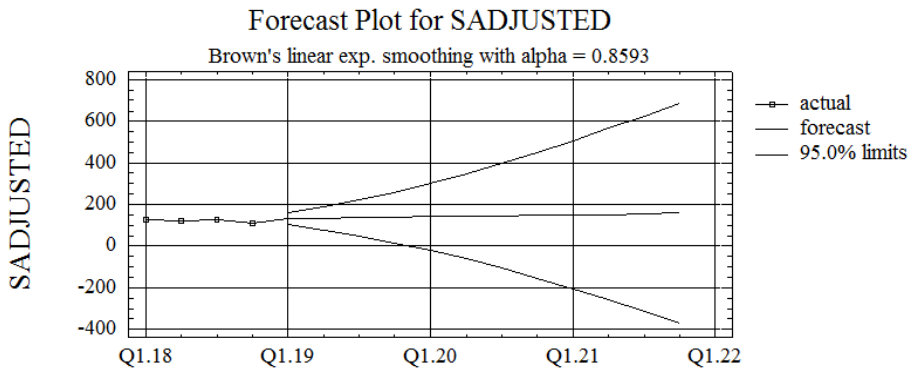
The optimal trend forecasts for seasonally adjusted time series of unemployed persons are obtained using the method of Brown´s linear exponential smoothing, with a smoothing constant $\alpha = 0.8593$ (see Graph 12 and Graph 13). The minimum accuracy measures of this smoothing are MSE = 192.60 and MAE = 10.312.

Graph 12: Smoothed values and forecasts of seasonally adjusted time series of unemployed persons.



Source: Czech Statistical Office, own processing.

Graph 13: Point and interval forecasts of adjusted time series of unemployed persons



Source: Czech Statistical Office, own processing.

Tab. 3: Point and interval forecasts of trend of adjusting time series and resulting values of the unemployed persons time series in thousands

Period	Trend Forecast	Upper Limit	Lower Limit	Seasona l Index	Time Series Forecast	Upper Limit	Lower Limit
Q1.19	131.227	158.294	104.161	1.031	135.291	163.196	107.387
Q2.19	133.637	187.456	79.819	0.972	129.835	182.123	77.548
Q3.19	136.047	221.599	50.496	1.007	137.009	223.166	50.853
Q4.19	138.457	260.11	16.804	0.990	137.128	257.613	16.643
Q1.20	140.867	302.534	-20.800	1.031	145.230	311.903	-21.444
Q2.20	143.277	348.529	-61.976	0.972	139.201	338.614	-60.213
Q3.20	145.687	397.828	-106.455	1.007	146.717	400.641	-107.208
Q4.20	148.096	450.214	-154.021	0.990	146.675	445.893	-152.543
Q1.21	150.506	505.509	-204.496	1.031	155.167	521.165	-210.829
Q2.21	152.916	563.562	-257.729	0.972	148.566	547.530	-250.397

Period	Trend Forecast	Upper Limit	Lower Limit	Seasona l Index	Time Series Forecast	Upper Limit	Lower Limit
Q3.21	155.326	624.242	-313.590	1.007	156.424	628.655	-315.807
Q4.21	157.736	687.438	-371.966	0.990	156.222	680.840	-368.396

Source: Czech Statistical Office, own processing.

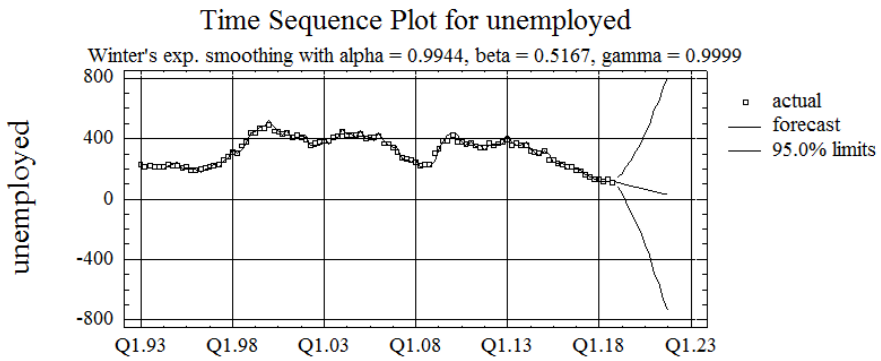
Another forecasting model used for obtaining forecasts is Winters exponential smoothing with alpha = 0.9944, beta = 0.5167, gamma = 0.9999. The accuracy of the obtained forecasts is characterized by MSE = 255.339 and MAE = 12.656. The smoothed values, as well as point and interval forecasts are shown in Table 4 and Graphs 14 and 15.

Tab. 4: Forecasting the number of unemployed persons in thousands obtained by Winters exponential smoothing with alpha = 0.9944, beta = 0.5167, gamma = 0.9999

Season	Unemployed	Forecast	Up. limit	Low. limit
Q1.18	129.767	120.230		
Q2.18	118.215	112.085		
Q3.18	127.470	112.926		
Q4.18	111.038	123.404		
Q1.19		110.750	142.734	78.766
Q2.19		98.1172	165.888	30.347
Q3.19		93.3834	209.394	-22.627
Q4.19		83.8453	248.664	-80.973
Q1.20		81.892	319.057	-155.274
Q2.20		70.769	359.865	-218.328
Q3.20		65.405	432.245	-301.435
Q4.20		56.691	486.472	-373.090
Q1.21		53.033	592.894	-486.828
Q2.21		43.421	638.048	-551.207
Q3.21		37.426	734.827	-659.974
Q4.21		29.536	796.692	-737.621

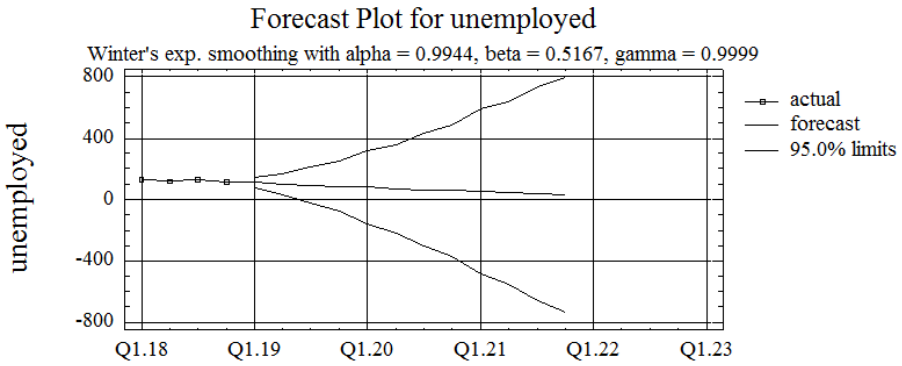
Source: Czech Statistical Office, own processing.

Graph 14: Smoothed values and predictions of seasonal time series of unemployed persons obtained by Winters method



Source: Czech Statistical Office, own processing.

Graph 15: Forecasts of seasonal time series of unemployed persons obtained by Winters method



Source: Czech Statistical Office, own processing.

For the seasonal time series of unemployed persons, the first model gives more accurate and adequate results. The second model shows underestimation. We work with a relatively low number of the unemployed and relatively high variability of the data, which results in the situation that from the second year, the forecast errors even exceed the point forecasts of the number of unemployed persons (the lower limit values are negative). However, point forecasts are close to expected values so, despite the possibility of large errors, these models can be used (results from more adequate models can be averaged).

Conclusion

Graph and basic numerical statistics describe the statistical distribution of the variables of employed and unemployed persons in the Czech Republic at the age of 15 and more. Their course over time is characterized by interesting graphs as seasonal time series, where the seasons represent the individual quarters of the years 1993-2018. It shows that their course was favourable especially in the last period. The average number of employed persons for the whole period (1993-2018) was 4,910,400. On average, the highest employment rate was in the 4th quarter (4,926,700 persons, i.e. 100.331%) and the lowest employment rate was in the 1st quarter (4,886,200 persons, i.e. 99.507%). The average number of unemployed persons was 313,500 persons. On average, the highest unemployment rate was in the 1st quarter (323,200, i.e. 103.097%) and the lowest unemployment rate was in the 2nd quarter (304,600, i.e. 97.155%). Relative variability of the data on the unemployed persons is high (expressed by the coefficient of variation 30.7%); therefore the forecast errors in forecasting models are large. For both time series, adequate and optimal forecasting models were derived. Point and interval forecasts of the number of employed and unemployed persons for the years 2019-2021 were summarized in tables and graphs. Their accuracy was evaluated by the most frequently used accuracy measures – MSE and MAE. The most precise models for forecasting appear to be the models based on the decomposition of time series and its smoothing using Brown´s linear exponential smoothing.

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A Performance-based Management Model and its Application

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Abstract

Outstanding professional standards, efficiency of delivery and continuous faculty advancement are the key determinants of any academic institution's sustainability and improvement. This paper describes the design and implementation of a performance management system set up to achieve these goals at the CTU MIAS School of Business upon its reorganization and objectives reassessment in 2015. The Key Performance Areas in the underlying quantitative model include teaching-related results, as well as those for research and internationalization. The system couples directly to the performance-related segment of remuneration and deliberately omits soft assessment factors whose management remains the responsibility of department heads. Post-implementation results suggest a significant restructuring impact and capability to induce behavioral change, as well as strong attraction for high achievers, making it a tangible competitive advantage in the search for academic talent.

Keywords: performance measurement, KPI indicators, academic management, organizational change

Introduction

The MIAS School of Business (MIAS) is a unit of the Czech Technical University in Prague (CTU). Alongside the eight Engineering Faculties of CTU, MIAS - established in 1992 - focuses on business and economics, as well as interdisciplinary studies including languages, regional development, engineering pedagogy and history. To-date, it has cca 1,400 enrolled students in accredited undergraduate and post-graduate programs and over eighty in-house teaching and research staff.

At its inception, MIAS did not strive to develop full research and teaching capacities that would embrace the full scope of scholarly activities, outsourcing the production of its study programs as well as the teaching of essential courses to externs from other CTU faculties, the University of Economics and the Academy of Sciences. In-house academic staff mainly provided organizational and study support and taught non-essential courses.

At the time, the strategy had some justification because, as relics of politically-motivated reorganizations of academic institutions following World War II (Connelly, 2008; Stellner and Szobi, 2013), several CTU Faculties still maintained their own departments and study programs dedicated to sectoral economics, and such outsourcing avoided resources dilution.

More recently, however, it became clear that such a policy was not tenable, due in part to repeated censure by the national accreditation authority (AK, 2016a), but also its incongruity with the long-term strategy endorsed by CTU. A completely new management team installed in 2015 was therefore charged with the transformation of MIAS into a standard, effective and properly staffed academic entity. This paper introduces a new and innovative performance-management and remuneration system, developed and implemented as a key component of this endeavor in order to achieve its main objectives and secure enduring personnel stability at MIAS.

Background Research

Measurement of Academic Performance

Early attempts to assess of higher education institutions based on quantitative measures have been undertaken since the mid-Twenties, when pioneering studies based on reputation assessments by expert panels appeared in the United States (Cartter, 1966). Much more comprehensive research, albeit similar in nature, has been undertaken by the American Council of Education in the Sixties and Seventies, and by the National Research Council and certain media outlets in the Eighties (Brooks, 2005; Ostriker and Kuh, 2003). At that point of time, the first attempts were made to include some quantifiable criteria; nonetheless, their actual contribution to the predicative value of such assessments was contentious (Austin, 1985). Many years later, Stake (1999) responded to an inundation by meaningless rankings, declaring that "assessing education well may depend on assessing it less".

Incidentally, at the same time academia became heavily involved in the development of various corporate management theories and performance assessment systems, including Management by Objectives (Drucker, 1954), Total Quality Management (Deming, 1986) and Balanced Scorecard (Kaplan and Norton, 1992). In due course, these brought about revolutionary changes in the management of companies, and ultimately even public administration (Wren and Bedelan, 2008). Strikingly enough, they remained neglected by the academic community as a potential tool for managing themselves (Birnbaum, 2000).

If any reasons at all were offered to explain such a discrepancy, they included purported complexity, ill-defined stakeholder structure, or vaguely stated missions of academic institutions (Burke and Minassians, 2002a). Cohen and March (1974) actually characterized them using the term "organized anarchy", emphasizing that this does "...not make the university a bad organization or a disorganized one, but [makes] it a problem to describe, understand, and lead."

In the Nineties, some of this reluctance has been overcome by the increasing demand of accreditation authorities for measurable output indicators. Only then did focus start to shift from elementary quantifications of resources, such as the numbers of library books, entry exam statistics, faculty characteristics or monetary indicators of research grant support, to more sophisticated assessment systems. Nonetheless, this process still has a long way to go towards satisfactory sytem-relevant outcomes, be it because of ambiguous visions and objectives of various academic institutions, difficult quantification of research outputs, bureaucratic obstacles, aversion to change, or a reluctance to assume personal responsibility (Carey, 2007; Lane, 2007; Kelderman, 2012).

KPI Method Characteristics

In most other domains, academia aside, Key Performance Indicators (KPI), defined by Parmenter (2010, p. 4) as "a set of measures focusing on those aspects of organizational performance that are the most critical for the current and future success of the organization", have long become common and essential instruments for managing performance in organizations. They should be measured frequently and tie directly to the success of an organization. Parmenter (2010) describes KPI usage in more detail, but, generally, speaking, they should meet the S.M.A.R.T. objectives-setting criteria (Doran, 1981), i.e. being specific, measurable, assignable, realistic and time-related. The system is usually developed in a top-to-bottom manner, based on the corporate vision, mission, strategy and specific objectives of the budget period (normally 12 months), which leads to definition of the appropriate Key Performance Areas (KPA) and Key Performance Indicators on all levels of management.

The only established accreditation system that explicitly promotes the use of KPI for the management of higher-education institutions is the Academic Quality Improvement Process (AQIP), launched in 1999 and based on Total Quality Management principles, but even it offers no guidance for actual application related to academic staff management or to direct institutional comparison (Arif and Smiley, 2004). In fact, based on their comprehensive study of existing programs, Burke and Minassians (2002b, p. 122) suggested institutions "avoid mandated-prescribed programs, where legislation not only mandates the policy but also prescribes the indicators."

Some countries including the United Kingdom and Canada mandate KPI usage for their colleges and universities, defining them in very broad terms only (Breakwell and Tytherleigh, 2010; Conlon, 2004). Nevertheless, significantly, Conlon (2004) stressed that indicators used for the management of academic institutions should be constructed so as to have a direct effect on their core budgets.

In the Czech university environment, a quantitative evaluation model for academic staff has been conceptually designed in 2006 and subsequently tested since 2010 at the Faculty of Science of the Palacký University in Olomouc (Stoklasa et al., 2011). In comparison with the system introduced herein it is much more complex and stresses application of statistical methods, such as fuzzy sets, which, among other factors, contributed to its

lengthy implementation which has still not been finalized in any organization (Holeček et al., 2016). A much simpler points-based assessment system is being used by the Tomáš Baťa University in Zlín (UTB, 2013). Both cite the objectification of performance assessment as one of their primary objectives, but neither makes the ultimate conclusion of directly coupling performance and remuneration by means of a transparent algorithm.

Problem Analysis

In the context of the 2015 MIAS management change, fundamental reorganization and strategic re-focus, it became essential to reconsider the whole system of academic staff management, including remuneration policies. This had three main reasons:

- The role of academic staff changed dramatically. Formerly, their workload focused on administration related to the organization of study programs taught by externs, combined with teaching non-essential courses. Research and other creative activities were not required, and thus virtually non-existent, which became inadequate under the new circumstances.
- Performance-based remuneration exceeding fixed salaries, determined centrally by CTU directive, was based on employment contracts and, first and foremost, depended on the individual's employment history with MIAS. Its actual coupling to current or recent performance was thus extremely weak and often arbitrary, with frequent abysmal gaps in the remuneration of faculty with comparable productivity.
- Since mid-2015, MIAS started recruiting new staff in various academic positions in order to meet its key objective of developing into a standard academic institution with an appropriate structure of lecturers, publications and research projects. The process took a very swift course, and by mid-2016 most of the stipulated targets were met. From the personnel composition point of view, however, this resulted in a highly fragmented environment, comprising multifarious types of staff, both original and new, with sundry previous experiences, research and teaching potentials, as well as motivations for their meaningful utilization and further development.

This led the new management team of MIAS to expedite the development and implementation of a quantitative performance assessment system based on KPI. Under the circumstances, it seemed obvious that any system aspiring to engineer sweeping material change at MIAS must meet the following attributes:

- Universal application: The system should take the form of a generally applicable directive for academic staff irrespective of their seniority (which is taken into account by the salary grade determining fixed remuneration) or departmental posting in order to avoid legacy biases, seniority and departmental conflicts and other issues.

- Strict fairness and objectivity: This attribute serves to satisfy legal requirements and facilitate universal acceptance by existing staff, a number of whom may perceive a prejudice and adverse personal impact by the new system. It also considers mitigation of undue personal influences on middle-tier managers (department heads), as well as potential legal risks that might possibly arise due to cuts in individual remunerations. Accordingly, the system strictly avoids any use of soft and arbitrary performance indicators.
- Immediacy combined with a capability to grasp the natural variability, both personal and intertemporal, which is characteristic for the workload structure of academic staff: To facilitate rapid progress in meeting the stipulated objectives and, in many cases, achieving fundamental behavioral change, it was essential to implement the system swiftly and with an appraisal period shorter than one year. On the other hand, extreme remuneration fluctuations resulting from natural output variations, such as uneven teaching workloads for particular courses among odd and even semesters or editorial deadlines in academic publishing, had to be avoided. This has been addressed by applying a structure of moving assessments.

System Design and Characteristics

Contrary to common practice when implementing KPI-based systems in business, MIAS undertook some rather substantial modifications, commensurate with its initial situation assessment and system objectives mentioned earlier.

In particular, due to the relatively flat organizational structure of MIAS and a size allowing the effective centralization of remuneration policy, as well as other policies related to internationalization or research, it would not have been practical to take a rigorous top-to-bottom approach to implementing KPI, initially setting indicators for the whole institute, followed by its departments, teams and individual staff. On the contrary, the system has been applied directly on the individual level for several distinct categories of academic staff including professors, associate professors, teaching assistants, researchers and instructors. In general terms, the former categories are expected to combine accredited teaching activities and research outputs, as well as career growth in these areas, while researchers are contracted to do primarily research and instructors to teach in non-accredited courses and perform non-essential teaching roles not directly linked to program accreditation, usually with little ambition to work their way up in academic careers.

The system has been structured so as to take into account priorities, guided by three determinants. The one was the consistence of its Key Result Areas (KRA) with the fundamental theses of the Long-Term Strategy of CTU in its updated edition adopted in October 2015 (CTU, 2016), the others ensured the coupling of its Key Performance Areas (KPA), and eventually the calibration of Key Performance Indicators (KPI), to extant and anticipated requirements by the National Accreditation Authority on the sustainable

structure and qualification characteristics of faculty teaching in its accredited study programs (AK, 2016b) and related requirements on professional promotions (doctorates, higher doctorates, professorships), as well as to the terms of financial support available from the Ministry of Education, Grant Agencies and other sources based on quantifiable or qualitative criteria.

Summarily, the Key Performance Indicators couple to:

- Accreditation terms of the programs and courses taught at MIAS.
- Career development requisites for MIAS faculty.
- Management objectives of MIAS, including its strategic priorities and financial sustainability.

The calibration of performance indicators has initially been derived from qualification and performance objectives benchmarked against generically defined requirements for particular faculty categories and regardless of current budgetary constraints. This was a viable approach insofar that the key performance areas on the general level were obvious (acquire research projects, boost publication outputs, achieve internationalization) and, in the short term at least, a dramatic payroll budget excess due to massive and manifold target overruns was inconceivable, while in the longer term any growth would be expected to become self-financing.

In fact, simulations performed at calibration stage suggested that the system's parameters would initially lead to payroll cost savings. On the other hand, not meeting some of the change objectives swiftly (e.g. accelerating publication output by faculty members overseeing the programs or lecturing in particular courses) has been perceived as prohibitive, because it could have led to accreditation restrictions or even forfeiture, thus jeopardizing the existence of MIAS.

It was also postulated that the activities partial to the selected Key Performance Areas tended to cascade and create numerous synergies, with e.g. research project work leading to valuable publications, publishing facilitating teaching innovations, and student work serving as partial inputs to research. This should create positive feed-backs in the system, further enhancing its efficiency.

Implementation Details

System Parametrization

Each individual's assessment takes place semi-annually, by the end of each semester term, taking into account performance indicators reported over the last twelve months. This assessment then directly determines his or her performance-based remuneration for the following six months.

The system uses two essential parametric elements:

- A KPI assessment table, determining basic and incremental productivity standards of faculty based on their functional category.
- A remuneration instruction, determining fixed salaries based on pay grade and performance-based remuneration rates.

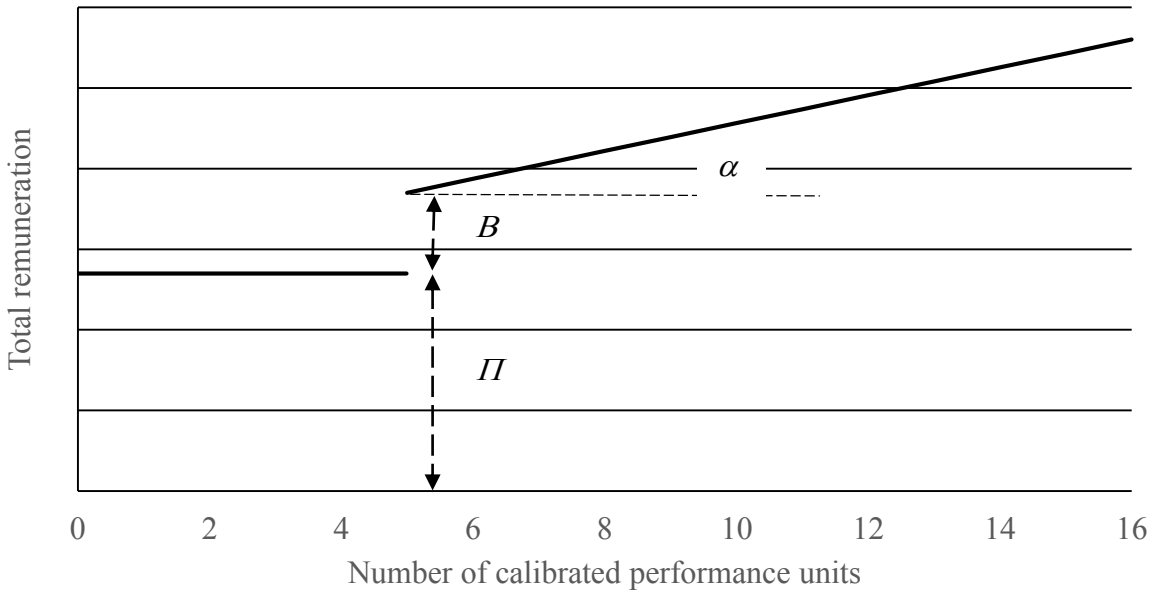
The KPI assessment of career academic staff makes allowance for the common individual and intertemporal variance of outputs, but principally requires a base component of accredited teaching combined with research. Accordingly, the criteria for satisfying minimal performance requirements needed to claim any performance-based remuneration are set as one mandatory calibrated unit of performance reported in each of the domains of accredited teaching and research outputs, supplemented with additional units of performance reported in the domains of teaching, research or internationalization that determine their fulfillment or excess.

The criterion for awarding 100% performance-based remuneration thus entails:

- Completion of both mandatory units of performance (accredited teaching and defined research outputs); as well as
- Completion of at least three supplemental units of performance related to at least two of the three Key Performance Areas (teaching, research, internationalization).

The person who does not meet this criteria, is not entitled to any performance-based remuneration, while any excess increases the base rate linearly as indicated in general terms by Figure 1 (i.e. without taking into account all specific rules determining the mandatory structure and recognition terms of performance units). The value Π (fixed salary) is determined by CTU centrally-defined pay grades, while B (performance remuneration base rate) and α (rate of performance remuneration progression) are part of the system's calibration.

Figure 1: An individual's total monthly income based on KPI fulfilment



Source: Author.

The algorithms for researchers and instructors are somewhat simpler, given the less complex set of objectives for these categories.

To improve functionality, the system also includes several specific regulations, including notably:

- Transitional provisions for newly appointed staff, who cannot be realistically expected to assume full initial productivity, for example related to publication on behalf of MIAS, and their assessments may thus be temporarily based on extrapolation or appraisal.
- Long-term assessments over five-year horizons, allowing faculty achieving universally outstanding performance levels over this period to claim performance-based remuneration without meeting all the specific minimal criteria in all the key result areas; this comprises a tenure-like measure that will allow such individuals to take e.g. partial research or pedagogical leave without any adverse effects, as it would not harm their qualifications or academic careers anyway.
- The option to reclassify individuals who, from a longer-term perspective, are not expected or motivated to meet the performance benchmarks commensurate with their current categorization if there is a common interest to continue their employment in a different role; typically, this arrangement may transfer a teaching assistant into an instructor role.

For the sake of illustration only, several examples of the system's parametrization follow:

- One performance unit can be attained by an Associate Professor in the first Key Performance Area (teaching) who teaches in an accredited program course for 4 hours per week; this would be 8 hours per week for an Assistant Professor.

Coefficients increase this value for teaching in a foreign language or for the design of a new course.

- One performance unit can be attained by an Associate Professor in the second Key Performance Area (research) for publishing two peer-reviewed papers and two conference research papers; the same result would be achieved by an Assistant Professor publishing just three such papers.
- A supplementary teaching domain unit can be obtained, for example, for additional 4 teaching hours, or supervising 8 theses and publishing a set of teaching materials.
- Performance units in the third Key Performance Area (internationalization) are collected by faculty who teach in English programs, lecture abroad, publish internationally or lead international projects.

Notes on Data Management

One particular issue arising as part of the system's implementation involved data collection and processing. For each individual, information needed to be obtained on performance indicators, which are normally administered in several distinct repositories, not connected at CTU. Also, much of the data needed to be structured in a completely different manner, while some information had previously net been collected at all. At the same time, implementation needed to be swift in order to achieve the required objectives.

This problem was addressed by a gradual phasing-in of system support. In the first stage, all information, including the necessary historical data, was collected manually. While, admittedly, this was a fall-back strategy, it brought several benefits. Above all, it involved all future stakeholders including the employees themselves and their supervisors in the process early during the development of the model, facilitating its acceptance and utilizing their feedback in its initial calibration. All data was thus also subject to rigorous initial control.

During the first year, all the data was organized in a structured Access database, with its user interface, as well as the necessary algorithms, embedded in Excel spreadsheets. This made the software structure sufficiently open and flexible to allow gradual development focusing on clear efficiency improvements.

Accordingly, it is now possible to download batches of data from several external repositories, even though some data still needs to be input manually. Given that the residual manual inputs typically relate to events that do not occur very frequently (such as the commencement and conclusion of external projects), and that the system's database generally needs to be updated only twice a year, this is not percieved as a major inconvenience.

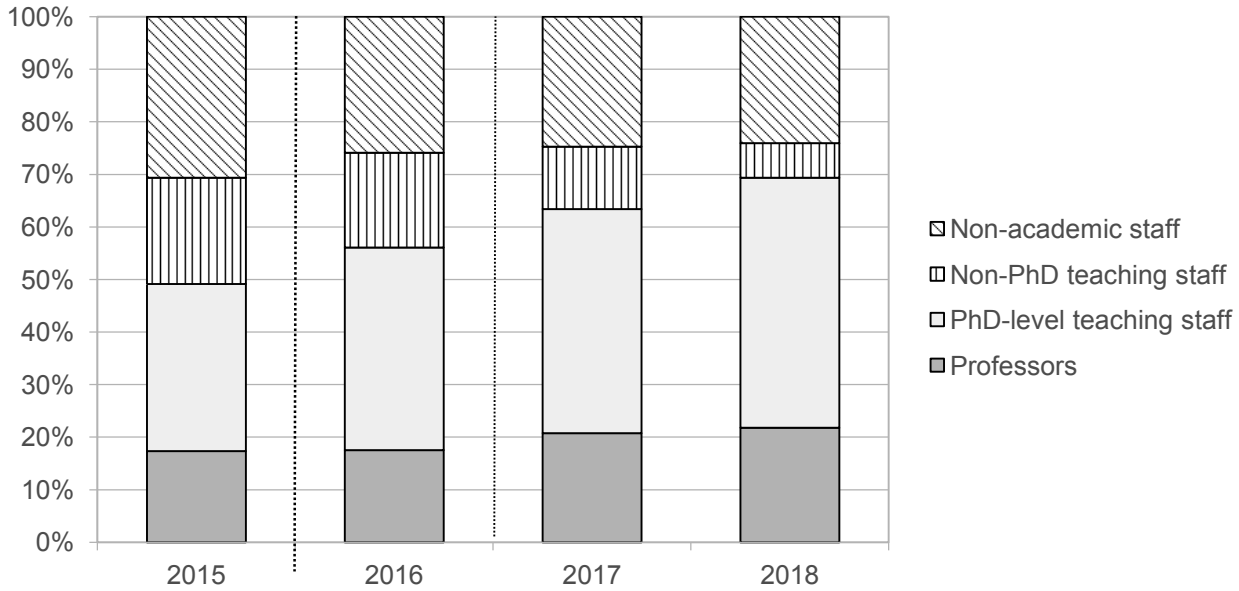
Results

Following the 2018 Winter Term, i.e. three years after inception of the system, it is possible to assess its impacts. There was obvious improvement in several indicators that are used to assess the performance and quality at MIAS, and also have a tangible impact on its financial standing.

Figures 2 through 5 demonstrate the development of MIAS faculty structure, research projects involvement, the quantity and quality of its publications, and the number of international students in English-taught programs MIAS and courses taught in English. In each case, vertical dotted lines indicate introduction of the new system. It is obvious that structural personnel changes have virtually eliminated non-PhD faculty in teaching positions and the newly ordained staff structure and increased motivation facilitated significant improvements in all target areas within two years.

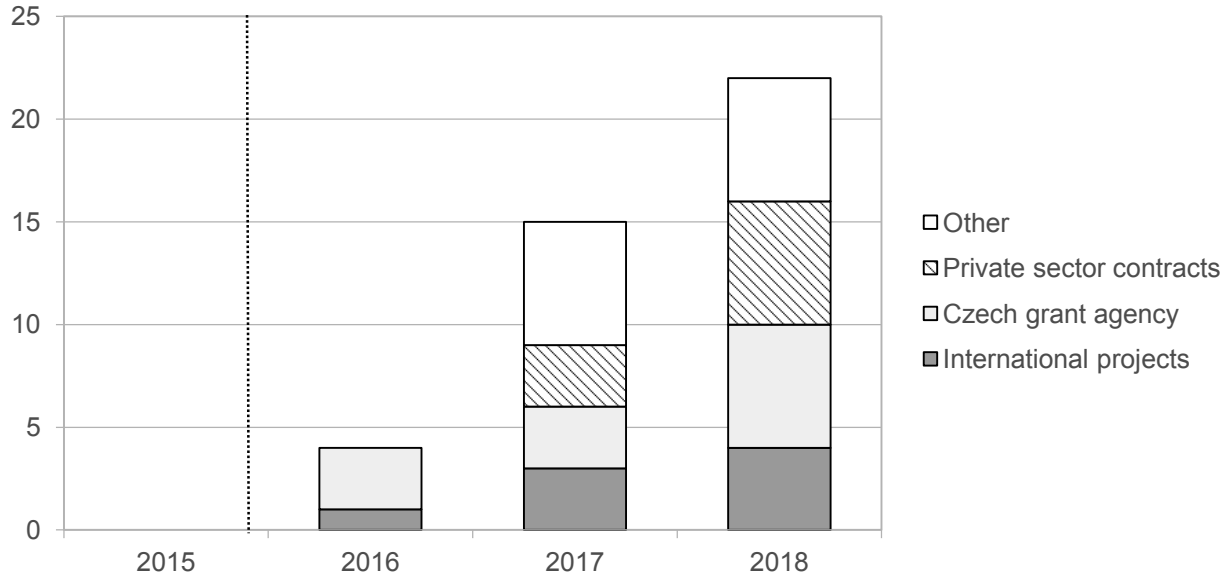
The budget structure also improved considerably, with the share of public funding based on student numbers declining from 85% in 2014 to less than 60%, based on preliminary 2018 data. Most importantly, however, MIAS was successful in the new accreditations of its study programs, consummated in June 2018.

Figure 2: Personnel structure



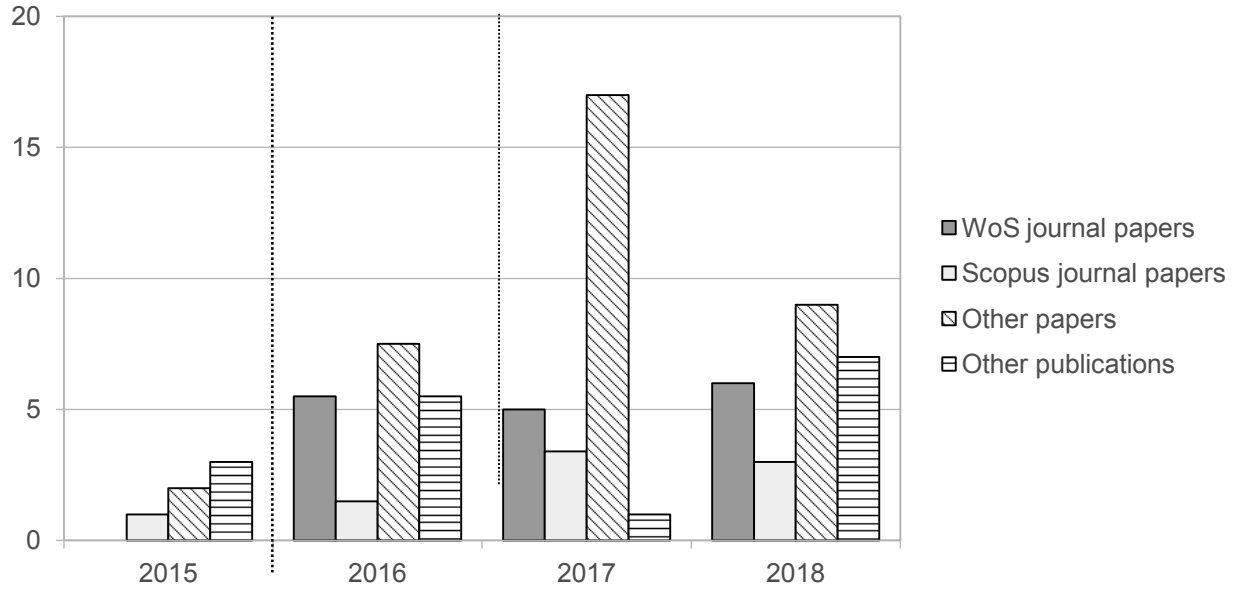
Source: Author, based on institution's data repository.

Figure 3: Involvement in projects



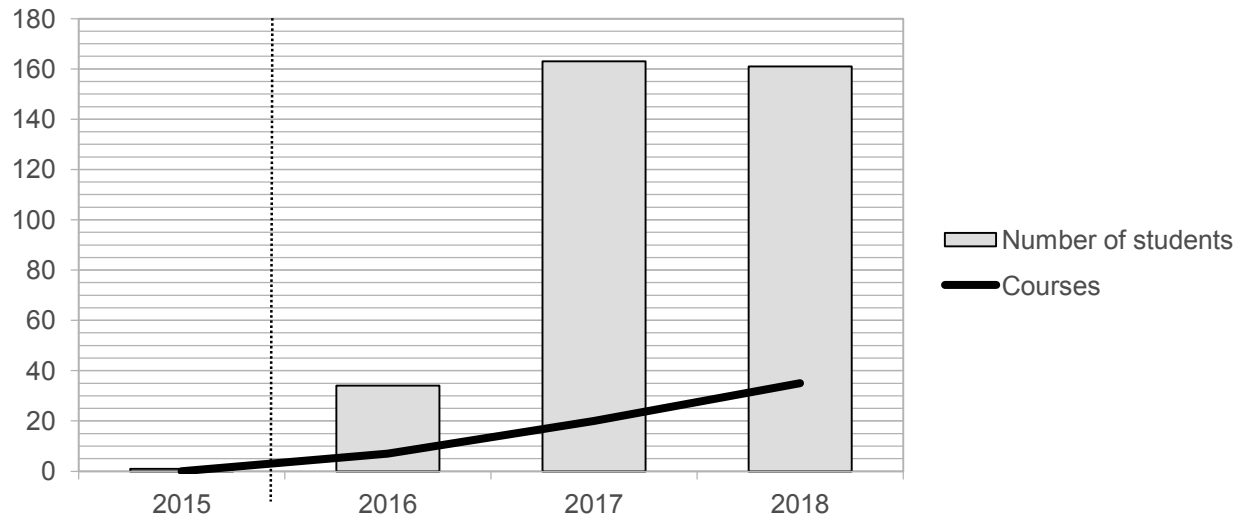
Source: Author, based on institution's data repository.

Figure 4: Publications



Source: Author, based on institution's data repository. Does not include conference papers and minor journals.

Figure 5: International students and courses taught in English



Source: Author, based on institution's data repository. Not including language courses. Many courses taught in English are also attended by students from the Czech programs.

Conclusion

The missions of higher learning institutions do not include just education and directly related processes, but also the development of science and research, as well as internationalization activities. This puts a highly demanding set of requirements on academic staff, who must fluently and effectively partition and organize their workloads so as to generate meaningful outputs in all these key performance areas. However,

maintaining a long-term balance between particular activities is critical, and evolves from the needs and priorities of the academic institution, as well as from the individual's personal capabilities, potential and preferences, with some naturally inclined to do more research, others to teach.

The establishment of a fair, transparent and efficient assessment system with immediate feedback and results inducing behavioral changemust necessarily involve simulations of various pattern scenarios of individuals' activities to ensure a well-balanced set of incentives that would not encourage moral hazard involving utilitarian and, from a long-term point of view undesirable, biased focus on particular outputs. On the other hand, a smart setup creates extremely valuable synergies between the key performance areas, benefiting the whole institution. For example, participating in research projects, most notably international ones, leads to an increase in creative outputs, as well as to more intense knowledge transfer in education. Last but not least, all of these outputs are critical in institutional assessments guiding the process of accreditation, while also having a direct impact on an academic institution's funding resources, making the system an essential instrument of sustainability, both from the institutional and financial points of view.

In its entirety, the system described herewith has first been used for the assessment of MIAS faculty in September 2016, comprising performance indicators registered from September 2015 through August 2016, with its results determining individual remuneration for the following six months. In terms of the principal objectives its impacts so far have been encouraging. On the one hand, a part of the original academic staff have decided to leave MIAS or requested role reassignments, on the other hand, a competitive environment swiftly came into being, with capable individuals aspiring for teaching assignments as well as research teamwork participation. At the same time, a number of recent applicants for faculty openings have frankly stated that the existence of such a system has positively motivated them to join MIAS, notwithstanding their short-term remuneration expectations, which suggested that it had become a material competitive advantage for attracting academic talent.

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Organizational Innovation Activities in the Czech Manufacturing Sector in 2014

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Abstract

The analysis aims at organizational innovation activities of enterprises from the manufacturing sector in the Czech economy. Data comes from the Czech Community Innovation Survey of 2014. The analyzed sample consists of observation about innovators and enterprises that did not engage in innovation activities in the last three years. This paper uses a standard innovation model. The Heckman procedure is used to estimate the probability to innovate and the research and development intensity measured by the log of innovation expenditures per one employee. In the last step, the log of sales from innovated goods and services per employee is estimated. This paper explores the relationship between the enterprise's performance and organizational innovations. Results suggest that there are only a few significant differences between all innovators and organizational innovators. Organizational innovation was not a driver of enterprise's ability to capture profits of innovated goods and services. Organizational innovation was more probable in medium-tech industries.

Keywords: organizational methods; adaptation; change; human resources

Introduction

The definition of innovation is usually based on activities or organizational processes. Martini et al. (2013) define innovation using three internal factors: exploration-exploitation, organizational ambidexterity, and paradoxical thinking. This view enables and starts innovation activities, but they have to be reasonable and based on the current market situation. According to Esmaeilpour, Dostar, and Taherparvar (2014), innovation activities depends on knowledge management and customer-value market research. Without external knowledge and market research, we observe the process of imitation, learning, and understanding of new technologies (new-to-the-firm innovations).

Organizational innovations are a new way of organizing supply-management relationships (SCM), a new way of organizing human resources (HR), and a new approach to organizing external relations (ER). This classification of organizational innovations is rather imperfect because the product and process innovation activities are intertwined,

but this division into three parts allows us to study organizational innovations in greater detail.

Current research confirms its beneficial role to all research and development (R&D) activities and a higher probability of technological innovations. The effect of internal and external R&D on the generation of complex technological innovations is higher as well (Anzola-Roman et al., 2018). The adoption of organizational innovations also enhances indirectly export performance and relates to the market orientation of enterprises (Azar and Ciabuschi, 2017; Prange and Pinho, 2017).

Organizational innovations are important drivers for SME performance. They are pushed by new information and communication technologies (ICT), supported externally by the collaboration with technology suppliers. Information sources and competitive pressures are also drivers of organizational change. The performance of organizations depends on the ability to identify goals, manage technical infrastructure, business relationships, and key individuals (Makkonen et al., 2016). Key employees are monitored by key indicators like "positions filled with talented workers" and sophisticated HR systems, competency models, and other methods like AHP, TOPSIS, and WINGS are used (Kashi, 2017).

This paper relates to the issue of Industry 4.0 and subsequent internet technologies (Internet of things), e-business activities of SMEs, modern HR practices, automatization. There are so-called transaction-based HR practices and commitment-based HR practices. The organizational innovations are the product of commitment based HR which are knowledge-intensive (statistics, data science, databases, modeling, simulations, and predictions). These activities relate to the use of big data and marketing research. In other words, ICTs are to some extent prerequisites of organizational innovation (Soto-Acosta et al., 2016).

Internal features enhance organizational performance (Kianto, 2011): individual creativity; (external and internal) knowledge implementation and commercialization, and we can also add organizational strategic flexibility (the rate of adaptability, crisis management)

Organizational "shift" towards continuous innovation (Denning 2011) depends on the viable enterprise's goal to engage customers. This can be achieved in an organization where managers enable instead of control; static coordination (hierarchy, commands, and focus on a single stakeholder) is replaced by dynamic linking (competences, by example-motivation, all stakeholders). Knowledge innovation capability (Chen, 2016) is one of three factors of continuous innovation. Cooperation and external acquisition of knowledge, as well as intra-organizational networks, are good at invoking organizational pressures like competition in the market (Karlsson and Björk, 2017).

The goal of this paper is to analyze the organizational innovations and organizational innovators. The analysis is about the probability of innovation activities and organizational innovations, R&D intensity (total R&D expenditure per one employee), and sales of innovated goods and services. This statistical exploration can be useful for further

research and contributes to the current debate about Industry 4.0 and theories of organizational innovation. Organizational activities are studied in cut-off samples (innovators vs. organizational innovators) and in innovation output analysis (contribution of organizational innovations to sales of innovated goods and services).

Material and methods

There are 3,069 observations about enterprises (Tab. 1). There are 1,197 new-to-the-firm or new-to-the-market innovators and 552 out of them are organizational innovators. Some of the observations are missing and the estimation sample is slightly smaller (3,017 full sample, 1,159 innovators, and 546 organizational innovators). Data comes from the Community innovation survey of 2014 about innovation activities of enterprises in the Czech manufacturing industry.

Tab. 1: Summary statistics

Variable	Obs.	Mean	Std. dev.	Min	Max
Innovator (%)	3,069	0.39	0.49	0	1
Organizational innovator (%)	3,069	0.18	0.39	0	1
A new way of organizing SCM, supply-management rel.(%)	3,069	0.15	0.36	0	1
A new way of organizing HR, human resources (%)	3,069	0.20	0.40	0	1
A new approach to organizing ER external relations (%)	3,069	0.07	0.26	0	1
R&D expenditures (1,000 CZK)	1,503	50070.57	517376.40	0	1.51E+07
Foreign ownership (%)	3,069	0.31	0.46	0	1
Technological level of industry (4 = high-tech)	3,069	0.98	0.94	0	3
Number of employees (average)	3,069	202.46	597.43	10	24,354

Source: Authors, based on CIS 2014 survey.

The most implemented organizational innovation included a new way of organizing human resources (20% of all enterprises in the sample). The average technological level of manufacturing industry is medium-to-low technology. This variable was the control variable for robustness checks. This sample has small and medium-sized enterprises with 250 and fewer employees, but the micro enterprises are omitted because the data are not collected by the Czech Statistical Office.

The estimation method follows the concept of Crépon, Duguet, and Mairesse (1998) and Hall, Lotti, and Mairesse (2009). The logic of estimation is based on the innovation process in enterprises. The first step is about the probability to innovate (new-to-the-market and new-to-the-firm innovators) with subsequent R&D intensity analysis of the innovators. The second step analyses the ability to capture profits form innovated production.

Continuous variables like sales and number of employees are in natural logarithms. The procedure (Tab. 2) comprises the general term $Xn_{it}\beta_n$*'s* (with n = 1, 2, and 3) which expresses vectors of explanatory variables and control variables like number of employees, cooperation on innovation activities, barriers of innovation activities, public support etc.; The error terms are assumed to be independent of the exogenous variables, they are denoted as ε_{itn}*'s* (with n = 1, 2, and 3). Single parameter to be estimated is α in the last equation (innovation input-output elasticity).

There are known biases from omitted variables, endogeneity, selection issues, and due to the quality (last dependent variable is self-reported) and representativeness of the sample. The first two error terms are estimated in the Heckman procedure to control for selection bias. Control variables describing the technological level of the industry are used for robustness check analysis of estimated coefficients.

The vector of parameters of interest is denoted by β_n (with n = 1, 2, and 3). In the case of Probit probability, marginal effects at means are reported. Their interpretation at means is not elegant but the goal is to detect differences between innovators and organizational innovators. In case of ordinary least squares technique, robust standard errors are reported in brackets below the coefficients.

Tab. 2: Innovation process estimation procedure

Innovation decision (r_i^*)	$\begin{cases} r_i^* = 1 \; if \; r_i = (X_{1i}\beta_1 + \varepsilon_{i_1}) > 0 \\ r_i^* = 0 \qquad\qquad\qquad if \; r_i \leq 0 \end{cases}$
R&D function (k_i^*)	$k_i^* = \ln(k_i) \mid (r_i > 0) = X_{2i}\beta_2 + \varepsilon_{i_2}$
Appropriability (t_i^*)	$t_i^* = \ln(t_i) \mid (k_i > 0) = X_{3i}\beta_3 + \alpha k_i^* + \varepsilon_3$

Source: Authors, based on Crépon, Duguet, and Mairesse (1998).

The first equation (r_{it}^*) accounts for selection into R&D activities (in-house R&D, training, acquisitions of knowledge, machinery, equipment, buildings, and software for innovation purposes) but only for new-to-the-market and new-to-the-firm innovators (self-reported variables). This is specified as a Probit model, i.e. $P(r_i^*>0) = \Phi(X_{1i}\beta_1)$, where r_i^* equals 1 if enterprise *i* is an innovator (organizational innovator respectively).

The second linear equation (k_i^*) describes the log of total R&D expenditures to the number of employees in enterprise *i*. This equation is uniquely dependent on public funding variables. The fourth equation (t_{it}^*) models the log of sales of goods and services from the

new-to-the-market and new-to-the-firm innovated goods and services to the number of employees. This variable has a nature of a category, but it can be estimated as a continuous variable because there is more variation in the relative per employee form.

Results

The decision to be new-to-the-market or at least new-to-the-firm innovator (new products and/or new methods for enterprises' process) is not different from the decision to be an organizational innovator (new method of HR, SCM and managing external relations). Both groups are similarly dependent on the number of employees, being part of a group of enterprises, foreign-owned, and market orientation (Table 3).

We can observe a few percentage points differences and the highest is in the foreign ownership variable (10 pp. higher in favor of organizational innovation). But the estimated coefficients are not directly comparable given the differences in baseline enterprise. The only reasonable comparison is in large differences.

The highest difference is at the technological level which was used in the robustness check procedure. The previously estimated coefficients stayed roughly the same. Organizational innovation is more probable in medium-tech industries in comparison to low-tech, low-to-medium-tech high-tech enterprises. Innovation, in general, is more likely to happen in high-tech and medium-tech enterprises.

In the next step, R&D expenditures per one employee (ln) were estimated (Table 4). At first sight, the estimated coefficients vary more than in case of innovation-decision model. Both groups of innovators depend on more variables than those reported (Table 4) because the explained variability is only between 10-14% and there are a lot of statistically not significant results.

Tab. 3: Probability to innovate – all innovators and organizational innovators

Probit marginal effects	**(1)**	**(2)**	**(3)**	**(4)**
	All	**Organizational**	**All**	**Organizational**
Log of number of employees	0.298***	0.284***	0.294***	0.275***
	(0.02)	(0.02)	(0.02)	(0.03)
Being part of a group	0.294***	0.267***	0.264***	0.247***
	(0.07)	(0.08)	(0.07)	(0.08)
Foreign owned	-0.306***	-0.208***	-0.316***	-0.210***
	(0.07)	(0.07)	(0.07)	(0.07)
Market orientation	0.521***	0.388***	0.492***	0.378***
National	(0.07)	(0.09)	(0.07)	(0.09)
Market orientation	0.401***	0.321***	0.346***	0.292***
Europe	(0.08)	(0.10)	(0.08)	(0.10)
Market orientation	0.637***	0.537***	0.545***	0.500***
World	(0.11)	(0.13)	(0.11)	(0.13)
Technological level			0.011	0.104
Low-Medium Tech			(0.06)	(0.07)
Technological level			0.290***	0.230***
Medium Tech			(0.06)	(0.07)
Technological level			0.318***	0.040
High Tech			(0.11)	(0.13)
Constant	-1.965***	-2.543***	-1.998***	-2.574***
	(0.10)	(0.12)	(0.10)	(0.12)
Observations	3,017	3,017	3,017	3,017

Source: Authors, based on CIS 2014 survey.

The innovation intensity is not dependent on enterprise size and being a part of a group variable. The selection bias is not should not be a problem in this step because Mill's ratio is not statistically significant. Foreign-owned companies seemed to spend on average more on R&D per one employee than the group of all innovators, but the results were not significant at 5% after the robustness check procedure.

Interesting results are in the additional effect of technological level. More enterprises engage the organizational innovation process in medium-tech industries but more R&D expenditures are on average spent in high-tech industries among organizational innovators. In the population of all innovators medium-tech and high-tech innovators

spend on average more on R&D per one employee than low-tech and low-to-medium-tech enterprises.

Public central government and all EU programmes public supports of R&D are on average beneficial to the innovation intensity. Both groups vary in the structure of estimated coefficients. Organizational innovators are more consistent. All innovators benefit the most from the central government programmes.

Tab. 4: R&D intensity – all innovators and organizational innovators

R&D expenditures per employee (ln)	**(5)**	**(6)**	**(7)**	**(8)**
	All	**Organizational**	**All**	**Organizational**
Log of number of employees	-0.052	-0.696	-0.029	-0.667
	(0.31)	(0.43)	(0.31)	(0.43)
Being part of a group	0.371	-0.484	0.347	-0.506
	(0.31)	(0.43)	(0.30)	(0.42)
Foreign owned	0.255	0.867**	0.207	0.826*
	(0.31)	(0.44)	(0.31)	(0.43)
Market orientation	0.633	-0.962	0.609	-0.952
National	(0.63)	(0.93)	(0.62)	(0.91)
Market orientation	0.642	-0.784	0.568	-0.846
Europe	(0.52)	(0.78)	(0.52)	(0.78)
Market orientation	1.506**	-0.379	1.379*	-0.499
World	(0.71)	(1.05)	(0.71)	(1.04)
Technological level			0.093	-0.005
Low-Medium Tech			(0.14)	(0.20)
Technological level			0.333**	0.284
Medium Tech			(0.13)	(0.19)
Technological level			0.641***	0.805**
High Tech			(0.23)	(0.38)
Public sources	-0.043	0.144	-0.041	0.170
Local government	(0.17)	(0.18)	(0.18)	(0.19)
Public sources	0.735***	0.604***	0.667***	0.562***
Central government	(0.11)	(0.16)	(0.11)	(0.16)
Public sources	0.850***	0.560***	0.862***	0.561***
EU funds	(0.12)	(0.17)	(0.12)	(0.17)
Public sources	0.519**	0.620**	0.479**	0.623**

EU Horizon/Framework	(0.20)	(0.26)	(0.20)	(0.26)
Mill's ratio	1.046	-2.839	1.119	-2.726
	(1.59)	(2.28)	(1.58)	(2.24)
Constant	1.494	9.877**	1.237	9.569**
	(3.40)	(4.84)	(3.37)	(4.78)
Observations	1,159	546	1,159	546
Adjusted R^2	0.133	0.102	0.140	0.110

Source: Authors, based on CIS 2014 survey.

The last step in the innovation process is the ability of an enterprise to capture profits from innovation activities. Again, the explained variability is quite low (10-12%) because there are more factors like intellectual property rights, marketing innovations, logistics innovations, design innovation, and the ability of sales-teams. A lot of variables are not statistically significant. Coefficients of public sources variables suggest there are no additional effects of public funding on innovation output. The effect of public sources is in innovation input-output elasticity (R&D expenditures per one employee variable).

In this step all innovators are estimated to capture the effects of organizational innovation activities. All the types of organizational innovation activities were statistically not significant at 5% level of alfa. Supply chain, Human resources, and External relations based organizational innovation activities did not contributed to higher sales of innovated goods and services. The results for introduction of new supply-management methods are consistent at 10% level of alfa. We can cautiously interpret them as on average beneficial to the enterprise's ability to capture profits from innovated goods and services.

Tab. 5: Innovation appropriability – all innovators and organizational innovators

Sales from innovated goods per employee (ln)	**(9)**	**(10)**
	All	**All**
Log of the number of employees	-0.005	0.192
	(0.04)	(0.26)
Being part of a group	0.346***	0.497*
	(0.11)	(0.27)
Foreign owned	0.358***	0.138
	(0.11)	(0.28)
Market orientation	0.064	0.416
National	(0.15)	(0.54)
Market orientation	0.155	0.387
Europe	(0.16)	(0.46)

Market orientation	0.315	0.659
World	(0.20)	(0.63)
Technological level		0.279***
Low-Medium Tech		(0.11)
Technological level		0.415***
Medium Tech		(0.10)
Technological level		0.441**
High Tech		(0.19)
Public sources	-0.130	-0.154
Local government	(0.16)	(0.16)
Public sources	-0.118	-0.158
Central government	(0.10)	(0.10)
Public sources	-0.191*	-0.179
EU funds	(0.11)	(0.11)
Public sources	0.206	0.162
EU Horizon/Framework	(0.20)	(0.19)
Mill's ratio		1.055
		(1.36)
R&D expenditures	0.175***	0.166***
per one employee (ln)	(0.03)	(0.03)
Organizational I.	0.191*	0.185*
Supply chain	(0.11)	(0.11)
Organizational I.	-0.089	-0.099
Human resources	(0.10)	(0.10)
Organizational I.	0.078	0.101
External relations	(0.13)	(0.13)
Constant	4.502***	2.177
	(0.20)	(2.91)
Observations	1159	1159
Adjusted R^2	0.109	0.119

Source: Authors, based on CIS 2014 survey.

Conclusion

Organizational innovation activities and innovation activities, in general, are intertwined in the manufacturing sector in the Czech economy. Result suggests there are only a few differences but the two groups. Organizational innovation activities like new HR, SCM and external relation methods were not a driver of enterprise's ability to capture profits of innovated goods and services.

Organizational innovation was more probable in medium-tech industries and higher R&D intensity was in high-tech industries. This is somehow different from the general population of all innovators where there is a linear relationship between the technological level of the industry and R&D intensity.

Dataset is prepared from the Czech Community Innovation Survey of 2014. This paper uses a standard CDM innovation model. The Heckman procedure is used to estimate the probability to innovate and the research and development intensity measured by the log of innovation expenditures per one employee. In the last step, the log of sales from innovated goods and services per employee is estimated.

This paper explored the relationship between the enterprise's performance and organizational innovations. Future research should explore the last link between value-added and organizational innovations. The problem is in data availability and the problematic nature of self-reported variables.

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Financial distress prediction for listed enterprises using Fuzzy C-Means

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Abstract

Enterprise financial distress prediction model is an important tool for enterprise risk management. Fuzzy C-Means (FCM) model is more suitable for the classification calculation in reality because of introducing the fuzzy membership. This article adopts the FCM model to predict financial distress. In the experiment, 90 distressed enterprises and 90 normal enterprises were selected as samples, which are all from the same time and the same industry in Chinese Shenzhen and Shanghai Stock Exchange, and 12 financial indicators of these enterprises as a sample dataset. After the data are pre-processed, we identified 11 financial indicators with a significant difference to make the financial distress prediction. Last, it can be concluded based on the FCM results that the performance is better in the case of distressed enterprises.

Keywords: financial distress prediction, financial indicator, fuzzy C-Means

Introduction

With economic globalization, enterprises are more vulnerable to economic crises. Once business bankrupt happens, it not only makes the enterprises' investors face a huge economic risk but also makes the government suffer great economic loss. In order to make enterprises operate healthily and prevent them from going bankrupt in periodical crises, enterprises must pay attention to risk management, strengthen crises monitoring and improve the accuracy of distress prediction. Each enterprise is able to survive an economic crisis only by using proper management of the financial indicators and ensuring normal operation. Therefore, financial distress prediction model can master the financial situation, predict financial distress, and avoid the situation of enterprise failure or restructuring. Many experts and scholars adopt many kinds of models and algorithms to study financial distress prediction.

Fuzzy C-Means (FCM) is an improved algorithm based on the thought of K-means. This algorithm is more suitable for the classification calculation in reality than the K-means. In this article, we adopt the FCM algorithm to predict financial distress and select the financial indicators of Chinese listed companies as the sample data. The data which are pre-processed are calculated by the FCM algorithm. The results can testify the good performance of the FCM algorithm.

The article is organized as follows: Section 2 shows the literature review about the financial distress prediction. Section 3 illustrates the foundation theories related to this paper. Section 4 is the empirical research that describes the process of the financial distress prediction by the FCM algorithm. Section 5 is the conclusion of this article.

Literature review

In the early time, statistical theory and classical econometrics were introduced in order to predict a business failure. Fitzpartrick first made research on financial distress prediction by analysing financial ratios (Fitzpartrick, 1932). Then, Beaver (1966) used a univariate model on financial ratios to predict enterprises bankruptcy. Finally, multiple discriminant analysis (MDA) (Altman, 1968) and regression analysis (Ohlson, 1980; Zmijewski 1984) were used to improve financial distress prediction. But these methods demand data to conform to strict hypothesis condition, which is hard to be realized in the case of complex financial data. With the development of artificial intelligence technology, artificial neural networks are commonly used to predict financial distress (Lahmiri and Bekiros, 2019). Besides, there are other prediction methods, such as support vector machine (Kim, Mun and Bae, 2018), fuzzy sets theory (Sanz et al., 2015), decision tree (Xia, Liu and Li, 2017), case-based reasoning (Leonardi, Portinale and Artusio, 2017), and so on. As undemanding hypothesis condition, these methods are more widely applied for the purpose of financial distress prediction than previous prediction methods.

FCM model is a classic unsupervised clustering algorithm, and has been widely applied in the fields of image processing (Zhao, Ha and Zhao, 2019), agriculture (Anter, Hassenian and Oliva, 2019), pattern recognition (Golsefid, Zarandi and Turksen, 2016), medicine0 (Singh and Bala, 2019), and so on. In terms of financial distress prediction, Liu and Wu (2019) used kernel-based fuzzy c-means to organize samples of companies and designed a hierarchical selective ensemble model for business failure prediction. De Andres et al. (2011) proposed a hybrid system, which combined fuzzy clustering and MARS. Both models were especially suitable for the bankruptcy prediction problem, due to their theoretical advantages when the information used for forecasting was drawn from company financial statements (De Andres, Lorca and Juez, 2011). Liu and Wu (2018) investigated the dynamic process of the company's financial status over years and proposed to design a financial path using fuzzy c-means (FCM) approach.

Foundation Theory

The fuzzy C-means algorithm was first formally introduced by Dunn (1973), which embedded the fuzzy c-partitions into K-means and adopted the degree of membership to determine which cluster an element belongs to. As the typical clustering techniques, the FCM is based on minimizing the following objective function (De Andreas, Lorca and Juez, 2011):

$$J_m(U,V) = \sum_{k=1}^{c}\sum_{i=1}^{n} u_{ik}{}^{m} \left\| x_i - v_k \right\|^2 \tag{1}$$

where x_i is the ith of input data in an D-dimensional space, v_k is the kth of D-dimension centre of the cluster, and c is the number of total clusters. $\|*\|$ is the Euclidean distance between the input x_i and the centre v_k. u_{ik} is the degree of membership of x_i in the cluster c, and need satisfy Eq. (2). m is any real number greater than 1, which determines the amount of fuzziness of the resulting classification.

$$U \in \left\{ u_{ik} \in [0,1] \middle| \sum_{k=1}^{c} u_{ik} = 1, \forall k \;\; and \;\; 0 < \sum_{i=1}^{n} u_{ik} < n, \forall i \right\} \tag{2}$$

Then, the FCM algorithm would be iteratively optimized to the degree of membership u_{ik} and the centre v_k for the minimization of Eq. (1). The concrete update equations are shown in the following equations:

$$u_{ik} = \sum_{p=1}^{c} \left[\frac{\left\| x_i - v_k \right\|}{\left\| x_i - v_p \right\|} \right]^{\frac{-2}{m-1}} \tag{3}$$

$$v_k = \frac{\sum_{i=1}^{n} u_{ik}{}^{m} \cdot x_i}{\sum_{i=1}^{n} u_{ik}{}^{m}} \tag{4}$$

This iteration will not stop until the difference of the degree of membership between iterations is smaller than one very small constant.

Empirical research

The selection of samples and financial indices

China Securities Supervision and Management Committee specially treated (ST) the quoted companies that had negative net profit in two consecutive years. This article

selects such companies as distressed samples and chooses non-ST companies as normal samples. All samples should be selected from the same time and the same industry so that a reasonable comparison was possible. Therefore, we selected 180 samples in the manufacture industry from Shenzhen and Shanghai Stock Exchange between 2012 and 2016, which included 90 distressed samples and 90 normal samples. In addition, the financial reports of the companies in question are published at the beginning of next year, then China Securities Supervision and Management Committee decides whether they should be specially treated in the same year. So, in this paper, financial data were selected in the year of T-2 when a company experienced a business failure in the year of T.

According to the description above, 12 financial indicators of these enterprises are used as candidate variables. They are shown in Table 1.

Tab. 1: Candidate financial indicators and definition

Variables	Definition	Variables	Definition
X1	Current ratio	X7	Operating profit ratio
X2	Quick ratio	X8	Growth rate of main income
X3	Asset-liability ratio	X9	Growth rate of net profit
X4	Inventory turnover ratio	X10	Cash to sale ratio
X5	Total assets turnover ratio	X11	Net cash flow per share
X6	Rate of return on total assets	X12	Undistributed profits per share

Source: Own processing.

Experimental design

After financial indicators have been confirmed, first, we need to pre-process these data because of the strong or weak correlations in which much repeated information exist and make many unnecessary matters. Then, the accuracy of distressed samples, the accuracy of normal samples and the accuracy of the entirety samples are regarded as the evaluation index for FCM model. Last, to enhance reliability of experiment results, the calculation process is repeatedly carried out 50 times. The final statistical results are average values based on 50 times repeated operation.

Experimental result

The basis predicting of financial distress is the obvious difference of the data between distressed and normal companies. The significance test is used to determine whether the differences of data in different groups are accidental or existential. This method consists of two steps: the first step is a judgment on the distribution of the whole dataset. As the second step, the analysis should be further made according to different situations of the distribution.

In the first step, the Kolmogorov-Smirnov Test (K-S Test) was used to make the normality test for the 12 financial indicators. The results are shown in Table 2.

Tab. 2: K-S test of ratio variables

Indicator	K-Value	P-Value	Indicator	K-Value	P-Value
X1	4.889	0.000	X7	3.474	0.000
X2	4.124	0.000	X8	1.819	0.003
X3	1.100	0.178	X9	1.982	0.001
X4	2.402	0.000	X10	1.695	0.006
X5	1.251	0.087	X11	0.688	0.731
X6	4.832	0.000	X12	0.727	0.666

Source: Own processing.

We can see from the table above that the P-values of X3, X5, X11 and X12 are bigger than 5%, which means that these four indicators are the normal distribution, and the others cannot be regarded as the normal distributed data.

In the second step, first, the T test is carried out on the financial indicators X3, X6, X11 and X12, which are the normal distribution. The results are shown in Table 3.

Tab. 3: T test of ratio variables

Indicator	T-Value	df	Sig.
X3	3.617	178	0.000
X5	-11.293	178	0.000
X11	-4.118	178	0.000
X12	2.998	168.444	0.003

Source: Own processing.

It results from the table above that the Sig. values are smaller than 5%, which means that these four indicators pass the T test, and there is a significant difference in these indicators. Therefore, these four financial indicators should be retained.

Then, the other 8 financial indicators, which are not the normal distribution, are tested by the Mann-Whitney U test. The results are shown in Table 4.

Tab. 4: Mann-Whitney U test of ratio variables

Indicator	Mann-Whitney U	Sig.	Indicator	Mann-Whitney U	Sig.
X1	5,430.000	0.000	X7	5,126.000	0.002
X2	5,079.000	0.003	X8	4,703.500	0.061
X4	6,298.000	0.000	X9	7,822.000	0.000
X6	7,080.000	0.000	X10	6,358.000	0.000

Source: Own processing.

The table above clearly shows that X8, which is the growth rate of main income, has the Sig. value 0.061>5%, which means that this indicator cannot pass the Mann-Whitney U test, and there is no significant difference for these indicators. Therefore, X8 (growth rate of main income) should be deleted. Finally, we included 11 financial indicators into FCM model to make financial distress prediction.

According to the description of the previous section, we obtain the prediction outcomes of the FCM model, which are shown in the Table 5. The prediction accuracy of the FCM model is 84.78% for the sake of completeness. In terms of the normal companies prediction, the FCM shows only 78.26% accuracy. On the contrary, in the case of the distressed companies prediction, the FCM shows better accuracy (91.30%).

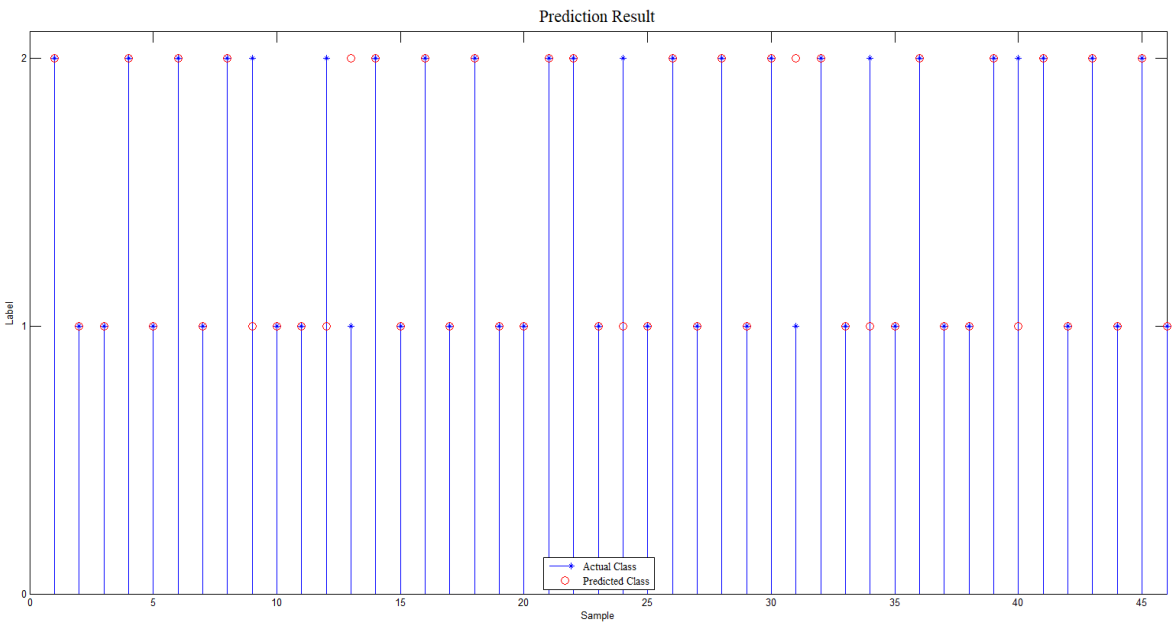
Tab. 5: Prediction accuracy of FCM model

Model	Normal (%)	Distressed (%)	Total (%)
FCM	78.26	91.30	84.78

Source: Own processing.

The specific prediction results of samples are shown in Figure 1 as follow.

Figure 1: Prediction results



Source: Own processing.

In Figure 1 the horizontal axis expresses the sample, and the vertical axis expresses the sample label. The blue star with the blue line expresses the actual classes of samples, and the red circle expresses the predicted classes of samples. Therefore, when the red circle coincides with blue star, the predicted results are correct. In other cases, the predicted results are wrong.

The above prediction results indicate that the FCM model´s performance is better in case of making predictions for predicting the distressed enterprise. In fact, if one distressed company is misclassified as a normal company, it is easy to make more serious conclusions because it does not consider risk prevention. Therefore, the FCM model appears to be more suitable to make the financial distress predictions.

Conclusion

In this article, we adopted the FCM model to predict financial distress. First, the calculated process of the FCM model was introduced. Then, 90 distressed companies and 90 normal companies, which were all from Chinese Shenzhen and Shanghai Stock Exchange, were selected as samples, and 12 financial indicators of these enterprises were chosen as a sample dataset. In the experiment, we pre-processed the sample data and deleted the indicator without a significant difference between the two classes, and introduced the 11 financial indicators into the FCM model. Last, we obtained the final results using the FCM model.

It can be concluded that the FCM model is more suitable for predicting the distressed companies, which is more important for the financial distress prediction.

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