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Analysis of the Competitiveness of Cuba and its Comparison with Selected Countries in Central America and the Caribbean

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Abstract

The foreign sector of the Cuban economy was dominated by sugar exports until the early 1990s, but its volume fell sharply after the collapse of the Soviet Union and the associated loss of major consumer markets. Since then, Cuba has suffered from a chronic trade deficit, which has been around 10% of the country's GDP in recent years. The aim of this article is to assess the development of competitiveness of the Cuban economy and its comparison with selected countries within the region (Costa Rica, the Dominican Republic, and Nicaragua). The analysis of the selected indicators shows the low level of competitiveness and comparative advantages of Cuba when compared to all of the other countries covered in this review, but at the same time it shows the existence of revealed comparative advantages in the hi-tech industries, which also confirms the comparison of values of the so-called Balassa Index.

Keywords: Cuba; Competitiveness, Comparative Advantage, International Market, Balassa Index

Introduction

Cuba has been a relatively closed country, both politically and economically, with a predominantly centrally planned economy since the 1959 political coup up to today. Until 1990, the country was strongly supported economically by the Soviet Union. After its collapse and the ending of their mutual cooperation, there was an economic crisis in Cuba, which was only overcome with the help of Venezuela in the late 1990s. Cuba's cooperation with Venezuela began to lose its intensity after 2014, when falling global oil prices and the

¹ **Disclaimer:** The author of this article is an employee of the Czech National Bank. The views expressed in this article are those of the author and do not necessarily represent the views of the Czech National Bank.

resulting income shortfall caused the Venezuelan economy to collapse. Naturally, both the Soviet Union and Venezuela contributed significantly to Cuba's foreign trade sector. This was dominated for most of the 20th century by sugar exports, which fell sharply, however, after the end of the cooperation with the Soviet Union and the loss of its most important markets. The country's inability to compensate for this loss is still evident from the low level of total amount of goods for export (below 3% of GDP in 2017²) and the country's chronic negative trade deficit (which reached 8% in 2016). In recent years, Cuba has only managed to reduce this deficit by 'exporting' government employees (mainly doctors) to Venezuela, which is reported in the services side of the balance sheet and has thus significantly helped to keep the current balance of payments account positive.

This article aims to assess the development of the Cuban economy in terms of its competitiveness. Cuba is not included in the commonly used competitiveness indicators and is only rated by one of the major rating agencies (Moody's). A number of relevant indicators are also missing in the databases of the World Bank and other global institutions. In view of these limitations, the article selects competitiveness indicators whose values can be calculated using official data published in the official annual reports of the Cuban Statistical Office. The development of the figures of these indicators is then compared with a small number of selected countries from within the region, which were chosen due to their similarities with Cuba in terms of their population size and geographical conditions. The countries were also chosen so that the two politically most closed and two most open countries in the region were represented, while also taking into account the other conditions mentioned above.

Literary Research

For example, Čapek, Hájek and Mertlík (2002) define the competitiveness of a country as its ability to penetrate foreign and global markets with its tradable goods and services and to realize comparative advantages from such international exchange. In terms of measuring competitiveness, Kubišta (2009) divides the possible tools for its assessment into inputs (e.g. labor cost indicators, labor productivity, relative prices, real effective exchange rate), outputs (e.g. export performance indicators, relative strength of specialization, value added by processing) and so-called multidimensional factors (comprehensive indicators compiled for example by the World Economic Forum, the Institute for Management Development or the World Bank). Štěrbová (2013) uses the ranking ratings of reputable agencies among the competitiveness indicators (which places weigh on the degree of probability that a given entity will meet its debt obligations) or the country's involvement in international trade, which provides information on the importance of trade to the overall economy. However, she adds that the informational value of this approach has certain limits (as an example, she mentions developing

² Cuban Statistical Office (ONEI), Anuario Estadístico de Cuba 2018, Sector Externo, 2019.

countries dependent on the exporting of one or a few commodities showing high indicator values, without this meaning that there is a high degree of competitiveness).

Regarding comparative advantage, which is a fundamental factor that affects the competitiveness of a given economy, the professional literature (Svatoš, 2009) defines it, for example, as a country's ability to produce goods and services at lower opportunity cost than its trading partners. Kubišta looks at the concept of "revealed comparative advantages" and the established assessments based on them, which follows the principle of economic theory that each country exports products for which it has better prospects than the partner country. As a way of assessing the country's comparative advantages, Kubišta recommends, in particular, an assessment of the commodity structure of exports, where the evident comparative advantages are evidenced by a higher share of manufactured products in the export of goods. To assess comparative advantages, the OECD has categorized the export industries according to their R&D intensity, with IT companies, and the aerospace and pharmaceutical industries among the most demanding, high-tech sectors. Comparative advantages can be seen in the share of hi-tech products exported within the exports of manufactured finished products.

Another frequently used measure in empirical literature (e.g. Czarny and Žmuda, 2018; Abbas and Waheed, 2017; Shahab and Mahmood, 2013; Bender and Li, 2002; Sahinli, 2012; Batra and Khan, 2005) to assess the revealed comparative advantages is the so-called Balassa Index (or its further modifications), which assesses the proportion of export of the commodity / product / industry in total exports of the examined country (minus the surveyed item) in total global exports (minus the surveyed item). The revealed comparative advantage of the item under investigation exists when the value on the index is greater than 1 (Balassa, 1965).

As far as empirical literature is concerned, the issue of the competitiveness of the Cuban economy has been given very little attention to date, which is among other things related to the mentioned problem of missing or internationally incomparable data. One evaluation was carried out by Bonnett, Taylor and Messina (2001), by analyzing the development of the so-called relative export benefits (RXA) for the 10 most important agricultural and fishery products of Cuba during the period of 1985-1999. The calculation for RXA was derived from the Balassa calculation used to assess revealed comparative advantages. The analysis pointed in particular to a sharp decline in the export performance of the Cuban sugar industry after 1990 and some reallocation of resources towards, in particular, citrus processing or the tobacco industry. However, this work did not deal with the comparison of Cuba with other countries.

There are several studies focused on evaluating competitiveness of countries in Latin America and the Caribbean, but mostly they exclude Cuba from the comparison. Worell, Greenidge and Lowe (2013) measured the impact of price competitiveness on the growth of tradable output in the Caribbean and Central America by comparing the impact of both price and non-price factors. The price competitiveness measures included real effective exchange rates and price competitiveness index. The concept of revealed comparative

advantage was used among the non-price measures and showed that although most countries in the sample improved between 1980 and 2010 the competitiveness in services (this was the case also for Costa Rica, Dominican Republic and Nicaragua), the competitiveness in goods was maintained or suffered losses. The main finding of the study is that the main factor in the growth of tradable output in the Caribbean and Central America was the growth of world demand for the region's exports, the impact of price competitiveness proved to be insignificant. Mortimore and Peres (2001) analyzed the evolution of international competitiveness in the countries of Latin America and Caribbean in the 1990s. The study assessed the competitiveness of different groups of countries through the comparison of technological specialization using the technological specialization indices (TSIs), which are calculated as the ratio between the market share of a country (or group of countries) in high- and medium-technology sectors and its share in low-technology sectors. Although the TSI of the region doubled between 1985 and 1998, it was still lower than the values achieved by other countries in the comparison (comparison comprised Latin American and East and South-East Asian countries). The study also compares changes in world market shares among Latin American countries between 1985 and 1998. Out of 25 countries, Cuba was on 14th place with change of its world market share between 1985 and 1998 of -0.01%.

Methods and Data

The assessment of Cuba's competitiveness is significantly hampered by the lack of availability of a number of sets of data on the Cuban economy and simultaneously by the country not being included in any of the major multidimensional competitiveness indicators (i.e. Cuba is not included in the Global Competitiveness Index, the Ease of Doing Business Index or the World Competitiveness Scoreboard). As far as its rating by rating agencies, it is assessed only by Moody's and its current (2019) rating is Caa2.

Given the availability of data on Cuba, the indicators (1) of the country's involvement in international trade have been chosen from the possible ways of assessing competitiveness and comparative advantages mentioned in theoretical literature; as well as (2) the proportion of exported manufactured finished products within the total amount of exported goods; and (3) the proportion of exports from the hi-tech sectors in terms of manufactured finished products; and (4) the Balassa index of revealed comparative advantages within hi-tech sectors.

The figures of the selected indicators can be found in the World Bank Open Data for most countries. However, in many cases Cuba is either not included among the countries under review, or the data for this country are incomplete. As a result, the figures of the indicators for Cuba are then calculated from the annual reports of the Cuban Statistical Office (Oficina Nacional de Estadísticas de Cuba – ONEI), in which the figures relate to the volumes of individual items of Cuban foreign trade that are itemized according to SITC standards.

This paper will focus on the assessment of exports of goods (excluding the export of services) for the countries under review due to the confusing reporting concerning the exports of services by Cuba, which is mainly comprised of Cuba's state employees working in Venezuela in the context of the political cooperation between the two countries (there is more information about this cooperation below). Taking into account the export of services would make it impossible to assess Cuba's competitiveness and for comparing it with the selected countries.

The development of the figures of the individual indicators will then be compared with the selected countries from Central America and the Caribbean. The four chosen countries represent a group of countries with similar geographic conditions and population sizes, and also represent the two most politically closed and two most open countries. (It should be noted that The Democracy Index prepared by the Economist Intelligence Unit was used for this evaluation). Nicaragua (Democracy Index in 2019 – 3.55), Costa Rica (8.13) and the Dominican Republic (6.54) were selected in this way. Cuba has a Democracy Index of 2.84.

The Cuban Economy, the development of the foreign trade sector including a comparison with the countries under review

Since the revolution in 1959, Cuba has been a country with a predominantly centrally planned economy, and according to the classification of the UN it remains a developing country (2019). Although its GDP per capita (at current rates) was \$8,617 USD³ in 2017, some analysts (for example Alejandro, 2020) dispute this figure and estimate its real value to be around a third. Due to the fact that Cuba is not a member of the World Bank or the International Monetary Fund, this figure is impossible to verify.

Since the revolution in 1959, the more economically successful periods in Cuba have always been associated with significant, politically motivated support from foreign partners – first from the Soviet Union (1962-1990) and later from Venezuela (2000-2016). During time periods when Cuba lacked a strong foreign supporter, especially during the 1990s, its economy has been in a state of deep crisis. These developments point to the considerable failure of the Cuban economic model, which, without foreign support, is unable to achieve economic success, in particular, in the form of sustainable growth and raising living standards. The poor performance of the Cuban economy has also been demonstrated by the state of its foreign trade sector, where the amount of imported goods has exceeded its exports (by a factor of four in 2017⁴) and the foreign trade deficit stood at 8% of GDP⁵ (2016). Cuba managed to maintain its current account balance only in positive terms thanks to a significantly surplus in its balance of services (11% of GDP in 2015⁶), which was largely due to the exporting of Cuban civil

³ ONEI: Anuario Estadístico de Cuba 2018, Cuentas nacionales, 2019.

⁴ ONEI, Anuario Estadístico de Cuba 2018, Sector Externo, 2019.

⁵ Ibid.

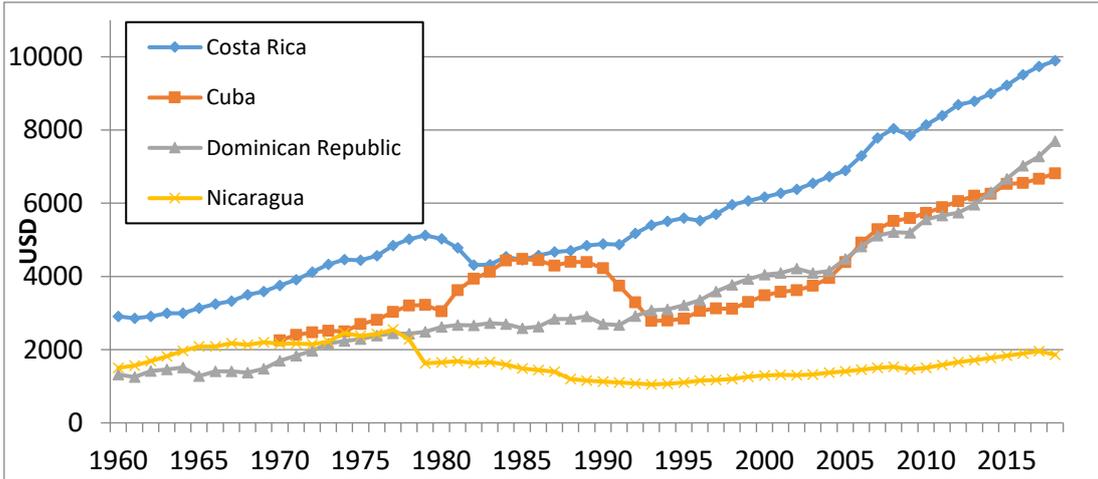
⁶ Ibid.

servants to Venezuela (the main part of which is reported in the services balance)⁷. Analysts (for example Mesa-Lago, 2019) have cited the complicated system of the country's two currencies (the Cuban peso and the convertible peso or CUC) as one of the fundamental limits of Cuban exports, whose non-transparent currency conversion favors imports over exports. Also, the non-convertible nature of the currencies and their fixed exchange rates do not allow them to be adapted to the size of demand for Cuban goods (using a so-called exchange-rate balancing mechanism).

Regarding the structure of Cuban goods for export, it is only represented by a narrow group of commodities. In 2017, Cuba's main export products were sugar (19% of Cuban exported goods), nickel (18%) and pharmaceuticals (13%). The main export destinations were Canada (19% of Cuban exported goods), Venezuela (16%) and China (15%). The total value of these exported goods was \$2.3 billion USD⁸.

Looking at the performance of the economies under comparison since 1960, as measured by GDP per capita in constant USD (see Figure 1), a similar starting point (between \$1,300 USD and \$2,900 USD) can be seen for all four countries and then followed by the widening of their differences. Cuba experienced considerable growth during the first half of the 1980s (in 1985 its GDP per capita was even higher than that of Costa Rica), but after 1990 and the end of its cooperation with the Soviet Union, Cuba experienced a profound slump, with its GDP falling by more than 30% between 1991 and 1993⁹. At present, the GDP per capita in Cuba is similar to that of the Dominican Republic with an interval of \$2,000 - \$3,000 USD less than Costa Rica. Since the 1980s, Nicaragua has consistently been at the lowest level of these four countries with a per capita GDP that has been below \$2,000 USD for a long time.

Figure 1: Per Capita GDP (in constant USD)



Source: The World Bank, arranged by the author.

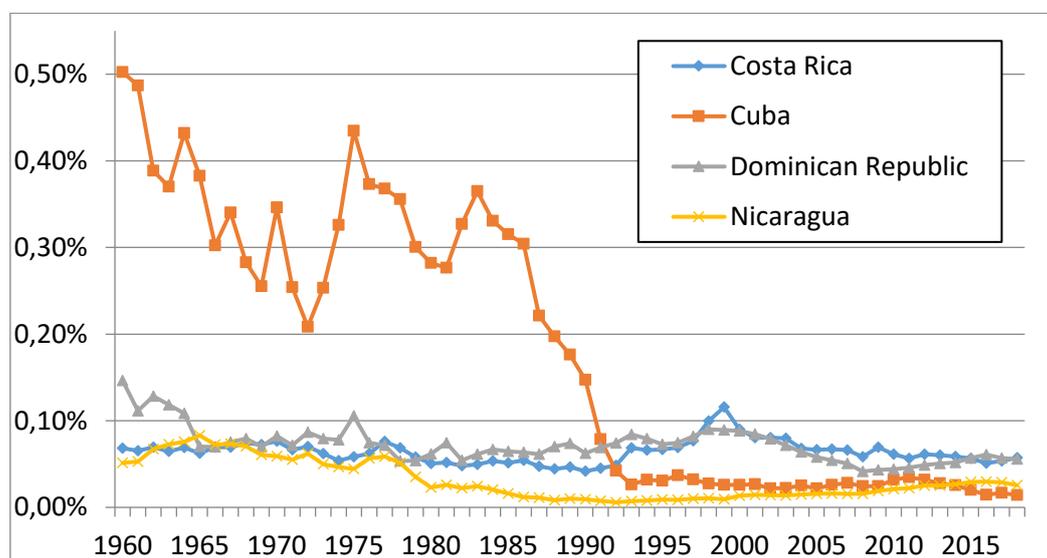
⁷ More on this topic for example in Hernández-Catá, E.: Cuba's swaps of petroleum for doctors and the impact of cutbacks in Venezuelan oil deliveries, 2019.

⁸ ONEI, Anuario Estadístico de Cuba 2018, Sector Externo, 2019.

⁹ World Bank.

With the analysis carried out above in mind, it is also worthwhile to compare the development of the percentage of exported goods of these selected countries in terms of the global export economy. Although this comparison has a number of limitations (e.g. it does not take into account the different populations of selected countries), it offers an interesting insight into the evolution of the importance of global trade for these specific countries. The comparison graphed in Figure 2 shows that Cuba's share of global trade was several times higher than in the other included countries before 1990, as well as the country's subsequent sharp decline. Since 2014, Cuba's percentage has been the lowest out of the four countries. Historically speaking, the high levels were related to Cuba's strong orientation towards sugar exports during its cooperation within the Council of Mutual Economic Assistance (COMECON).

Figure 2: Percentage of Exported Goods from the Selected Counties in the Global Export Economy



Source: The World Bank, arranged by the author.

Results

In this section, the results of the comparison of Cuba's competitiveness with the three selected countries from the region will be presented using the above-described indicators offered by theoretical literature.

Degree of involvement in international trade

The degree of country's involvement in international trade (often referred to also as the degree of openness of an economy) is usually assessed on the basis of its share of exports in relation to its GDP (sometimes also the share of imports or the sum of exports and imports). As far as Cuba is concerned, the country has gone through several fundamental changes since the 1960s in terms of its share of exports (in this analysis we consider only the export of goods, see above) in relation to its GDP. In Figure 3, we can see an increase

in this proportion and that it maintained shares between 25-30% during the 1970s and 1980s. However, after 1990 this was followed by a sharp decline to figures that have been below 5% since 2015.

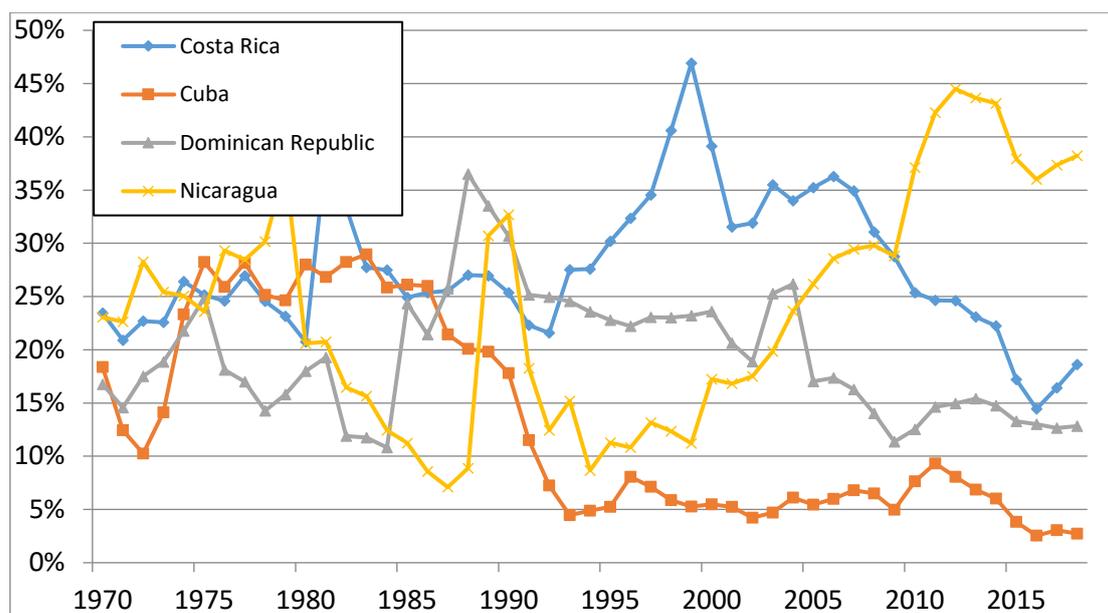
As previously outlined above, the significantly higher importance of exports to the Cuban economy was due to its strong focus on the production of sugar and sugar exports, which lasted until the early 1990s. Sugar exports were already dominant in the Cuban economy prior to the Cuban Revolution of 1959, when the Cuban sugar industry was closely connected to the US, where most of the sugar exports went. Following the political reorientation of Cuba and the related imposition of a US trade embargo in the early 1960s, Cuba entered into close cooperation with the Soviet Union and the Eastern Bloc countries, which was institutionalized by Cuba's accession to the Council of Mutual Economic Assistance (COMECON) in 1972. Within the framework of their role as the main supplier of sugar, Cuba was allowed to export sugar at prices several times higher than the going market rates (Pérez-López, 2016). One consequence of this support was the abandonment of Fidel Castro's initially proclaimed goal of the diversification of agriculture and the industrialization of the economy. On the contrary, this led to an intensification of Cuba's orientation towards the sugar industry (Politt, 2004). For instance, the percentage of sugar in the country's total exports was around 75% during the second half of the 1980s (Pérez-López, 2016). After the collapse of the Soviet Union and the end of mutual cooperation, Cuba lost the majority of its export markets, which it failed to replace. Production was also declining due to missing inputs (e.g. spare parts for agricultural machinery, fertilizers or pesticides), which had been largely provided by the Soviet Union until then. In the most current available figures, the share of sugar in the total exports of goods was 19% (2017)¹⁰. Cuba has been unable to compensate for the loss of sugar exports by any other product, and its share of exported goods to GDP fell from an average of 25% from the 1980s to around 3% (2017)¹¹.

In particular, the long-term inability to substitute sugar exports for exports of another commodity or another product has led Cuba to lag behind in this indicator in comparison with the selected countries in the region (see Figure 3). Since 1990, Cuba has been the most closed economy out of these countries. In 2018 (the last set of figures available) the value of the indicator for Cuba was 3%. Nicaragua (38%) was the highest this year, followed by Costa Rica (19%) and the Dominican Republic (13%).

¹⁰ ONEI, Anuario Estadístico de Cuba 2018, Agricultura, ganadería, silvicultura y pesca, 2019.

¹¹ ONEI, Anuario Estadístico de Cuba 2018, Sector Externo, 2019.

Figure 3: Percentage of Exported Goods in relation to GDP



Source: The World Bank, arranged by the author.

The percentage of manufactured finished products within exported goods

The indicator of the percentage of manufactured finished products within exported goods, takes into account the commodity structure of the country's exports and points out the degree of its revealed comparative advantages, while also providing a greater indication of the country's competitiveness. Evident comparative advantages are shown by a higher proportion of manufactured finished products. For developed countries, this proportion usually exceeds 80% (Kubišta et al., 2009).

The World Bank database contains the values of the monitored indicator for Cuba only for the period between 1998 and 2006, the data for the later period were calculated from data in the Cuban Statistical Office's Annual Reports. As can be seen in Figure 4, the share of manufactured finished products in Cuba grew from 11% in 1998 to the current rate of 28% (2018). This share reached its highest percentage in 2009, when it was 30.9%. However, the higher figures of this indicator (especially in 2005, 2009, 2016 and 2018, when they ranged between 25-31%) were mainly due to a decline in the total of exported goods. Regarding Cuba's manufactured export composition (as shown in Figure 5) by far its most important category is Category 5 of the International Standard Classification of Goods, Revision 4 (SITC) - 'Chemicals and related products not mentioned anywhere else', whose share in the manufactured finished products increased from 28% in 2000 to 80% in 2016, when its value reached \$494 million USD. In 2017 and 2018, the share of Category 5 goods fell to 75% and 69%, respectively, however, the data for the last two years are incomplete in the current annual reports from Cuba's Statistical Office and may be corrected. The actual value of the Category 5 goods is comprised mainly of goods that fall under subheading 54 (pharmaceutical products), which in 2016 (the latest available figures) accounted for 90% (and 72% of the total exports of manufactured finished goods).

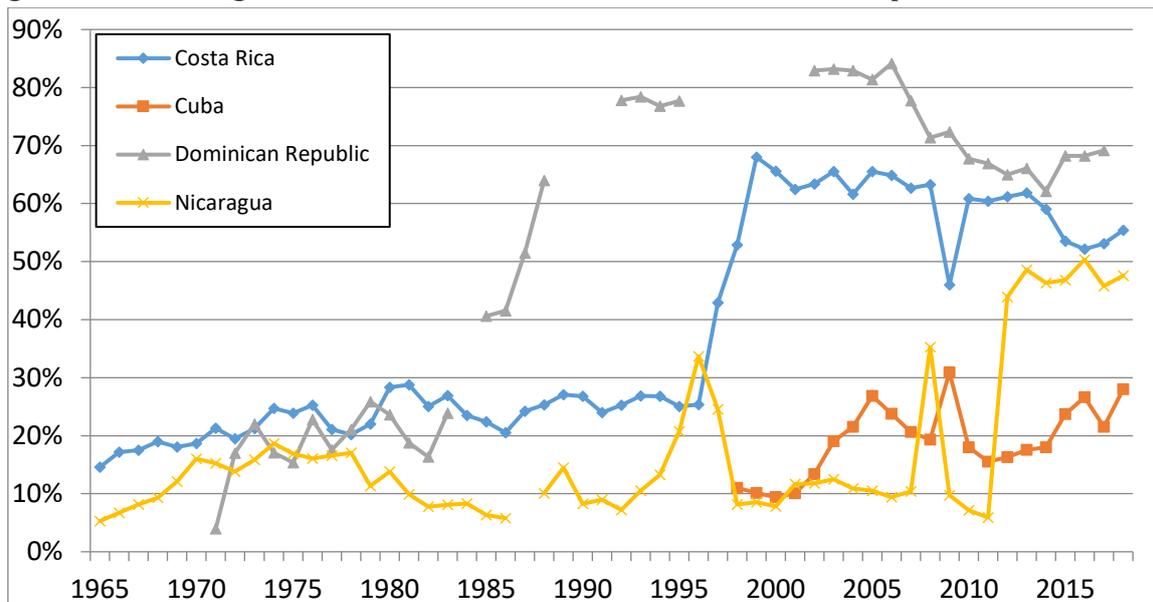
The figures of this monitored indicator are thus mainly made up of the exports of pharmaceuticals. This makes sense given Cuba's long-term focus on the pharmaceutical sector and how strongly it is connected to the Cuban health system, which had to be reoriented and become more self-sufficient as a result of the US trade embargo. In the 1980s, a number of Cubans were sent to study academic fields related to biotechnology in the Soviet Union and Eastern European countries. These fields remained a priority even during the crisis of the 1990s when Cubans studied at universities and worked in research institutes in countries such as Sweden, Germany or Spain. Between 1990 and 1996, the Cuban government invested \$7 billion USD in the development of biotechnology centers around Havana. These centers currently employ more than 7,000 Cuban scientists and technicians and are the heart of Cuba's drug research and production facilities. The Cuban biotechnology complex produces a wide range of products such as vaccines, diagnostic systems, enzymes, products for molecular biology, monoclonal antibodies, among others (Spadoni, 2014). Although in terms of R&D expenditures as a percentage of the GDP, Cuba invests more than most of the other countries in the region, compared with the rest of the world the amounts of investment are not exceptional (Cárdenas, 2009).

Regarding the export of pharmaceuticals, the government has established a number of partnerships, both with developing and developed countries, with the goal of furthering the development of the research, production, commercialization and international recognition of Cuban products. However, due to the complicated approval process, most of these exports still go to developing countries. (Cárdenas, 2009). For example, in 2017, the main importers of packaged medicines were Belarus 16% (of packaged medicines for export), Algeria 17%, Ecuador 13%, as well as the Czech Republic with 8%¹² (according to the Czech Statistical Office the total value of imported medicine from Cuba was \$657,000 USD last year). Part of this production was also exported to Venezuela as a result of the mutual cooperation between the two countries, which led to a significant increase in pharmaceutical exports after 2003. Due to the gradual reduction of the mutual cooperation after 2014, we can expect a decline in pharmaceutical exports, which is a highly likely explanation for the decrease in total pharmaceutical exports since 2015, when the volume of exported medicines decreased by 27% year-on-year. However, given the decline in total exports of goods, this decline had no significant impact on the indicator being discussed.

Despite the well-developed pharmaceutical industry, Cuba lags behind all of the countries under review in terms of the indicator of the percentage of manufactured finished products within exported goods. Its current figure of 28% is also very different from that of developed countries. The best results are compared to those of the Dominican Republic and Costa Rica, which (last year is 2017) reached 69% and 53% respectively, while the figure for Nicaragua was 45.8%.

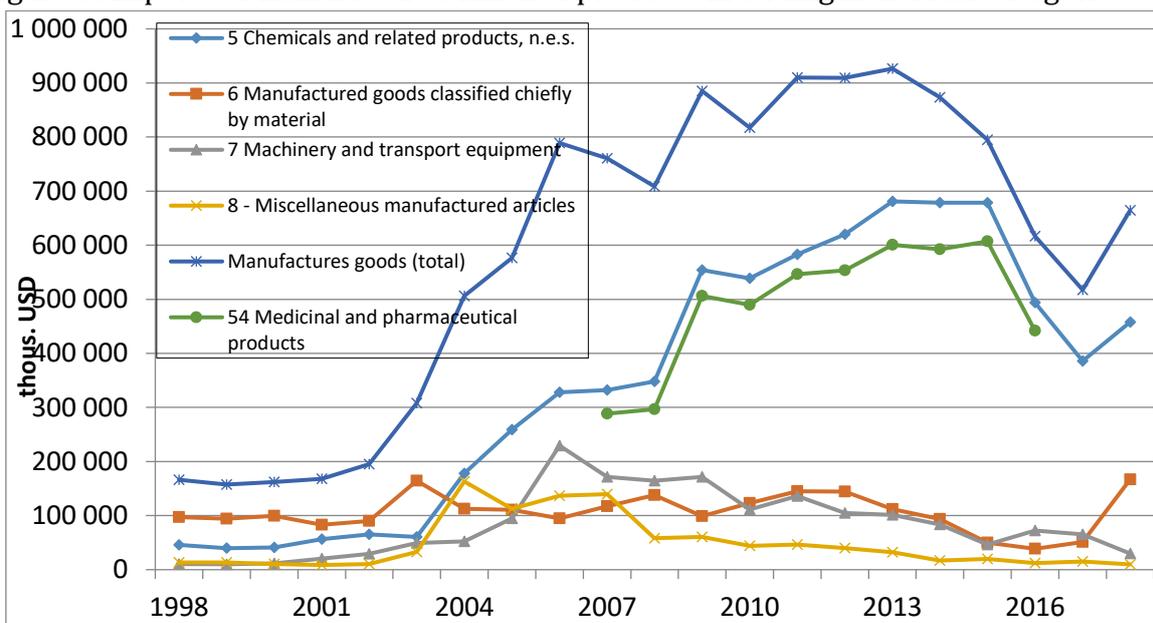
¹² Observatory of Economic Complexity

Figure 4: Percentage of Manufactured Finished Products within Exported Goods



Source: The World Bank and the Cuban Statistical Office, arranged by the author.

Figure 5: Exports of manufactured finished products including individual categories



Source: The World Bank and the Cuban Statistical Office, arranged by the author.

The percentage of hi-tech products within exported manufactured finished goods

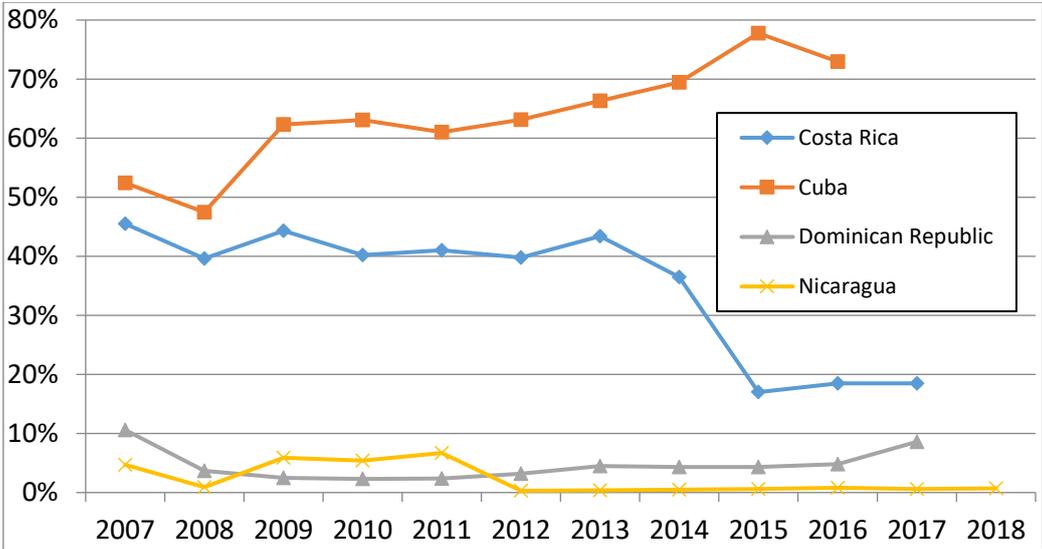
Another indicator used to assess the amount of comparative advantages and the degree of competitiveness of the examined economies is the indicator of the proportion of exported hi-tech products within exported manufactured finished products. The figures for this indicator are available for most countries in the World Bank database. However, this database does not contain data for Cuba, which has therefore been calculated from the data available in the Cuban Statistical Office's Annual Reports. According to the Classification of Economic Activities of Revision 2 (NACE Rev. 2), the high-tech industries

include products classified under Division 21 (the manufacture of basic pharmaceutical products and pharmaceutical preparations), Division 26 (the manufacture of computers, electronic and optical equipment) and the group of goods that fall under Division 30.3 (the manufacture of aircraft and their engines, spacecraft and related equipment). According to the Cuban Statistical Office’s Annual Reports the Cuban exported goods are reported in accordance with Chapters 54, 75, 76, 87 and 88 as classified within the SITC system.

The development of this indicator for Cuba and the countries under review is shown in Figure #6. The value of the monitored indicator for Cuba between 2007 and 2016 (data is available only for this period) increased from 52.4% to 77.8% in 2015. In 2016 it fell to 73%. The high figures are explained by the dominance of the pharmaceutical industry within the manufactured finished products sector, which is classified as a hi-tech sector and whose export position has been described in the previous section.

Cuba’s unambiguous lead and separation from the researched countries in terms of this indicator, which increased even more between 2007-2017 (though a certain drop can be seen in the latest data between 2015 and 2016), can be seen by looking at Figure #6. In 2017 the figure for the indicator was 18.5% for Costa Rica, 8.6% for the Dominican Republic and 0.6% for Nicaragua.

Figure 6: Percentage of hi-tech products in the export of manufactured finished goods



Source: The World Bank and the Cuban Statistical Office, arranged by the author.

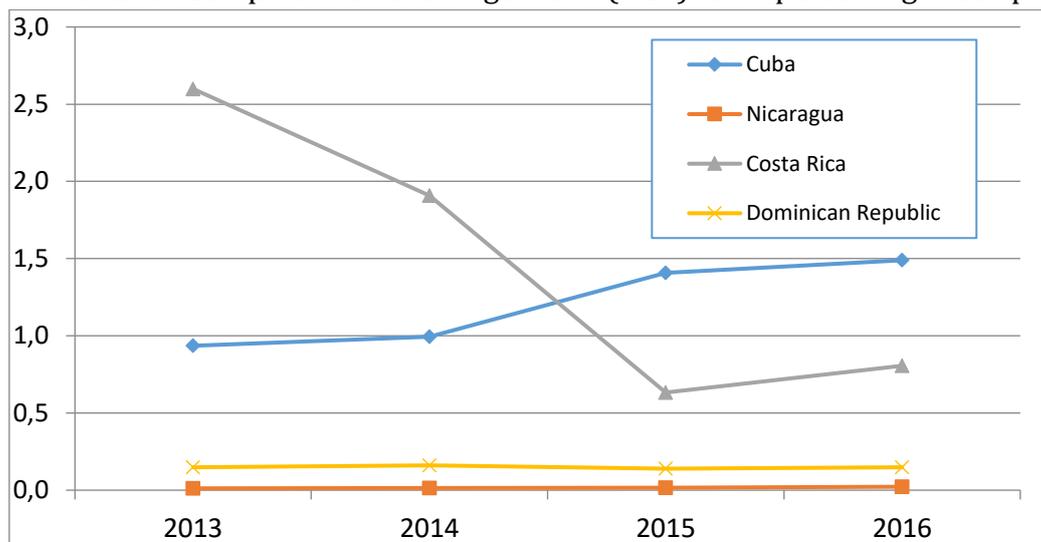
Index of revealed comparative advantages (RCA) in hi-tech industries

The last indicator examined here is the Balassa Index of Revealed Comparative Advantages (RCA) in terms of the hi-tech sector. This indicator broadens the assessment made in section 3 (the percentage of exported hi-tech products within exported manufactured finished goods), by comparing the existence of a comparative advantage in a global context through the RCA index. The period under review in this case is from 2013

to 2016, for which the figures for exported hi-tech manufactured goods are measurable in the database of the World Bank.

As can be seen from Figure 7, revealed comparative advantage has been shown, according to this index for high-tech industries only in Costa Rica in 2013 and 2014, and for Cuba in 2015 and 2016, which is the only country out of these four that has a clear comparative advantage for hi-tech industries since 2015. In 2016, the index value for Cuba was 1.49, for Costa Rica 0.8, for the Dominican Republic 0.15 and for Nicaragua 0.02.

Figure 7: Revealed Comparative Advantage Index (RCA) for exported high-tech products



Source: The World Bank and the Cuban Statistical Office, arranged by the author.

Discussion

The aim of this article was to evaluate the competitiveness of Cuba and to see how this measure was in comparison with the selected countries from Central America and the Caribbean. There was a significant reduction in Cuba's involvement in international trade after the end of its cooperation with the Soviet Union in the early 1990s and has led to it lagging behind the countries under review over the long term. Another finding was the very low share of exported manufactured finished products within its total exports, which is also at the lowest level in comparison with the countries under review. This finding points to a low level of the revealed comparative advantages of Cuban exports over the countries chosen within the region. In general, these comparisons point to Cuba's low level of competitiveness within the region and low comparative advantages when compared to both more politically open countries (Costa Rica, Dominican Republic) and more closed countries (Nicaragua). Thus, the poor development and ongoing isolation of Cuba's merchandise trade proved to be rather exceptional in the regional context.

The comparison between the development of high-tech products for export to the overall amount of the manufactured finished goods for export, which has reached shares close to 80% in recent years and was consistently the highest rate among the countries under review, points to a more positive finding for Cuba. The Balassa RCA Index showed a clear

comparative advantage in the hi-tech sector, with Cuba achieving the highest figures among the countries under review in 2015 and 2016 (the two most recent years with available data). An analysis of the composition of these exports has shown that the value of hi-tech exports is predominantly made up of exported pharmaceutical products, in whose production the Cuban government invested heavily during the 1980s and 1990s.

The findings of this analysis are generally in line with the findings of other studies that show significant decline in Cuban sugar industry and reallocation of resources towards other industries (Bonnett, Taylor and Messina, 2001), and also major decline (highest among selected countries) of Cuba's export market share at the beginning of the 1990s (Mortimore and Peres, 2001). The analysis further extends these results by making a comparison with other countries within the region.

The findings regarding the existence of Cuba's comparative advantages in the hi-tech sector further complement the analysis of Cuba's biotechnology industry by Spadoni (2014) and Cárdenes (2009). Nevertheless, there is a lack of more detailed, especially up to date, analysis of this issue, which would be important to conduct in context of Cuba's potential development and also possible future shift towards more market-oriented economy. Questions for further assessment include for example Cuba's possibilities to attract foreign direct investment in the biotechnology sector, possibilities to compete with major pharmaceutical companies in developed countries and increase of its market share or Cuba's possibilities to sustain or increase its R&D expenditures.

Conclusion

The conclusion of this analysis is the finding that Cuba has a low competitiveness in comparison with all of selected countries from the region. However, at the same time the existence of comparative advantages has been demonstrated in the hi-tech sector, especially within the pharmaceutical industry, where Cuba is achieving significantly better results than the other countries in the region. This result points to some of the island's potential in terms of the allocation of Cuba's resources, especially when it comes to manufactured finished goods, which could be further addressed, for example, in the context of analyzing opportunities for foreign investors, or in regard to the potential transformation of the Cuban economy into a market based economy.

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Business Models, Strategy and Innovation in the New World of Digitization

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Abstract

The aim of this article is to specify the business models and their use when companies enter to foreign markets. An integral part of this is the digitization of today's world, including business models. The purpose of the article is to map the level of knowledge about business models, the impact of digitization on them and how companies to enter specifically German market from business models point of view. The aim of this article is to compare concept of business model as such, its use and access to digitization. By comparing literary revisions, the author will focus on the Canvas business model, which meets the criteria for entering the foreign markets and its structure and uses it as a "winner" among other models. According to results, it is necessary to prepare internal corporate environment in context to digitization, when trades enter to unknown foreign markets.

Keywords: business models, Canvas business model, Lean Canvas business model, foreign markets, innovation, strategy, digitization, Industry 4.0

Introduction

This article presents the topic of future research with links to the growth of the digital economy in European countries, e-commerce, digital business models, and, above all, the digital transformation of businesses. The digitization trend can ensure competitiveness and sustainability in an international environment. The article also develops the logic of the study, including the goal, survey methodology, research, summary and conclusion. The digital economy is "that part of economic output derived solely or primarily from digital technologies with a business model based on digital goods or services" (Bukht and Heeks, 2017).

The most valuable businesses in the world have embraced digital business models. According to Financial Times UK, seven out of the ten most valuable companies in the globe in 2010 and 2017 are digital businesses. Digital business model is transforming several businesses around the world examples of which are Alphabet (Google), Facebook, and Amazon. Many authors describe linkage between internet and internationalisation and emphasise the impact of technological development in market entry (Madsen and Servais, 1997; Musteen, Francis and Datta, 2010; Johanson and Martín, 2015; Kim, et al., 2011).

Internationalization is one of the basic concepts that can be encountered when studying export behaviour. It is so closely related to export and its research. According to Katsikeas, Leonidou and Morgan (2000), the export debut is even the most significant point in the process of internationalization of the company. Inter-nationalization is a term that is a superior term to the term export.

As with other export performance terms and concepts, it is not possible to find its only and generally accepted definition and the only theory to explain it in its entirety. This shortcoming is all the more so because the beginnings of internationalization considerations can be found in the works of Adam Smith and David Ricardo (Fillis, 2001) and are more than two centuries old.

Globalization can be seen as a phenomenon where business operations are managed globally and not just in a few selected countries. It is characterized by the worldwide integration of competing markets and businesses facing global competition.

Examples of businesses can be companies that are referred to in the literature as international new ventures or born globals. These have been and are able to internationalize in one single step and do not go through the different phases as these phases are predicted by the internationalization phase models. The existence of born global demonstrates, among other things, that the pace of internationalization of businesses is accelerating.

This research will contribute to new knowledge and understanding of how digital firms evolve and internationalize. This is the first research that deals with the in-depth look at what it represents the business model of the digital internationalization of companies by combining international business knowledge, digital internationalization and business modelling literature.

Theoretical Framework of Internationalization

A large number of forms of entry to foreign markets can be found in the literature. The traditional criterion according to which the individual methods are classified is their capital intensity. According to this criterion, non-capital and capital input forms are recognized (Kotler and Keller, 2012):

- **Indirect export:** It is the easiest and most common way to enter foreign markets. Indirect export is suitable for businesses that do not have enough capital (no or minimal investment required) or sufficient export experience. The disadvantage

is that the company has no contact with foreign markets and no control over foreign activities. An enterprise can take an active or passive approach to indirect export. An active approach means that the company seeks export opportunities to new markets. In a passive approach, the company exports only occasionally and does not systematically seek out opportunities in foreign markets. The lack of export experience can be overcome through cooperation with an independent intermediary company.

- **Direct export:** Direct export means that the company no longer needs any intermediaries to secure export activities and bears all the risks associated with activities on foreign markets. It follows that the company no longer has to pay any remuneration to intermediaries. Direct export chooses businesses that already have export experience. The risk is higher than for indirect exports, but the company can influence its operations in foreign markets.
- **Contractual forms of entry to foreign markets:** In the case of indirect and direct export, the company tries to succeed on foreign markets thanks to its products. Contractual forms of entry to foreign markets represent a fundamentally different way of entering new markets. Businesses enter the international environment with their intangible assets and knowledge that are provided under a contract. There is a relatively low risk associated with this form of entry. The disadvantage is that after the period for which the contract has been concluded, a competitor can use it to grow abroad, using the intangible assets and knowledge that were the subject of the contract.
- **Joint venture:** A joint venture creates a new joint venture that is owned and controlled by two or more businesses. Undertakings having ownership interests in a joint venture retain economic and legal autonomy. The advantage of a joint venture is that it allows a foreign venture to use the knowledge and built-up relationships of a local partner. The disadvantage is the need to find a compromise in strategic decisions, sharing knowledge (similar to licensing) and higher risk.
- **Direct investment:** Direct foreign investment is the most capital intensive and also the riskiest form of entering foreign markets. An enterprise may purchase an existing company abroad, establish a subsidiary or a foreign branch abroad. The difference between a subsidiary and a foreign branch lies in its legal personality. The subsidiary has legal personality, a foreign branch no: it cannot enter into contractual relations. In the long run, the direct foreign investment of a company can bring a number of benefits. These advantages include lower production costs and the possibility of using investment incentives.

It follows from the above that businesses today can choose from a wide range of entry into foreign markets. Choosing the right form of entry into foreign markets becomes a very difficult decision. The difficulty of the decision is mainly due to its difficult future revision, whether it is time or money.

Schellenberg, Harker and Jafari (2017) research a wide range of literature on ways to enter the international market. This is a crucial and strategic issue for managers in

growing organizations of all sizes in all sectors. A set of key internationalization theories are then systematically and critically reviewed: transaction cost approach, institutional theory, eclectic paradigm, and inter-nationalization model in Uppsala.

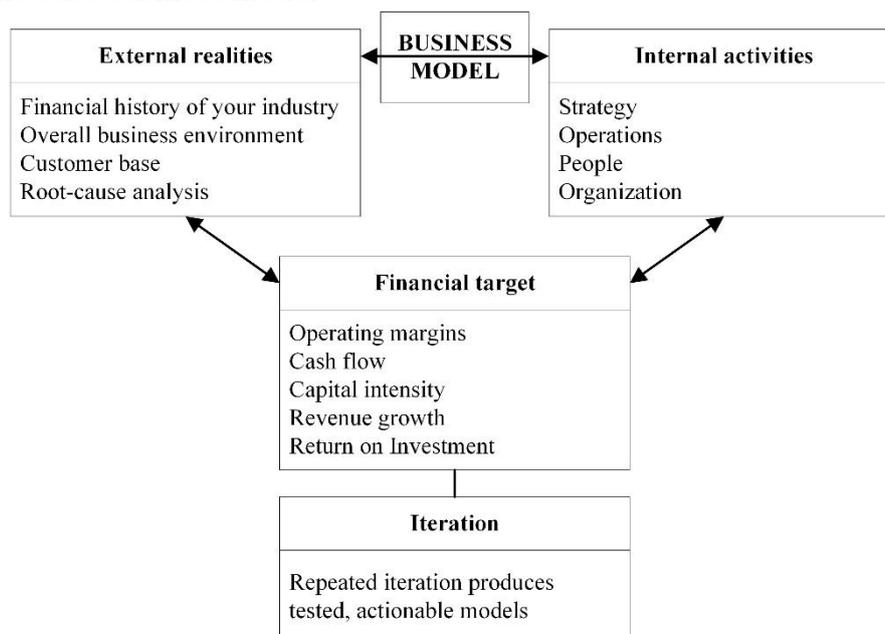
Determination and Definition of Business Model and its Configuration

This part of article is divided into sections. First, it presents definitions, meanings, and elements of the business model. Second, the configuration and application of business models in international business literature, especially in terms of identifying opportunities and creating value.

Zott and Amit (2008) define a business model as "a structural template that describes the organisation of a focal firm's transactions with all of its external constituents in factor and product markets".

According to Teece (2010, p. 20), a business model is "management's hypothesis about what customers want, how they want it and what they will pay, and how an enterprise can organise to best meet customer needs, get paid well for doing so". This definition is similar to the conceptualisation of a business model by Bossidy, Charan and Burck (2009) who note that a business model consists of: a firm's external realities (financial history of the industry, overall business environment, customer base, root-cause analysis which determine best solutions to the firm's problems); its internal activities (strategy, operations, people and organisation); financial targets (operating margins, cash flow, capital intensity, revenue growth, and return on investment); and importantly iteration which tests and refines the model in different application contexts. See the Figure 1 illustrating the base business model.

Figure 1: The base business model



Source: Bossidy, Charan and Burck (2009).

The following notes discuss further the notion that strategy and business model are intimately linked, though subtly different in meanings.

The above model is referred to as a base business model in this article because it shows the key aspects of a meaningful business model in the way it links the external and internal environments and the usual financial performance metrics.

Business model and strategy are often used interchangeably by many researchers and business practitioners; they are quite distinct but complement each other. Magretta (2002) outlines differences and similarities between strategy and business model. Business model describes how firms create and deliver value to customers, while strategy determines how a firm uses the business model to gain competitive advantage (Markides and Charitou, 2004).

Daas et al. (2012) claim that business model (BM) can be described as "the way a company or company network is trying to make money and create value for customers" (Haaker, Faber and Bouwman, 2006) and can be defined as a plan describing the service definition and intended value for the target group, income sources and provision of service delivery architecture, including a description of the resources needed and an organizational and financial agreement between the involved entrepreneurs, including a description of their roles and the distribution of costs and revenues between business entities.

Shafer, Smith and Linder (2004) mention that many authors offer a definition of business model. "Our own review of relevant literature revealed 12 definitions in publications in 1998-2002." However, none of these definitions has been fully accepted by the business community. This may be due to many different aspects (E-business, strategy, technology and information systems).

Franceschelli, Santoro and Candelo (2018) state that business model is important because it relates to the way a product or technology is commercialized and creates value (Chesbrough, 2010). In fact, a product or technology alone does not create value without an efficient and valuable business model (Johnson et al., 2008). Likewise, it is possible to define a business model as a logic according to which the company it works and creates value for all stakeholders (Casadesus-Masanell and Ricart, 2011).

More specifically, Lindgardt et al. (2009) suggest that the business model is composed of two main elements, namely a value design and an operating model. The first part contains target segments, product or service offered, and revenue model. The second part consists of a value chain, a cost model and an organization.

Osterwalder (2004) discusses whether to compare business models. He states that the general characterization and classification of business models could be an interesting direction of research in order to match them. Timmers (1998) classifies business models between the degree of innovation and the degree of integration.

Mason and Spring (2010) see BM development as positive, improving and innovative. They point out that by the year 2000, the concept of business models was mostly cited by internet businesses. The concept of business model has often been used to explain how

emerging types of businesses (e-markets, online service providers) could actually make money. This was vital in an industry that was not known to potential investors. Writers at that time saw business models as descriptions of the roles of various "network actors" (Timmers, 1998) and flows between product, service, information and income actors (Weill and Vitale, 2001).

Souto (2015, p. 145) defines business model innovation as "a new configuration of what is done in the company and how it is done, to provide a new value proposition to customers". In other words, it is the new or significantly improved system of activities required for the generation of a new value propositions.

Burmeister, Lüttgens and Piller (2016) focus on innovation of business models for Industry 4.0, i.e. the implementation of cyber-physical systems across the value chain and the far-reaching digitization of products and processes is considered a significant change in our current industrial system. According to Teece (2010), they define the business model as a managerial hypothesis about what customers want, how they want it. How a business can organize itself to best meet its needs and get paid and make a profit.

Methodology

The purpose of the research as base for this paper is to find out literary overview, then comparison of author's views on the use of business models, their innovation an adaptation under the influence of digitization. Looking at the creation of own business models, exploring areas of knowledge and possible ways of entering to foreign markets. The aim of this article summary is to compare author's views in the concept of business model as such, its use and access to digitization. Focusing on this area can lead to future research. This literature review focuses on recent literature.

Since it is necessary to determine the relevance of potential business model, it is necessary to examine specification of relevant business models what can be obtained. In order, to achieve this aim it was necessary to choose an approach to achieve the following objectives:

1. Overview of relevant literature focusing on business models;
2. Draw conclusions based on the survey.

To achieve objectives mentioned above, it was necessary to carry out the analysis of selected articles, studies and other publications, which are included in scientific databases.

Results

The different definitions of business model (see Tab. 1) and terms used to describe the business model process make it difficult for researchers to reach consensus on what

constitutes a business model (Linder and Cantrell, 2000; Osterwalder, Pigneur and Tucci, 2005; Zott, Amit and Massa, 2011).

Tab. 1: Definitions of business model

Author	Definition
Amit and Zott, (2001, p. 511)	The business model describes content of business transactions with high control focus as reaction of the business opportunities in a market.
Chesbrough and Rosenbloom (2002, p. 529)	The business model includes rational activities, which link technical potentials with required economic value.
Magretta (2002, p. 4)	Business models represent a description how business activities are realised. Relevant business model can explain specification of customer and value for consumer, what lead to money earning with adequate costs.
Morris, Schindehutte and Allen (2005, p. 727)	A business model is brief explanation of connections between individual areas of economics, venture strategy and construction. These areas are considered as key ones how is possible to create long-time sustainable competitive advantage.
Casadesus-Masanell and Ricart (2011, p. 102)	A business model reflects corporate activities that were realised under condition of complex strategy.
Teece (2010, p. 179)	A business model expresses the logic, that the facts and other data support a value offer for the customer, and a possible structure of revenues and costs for the firm delivering that value.
Zott and Amit (2010, p. 216)	It is created on base of interconnection of activities in the company. These business activities must be multidisciplinary, crossing boundaries of the company.

Source: Authors.

The business model constructs encompassed by these definitions include: the architecture or plan of a business; content, structure and governance of transactions; value creation via exploitation of business opportunities (which directly links business models to entrepreneurship theories); economic value; ‘stories’ about how enterprises work; concise representation (typically graphically or in tables) of the interconnections among key aspects of how a business works (as we will see in the business model canvas later, for example); and crucial elements like customer value propositions, revenue and profit formula and processes.

The primary idea is to be able to simply imagine the individual parts of the model as well as the model as a whole. This can be achieved by printing a large copy of the nine Canvas building blocks on a large paper or canvas (hence the name) and placing the copy on the

wall so that more people can also look at the same model and think, discuss and imagine how to create the right business model (Daniel, Wilson and Myers, 2002).

Components of e-business models by Zott, Amit and Massa (2011) and business model canvas by Osterwalder and Pigneur (2010) are important elements of the conceptual framework for this research. E-business models describe how businesses create value through the internet, for example customer relationship management, product innovation, and infrastructure. Business model canvas is a strategic management and lean-start-up template for developing a new or documenting existing business models (Osterwalder and Pigneur, 2010). However, it is not only start-ups that benefit from using the business model canvas; it is a strategic tool which facilitates the evolution of existing firms like SMEs and multinational firms. Augmenting the elements of the canvas with e-business components makes it more suitable for supporting the development of digital internationalising firms. This view is implemented in the proposed conceptual framework for this research, later in this chapter. It also helps existing firms to align their new business.

Testing the assumptions of a business model through the steps of the business model canvas and doing appropriate risk quantifications to understand what might occur in the future among stakeholders in the canvas, helps to achieve good fit between value propositions and customers' needs. Developing prototype products and services using the canvas and testing them with prospective customers is an effective way to build successful business models (Blank and Dorf, 2012; Trimi and Berbegal-Mirabent, 2012).

The researcher notes in a nutshell that the nine stages of an integrated business model are almost equally power-fully developed in both Osterwalder and Pigneur (2010) business model canvas and Amit and Zott (2001) components of e-business models. The components serve as some important elements of conceptual frameworks for building the IBMT in this research. A theoretical justification for using the canvas is the fact that its elements, in addition to explicating the nine important stages of a business model, consider the design features (context, structure, and governance), as well as the design themes (novelty, lock-in, complementarity, and efficiency) noted by Zott and Amit (2010) as core facets of an e-business model. Table 1 depicts business model canvas and component of e-business model.

Discussion

According to the literature used, the author summarizes the fact that not only modern technology of today's age is undergoing dynamic development, but also organizations with their business models have to adapt to rapidly changing trends. In fact, the business model is a personal story that describes how a business works, what value it creates, who it serves, and the way it generates profit. The main goal of each company should be to create a business model to ensure a relatively sustainable or long-term growth and financial sustainability of the business.

The Canvas business model, as the answer to previous results, ranks among the widely used, clear-cut and clear business models. The authors also emphasize the economic and social benefits of the business model (Kühn et al., 2018; Urban et al., 2018).

Ideally, exploring business models should be done as a whole, but it is also possible to explore selected parts of the model. The author appeals to the importance of adapting the business model to customer needs. Because the fact that a business model works anywhere in the world does not mean it will work in the Europe. Tab. 2 provides a specification of parameters in business model Canvas.

Tab. 2: Specification of parameters in business model Canvas

Key partners (KP) Who are our Key partners? Who are our Key suppliers? Which Key resources are we acquiring from partners? Which Key activities do partners perform?	Key activities (KAs) What Key activities do our Value Propositions requires; our distribution channels; customer relationships; revenue streams?	Value propositions (VP) What value do we deliver to the customer? Which one of our customer's problems are we helping to solve? What bundles of products and services are we offering to each Customer Segment? Which customer needs are we satisfying?	Customer Relationship (CR) What type of relationship does each of our Customer Segments expect us to establish and maintain with them? Which ones have we established? Who are they integrated with the rest of our business model? How costly are they?	Customer Segments (CSs) For whom are we creating value? Who are our most important customers?
	Key resources (KR) What Key resources do our Value Propositions requires; our distribution channels; customer relationships; revenue streams?		Channels (C) Through which channels do our customer segments want to be reached? How are we reaching them now? How are our channels integrated? Which ones work best? Which ones are most cost-efficient? How are we integrating them with customer routines?	
Cost structure (CS) What are the most important cost inherent in our business model? Which key resources are most expensive? Which key activities are most expensive?			Revenue Streams (RS) For what value are our customers really willing to pay? For what do they currently pay? How are they currently pay? How would they prefer to pay? How much does each revenue stream contribute to overall revenues?	

Source: Authors.

According to the requirements from the market and technology development, canvas business model is considered as rigid tool on the way of supporting businesses in global

environment. Therefore, Canvas model was transformed according to conditions of lean form and Industry 4.0 into Lean Canvas model. Lean canvas model includes more areas except traditional canvas areas. These new areas are (Maurya, 2012):

- Problem: definition process as prevention of wasting key sources such time, money on the way of creation product or solution;
- Solution: after problem definition it is important to design and describe final product;
- Key Metrics: recommendation for start-ups is to define at least one key metric by which is evaluate the range of products or services. Choice of right metric could have significant impact;
- Unfair Advantage: from fundamental of start-up could be defined kind of unfair market advantage because of the uniqueness of provided product.

The basic principles in lean canvas, which help to identify potential risks, help to design plan in better way. These principles are (Nidagundi, Novickis, 2016):

- (1) Forming a document with description of future activities (a plan);
- (2) Determination of process wastage in connection to designed plan;
- (3) Periodic verifications of reached results according to plan.

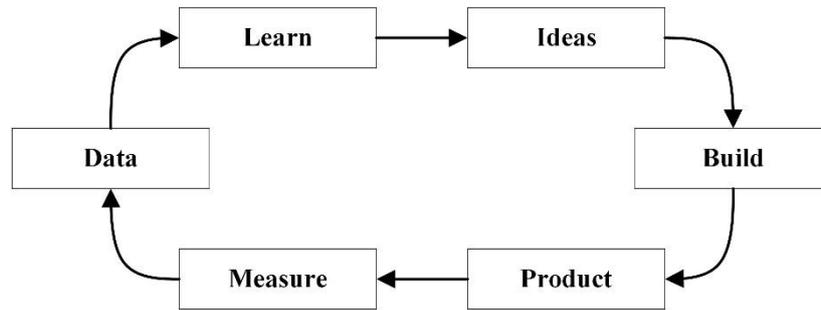
The core principles of Lean Canvas include six areas, on which organization must focus on (Nidagundi, Novickis, 2016). These areas are as follow:

- Ideas: generating of solution for customer's problems;
- Build: focus on continuous development of corporate activities;
- Product: producing generated solution;
- Measure: description of created results from realised activities;
- Data: data verification according to defined aims;
- Learn: improvement of activities on data base.

All of these areas are put into circle loop, where is necessary to work continuously in long period. The connection of individual areas is shown in Figure 2.

According to Duarte, Rosário and Cruz-Machado (2019) lean business model is important answer on environmental issue of global governance. Companies must adapt and integrate their corporate activities to meet green requirements on the way of improvement of global supply chain. In conditions of industry 4.0 it is important to start apply lean business model in effective definitions of individual parts, and work with the highest influence in digitization processes (Kovacs, 2018).

Figure 2: The base Lean Canvas Business model life cycle



Source: Nidagundi and Novickis (2017).

Conclusion

The main objective was to assess a greater number of authors in the assessment of business models in the sector under study or across disciplines. Furthermore, the author considers it necessary to try to analyse the possibilities of innovation and adaptation of business models and their impact on the use in the foreign environment. In the future, the Canvas business model (in all potential varies) will certainly be the focus of research and innovation will be the innovation of business models as it enters foreign markets (Doganova and Eyquem-Renault, 2009; Fjeldstad and Snow, 2018).

Lean business model with focus on green requirements is accepted by large professional audience and it is considered as business advantage in competitive battle. Specific position of lean business model is its usage by start-ups regardless to industry or market (Martínez León, Calvo and Amodio, 2017; Ibáñez-Forés et al., 2016; Verrier, Rose and Caillaud, 2016). Relevance of relationship between lean canvas and industry 4.0 verify Sony (2018) and Varela et al. (2019) as actual connection for each company and organization, not only in well-developed countries, but especially in developing countries (Mas-Ruiz, Ruiz-Conde and Calderón-Martinez, 2018; Surdu et al., 2018).

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Contagion in the LAC Financial Markets: The Impact of Stock Crises of 2008 and 2010

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Abstract

This research aims to evaluate financial contagion in the six main Latin American Countries (LAC) markets, as well as in the US, Greece and the EURO STOXX 50 indexes. Achieving this objective will allow us to answer the following questions: is there contagion among the emerging markets of Latin America? If so, what was the most critical moment of this phenomenon, the financial crisis of 2008 or 2010? If there is autocorrelation in the time series, will it be possible to detect serial volatility clusters? The results suggest the existence of financial contagion resulting from the financial crisis of 2008, with no significant contagion during the financial crisis of 2010. In the final phase, stock markets in Latin America have been infected by the subprime financial crisis. However, there was a readjustment in these regional markets during the European sovereign debt crisis of 2010, which could create conditions for implementing portfolio diversification strategies.

Keywords: financial contagion, financial crisis, LAC financial markets

Introduction

Until the 1980s, crises in emerging markets, particularly in Latin American countries, with their long history of heavy external debt, successive devaluations, bank crises and deep economic recessions were attributed to inconsistent domestic policies. Financial crises were considered as events that occurred in individual markets, without a systemic character and, therefore, little attention was paid to the possibility of the transmission of shocks between countries.

The situation changed in the course of the 1990s as a series of serious financial crises unfolded: the crisis of the European Exchange Rate Mechanism in 1992, the Mexican crisis in 1994-95, the Southeast Asian crisis in 1997-98, the Russian crisis in 1998, the Brazilian crisis in 1999, the Dot-com crisis of 2000, and the Argentine crisis in 2001-2002. It is important to note that the negative consequences related to episodes of instability were not limited to the countries of origin but were transmitted rapidly to several markets with very diverse structures and dimensions throughout the world, representing what has been referred to in the literature as contagious effects.

The aim of this paper is to investigate the existence of financial contagion in the six main Latin American markets, as well as in the US, Greek and EURO STOXX 50 markets, during the period 2005-2012, especially in the crisis periods of 2008 and European sovereign debt in 2010. Forbes and Rigobon (2002) distinguish the effect of contagion from interdependence. According to these authors, interdependence occurs when the comovement does not increase significantly after a shock, while the contagion shows an increase in comovements in the face of any shock.

In order to achieve the proposed goal, this research tries to answer two questions, namely whether if: there was a phenomenon of contagion among the emerging markets of Latin America? If so, what would have been the most critical moment of such a phenomenon, the financial crisis of 2008 or 2010? If there is autocorrelation in the time series, will it be possible to detect temporal clusters of volatility?

The results suggest there was significant financial contagion during the 2008 financial crisis, with no evidence of contagion arising from the financial crisis of 2010. In the final phase, we found that financial markets in Latin America were infected by the subprime crisis. However, there was a readjustment in these regional markets during the financial crisis of 2010, creating conditions for the implementation of portfolio diversification strategies.

This research presents two contributions to the existing literature. The first contribution relates to the study of financial contagion in the six main Latin American markets, as well as in the US, Greek and EURO STOXX 50 markets, in the context of the financial crises of 2008 and 2010.

Some studies analysed the emerging markets of Latin America, namely, Chen, Firth and Meng Rui (2002) and Bejarano-Bejarano et al. (2015) and Dias, da Silva and Dionísio (2019) using a different approach from this research. Specifically, this paper presents different goals, derived in part from the sample period incorporating two subperiods of financial crisis and a subperiod of a rise in financial markets. The second contribution is related to the selection of these regional emerging markets, since, as far as we know, this is the first study to analyse the effects of the subprime and European sovereign debt crises on the financial markets of the LAC region. In addition, following the recent financial crisis of 2008 in international emerging markets, and those in Latin America, these markets have become an important investment destination. In this context and bearing in mind the large inflows of capital, it is important to understand the interdependencies between

Latin American markets in order to provide relevant information for international investors about portfolio diversification strategies.

This paper is organized in 6 sections: Section 2 presents a review of the literature on contagion and interdependence in stock markets. Section 3 describes the methodology. Section 4 presents the data and results. Finally, Section 5 concludes.

Literature Review

The transmission of shocks in moments of crisis has been one of the main topics of research in the financial literature. There are many definitions of financial contagion adapted to the specific nature of each study. Given this, we will follow the definition of contagion according to Forbes and Rigobon (2002). According the authors, this is a significant increase in the links between markets after a shock in a country (or group of countries). In practical terms, it means that there is financial contagion when the correlation between the returns of two markets shows a significant increase after an unexpected event.

According to Dungey et al. (2006), the first empirical studies on contagion were carried out by Grubel and Fadner (1971). For example, Calvo and Reinhart (1996) studied the Mexican crisis of 1994/95 using correlation coefficients and concluded there was contagion in Latin America and Asia. Baig and Goldfajn (1999) also confirmed contagion in the markets of Malaysia, Indonesia, the Philippines and South Korea during the Asian crisis.

With some similarity, several empirical studies propose the presence of common creditors in the development of contagion episodes occurring throughout the 1980s and 1990s. Caramazza, Ricci and Salgado (2000) and Van Rijckeghem and Weder (2001) identified common factors in the presence of indirect effects of the financial channel through common creditors in the crises of Mexico, Southeast Asia and Russia. Hernández and Valdés (2001) found that the common creditor effect was the basis of the contagion episodes of Southeast Asia, Brazil and Russia when considering the propagation of shocks through the bond market. In the 1980s. Corsetti, Pericoli and Sbracia (2005) and Kaminsky, Lyons and Schmukler (2004) attribute the crises that have occurred in Latin America and Southeast Asia since the 1980s to the behaviour of the US, concerning loans to the regions. Bhimjee, Ramos and Dias (2016) looked at the banking sector before and after the subprime financial crisis from January 2002 to August 2010. The authors suggest that bank stock prices in emerging countries were less affected than the indices of the banking sectors of developed countries.

In more recent studies, several authors have analysed the 2008 financial crisis impacts. Luchtenberg and Vu (2015) studied the most relevant markets in North America, Europe and Asia, from January 1, 2003 to April 31, 2009. The authors concluded that the US market influences all the markets under study, except for China, Japan and Germany. The empirical evidence suggests a significant change in the behaviour of institutional

investors in relation to risk at the beginning of the 2008 financial crisis. These results are in line with Kenourgios (2014), regarding the existence of increased risk aversion among institutional investors.

Cho, Hyde and Nguyen (2015) analysed 30,838 stocks corresponding to thirty-one markets in the period between 1973 and 2011. The results suggest that the subprime financial crisis affected markets globally, while the impacts of the Mexican and Asian crises were smoother and limited to the respective region of origin. In the same vein, Antonakakis, Breitenlechner and Scharler (2015) investigated the dynamic interdependencies between the real estate market, the stock market, political uncertainty and UK macroeconomic indicators from January 1997 to February 2015. The authors suggest that the subprime financial crisis promoted unprecedented shocks, more specifically in stock markets. The authors conclude that the contagion caused uncertainty in economic and monetary policy, with considerable effects on the real economy.

With some similarity, Karanasos, Yfanti and Karoglou (2016) analysed 8 stock markets, considering structure breaks, from 1988 to 2010. The authors argue that markets were abruptly infected by the financial crisis of 2008 when compared to the Asian financial crisis. Shahzad et al. (2017) analysed the Islamic financial markets and the US, UK and Japanese markets from July 15, 1996 to June 30, 2016. The results suggest that Islamic financial markets were infected, just as the developed markets under analysis. The authors argue that Islamic markets, not being immune to global contagion, hinder institutional investors when they want to diversify their investment portfolios, especially in financial crisis. BenSaïda (2017) analysed the US bond market and 10 European markets from January 1, 2000 to September 21, 2016. The results suggest financial contagion from the more developed markets to the peripheral Euro Zone markets, showing that the level of turbulence has remained high since the financial crisis of 2008.

Methodology and Data

In order to answer the research questions, we will perform the descriptive statistics of returns, as well as tests on the stationarity of the time series. Next, we identify structure breaks in the data series using the Clemente, Montañés and Reyes (1998) test. The time persistence of returns will be evaluated through the Ljung-Box test, ARCH-LM (Engle, 1982) and BDS (Brock and de Lima, 1996). The importance of studying the level of autocorrelation in investigations related to contagion is due to the existence of clusters of volatility. According to Mandelbrot (1963) and Engle (1982) if volatility is high (low), in each period, it tends to continue to be volatile in the following period, since the new information that comes to the market is correlated in time.

To test for the existence of autocorrelation in time series, we use the Ljung-Box test (Ljung and Box, 1978). To determine the linearity of a series, the BDS test is often considered (Brock and de Lima, 1996). This test is an important tool to detect dependence in the time series, testing the null hypothesis of a series being *i.i.d.* (independently and identically

distributed). According to Peters (2015) and Díaz, Grau-Carles and Mangas (2002), the test should be applied to filtered series of linear dependence, for example, the residuals of an ARMA process.

In order to understand whether linear correlations registered an increase with statistical significance, we apply the two-sample t test, also called the t -test of heteroscedasticity, which results from Forbes and Rigobon (2002). This methodology adjusts the null hypothesis that the correlation in the crisis subperiod of 2010 is greater than or equal to the correlation in the two preceding subperiods, against the alternative hypothesis that the correlation is higher in the two preceding subperiods.

$$H_0 = r_{ij}^t \geq r_{ij}^0 \quad (1)$$

$$H_1 = r_{ij}^t < r_{ij}^0 \quad (2)$$

Where r_{ij}^t is the correlation coefficient between market i and market j , in the t period.

In the previous scenarios, the subperiod of the sovereign debt crisis corresponds to the value "1", while for the previous subperiod it corresponds to the value "0".

The use of this test considers Fisher's transformation (Fisher, 1930), which in turn is applied to the correlation coefficients, such that they present an approximate normal distribution, in asymptotic terms, with average μ_t and variance σ_t^2 , defined as follows:

$$\mu_t = \frac{1}{2} \ln \left(\frac{1+r_{ij}^t}{1-r_{ij}^t} \right) \quad (3)$$

$$\sigma_t^2 = \frac{1}{n_t-3} \quad (4)$$

The test statistics are determined from

$$U = \frac{\bar{\mu}_1 - \bar{\mu}_0}{(\sigma_0^2 + \sigma_1^2)^{\frac{1}{2}}} \quad (5)$$

where μ_t and σ_t^2 are the average and the transformed sample variance. The test statistic follows normal distribution.

Data

In order to analyse contagion in Latin America, in the context of the financial crises of 2008 and 2010, we examined the returns of nine indexes, namely the six main markets in Latin America (Argentina, Brazil, Chile, Colombia, Peru and Mexico), as well as the US, Greece and the EURO index STOXX 50 in order to gauge the focus and origin of the crises

under study. Daily closing prices of the various stock markets were obtained from the *DataStream* platform in US dollars. The daily returns, given by the difference of the logarithm of prices, cover the period from January 3, 2005 to April 30, 2012 (1910 observations). We divide the sample into three subperiods, one of pre-crisis, which we define as *Calm Period*, which corresponds to the subperiod from January 3, 2005 to July 31, 2007, and two subperiods, which we call *Subprime Crisis Period* (2008) and *Sovereign Debt Crisis Period* (2010). The Subprime Crisis Period comprises the subperiod from August 1, 2007 to December 7, 2009, while the Sovereign Debt Crisis Period corresponds to the subperiod from December 8, 2009 to April 30, 2012.

Results

In this section we present the data under study and the results obtained. In a first phase we analyse the stationarity tests and then the tests of the time persistence of returns, and the contagion tests.

In order to evaluate the stationarity of the series under study, we perform ADF and PP tests (Dickey and Fuller, 1981; Perron and Phillips, 1988) which have similar null hypotheses. We also used the KPSS test (Kwiatkowski *et al.*, 1992) in order to evaluate the robustness of results.

The teste of Clemente, Montañés and Reyes's (1998) identified structural breaks in the three subperiods, making it difficult to identify periods of crisis and non-crisis (see Tables 1, 2 and 3). The structural breaks occurred in 2006 and 2007, i.e., in a period where subprime assets already present very significant risks.

Tab. 1: Clement Unit Root test for the 9 stock index returns, in the *Calm Sub period*

Country	Index / Cod.	t-stat	Break Date
Argentina	ARG	-24.46(0)***	26/02/2007
Brazil	BRA	-23.86(0)***	19/05/2006
Chile	CHI	-24.82(0)***	26/02/2007
Colombia	COL	-22.51(0)***	14/06/2006
Europe	EURO STOXX	-27.34(0)***	13/03/2007
Greece	GREECE	-23.85(0)***	19/05/2006
Mexico	MEX	-22.57(0)***	26/02/2007
Peru	PER	-24.46(0)***	29/05/2007
United States	USA	-27.43(0)***	26/02/2007

Note: Lag Length (Automatic Length based on SIC). Break Selection: Minimize Dickey-Fuller t-statistic. The lateral values in parentheses refer to lags. ***, **, *. represent significance at 1%, 5% and 10%. respectively.

Source: Authors.

In Table 2 it can be observed that the structure breaks are in line with the fall of *Lehman Brothers Holdings Inc.* On September 15, 2008, the company filed for bankruptcy, because of accumulated losses due to the large exposure of "subprime". These situations caused a lack of confidence, turbulence and, the pessimism experienced in the financial markets led to chaos in international markets. In addition, risk-aversion was so present in the

behaviour of institutional investors, that it led to a mass flight from the stock markets and a reinvestment in the bond markets, the so-called "flight to quality..." assets.

Tab. 2: Clement Unit Root test for the 9 stock index returns, in the *Subprime Crisis Sub period*

Country	Index / Cod.	t-stat	Break Date
Argentina	ARG	-22.05(0)***	06/03/2009
Brazil	BRA	-25.07(0)***	21/10/2008
Chile	CHI	-23.48(0)***	07/10/2008
Colombia	COL	-25.22(0)***	09/10/2008
Europe	EURO STOXX	-27.48(0)***	09/10/2008
Greece	GREECE	-23.37(0)***	23/10/2008
Mexico	MEX	-22.43(0)***	21/10/2008
Peru	PER	-22.43(0)***	09/10/2008
United States	USA	-28.81(0)***	14/10/2008

Note: Lag Length (Automatic Length based on SIC). Break Selection: Minimize Dickey-Fuller t-statistic. The lateral values in parentheses refer to lags. ***, **, *. represent significance at 1%. 5% and 10%. respectively.

Source: Authors.

From the very end of 2009, the fear of a public debt crisis developed among investors as a result of the increase in government and private debt levels in some European countries. The causes of the crisis have been different from country to country. In some countries, private debt originated from the real estate speculation bubble were transferred to public debt as a result of bailouts by the banking system and government responses to the economic slowdown in the post-bubble period. This situation put a lot of pressure on the financial markets causing significant structural breaks (see Table 3).

Tab. 3: Clement Unit Root test for the 9 stock index returns, in the *Sovereign Debt Crisis Sub Period*

Country	Index / Cod.	t-stat	Break Date
Argentina	ARG	-23.25(0)***	17/04/2012
Brazil	BRA	-23.08(0)***	05/08/2011
Chile	CHI	-21.72(0)***	21/09/2011
Colombia	COL	-23.20(0)***	11/11/2010
Europe	EURO STOXX	-24.01(0)***	02/09/2011
Greece	GREECE	-24.66(0)***	26/08/2011
Mexico	MEX	-23.36(0)***	21/09/2011
Peru	PER	-22.63(0)***	03/06/2011
United States	USA	-27.69(0)***	05/08/2011

Note: Lag Length (Automatic Length based on SIC). Break Selection: Minimize Dickey-Fuller t-statistic. The lateral values in parentheses refer to lags. ***, **, *. represent significance at 1%. 5% and 10%. respectively.

Source: Authors.

Time persistence

In order to analyse the presence of conditioned heteroscedasticity in the return series, we use the Lagrange Multiplier test (ARCH-LM test).

The ARCH-LM test is applied to the residuals of the first-order autoregressive processes and the null hypothesis of homoscedasticity is rejected for all series. This means that residuals of the autoregressive processes of the return's series show conditional heteroscedasticity, corroborating this characteristic frequently present in financial assets. In addition, the results of the Ljung-Box tests, applied to the square of returns, for lags 4 and 12, confirm the results of the ARCH-LM test, showing the presence of ARCH effects in the time series under study (see Tables 4 and 5).

Tab. 4: Results of the Ljung-Box tests of index returns in the whole period

	ARG	BRA	CHI	COL	EUA	EURO	GRE	MEX	PER
LB (4)	20,93*	10,37**	39,71**	35,29**	27,17**	24,17**	13,44*	34,64**	54,14*
LB (12)	68,21*	33,89**	73,60**	55,93**	44,39**	35,91**	27,23*	49,40**	70,73*
LB ² (4)	56,48*	583,33*	429,36*	893,79*	608,04*	445,43*	260,08	495,43*	455,03
LB ² (12)	144,27	2256,1	1235,1	1265,6	2106,7	1056,3	708,64	1594,9	579,30
Observat	1.910	1.910	1.910	1.910	1.910	1.910	1.910	1.910	1.910

Note: Asterisks ***, **, *, represent significance at 1%, 5% and 10%, respectively.

Source: Authors.

Tab. 5: ARCH-LM test of the residuals of the autoregressive process for all return series in the whole period

	ARG	BRA	CHI	COL	EUA		GRE	MEX	PER
ARC	18,59*	60,32*	112,45*	207,88*	141,66*	113,29*	26,11*	108,64*	231,99*
H-LM	**	**	**	**	**	**	**	**	**

Note: The LM test was applied to the residuals of a first-order autoregressive process (ARMA estimation) of each time series. The asterisks ***, **, *, represent significance at 1%, 5% and 10%, respectively.

Source: Authors.

The residuals filtered from an ARMA model show the presence of nonlinear serial dependence, given rejection of the null hypothesis (see Table 6). According to Taylor, (1986), the significant presence of higher autocorrelation between the square returns than between the original return values also indicates the presence of non-linearity. Rejection of the null hypothesis of the BDS test can be explained, among other factors, by the existence of autocorrelation or by the existence of heteroscedasticity in the series of stock indexes and a possible sign of nonlinear serial dependence. These results are in line with studies by Appiah-Kusi and Menyah (2003) and Lim and Hinich (2005).

Tab. 6: BDS test for filtered return series for the whole period

	ARG	BRA	CHI	COL	EURO	MEX	PER	EUA
m = 2	7,32***	7,98***	8,18***	11,13***	7,65***	10,39***	11,11***	7,75***
m = 3	9,48***	10,10***	10,37***	13,05***	10,90***	13,19***	12,95***	11,41***
m = 4	10,62***	12,00***	12,41***	14,20***	12,82***	14,97***	14,44***	13,93***
m = 5	11,32**	13,31***	13,58***	14,59***	14,80***	16,61***	15,97***	16,31***
m = 6	12,10***	14,37***	14,86***	15,29***	16,58***	18,20***	17,45***	18,61***

Notes: m concerns the size of the dive (*embedding dimension*). The method considered in the BDS test was the fraction of standard deviation pairs, to a value of 0.7. The method of estimation of the first order autoregressive process was the ARMA. The asterisks ***, **, *, represent significance at 1%, 5% and 10%, respectively.

Source: Authors.

Contagion among stock markets

In order to analyse the occurrence of financial contagion among the nine indexes under study, the non-conditional correlations were estimated, and the statistical significance was examined. To test whether the matrix of correlation coefficients is globally different from an identity matrix, we use the likelihood ratio test, suggested by Pindyck and Rotemberg (1990).

In order to evaluate the significance of the co-movements between the indices under study, we apply the heteroscedastic test of Forbes and Rigobon (2002). If the correlation coefficients between two markets are significant and the null hypothesis is rejected, the contagion effect occurs. If the correlation coefficients are significant and the null hypothesis is not rejected, there is an interdependence relation.

The results of the *t* test, the contagion effect between the *Calm Period* and the *Subprime Crisis Period*. The results suggest the existence of 44 pairs that reject the null hypothesis and point to the existence of contagion. The remaining pairs, more specifically 28 pairs with significant correlation coefficients, do not reject the null hypothesis, indicating the presence of interdependence.

The Brazilian and Mexican Stock Exchanges, as well as the EURO STOXX50 index are the markets with the greatest effect on their peers. However, and surprisingly, the US market did not significantly affect some of the more important stock markets in Latin America, namely the Brazilian and Mexican markets.

These results are in line with those obtained by (Tola and Wälti, 2015; Gómez-Puig and Sosvilla-Rivero, 2016; Ehrmann and Fratzscher, 2017; Ters and Urban, 2018; Bahaj, 2020), suggesting that the *Subprime Crisis* has led to significant contagion in international financial markets.

The *t*-test results for the contagion effect between the *Subprime Crisis Period* and the *Sovereign Debt Crisis Period* (SDC). The results suggest the existence of 3 pairs rejecting the null hypothesis and 69 pairs with significant correlation coefficients, but that do not reject the null hypothesis. The results point to the existence of interdependence between stock markets. In addition, there are signs that the Sovereign Debt Crisis was not reflected

in the Latin American stock markets. Specifically, after the chaos in the international markets as a result of the *Subprime Crisis*, investors started to diversify their portfolios, creating market liquidity and reducing the shocks resulting from the financial crisis of 2010. In view of these results, the implementation of portfolio diversification strategies in the stock markets of the LAC Region, in the sub-period 2010-2012, may be considered by international investors to minimize risk.

Conclusions

In this research, we study financial contagion in the six major Latin American markets, US, Greece and index EURO STOXX 50, in the context of the *Subprime Crisis* and *Sovereign Debt Crisis*. The main goal is to understand the behaviour and type of relationships between markets at times of financial crisis.

The general conclusion to be drawn from this research is supported by the results obtained from the econometric models, that is, the markets of Brazil and Mexico have “infected” all their regional peers. However, the US market was expected to have more expression in these regional markets. In the concluding phase, we believe that in the post-crisis period of the *subprime* financial crisis, portfolio diversification in these stock markets will be feasible because the level of contagion has decreased significantly.

In terms of future research, we believe this study should be complemented with analysis of sectoral indexes, and the inclusion of macroeconomic variables helps to explain in a deeper way, the relations between markets. It is also important to develop new approaches on the subject with the purpose of helping to clarify what is contagion or interdependence.

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Appendices

Appendix A: - Results of contagion between the sub periods Calm / Subprime financial crisis

Countries	Results	Countries	Results
Argentina - Brazil	Inexistent	Euro - Argentina	Contagion(2,66)**
Argentina - Chile	Inexistent	Euro - Brazil	Contagion(1,46)*
Argentina - Colombia	Contagion(1,91)**	Euro - Chile	Contagion(2,31)**
Argentina - EUA	Inexistent	Euro - Colombia	Contagion(3,48)**
Argentina - Euro	Inexistent	Euro - USA	Contagion(2,22)**
Argentina - Greece	Contagion(1,69)*	Euro - Greece	Contagion(3,32)**
Argentina - Mexico	Inexistent	Euro - Mexico	Contagion(1,35)*
Argentina - Peru	Contagion(3,99)**	Euro - Peru	Contagion(4,77)**
Brazil-Argentina	Contagion(2,70)**	Greece - Argentina	Contagion(1,45)*
Brazil - Chile	Contagion(2,37)**	Greece - Brazil	Inexistent
Brazil - Colombia	Contagion(3,45)**	Greece - Chile	Inexistent
Brazil - USA	Contagion(2,29)**	Greece - Colombia	Contagion(2,35)**
Brazil - Euro	Contagion(2,39)**	Greece - EUA	Inexistent
Brazil - Greece	Contagion(3,30)**	Greece - Euro	Inexistent
Brazil - Mexico	Contagion(1,48)*	Greece - Mexico	Inexistent
Brazil - Peru	Contagion(4,61)**	Greece - Peru	Contagion(3,90)**
Chile - Argentina	Contagion(2,27)**	México - Argentina	Contagion(2,51)**
Chile - Brazil	Inexistent	México - Brazil	Contagion(1,44)*
Chile - Colombia	Contagion(3,13)**	México - Chile	Contagion(2,19)**
Chile - USA	Contagion(1,83)**	México - Colombia	Contagion(3,22)**
Chile - Euro	Contagion(1,92)**	México - EUA	Contagion(2,13)**
Chile - Greece	Contagion(2,96)**	México - Euro	Contagion(2,20)**
Chile - Mexico	Inexistent	México - Greece	Contagion(3,08)**
Chile - Peru	Contagion(4,52)**	México - Peru	Contagion(4,32)**
Colombia - Argentina	Inexistent	Peru - Argentina	Contagion(1,49)*
Colombia - Brazil	Inexistent	Peru - Brazil	Inexistent
Colombia - Chile	Inexistent	Peru - Chile	Inexistent
Colombia - EUA	Inexistent	Peru - Colombia	Contagion(2,51)**
Colombia - Euro	Inexistent	Peru - USA	Inexistent
Colombia - Greece	Contagion(2,07)**	Peru - Euro	Inexistent
Colombia - Mexico	Inexistent	Peru - Greece	Contagion(2,30)**
Colombia - Peru	Contagion(4,07)**	Peru - Mexico	Inexistent
USA - Argentina	Inexistent		
USA - Brazil	Inexistent		
USA - Chile	Inexistent		
USA - Colombia	Contagion(2,00)**		
USA - Euro	Inexistent		
USA - Greece	Contagion(1,86)**		
USA - Mexico	Inexistent		
USA - Peru	Contagion(3,26)**		

Source: Own elaboration.

Note: Unicaudal significance to the right tail, 2.7638 (1%), 1.8125 (5%) and 1.3722 (10%).

Asterisks ***, **, * indicate significant results at 1%, 5% and 10% respectively.

Financial Market Integration of ASEAN-5 with China

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Abstract

This study aims to estimate the potential portfolio diversification in the financial markets of Indonesia, Malaysia, Philippines, Singapore and Thailand (ASEAN-5), and of China, in the context of China stock market crash, in 2015. For this purpose, we establish two research questions: i) China stock market crash promoted financial integration between the ASEAN-5 and China markets? ii) if so, does this effect had a positively influence in the occurrence of short-term co-movements between markets? Using stock market data from January 2015 to January 2019, we found that, during the crash, the level of financial integration rose 533%, which supports our first research question. However, during the 2015 stock market crash, most markets decreased the co-movements with their regional peers, which does not corroborate the second assumption. Additionally, analysis to the relationship between the markets, through the impulse response function showed evidence of positive co-movements, with statistical significance and persistence longer than one week. Thus, the ASEAN-5 and China markets may not be efficient in their weak form, since there was no immediate adjustment in prices between markets, due to the high levels of market shocks identified. However, we believe that the implementation of efficient portfolio diversification strategies, based on historical prices, remains beneficial for investors.

Keywords: financial integration, co-movements, ASEAN-5, portfolio diversification

Introduction

The Chinese financial market has expanded exponentially since the creation of the Shanghai and Shenzhen Stock Exchanges in the 1990s. At the end of 2014, the market

capitalization of the two stock exchanges was equivalent to 58.53% of the country's GDP, according to the Annual Report of China Security Regulatory Commission (2014). In order to liberalize local markets, the Chinese government introduced two categories of shares, namely shares A and B, defined according to their rating. The dual listing nature of the Chinese stock market has resulted in a partially segmented financial market, although the government has taken several steps to liberalize China's financial operations. After joining the World Trade Organization (WTO) in 2001, several financial liberalization measures were taken by the Chinese authority to open the financial market and improve financial regulations, to Qualified Domestic Institutional Investors and Qualified Foreign Institutional Investors. The implementation of these reforms has led to a gradual easing of restrictions on domestic and international investors and has further encouraged international financial integration. These selective reforms in the financial markets were aimed at promoting the process of "globalization" of Chinese stock exchanges. As a result, we see China increasingly playing a leading role and increasing its influence in the global financial markets (Jakpar et al., 2013; Teng et al., 2014; Chien et al., 2015; Ahmed and Huo, 2019).

Despite these positive developments, the Chinese stock market suffered the most severe crash in the post global financial crisis (GFC). The stock market turmoil began in June 2015 after a sharp slowdown in Chinese economic growth and ended in late January 2016. The unexpected devaluation of the Chinese currency (RMB) and the weakening outlook for future GDP growth, in China, may have been important contributions to this fall. After weeks of volatility and swings in stock prices, the Shanghai composite index lost about 25% of its value in one month, the index dropped from 5,178 to 2,850 on June 12, 2015. Particularly on Monday, August 24, 2015, the Shanghai stock market saw a sharp drop of 8.5% and on Tuesday, August 25, 2015, shares fell a further 7.6%. These two days of sharp decline had a major impact on the Chinese economy. The observed financial turmoil spread to other regional stock markets, currencies and commodities. As a result, the Dow Jones Industrial Average fell about 1,000 points on Monday, August 24, 2015. In January 2016, China's stock market fell about 25%. In particular, on January 4 and 7, 2016, trading in the stock market was interrupted, after a 7% drop, which led to the suspension of trading (Salidjanova and Koch-Weser, 2015).

Thus, the main objective of this investigation is to estimate potential portfolio diversification in the financial markets of Indonesia, Malaysia, Philippines, Singapore and Thailand (ASEAN-5), and the market of China, in the context of the stock market crash in the latter country in 2015. For this purpose, two research questions were established: *i) China stock market crash promoted financial integration between the ASEAN-5 and China markets? ii) If so, does this effect had a positively influence in the occurrence of short-term co-movements between markets?*

This research adds two relevant contributions to the literature. First, it explores financial integration in ASEAN-5 and China stock markets in the context of China stock market crash in 2015, including the different predictability between them. Following the Asian financial crisis, China and ASEAN-5 are showing a significant growth on the international

economic scene, which has highlighted the importance of analyzing the level of integration between these markets. To this purpose, several studies analyzed the integration of stock markets in ASEAN (Chen et al., 2009; Lim, 2009; Shabri Abd Majid et al., 2009), the synchronizations between China and other financial markets (Burdekin and Siklos, 2012; Lean and Teng, 2013; Teng et al., 2016), and the links between ASEAN-5 and Japan or the United States (Azman-Saini et al., 2002; Ibrahim, 2006; Majid, Meera and Omar, 2008; Rahman, Othman and Shahari, 2017; Rijanto, 2017). However, few studies have analyzed the relationship between China's stock markets and ASEAN-5. Thus, we try to respond to this literature gap by studying the synchronizations between these Asian markets, in the context of the 2015 stock market crash.

The second contribution is related to the growing importance of the ASEAN-5 markets. According to Lim (2009), ASEAN is the fourth largest trading region in the world, with ASEAN-5 countries representing 72.8% of the ASEAN population and 95.1% of its GDP. The average annual economic growth rate of ASEAN has been approximately 5% over the last two decades (Petri, Plummer and Zhai, 2012). Several comprehensive political and economic reforms were implemented, in the region, during the Asian financial crisis. In addition, the region benefits from political and economic partnerships with China, Japan, the US and the European Union (Chachavalpongpun and Chachavalpongpun, 2018). Indeed, China's recent economic growth and the signing of the Free Trade Agreement with ASEAN for the development of a single market has increased economic integration between China and ASEAN. The preference for these ASEAN-5 financial markets is explained by their unstable and rapidly developing economies, which are therefore linked by a cultural heritage and similar economic conditions. In addition, these markets have become an important investment destination, after the recent financial crisis in 2008. In this context and due to the large capital flows, it is of great importance to understand the interdependencies and links between these regional financial markets.

Literature Review

Since the mid-2000s, international financial markets have been subject to a number of significant financial crises, as the subprime crisis in the US in 2008 and the sovereign debt crisis in Europe in 2010, originated in developed economies. These events significantly affected developed economies, but significance was not accentuated in emerging economies (Wong and Li, 2010). Coeurdacier and Guibaud (2011) analyzed whether investors correctly protect portfolios from domestic risk by investing in international stock markets that have low correlation with their domestic stock market. The authors suggest that investors move their investments to foreign markets, which offer better opportunities for diversification. Understanding the international links between stock markets and research on the occurrence of financial integration and co-movements phenomena, in the context of stock market crashes, is important for investors, investment fund managers and academics in several aspects, namely portfolio diversification in an international context (Dias, da Silva and Dionísio, 2019). From the investor's point of

view, knowledge of the form and intensity of interdependence between the different financial markets is vital for efficient hedging decisions, in order to minimize the adverse effect of uncertainty on expected returns. Similarly, an understanding of the interdependence relationships between international stock markets facilitates the identification of opportunities for diversification (Pownall, Satchell and Srivastava, 2019).

McKinnon and Schnabl (2003) and Forbes and Rigobon (2002) found that China played a stabilizing role in the Asian region, during the 1997 Asian financial crisis, since its economy was not affected. The possibility of external financial turbulence influencing China's stock market was relatively low, because its stock market was still isolated from the rest of the world (Yu, Fung and Tam, 2010; Huyghebaert and Wang, 2010). This is also supported by the results of Azad (2009) and of Caporale et al. (2013). Both showed that the volatility spillover from mature markets (US and Japan) to emerging markets (China) did not result in significant contagion. In addition, the Chinese stock market shows some predictability Azad (2009). Therefore, it is beneficial for international investors to diversify their portfolios into this market. However, this recommendation is only effective during tranquility periods in China, but not in periods of financial turbulence as demonstrated by Wang, Chen and Huang (2011).

More recently, Glick and Hutchison (2013), Auer and Mehrotra (2014), Boubakri and Guillaumin (2015), Pradhan et al. (2016), Wu (2019), Gulzar et al. (2019) examined the synchronizations between China's market and Asia's financial markets, and how these links changed during and after the 2008-2009 global financial crisis. Glick and Hutchison (2013) show little synchronization between long-term interest rates, but the financial integration between stock markets is very significant. This conclusion is consistent with the further development and liberalization of stock markets relative to the securities markets in China, as well as with the increase in trade links in the region. Auer and Mehrotra (2014) argue that increased integration has led to greater co-movement among asset prices. The authors point out that real integration, through the supply chain, is important for domestic prices dynamics in the Asia-Pacific region. Boubakri and Guillaumin (2015) show that East Asian stock markets were partially segmented (except Japan) in the region until 2008. However, the recent years are characterized by an upward trend in the regional integration of these stock markets. Pradhan et al. (2016) used a multivariate structure, showing that all variables are co-integrated and revealing a network of causal connections, including short-term bidirectional causality between market penetration and economic growth. Wu (2019) argues that a large part of this evident high level of integration is demonstrated by common global factors. After filtering out these factors in each stock market, the magnitude of integration decreases substantially. Thus, the results suggest that stock market integration in East and Southeast Asia is not as strong as it appears, despite the regional governments are promoting collaboration and financial integration in these markets. Gulzar et al. (2019) examined Asian financial markets (India, China, Pakistan, Malaysia, Russia and Korea) and the US. The analysis included daily stock returns from July 1, 2005 to June 30, 2015, with

the sample divided into three periods. The results show long-term cointegration between the US market and emerging stock markets, and the level increased after the crisis period.

Methods and Data

To respond to our research questions, we used the daily index quotations of ASEAN-5 and China (Shanghai) stock markets, taken from Thomson Reuters database. We used local currency quotations in order to mitigate exchange rate distortions. Daily quotations comprise the period from January 5, 2015 to January 31, 2019.

In addition, and in order to highlight the impact of the Shanghai (China) stock market crash on the evolution of the different markets, the sample was divided into three sub-periods. The pre-crash subperiod from 5 January 2015 to 11 June 2015, the crisis subperiod, which represents the stock market crash and goes from 12 June 2015 to 30 January 2016, and a third subperiod from 1 February 2016 to 31 January 2019, which we call the post-crash subperiod (Ahmed and Huo, 2019). The table 1 provides an overview of the countries and their indices.

Tab. 1: Sample – Countries and their indices

Country / Region	Indices
INDONESIA / ASEAN-5	Jakarta Stock Exchange Composite Index
MALAYSIA / ASEAN-5	FTSE Bursa Malaysia Index
PHILIPPINES / ASEAN-5	Philippines Stock Exchange PSEi Index
SINGAPORE / ASEAN-5	Singapore Exchange - SGX
THAILAND / ASEAN-5	Stock Exchange of Thailand
CHINA / ASIA	Shanghai Stock Exchange Composite Index

Source: Authors.

Research methodology is carried out through several stages, starting with the samples' characterization using descriptive statistics and the adherence test (Jarque and Bera, 1980) in order to show the values of the means, standard deviations, asymmetry and kurtosis of the financial market indices analyzed. Then, we perform an evaluation to the stationarity of the time series, in order to check if the variance of financial market prices was stable over the period in study. Third, we proceed to the identification of possible structural breaks of the time series in order to estimate the most adequate integration model. Finally, we analyze the level of integration or segmentation of all the stock market indices in test and then proceed to the evaluation of shocks (co-movements) between the stock markets in crash and both non-crash subperiods.

To evaluate time series stationarity of all ASEAN-5 and China markets we will use the ADF, PP and KPSS tests. Following to the analysis of the data series, we will use the Clemente, Montañés and Reyes (1998) test to assess the existence or not of structural breaks in the six financial markets.

The decision to employ tests with null opposite hypotheses is to mitigate the fact that the ADF tests (Dickey and Fuller, 1981), PP (Phillips and Perron, 1988) and KPSS

(Kwiatkowski et al., 1992) have low power when compared with econometric methodologies that postulate structural breaks (Maddala and Kim, 1998). Complementarily, Noman and Rahman (2010), when examining stationarity of time series-data, support the idea that results of linear unit root tests (such as ADF, PP and KPSS) can lead to biased results when used in time series that present structural breaks.

As previously mentioned, in addition to the ADF, PP and KPSS stationarity tests, we will use methodologies that aim at measuring possible structural breaks, namely the CUSUMQ test of Inclán and Tiao (1994) and the test of Clemente, Montañés and Reyes (1998). These tests allow the identification of possible structural breaks, and in the case of Clemente, Montañés and Reyes (1998), we may identify the year with the most severe breakage. A structural break leads to a significant change in the level and/or trend of a time series, a change, which may be of a stable or transitory nature. If the series is stationary, the shocks should have temporary effects, if not, they will have permanent effects, i.e., they do not recover to the initial level.

The modelling of structural breaks in cointegrated processes has been a widely studied topic in the last years. The reason why standard cointegration tests like Engle and Granger (1987) and Johansen (1988) are not suitable for testing cointegration with regime change (structural breaks), is based in the fact that such tests assume that the cointegration vector is invariant in time.

The cointegration tests with structural break will follow the methodology of Gregory and Hansen (1996). In this study, the authors were concerned with a general test model in which the cointegration vector varies with time. The method developed by Gregory and Hansen (1996) is considered a complement to the ADF test. In addition, it can also be affirmed, from an econometric point of view, as a multivariate version of the Zivot and Andrews (1992) model. According to the authors, the existence of structural breaks may lead to erroneous conclusions regarding the acceptance of the null hypothesis of non-cointegration and, therefore, the non-existence of any type of long-term relationship between variables $I(1)$.

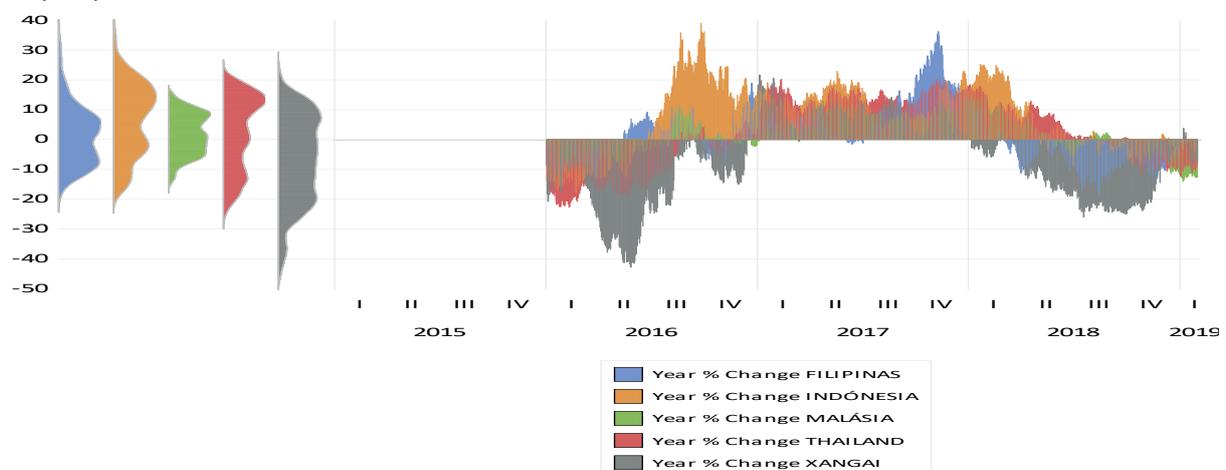
In order to analyze whether the co-movements among the five main ASEAN markets are positive or negative, in the context of the China stock market crash, we will use the impulse response function (IRF) methodology, with Monte Carlo simulations. These functions provide a dynamic analysis (variable with time), created from the estimates of the VAR model, making possible to study the calculated causality relationships, even when no previous Granger causality relationships between the variables are detected (Lütkepohl and Saikkonen, 1997).

The impulse-response function shows how a given variable responds over time to an unexpected increase in that variable (stimulus or innovation) or in another variable included in the VAR model. In other words, an innovation in a given variable produces a chain reaction over time in the other variables of the VAR, which the impulse-response function allows to follow and interpret.

Results

With regard to the evolution of the financial market indices, figure 1 shows the oscillations, in first differences, of the six financial markets (ASEAN-5 and China). The sample comprises the time horizon from January 5, 2015 to January 31, 2019, being a very complex period, due to the necessity of understanding the effects of stock market crash in China. The analyzed financial market indices clearly reveal the instability experienced in these markets, being more intense in the years 2015-2016. It is also possible to see an "equilibrium" movement in the year 2017, however, the year 2018 suggests an increase in volatility.

Figure 1: Annual first differences in the financial markets from 05/01/2015 to 30/01/2019



Note: Thomson Reuters: 5 January 2015

Source: Authors.

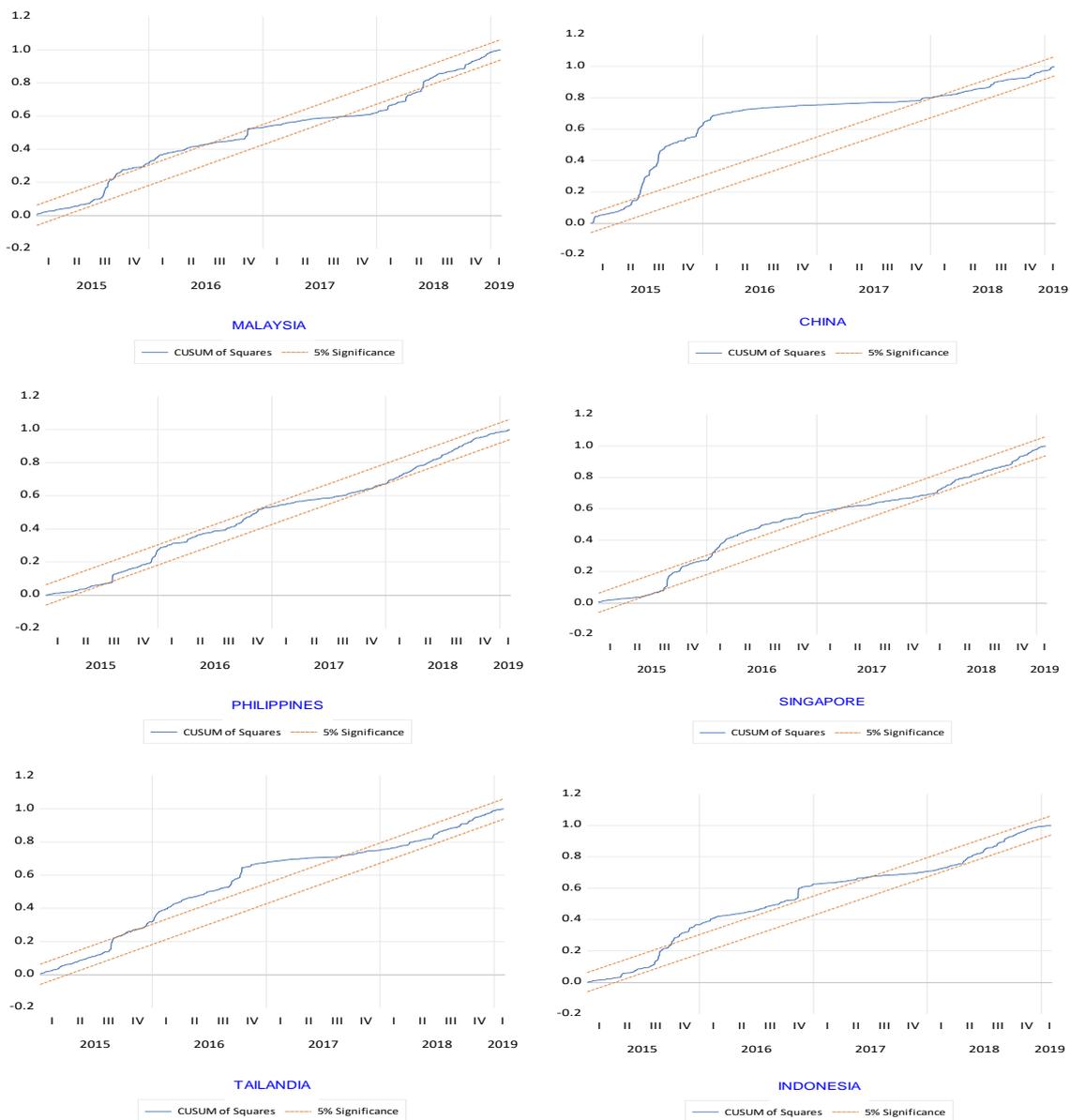
Descriptive statistics of profitability, in the six financial markets, allow us to assess that Indonesia, Philippines and Thailand show daily positive profitability means. However, in Malaysia, China and Singapore the means are negative. China is the market with the largest standard deviation and the largest kurtosis, which suggests the existence of significant volatility. On the other hand, all series showed signs of deviation from the normality hypothesis, given the asymmetry and kurtosis coefficients. The asymmetry characteristics are negative, with greater emphasis on the Chinese market. Additionally, the asymmetry and kurtosis coefficients are statistically different from those of a normal distribution.

Since we are estimating time series, we should analyze profitability stationary nature in the six financial markets. In the table below, we can observe that the performed ADF tests (Dickey and Fuller, 1981), PP (Phillips and Perron, 1988) and KPSS postulate the same null hypotheses, while the KPSS test (Kwiatkowski et al., 1992) exposes opposite hypotheses. The intersection of the unit root tests shows the stationarity of profitability.

However, we should highlight the lags in the tests (observed by the differences between the lags that presented in brackets in the various tests), which suggest that the time series may not be stable and. Due to this evidence, we will perform the test of Clemente et al. (1998) which analyses the stationarity with the effect of structural breaks.

In order to confirm the unit root tests, we run the CUSUMQ test of Inclán and Tiao (1994). The determination of structural breakage is relevant, as it has a potentially similar effect to unitary roots. Through the graphical analysis, we can assess whether there are disturbances in variance. Thus, by examining the graphs of the cumulative sums (CUSUMQ) of the 95% probability limits, we determine the violation of the probability limits, which induce that series have an unstable behaviour. Figure 2 illustrates the results obtained from the CUSUMQ test for the financial markets' profitability.

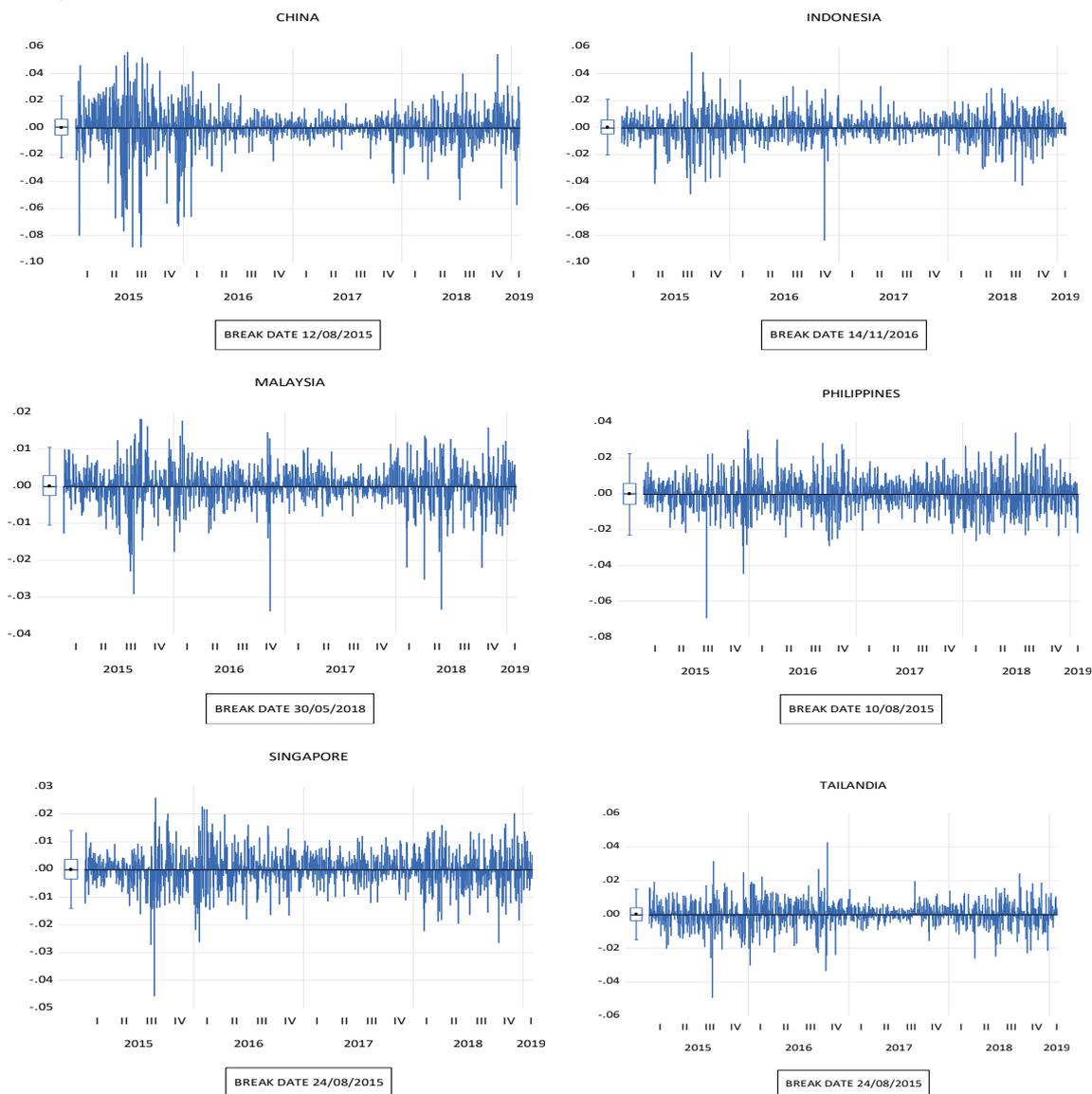
Figure 2: CUSUMQ test for the financial markets' profitability in the full period



Source: Authors.

As for the test of Clemente, Montañés and Reyes (1998) represented by Figure 3, it identified the most significant structural breaks in the period from January 2015 to January 2019, showing the turbulence experienced in these markets in the period of China stock market crash, in 2015. The Chinese market crashed in August 2015, the Philippines, Singapore and Thailand followed the same trend. However, the financial markets of Indonesia and Malaysia show the most significant breaks in structure in the years 2016 and 2018, respectively.

Figure 3: Structural breaks through Clemente, Montañés and Reyes (1998), test (full period)



Source: Authors.

Financial Integration

Table 2 shows the results of the integration tests between the ASEAN-5 and China markets, in the 2015 pre-crash subperiod. The markets that integrated were the pairs, Malaysia/Singapore and China/Philippines, with structural breaks in 2015, i.e. in 30

possible combinations there was only integration in three cases. These results are in line with the evidence suggested by Teulon, Guesmi and Mankai (2014), who argue that these markets are segmented. However, when compared with the results suggested by Boubakri and Guillaumin (2015), Pradhan et al. (2016), Gulzar et al. (2019), the results are partially contrary, because these markets are segmented rather than integrated.

Tab. 2: Financial integration with structural breaks by Gregory and Hansen (1996) in the pre-crash subperiod

Markets	t-statistic	Method	Lags	Break Date	Results
MALAYSIA / SINGAPORE	-5,25**	Trend	3	12/02/2015	Cointegration
SINGAPORE / MALAYSIA	-5,25**	Trend	5	22/03/2015	Cointegration
CHINA / PHILIPPINES	-5,16**	Regime	1	03/04/2015	Cointegration

Notes: Data analysis using software STATA. The AIC information criterion was chosen. The critical values for the ADF and Zt parameters are: -5,45 (1%); -4,99 (5%); -4,72 (10%). For the Za parameter, the critical values are: -57,28 (1%); -47,96 (5%); -43,22 (10%). The asterisks ***, **, * indicate statistical significance at 1%, 5% and 10%, respectively.

Source: Own elaboration.

The results of the integration tests between the markets, in the 2015 sub-period of the stock market crash are shown in Table 3. The results show 16 pairs of integrated markets with structural breaks (in 30 possible).

Tab. 3: Financial integration with structural breaks by Gregory and Hansen (1996) in the crash subperiod

Markets	t-statistic	Method	Lags	Break Date	Results
INDONESIA / MALAYSIA	-5.90***	Trend	1	10/09/2015	Cointegration
INDONESIA / PHILIPPINES	-4.96*	Trend	1	12/08/2015	Cointegration
INDONESIA / SINGAPORE	-5.99***	Regime	1	06/10/2015	Cointegration
INDONESIA / THAILAND	-5.20**	Trend	1	12/08/2015	Cointegration
INDONESIA / CHINA	-5.20**	Trend	1	12/08/2015	Cointegration
MALAYSIA / INDONESIA	-5.50***	Trend	1	10/09/2015	Cointegration
MALAYSIA / PHILIPPINES	-5.08**	Regime	5	24/09/2015	Cointegration
MALAYSIA / SINGAPORE	-4.89*	Regime	3	21/09/2015	Cointegration
MALAYSIA / CHINA	-5.13**	Regime	5	07/10/2015	Cointegration
PHILIPPINES / SINGAPORE	-4.74*	Regime	0	08/12/2015	Cointegration
THAILAND / CHINA	-4.88	Trend	5	20/11/2015	Cointegration
CHINA / INDONESIA	-5.92***	Regime	4	18/12/2015	Cointegration
CHINA / MALAYSIA	-6.07***	Regime	4	18/12/2015	Cointegration
CHINA / PHILIPPINES	-4.86	Trend	5	09/10/2015	Cointegration
CHINA / SINGAPORE	-5,95***	Trend	4	15/12/2015	Cointegration
CHINA / THAILAND	-5,14**	Trend	5	13/08/2015	Cointegration

Notes: Data analysis using software STATA. The AIC information criterion was chosen. The critical values for the ADF and Zt parameters are: -5,45 (1%); -4,99 (5%); -4,72 (10%). For the Za parameter, the critical values are: -57,28 (1%); -47,96 (5%); -43,22 (10%). The asterisks ***, **, * indicate statistical significance at 1%, 5% and 10%, respectively.

Source: Authors.

Evidence show that the Indonesian and Chinese markets are the most integrated stock market indices with their pairs, 5 integration (out of 5 possible). Malaysia, the Philippines and Thailand have 4 and 1 integration respectively. Structural breaks are synchronized between August and December 2015, showing the impact of China's stock market crash, on these regional markets. When compared with the previous sub-period, we found that during the stock market crash the level of financial integration (number of integrated markets) increased by 533%. These results give support to our first research question. The evidence are in line with the results presented by Glick and Hutchison (2013), Auer and Mehrotra (2014), Boubakri and Guillaumin (2015), Pradhan et al. (2016), Wu (2019), Gulzar et al. (2019), which show that these markets tend to integrate in turbulent periods. In addition, these results should be relevant for public policies related to regional financial integration, which may reduce the benefit of regional diversification strategies, and expose countries in the region to an increased contagion risk.

As for Table 4, it shows the results of financial integration analysis in the post-crash subperiod. Evidence shows the existence of 8 pairs of integrated markets with structural

breaks (in 30 possible). Indonesia and China are the indexes that most integrated with their pairs, 3 integrations (out of 5 possible). While Thailand and Singapore have a single integration with other markets. As for Malaysia and Philippines, these markets did not integrate with their regional peers, while the structural breaks occur mostly in the year 2018. When compared with the crash subperiod, the level of integration (number of integrated markets) decreases by 50%. This evidence is also of interest to policy makers and investors in relation to the development of regional policies and portfolio diversification strategies in the ASEAN-5 region. These results are in line with findings obtained by Pradhan et al. (2016) and Wu (2019).

Tab. 4: Financial integration with structural breaks by Gregory and Hansen (1996) in the post-crash subperiod

Markets	t-statistic	Method	Lags	Break Date	Results
INDONESIA / PHILIPPINES	-5.07**	Trend	0	27/04/2018	Cointegration
INDONESIA / THAILAND	-44,44*	Regime	0	06/08/2018	Cointegration
INDONESIA / CHINA	-5.16**	Regime	1	07/12/2017	Cointegration
SINGAPORE / MALAYSIA	-5.34**	Trend	5	06/07/2018	Cointegration
TAILANDIA/ INDONESIA	-4.89*	Regime	0	04/07/2018	Cointegration
CHINA / INDONESIA	-5.50***	Regime	3	02/01/2018	Cointegration
CHINA / MALAYSIA	-4.76*	Trend	3	28/03/2018	Cointegration
CHINA / THAILAND	-4.93*	Trend	3	29/03/2018	Cointegration

Notes: Data worked on by the authors (software: Stata). The AIC information criterion was chosen. The critical values are found in Gregory and Hansen (1996). The critical values for the ADF and Zt parameters are: -5,45 (1%); -4,99 (5%); -4,72 (10%). For the Za parameter, the critical values are: -57,28 (1%); -47,96 (5%); -43,22 (10%). The asterisks ***, **, * indicate statistical significance at 1%, 5% and 10%, respectively. Source: Authors.

Co-movements between markets

Granger's causality test helps to understand the linkages between markets, but does not allow us to understand whether the financial markets profitability produce a negative or a positive effect on their peers, nor does it allow us to know whether some links are stronger than others. To this end, we use the generalized impulse-response functions, of a magnitude corresponding to a standard deviation, in order to obtain additional evidence on the short-term co-movements between the ASEAN-5 financial markets and the Chinese market. The results of the impulse response functions, with Monte Carlo simulations, applied to the financial market profitability, in the three sub-periods.

Results of the impulse response functions, calculated based on the autoregressive vector model, in the pre-crash subperiod show that Malaysia is the market that originates the majority of the shocks (29), causing a higher number of reactions in the Indonesian and Singapore markets, 8 and 7 shocks respectively (out of 10 possible). Indonesia, Thailand,

causes 26, 25 reactions, respectively, while Singapore, Philippines and China originated 24, 23 shocks in their pairs. Indonesia and Singapore markets absorbed more shocks from their peers, with 32 and 28 shocks, respectively.

Most of the observed shocks resulted in statistically significant effects for more than one period. Nine shocks had statistically significant effects for only one period (10 days), namely the impulses caused by the Indonesian market in the Chinese market, which raises some surprise. These results are not in line with some studies, like the ones from Yu, Fung and Tam (2010), Huyghebaert and Wang (2010), which show that the possibility of other markets influencing the Chinese stock market is relatively low because the Chinese market is still isolated from the rest of the world.

In the subperiod representing the 2015 stock market crash, the majority of the relationships between the markets proved to be significant. Thailand is the market that generates the higher number of impulses in its pairs (26), causing significant shocks in the Chinese market (7 out of 10 possible). The Singapore, Philippines and Malaysia markets caused 23, 22, 21 shocks in their peers, in comparison, while the China and Indonesia markets caused 18 shocks in their peers. The market that absorbed the higher number of shocks from its peers, was the Chinese market (37), receiving 9 shocks (out of 10 possible) only from the markets of Malaysia and Philippines. These results, clearly shows that the Chinese market suffered very significant shocks during the crash subperiod, which is an evidence of significant levels of arbitrage and may jeopardize market efficiency, in its weak form.

However, in the crisis subperiod, most markets decreased the co-movements with their regional peers, with the exception of Thailand. Compared to the pre-crash subperiod the shocks decreased significantly, from 151 to 128. These results reject the second research question and contrary to the evidence showed in Boubakri and Guillaumin (2015), Pyun and An (2016), Virk and Javed (2017) and Gulzar et al. (2019), who advocate that financial integration promote short-term co-movements among financial markets.

As for the post-crash subperiod, the impulses were, in general, statistically significant with the identification of 150 reactions between the markets. Singapore financial market caused the majority of shocks in its peers (28), with higher relevance in Indonesia and Thailand (7 out of 10 possible). In comparison, the markets of Indonesia, China and Thailand caused 26, 25 shocks in their pairs. Indonesia and Philippines markets caused the lowest reaction in their pairs, with 24 and 22 shocks, respectively. Malaysia and Indonesia markets were the most affected, respectively, with 27 and 26 shocks. The ASEAN-5 financial markets increased their co-movements in the post-crash period. However, the Thai market decreased its co-movements with its peers, but with little significance.

The number of statistically significant shocks in the three sub-periods was of 151 (pre-crash), 128 (crash) and 150 (post-crash), which lead to the conclusion that the 2015 stock market crash caused a decrease in co-movements between the financial markets of the ASEAN-5 Region and China. These evidence are in line with Azad (2009) showing that the

Chinese stock market presents some predictability, and in opposition to the results of Auer and Mehrotra (2014), Pyun and An (2016), Virk and Javed (2017) and Gulzar et al. (2019). These authors defended that the increase in financial integration promotes short-term co-movements among financial markets.

Conclusion

In this study, we investigate financial integration and short-term co-movements between the financial markets of Indonesia, Malaysia, Philippines, Singapore and Thailand (ASEAN-5), and the market of China, during China stock market crash in 2015. The overall objective of this research was to estimate potential portfolio diversification in these regional financial markets. The sample period comprises the time span from January 2015 to January 2019, and has been broken down into three sub-periods. We conducted two main statistical tests for this purpose. The first test estimates whether the markets show significant levels of financial integration, resulting from the stock market crash in China. The second assesses whether the price indices exhibit co-movements, showing reversion to the average, that is, whether the hypothesis of arbitrage and anomalous profitability are feasible.

As for the issue of integration, the results show 3 pairs of integrated markets with structural breaks in the pre-crash subperiod, i.e. these markets are segmented and not integrated. In the 2015 stock market crash subperiod, the results suggest 16 pairs of integrated markets, with structural breaks (out of 30 possible). We found that the structural breaks are synchronized between August and December 2015, showing the impact of the crash in these regional markets. When compared with the previous subperiod we found that during the stock market crash the level of financial integration rose 533%. In the post-crash, only 8 markets show to be integrated with their peers, with structural breaks. Thus, the level of integration decreased by 50%, when compared to crash subperiod. This evidence confirm our first research question and it is relevant for policy makers and investors, regarding the development of regional policies and portfolio diversification strategies in the ASEAN-5 region.

The second set of tests shows that during the 2015 stock market crash, the majority of the financial markets decreased the co-movements with their regional peers, with the exception of Thailand's market. The number of statistically significant shocks in the three sub-periods was 151, 128 and 150, respectively, which indicates that the 2015 stock market crash decreased the co-movements between markets in the ASEAN-5 region and China, which were higher in non-crisis subperiods. Additionally, the impulse response functions showed positive co-movements, with statistical significance and persistence exceeding one week. Thus, evidence shows that the assumption of market efficiency is questionable, since the forecast of market movements may be improved, if the lagged movements of the remaining markets are taken into account, allowing the occurrence of arbitrage operations. Therefore, it is beneficial for international investors to diversify their portfolios in these regional markets.

Overall, the study demonstrates, sustained by evidence obtained in the econometric models, that China stock market crash, in 2015, had a significant impact on the memory properties of the financial market indices of ASEAN-5 and China. Due to the significantly decreased of financial integration, in the post-crash period, the implementation of portfolio diversification strategies may be achieved. In conclusion, the ASEAN-5 and China markets may not be efficient in their weak form due to the high levels of arbitrage identified. However, we believe that implementing efficient portfolio diversification strategies, based on historical prices, is still beneficial for investors. These conclusions also contribute to robust market regulators knowledge in order for them to take measures that reduce information asymmetry between these markets and other international markets.

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Higher Education as a Determinant of the Competitiveness of the National Economy

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Abstract

The aim of this paper is to contribute to a clearer understanding of the impact of higher education on the competitiveness of the national economy. The realization of this research was carried out by applying correlation and regression analysis. The results of research show that there is a direct correlation between higher education and the level of national competitiveness. The key contribution of this paper is that, based on previous literature and published results of scientific research, it gives a clearer insight into the competitiveness factors of the analyzed countries expressed in the field of higher education, and indicates the priority activities of the competent state bodies for advancement and raising the level of competitiveness of the national economy.

Keywords: Higher Education, Reforms, Skills, The New Methodology of the Global Competitiveness Index, the employability of students, Dual Education System in Higher Education Institutions

Introduction

The significance of the nine-century long history of higher education for the development of today's Europe is definitely big and indisputable, as it is its reputation and influence around the world. The first and oldest university in the world is the University of Bologna, Italy, was founded in 1088. It should therefore be no surprise that Europe has always paid great attention to the development of higher education on its own territory. There are numerous reasons for this. First, the potential of higher education to stimulate economic development, social cohesion and improve the quality of life in society is high. Every

additional year of education above the population average is estimated as increasing the country's average productivity by 6.2% (de la Fuente and Jimeno, 2005). Second, the higher education system enables higher employment rates to be achieved (Lavrínovícha et al., 2015). According to the scientific research of Federico Biagi and Claudio Lucifora conducted in 10 countries of the European Union, it can be concluded that higher education level reduces unemployment (Biagi and Lucifora, 2008). Third, the impact of higher education on society is significant even in reducing crime rates and in the higher active participation of educated people in social life. Population with lower level of education is considered to be physically inactive and more susceptible to obesity than more educated population. This also can be applied to the mental health of individuals. Individuals with lower incomes or less material resources are poorly educated and often suffer from depression, especially in northern Europe. According to Eurostat survey from 2010th, a systematic relationship was found between education levels and mortality. Life expectancy is lower for less educated social groups and increases with education level (EC-DG ECFIN, 2010, p. 16).

Undoubtedly, higher level of education provides clearer picture of the world and how the world works. New knowledge changes people, their habits and values. After all, they are changing individuals, society and the world for the better. Therefore, any humane, social and responsible society that seeks to ensure continued GDP growth and world-class quality of life should always have (higher) education in the focus of interest.

Although Europe has always been known as the world's university center and incubator of global intelligence, in recent decades, European higher education institutions seem to be failing to "keep up" with the best universities in Anglo-Saxon countries that seem to dominate the market. Many world rankings (universities), such as the list of Shanghai Universities (*Chinese University Rankings*) or Times Higher Education (*British University Rankings*), show that the top 20 universities come from Anglo-Saxon countries. For example, in the academic year 2019/2020 on the Shanghai List, only four European universities are among the top 20 universities in the world: the Swiss Federal Institute of Technology Zurich (*Switzerland*), the University of Cambridge, the University of Oxford and University College London (*United Kingdom*) (Cheng, 2015).

The text is structured in following manner. The first part presents the reforms in higher education in Europe. Then, in the second part, the characteristics of the higher education system in Serbia are analyzed. The third part outlines the methodology and information base of the research and defines the starting hypotheses. The fourth part of the paper deals with the research results and discuss it. The concluding considerations provide recommendations for undertaking desirable activities by the competent state authorities in order to improve higher education and raise the level of national competitiveness.

Reforms in European Higher Education

In the late 1990s, awareness of global competition increased in European higher education. It is understood that despite the success achieved in advancing (improving)

intra-European mobility, the “picture” of the visibility of European higher education institutions outside Europe is still not sufficiently successful. Europe has lost its position as an ideal destination for international students in the US. Also, Europe had significantly less effective degree structures (or degrees) than the US graduates entered the job market at an older age than American. Awareness of these factors has led to initiatives at various levels. First, the ministers of Great Britain, Germany, France and Italy called for the equalization of diplomas. This was the initiative that launched the Bologna Process. In 1999, the Ministers of Education of 29 European countries signed the so-called Bologna Declaration in Bologna (European Commission, 2001).

The European Commission (EC) itself became more active in the field of education only after the meeting of the Prime Ministers and EU Member States, held in March 2000th in Lisbon. At the meeting, representatives of EU member states stated that by the 2010th the European Union should become the most competitive and dynamic knowledge-based economy in the world. Higher education has been identified as one of the key areas in achieving this goal, which has provided the EC with political mandate in the higher education policy segment. The EC has also been able to develop wide range of initiatives, and on its basis has been created the Lisbon Strategy (European Commission, 2002; Lisbon Council, 2007).

In the EC document on university reform entitled *Delivering on the modernization agenda for universities: education, research and innovation*, is pointed out the following: “With 4,000 institutions, over 17 million students and about 1.5 million employees – 435.000 of whom are researchers – higher education institutions in Europe have great potential, but that potential has not been fully utilized and put into function of economic growth and development. ... Continued globalization means that the European Higher Education Area and the European Research Area must be open to the world and become competitive players at the global level ... Universities are key players for European future and successful transition to knowledge-based economy and society. ... Yet, this key sector of society needs deep restructuring and modernization if Europe is to win the global competition in the education market” (European Commission in UK, 2006).

In the following, certain characteristics of the higher education system in Serbia are analyzed. In addition to the emphasis on the underfunding of higher education institutions in Serbia, they also pointed on the negative effects of the implementation of the Bologna Declaration on the quality of higher education.

The State of Higher Education in the Republic of Serbia

Today, higher education in the Republic of Serbia is treated as a public good. Universities have undergone serious expansion. The number of students increased from 145,493 students in 2007 to 195,256 students in 2019. The increase in student numbers was accompanied by an even larger increase in the number of universities – from several state universities in 2000/2001. up to 18 universities in 2019 (8 state and 10 private) (Krstić

and Krstić, 2015). Unfortunately, budgetary allocations for education did not meet the growing needs of higher education. All this has led to Serbia's low rating.

A serious problem is the implementation of the Bologna Declaration, which according to many authors (Topić, 2014; Cavalli et al., 2019; Krstić and Krstić, 2017), has negative effects on the quality of higher education which is why deep reforms of the entire education system are also needed. From the Humboldt system of study, when the studies were more thorough, it went to the extreme of the absurdly easy acquisition of higher education diplomas. We have unburdened the curricula of the "subject-matter knowledge". We have kept the exam preparation literature to a minimum. We have done all this by striving for higher education that will be effective, productive and competitive. Being guided by economic categories, it is as if we have forgotten that education has its lasting humanistic values, such as knowledge as value, justice, freedom, equality of citizens, etc (Pavlović, 2017).

The next part of the paper defines the research objective, hypotheses and explanations of higher education research methodologies in selected countries. The research was conducted according to the concept of the Global Competitiveness Index 4.0 of the World Economic Forum.

Methodological Framework for Research and Hypotheses

We conducted this research to examine the impact of tertiary education on the competitiveness of the national economy (research objective). We believe that the World Economic Forum's "Skills" index determines (predicts) the results of the Global Competitiveness Index 4.0. In our research, we collected data on the "Skills" Index for a group of 36 countries. However, Professor Marija Ivaniš, our colleague, believes that we should not use the "Skills" Index as a predictor variable, but should use individual indicators of the World Economic Forum and Eurostat related to higher education.

Professor Marija Ivaniš states that some indicators of the World Economic Forum and Eurostat better predict the results of the Global Competitiveness Index 4.0 compared to the "Skills" index. Based on the advice we received from Maria, we decided to conduct multiple regression analyzes with seven predictor variables: 1) "Skillset of graduates" (*SoG*), 2) "Critical thinking in teaching" (*CTiT*), 3) "Scientific Publications" (*SP*), 4) "Patent applications" (*PA*), 5) "Research institutions prominence" (*RIP*), 6) "R&D expenditures" (*RDE*), and 7) "Total public expenditure at tertiary level of education" (*TPET*).

As we began to see that the World Economic Forum and Eurostat indicators were more effective in predicting the Global Competitiveness Index 4.0 (criterion variable) than the "Skills" index, we decided to divide the predictor variables (or indicators) into three groups: measures for "quality of teaching in the higher education system", measures for the "quality of science and research at university" and indicators of funding for the higher education system. Measures for "quality of teaching in the higher education system" are: "Skillset of graduates" and "Critical thinking in teaching" (indicators of the World

Economic Forum). Measures for “quality of science and research at university” are: “Scientific publications”, “Patent applications” and “Research institutions prominence” (indicators of the World Economic Forum). Financing indicators for higher education include: “Total public expenditure at tertiary level of education” and “R&D expenditures” (Eurostat indicators).

However, Marija Ivaniš reminded us that at the beginning of our research we also collected data on the financial system in the countries. She thinks countries that have had financial problems may be less competitive. If this assumption (about the country’s “financial health”) is true, then the low scores for the variables “Skillset of graduates”, “Critical thinking in teaching”, “R&D” expenditure, etc. are not what leads to low competitiveness. To explore this possibility, Maria suggested that we first analyze whether, for example, Eurostat variables relating to the country’s financial situation – *GDP per capita in PPS* (index – EU28 = 100) and *Export of goods and services in % of GDP*, have significant impact on Global Competitiveness Index 4.0. If so, then we should evaluate the extent to which variables “Critical thinking in teaching”, “Scientific publications”, “Skillset of graduates”, etc. help predict the Global Competitiveness Index 4.0, through indicators of the country’s “financial health”.

As previously stated, the information basis for the research is the data contained in the Global Competition Report 2019 of World Economic Forum (*WEF*).

It is the fact that numerous international institutions create indices on the basis of which they measure and rank countries according to various aspects of competitiveness, but the most influential are the global indices of the World Economic Forum and the International Institute for Management Development. The paper uses the composite index of the World Economic Forum, first of all, because the report of this international institution covers far larger number of countries than the report of the International Institute for Management Development (Lovrinčević et al., 2008; Krstić et al., 2018).

Based on the results of complex analysis of WEF experts, new tool for assessing the performance of world economies, named the Global Competitiveness Index 4.0, expresses the ability of country to compete with other countries in the conditions of the fourth industrial revolution. According to the Global Competitiveness Index 4.0, the country’s competitiveness is assessed on the basis of 12 pillars of competitiveness, which are the most important determinants of the long-term growth of national economies and their profits. Changes in the results (or performance) of *GCI 4.0* explain over 80% of variations in income levels and 70% of variations in long-term growth of countries and economies (Schwab, 2019).

With all of the above in mind, the aim of this paper is to analyze the impact of higher education systems on the competitiveness of the national economy and to determine how higher education can contribute to improving national competitiveness. In accordance with the set goal, the following hypotheses were defined and tested:

H1: Variable “Scientific publications” compared to the measures “Skillset of graduates”, “Critical thinking in teaching”, “Patent applications”, “Research institutions prominence”,

“Total public expenditure on tertiary level of education” and “R&D expenditures” better determines the Global Competitiveness Index 4.0.

H2: Variables for “quality of teaching in higher education system” have statistically significant effect on the competitiveness of the economy.

H3: Variables for “science and research at university” predict statistically significant global competitiveness index of 4.0 via the variables “quality of teaching in higher education”.

H4: Variables for “science and research at university” have a statistically significant effect on the competitiveness of the national economy.

H5: Variables for “quality of teaching in higher education” predict statistically significant global competitiveness index 4.0 over variables for “science and research at university”.

H6: The country’s previous financial difficulties lead to low competitiveness of the national economy.

H7: Countries that have high scores in one area of “strength” rating or quality of higher education systems generally have high scores in other areas of quality assessment of the higher education system and vice versa.

H8: The quality of the higher education system in selected areas (the quality of teaching in the higher education system and the quality of science and research at university) is crucially dependent on the amount of public expenditure on higher education.

In order to achieve the goal of research and to confirm or refute hypotheses, in the paper we will apply: multiple regression analysis and correlation analysis. Multiple regression analysis aims to show the impact of measures for higher education quality at the achieved level of the Global Competitiveness Index 4.0. Correlation analysis will be used to determine does interdependence between the variables: “Skillset of graduates”, “Critical thinking in teaching”, “Scientific Publications”, “Total public expenditure on tertiary level of education”, “Research institutions prominence” exist? The study was performed on two samples. Sample I includes *EU* countries, candidate countries¹ and countries have signed the Stabilization and Association Agreement². Sample II covers countries from sample I that have low³ *GDP per capita in PPS* (index – EU 28=100) and/or low *Export of goods and services in % of GDP*.

The next part of the paper is devoted to the analysis and discussion of the results of multiple regression with one set of predictor variables, with two unordered sets of predictor variables, and with 2 ordered sets of predictor variables.

¹ Northern Macedonia, Serbia, Montenegro, Albania and Turkey.

² Bosnia and Herzegovina.

³ The result of a variable or indicator is low (or high) as long as it is below (or above) the mean of the result of that variable.

Research Results and Discussion

Multiple regression with one set of predictor variables

The results of multiple regression analysis with one set of predictor variables are shown in Figure 1. in the Model Summary table. The regression equation or prediction equation with seven (predictor) variables is statistically significantly related to the Global Competitiveness Index 4.0., $R^2 = 0.898$, adjusted $R^2 = 0.868$, $F(7,24) = 30.137$; $p=0.000 < 0.005$ (we have proved hypothesis 1). The regression formula includes partial slopes or B values that are marked in the Unstandardized Coefficients column (George and Mallery, 2016; Savić et al., 2019). According to these B values, the regression equation is:

Predicted Global Competitiveness Index 4.0 = 2.543 Skilset of Graduates+ 2.371 Critical thinking in teaching + 0.000 R&D expenditure + 1.127 Total public expenditure at tertiary level of education + 0.009 Scientific publications + 0.010 Patent applications per million pop. + 1.789 Research institutions prominence

The maximum partial slope in the Standardized Coefficients column (see Beta in the Coefficients table) is 0.393, which is the value for the “Scientific publications”. This means that this predictor variable most contributes to explaining the Global Competitiveness Index 4.0 (Hinton et al., 2014). The variable “Scientific publications” makes a unique and statistically significant contribution to explaining the changes in the Global Competitiveness Index 4.0 (the value in the Sig column for this variable is 0.005). Other variables in the model (or equation) are not statistically significant in explaining changes in the Global Competitiveness Index 4.0 in the analyzed countries.

From a standpoint of the topic of the paper, it should be emphasized that the results of multiple linear regression analyzes indicate that improving “Scientific publications” should be the primary goal of public policy makers in countries with few papers in international citation databases (*Web of Science, Scopus* etc.). A country that has few papers in bases such as *Web of Science, Scopus* and the like should only fund the best researchers in order to achieve excellence in research and improve the competitiveness of the national economy. However, this model of science funding will only be effective if other measures are introduced in parallel, such as: providing modern equipment, improving working conditions and establishing adequate criteria for evaluating results (Krstić et al., 2019; Krstić, 2018).

Multiple regression with two unordered sets of predictor variables

In the study, we also want to determine if and how well the Global Competitiveness Index 4.0 is predicted by each set of predictor variables?, which in this case are measures for “quality of teaching in the higher education system” and measures for the quality of “science and research at university”. In addition, we are interested how well each set of predictor variables predicts the Global Competitiveness Index 4.0 over another set of predictor variables? The results of the first analysis are shown in Figure 2. The first

analysis estimates how well the Global Competitiveness Index 4.0 is predicted by the measures for “quality of teaching in the higher education system” and how well the Global Competitiveness Index 4.0 is predicted by the measures for “science and research at university” over measures for “quality of teaching in the higher education system”. The relation between the measures for “quality of teaching in higher education” and the Global Competitiveness Index 4.0 is statistically significant, $R^2 = 0.696$; adjusted $R^2 = 0.677$, $F(2,33) = 37,743$; $p = 0.000 < 0.05$ (we have proved hypothesis 2). Also, measures for “science and research at university” predict a statistically significant the Global Competitiveness Index 4.0 through measures for “quality of teaching in the higher education system”, R^2 change = 0.179; $F(3,30) = 14,236$; $p = 0.000 < 0.05$ (see Change Statistic column, second row) (we have proved hypothesis 3).

The results of multiple regression with two unordered sets of predictor variables allow us to draw the following conclusion. Governments in the analyzed countries should be involved in the implementation of all activities aimed at improving the quality of work of higher education institutions and the quality of learning outcomes. As some of the most important among these activities, we have recognized the following: 1) introduction of a quality dual system in the higher education system and support for the development of all forms of cooperation between higher education institutions and the economy; 2) encouraging the mobility of students and teaching staff; 3) encouraging the formation of joint study programs of domestic and foreign universities and the like (Mbonigaba and Wilfred, 2019; Highman, 2019).

The results of the second analysis are shown in Figure 3. The second analysis estimates how well does the Global Competitiveness Index 4.0 is predicted by the “science and research at university” measures and how well the Global Competitiveness Index 4.0 is predicted by the “quality of teaching in higher education” measures across measures for “science and research at university”. We find that measures for “science and research at university” predict a statistically significant the Global Competitiveness Index 4.0, $R^2 = 0.785$; adjusted $R^2 = 0.765$, $F(3,32) = 38.949$; $p = 0.000 < 0.05$ (Fig. 2) (we have proved hypothesis 4). Also, measures for “quality of teaching in higher education” predict a statistically significant global competitiveness index of 4.0 through “science and research at university” measures, R^2 change = 0.089; $F(2,30) = 10.693$; $p = 0.000 < 0.05$ (Fig. 3) (we have proved hypothesis 5).

Multiple regression with two ordered sets

Finally, we want to determine whether and how well the Global Competitiveness Index 4.0 is predicted by the country’s financial difficulties, as well as whether and how well measures for “quality of teaching in the higher education system”, measures for “science and research at university and indicators for financing higher education (“Total public expenditure on tertiary level of education” and “R&D expenditure”) predict Global Competitiveness Index 4.0 after controlling for the impact of a country’s financial problems (first set of predictor variables)?

The results of multiple regression with two ordered sets of predictor variables are shown in Figure 4. The first set of predictor variables – *GDP per capita in PPS* (index – EU = 100) and the *Export of goods and services in % of GDP* have a positive effect at the Global Competitiveness Index 4.0, $R^2 = 0.859$; adjusted $R^2 = 0.824$, $F(2,8) = 24.441$; $p = 0.00 < 0.05$ (Figure 4) (we have proved hypothesis 6).

The result of research indicates that some countries, that are the subject of this study (see Table 1) should pay more attention to the current account deficit and balance of payments developments. As is well known, the current account deficit shows how much states, businesses and citizens spend more than they create. As the state imports much more than it exports and as foreign investors, on various ways, continually export money, current outflows of foreign exchange are much higher than inflows.

Tab. 1: Selected countries with current account deficits in sample II

Countries	Export	Import	Current account deficit
Romania	85102.9	91242.9	61400
Northern Macedonia	6480.7	7825.9	13452
Albania	4050.1	5802.9	17528
Serbia	21760.1	25410.3	36502
Bosnia and Herzegovina	6932.8	9528.1	25953

Source: Author's calculation based on Eurostat data in 2018th year (Available from: <https://ec.europa.eu/eurostat>).

The macro balance that best reflects the financial risks of a country is an international investment position or balance sheet. What is a negative value of balance sheet more, that the risk of financial crisis is greater. A key factor contributing to the increase in the negative value of balance sheet is the current account deficit, and this dangerous situation can only be corrected by reducing it. This requires serious correction of exchange rate and accelerated depreciation. If this does not happen, the increasing current account deficit will have a negative impact on the amount of funds from the budget allocated to tertiary education.

Seven indicators of the strength or quality of the higher education system (variables for “quality of teaching in the higher education system”, for “quality of science and research at university” and indicators of financing the higher education system) have a significant proportion of variance of the global competitiveness index 4.0 after controlling for the impact of financial difficulty of country, R^2 change = 0.141; $F(7,1) = 266.746$; $p = 0.047 < 0.050$ (Fig. 4).

The results of the partial and two-dimensional correlation analysis, that examining the interdependence of the variables: “Skills of graduate”, “Critical thinking in teaching”, “Scientific publications”, “Total public expenditure on tertiary level of education” and “Research institutions prominence” will be discussed below.

Two-dimensional and partial correlation

We hypothesized that countries that have high scores in some area of quality of higher education system are also more likely to have high scores in other areas of quality of higher education system (see hypothesis 7 in the section titled *Methodological framework for research and hypotheses*). To test this hypothesis, we collected results for 5 variables from the regression equation in a previous study (research of multiple regression). These are the following variables: “Skillset of graduates”, “Critical thinking in teaching”, “Scientific publications”, “Research institutions prominence” and “Total public expenditure on tertiary level of education”. In this study, we are particularly interested in the partial correlation between the four measures for quality of the higher education system, excluding the impact of the measure “Total public expenditure on tertiary level of education”. The variables in the two-dimensional and partial correlation studies are given in Table 2.

Tab. 2: Analyzed variables

Variable	Definition of Variable	Explanation of result of variable
Skillset of graduates	Measuring the “strength” of a high education system related to quality of teaching in the higher education system	High scores for this variable indicate that the higher education system in a country creates staff that meets the demands of the market and the economy and who have transferable skills in accordance with different contexts
Critical thinking in theaching	Measuring the “strength” of a high education system related to quality of teaching in higher education	The high results for this variable indicate that lectures and exercises emphasize on illustrations, tasks and other forms of knowledge application that encourage the student to think, be creative, work autonomous, etc.
Total public expenditure on tertiary level of education	Percentage of gross domestic product (GDP)	High scores for this variable indicate that the country allocating large funds for higher education needs
Scientific publications	Measuring the “strength” of a high education system that related to the quality of science and research at university	High scores for this variable mean that the country has effective or productive researchers in state-owned scientific organizations (colleges and institutes)
The reputation of scientific organizations (faculties and institutes)	Measuring the “strength” of a high education system related to the quality of science and research at university	Low scores for this variable means that R&D organizations in a particular countries have poor results and do not competitive enough to function in market conditions

Source: Schwab (2019); Leech et al. (2014).

The results of the two-dimensional and partial correlations are shown in Table 3. Each cell in the table shows a certain correlation coefficient (two-dimensional correlations or partial correlations), a p value of a certain correlation (marked Significance), and a degree of freedom (df = N - 2).

Tab. 3: Correlations

Control Variables			SOG	CTiT	SP	RIP	TPET
-none ^a	SOG	Correlation	1.000	.844	.463	.247	.630
		Significance (2-tailed)	.	.000	.008	.173	.000
		Df	0	30	30	30	30
	CtiT	Correlation	.844	1.000	.533	.200	.025
		Significance (2-tailed)	.000	.	.002	.270	.000
		Df	30	0	30	30	30
	SP	Correlation	.463	.533	1.000	.750	.255
		Significance (2-tailed)	.008	.002	.	.000	.159
		Df	30	30	0	30	30
	RIP	Correlation	.247	.200	.750	1.000	.002
		Significance (2-tailed)	.173	.273	.000	.	.990
		Df	30	30	30	0	30
	TPET	Correlation	.630	.625	.255	.002	1.000
		Significance (2-tailed)	.000	.000	.159	.990	.
		Df	30	30	30	30	0
TPET		Correlation	1.000	.742	.402	.316	
		Significance (2-tailed)	.	.000	.025	.083	
		Df	0	29	29	29	
		Correlation	.742	1.000	.496	.254	
		Significance (2-tailed)	.000	.	.005	.168	
		Df	29	0	29	29	
		Correlation	.402	.496	1.000	.775	
		Significance (2-tailed)	.025	.005	.	.000	
		Df	29	29	0	29	
		Correlation	.316	.254	.775	1.000	
		Significance (2-tailed)	.083	.168	.000	.	
		Df	29	29	29	0	

a. Cells contain zero-order (Pearson) correlations

Source: Author's calculation in SPSS.

Generally, 5 out of 10 two-dimensional correlations are statistically significant and greater than or equal to 0.533 (positive correlations). However, the two-dimensional correlations between the variable “Skillset of graduates” on the one hand and the variables “Scientific Publications” and “Reputation of Scientific Organizations” on the other, are lower and not statistically significant. Generally speaking, the results of the two-dimensional correlation indicate that if countries have a high score in one area of higher education system quality assessment, they usually have high scores in other areas of higher education system quality assessment (we have proved hypothesis 7).

The partial correlation coefficients were then calculated between the variables “Skillset of graduates”, “Critical thinking in teaching”, “Scientific Publications”, and “Research institutions prominence”, keeping the constant variable “Total public expenditure at tertiary level of education”. Three of the six partial correlations are statistically significant and large. One of the most significant partial correlations is the partial correlation between the two measures of “strength” of the higher education system that are related to the quality of teaching (partial correlation between the variables “Skillset of graduates” and “Critical thinking in teaching”, $r(34) = 0.742$, $p = 0.000 < 0.006$), while the second (largest or most significant) partial correlation relates to the evaluation of the quality of science and research at the university (partial correlation between the variables “Scientific publications” and “Research institutions prominence”, $r(34) = 0.775$, $p = 0.000 < 0.008$).

The results of partial correlation support the hypothesis that the quality of the higher education system in the assessment areas is highly dependent on the amount of public expenditure on higher education (see hypothesis 8 in the *Methodological framework for research and hypotheses* section). The empirical research presented above states that the state should give education a priority in the allocation of funds from the budget, which in itself has a positive effect on the quality of education and, consequently, the competitiveness of the economy (Mourato and Patrício, 2019).

Conclusion

The poor state of the higher education system is a significant constraint on the future growth and development of the economy. However, the perceived competitive disadvantages should be seen as a benchmark (priority) for undertaking future activities. In accordance with the key results of the analysis, presented in this paper, the measures and activities of the competent state authorities in the coming period should be directed towards: 1) improving the employability of students; 2) increasing funding for higher education and 3) developing science at university and 4) improving innovation capacity.

1) Improving employability of students. The primary objective of public policy of higher education in each country should be to improve the employability of students in the coming period. Employability refers to “a set of achievements - skills, knowledge and

personal traits - that enable students to get a job and be successful in the profession they have chosen.

The following will address the following measures and activities of universities aimed at increasing employability of student: foundation of university business incubators, organizing student practices and implementing dual education systems in higher education. Improving business-university collaboration can help encourage the innovative potential of the firm and, at the same time, enable universities to improve opportunities of students' employment. Closer, universities can increase student employability and stimulate development of firms by establishing university business incubators (Voronov and Lavrinenko, 2014). University business incubators should function as a mechanism for transferring knowledge to firms. Interviews with representatives of firms located in university business incubators revealed that firms identified the following benefits arising from their relationships with incubator: increased strategic focus, improved R&D activities, and a database for knowledge transfer. A special type of university business incubators are business villages that allow to small businesses to use premises and facilities (Adesola et al., 2019). Student internship programs may also be extremely useful. Internship refers to work experience gained in the education process through a planned and supervised program (Piterou and Birch, 2016). In the study titled *Internships in SMEs and career intentions*, Andreas Walmsley, Rhordi Thomas and Stephanie Jameson indicate that most research on internships focuses on benefits for students and employers, but not for higher education institutions (Walmsley et al., 2012). Some of the benefits of an internship for students are: earlier job offers, higher starting wage, etc. Andreas Walmsley, Rhordi Thomas and Stephanie Jameson also indicate that students are improving their job search skills and developing networking opportunities. Employers (businesses) gain an advantage by developing competencies that allow them to evaluate how students' skills can be used in firm, as well as exposure to new ideas. We agree that the last point is more important for the development of innovation. Benefits for the university relate to: enhancing the reputation, improving the employability of students, the contribution of employers in creating curricula and networking universities with the local community (Pavlović, 2015; Melović, 2019; Slavić and Berber, 2019).

The next analyzed measure for improving the employability of students is the implementation of a dual education system in higher education institutions. The aim of such a system is overcoming the gap between the theoretical knowledge acquired during schooling, on the one hand, and the required practical skills in the labor market, on the other. Some studies at the application of the dual education system in higher education institutions have shown a higher rate of employability and easier orientation of students in the labor market, thanks to the ability and acquired skills to respond to tasks immediately after graduation, without the need for additional training (Mafenya, 2013; Lavrinovica and Lavrinenko, 2013).

2) Increasing of higher education funding. The research conducted in this paper shows that the higher education system will not be able to contribute to the development and

growth of the economy as long as it faces serious funding problems. In order to increase funding for higher education, higher education institutions need to focus on other sources of funding, such as the new generation of EU funding for research, teaching and innovation funding in education (Pavlović, 2014; Ohotina and Lavrinenko, 2013).

3) Development of science at university and enhancement of innovation capacity.

Considering the above results of the analysis, we can conclude, that there is extremely limited role of innovation in the economies of Romania, Northern Macedonia, Albania, Serbia and Bosnia and Herzegovina, which, combined with the unfavorable business climate, represents great challenge for these countries. The lag of these countries is especially evident when it comes to the formation of knowledge-based economy that enables the application of the results of fundamental research and the creation of products that meet consumer needs. Further progress and improvement of the position of Romania, Northern Macedonia, Albania, Serbia and Bosnia and Herzegovina on the global market includes successful implementation of the following measures: 1) formation of non-governmental funds that should be used to finance the most productive researchers and for other needs (procurement of materials, apparatus, samples and Similarly); 2) creation of high-paying permanent positions at colleges and institutes; 3) defining and implementing more stringent employment and promotion conditions (Piro, 2019; Krstić et al., 2018; Tošović-Stevanović et al., 2017).

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Attachment

Figure 1: Selected results of multiple regression with selected set of predictor variables

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.948 ^a	.898	.868	2.579

a. Predictors: (Constant), RDE, TPET, SoG, RIP, SP, PA, CTIT

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1402.870	7	200.410	30.137	.000 ^b
	Residual	159.599	24	6.650		
	Total	1562.469	31			

a. Dependent Variable: GCI
b. Predictors: (Constant), RDE, TPET, SoG, RIP, SP, PA, CTIT

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations		
		B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part
1	(Constant)	43.978	4.800		9.161	.000	34.071	53.886			
	SoG	2.543	1.450	.232	1.754	.092	-.449	5.536	.808	.337	.114
	CTIT	2.371	1.258	.292	1.885	.072	-.225	4.967	.844	.359	.123
	SP	.009	.003	.393	3.099	.005	.003	.015	.774	.535	.202
	PA	.010	.011	.123	.846	.406	-.014	.033	.847	.170	.055
	RIP	1.789	2.903	.075	.616	.543	-4.203	7.782	.501	.125	.040
	TPET	1.127	1.422	.075	.792	.436	-1.808	4.061	.578	.160	.052
	RDE	.000	.000	-.061	-.590	.561	-.001	.000	.424	-.120	.039

a. Dependent Variable: GCI

Source: Calculation of authors – SPSS.

Figure 2: Selected results of multiple regression analysis for two unordered sets of predictor variables

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.834 ^a	.696	.677	4.410	.696	37.743	2	33	.000
2	.935 ^b	.874	.854	2.971	.179	14.236	3	30	.000

a. Predictors: (Constant), CTIT, SoG
b. Predictors: (Constant), CTIT, SoG, RIP, SP, PA

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1468.162	2	734.081	37.743	.000 ^b
	Residual	641.838	33	19.450		
	Total	2110.000	35			
2	Regression	1845.167	5	369.033	41.804	.000 ^c
	Residual	264.833	30	8.828		
	Total	2110.000	35			

a. Dependent Variable: GCI
b. Predictors: (Constant), CTIT, SoG
c. Predictors: (Constant), CTIT, SoG, RIP, SP, PA

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations		
		B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part
1	(Constant)	30.566	5.166		5.916	.000	20.055	41.077			
	SoG	6.804	2.002	.595	3.399	.002	2.732	10.877	.821	.509	.326
	CTIT	2.409	1.558	.271	1.546	.132	-.760	5.578	.768	.260	.148
	SP	.011	.003	.460	3.883	.001	.005	.017	.763	.578	.251
	PA	.018	.011	.199	1.555	.130	-.006	.041	.834	.273	.101
2	(Constant)	40.593	4.763		8.523	.000	30.866	50.321			
	SoG	5.124	1.422	.448	3.605	.001	2.221	8.027	.821	.550	.233
	CTIT	.279	1.210	.031	.231	.819	-2.193	2.751	.768	.042	.015
	SP	.011	.003	.460	3.883	.001	.005	.017	.763	.578	.251
	PA	.018	.011	.199	1.555	.130	-.006	.041	.834	.273	.101
	RIP	-1.867	2.866	-.069	-6.651	.000	-7.720	3.987	.491	-.118	-.042

a. Dependent Variable: GCI

Source: Calculation of authors – SPSS.

Figure 3: Selected results of multiple regression analysis for two unordered sets of predictor variables

Model Summary									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.886 ^a	.785	.765	3.765	.785	38.949	3	32	.000
2	.935 ^b	.874	.854	2.971	.089	10.693	2	30	.000

a. Predictors: (Constant), RIP, PA, SP

b. Predictors: (Constant), RIP, PA, SP, SoG, CTIT

ANOVA ^a						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1656.378	3	552.126	38.949	.000 ^b
	Residual	453.622	32	14.176		
	Total	2110.000	35			
2	Regression	1845.167	5	369.033	41.804	.000 ^c
	Residual	264.833	30	8.828		
	Total	2110.000	35			

a. Dependent Variable: GCI

b. Predictors: (Constant), RIP, PA, SP

c. Predictors: (Constant), RIP, PA, SP, SoG, CTIT

Coefficients ^a											
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations		
		B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part
1	(Constant)	62.161	1.156		53.770	.000	59.806	64.516			
	SP	.012	.004	.502	3.420	.002	.005	.019	.763	.517	.280
	PA	.051	.010	.578	5.267	.000	.031	.071	.834	.681	.432
	RIP	-4.363	3.377	-.161	-1.292	.206	-11.242	2.515	.491	-.223	-.106
2	(Constant)	40.593	4.763		8.523	.000	30.866	50.321			
	SP	.011	.003	.460	3.883	.001	.005	.017	.763	.578	.251
	PA	.018	.011	.199	1.555	.130	-.006	.041	.834	.273	.101
	RIP	-1.867	2.866	-.069	-0.651	.520	-7.720	3.987	.491	-.118	-.042
	SoG	5.124	1.422	.448	3.605	.001	2.221	8.027	.821	.550	.233
	CTIT	.279	1.210	.031	.231	.819	-2.193	2.751	.768	.042	.015

a. Dependent Variable: GCI

Source: Calculation of authors – SPSS.

Figure 4: Results of multiple regression with two ordered sets of predictor variables

Model Summary									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.927 ^a	.859	.824	2.26783	.859	24.441	2	8	.000
2	1.000 ^b	1.000	.999	.14840	.141	266.746	7	1	.047

a. Predictors: (Constant), GDPpc, Export

b. Predictors: (Constant), GDPpc, Export, CTIT, SP, TPET, RIP, SoG, RDE, PA

ANOVA ^a						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	251.401	2	125.700	24.441	.000 ^b
	Residual	41.144	8	5.143		
	Total	292.545	10			
2	Regression	292.523	9	32.503	1475.826	.020 ^c
	Residual	.022	1	.022		
	Total	292.545	10			

a. Dependent Variable: GCI

b. Predictors: (Constant), GDPpc, Export

c. Predictors: (Constant), GDPpc, Export, CTIT, SP, TPET, RIP, SoG, RDE, PA

Source: Calculation of authors – SPSS.

Machine Learning Prediction of USA Export to PRC in Context of Mutual Sanction

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Abstract

On the basis of the time series data, machine learning can also be used for predicting the future development of export in various states. It offers, of course, to measure trade between the world's two largest economies – China and the USA, which has an impact on the global world economy. Therefore, the objective of this contribution is to predict the USA export to the People's Republic of China in the context of mutual sanctions using machine learning. The data set contains monthly data on the development of the USA export to China between January 2000 and July 2019. Regression is carried out using neural networks. There are generated three sets of multilayer perceptron networks considering the time series lag of 1 month, 5 months, and 10 months. A total of 10,000 neural structures are generated, out of which 5 with the best characteristics are retained. Export values between August 2019 and December 2020 are predicted and subsequently, the results of all three experiments are compared. The result closes to the ideal one is with the time series lag of 10 months; the networks are also able to capture the trend and fluctuations of the time series. Yet, there is certain overfitting notable, mainly due to the gradation of mutual trade war between the USA and the PRC.

Keywords: machine learning, export, prediction, artificial neural networks, time series

Introduction

In an article, Bernhofen et al. (2018) recounted trade policy change of a country is usually gradual. For developing economies, trade policy changes always go with initiation of a national policy reform strategy. Between 2004 and 2005 previously textile quota-bound products experienced a 155% growth in export value, while non-quota products

experienced a 61% growth. Global Imports from China between 1990 and 2010 rose from 2% to 11%. This rise is even greater for the U.S, rising from 3% to 19% (Handley and Limao, 2017). The tenfold increase in the share of U.S manufacturing expenditure on Chinese goods has contributed to a decrease in U.S prices (Auer and Fischer, 2010), manufacturing employment, and local wages (David et al., 2013). On the other hand, in Doan and Long's, (2019) opinion, contribution of US imports from China to job creation has improved meaningfully, mainly in manufacturing and agriculture.

Machine predictions facilitate businesses to make exact suppositions with accurate presumable results of an inquiry dependent on recorded facts. In fact, numerous studies have revealed that machine learning model prevails against time series models because it works better with volatile and irregular series as put forward by Ülke et al. (2018). For instance, extreme learning machine can be utilized effectively to forecast GDP growth rate as purported by Sokolov-Mladenović et al. (2016).

The objective of the contribution is to forecast the export of the United States of America (USA) in the People's Republic of China (PRC) using machine learning.

Literary Research

China's import duty advancement on normal trade may affect Chinese firms and trigger intra-industry asset reallocation towards firms with high capital power. Firms import contributions with more noteworthy multifaceted nature comes from nations with higher salary per capita, such instances holds just for customary imports not for imports for export progression as claimed by Wang and Yu (2012). Rodrigue and Tan (2019) put forward that corporations sales growth is directly related to product quality upgrading, and trade emancipation affects margins through which businesses strive for clients over time.

Over the years, China's rapid penetration of U.S product markets increased dramatically. It is reported that China was present in just 9% of all manufacturing product categories in 1972, it was present in 85% of categories by 2005 (Schott, 2008). Assessing the impact of trade policy uncertainty (TPU), Handley and Limao (2017) informed that increased TPU reduces investment in export entry and technology upgrading, also believed to reduce trade flows and real income for consumers.

Trade among the U.S and China have triggered significant loss of job; which researchers believe cannot be handled by realigning labor in viable industries in the United States. Decades ago, 64,000 American workers were employed in production associated to China's export to the U.S in contrast to 186,000 Chinese workers employed in the U.S export to China (Lin et al., 2018). This finding is not that different from that put forward by Feenstra and Sasahara (2018) recounting a reduction in labor demand of 1.4 million jobs in manufacturing and 0.6 million in services, for total job losses of 2.0 million between 1995-2011.

Li et al. (2019) proposed that China's export economy has become more diversified and has evolved from polarized structure to relatively balanced system.

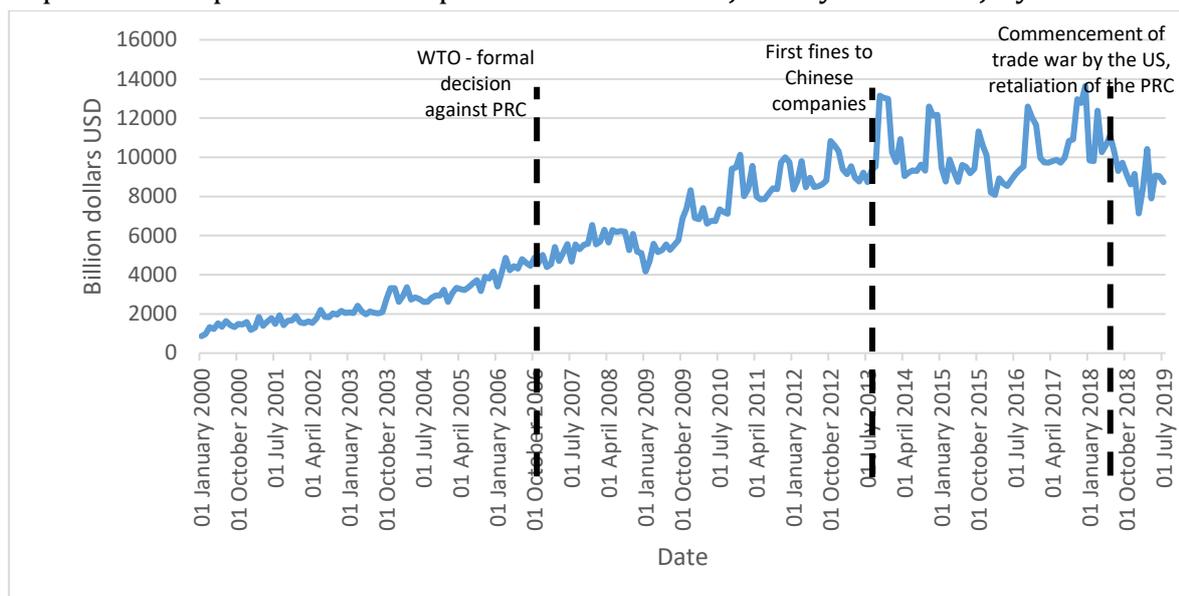
This paper presents machine predictions, U.S-China exports and imports relation. In the vein of Hummels and Klenow (2005) and Hallak (2006) larger rich economies like the United States export from countries that produce good quality products more than smaller economies. The literatures reviewed demonstrates that mechanical, agricultural, and technological US exports to China sharply increased over the past decade. According to the literatures, the following can be concluded: (1) China is one of the biggest US export partner regardless of mutual sanctions, (2) Using time series data, machine learning techniques can be used to predict future US-China export, (3) US exports to China is a driver of employment growth in the PR China.

Methods and Data

Mutual trade restrictions of the USA and PRC caused by the USA feeling of imbalance of the two countries mutual trade significantly influence the overall climate of the international trade. The US leaders decided to regulate the mutual trade by imposing duties on specific types of traded goods. The PRC leaders accepted this policy over time and started to introduce retaliatory measures. The whole situation raises tension between both countries and affects the development of overall trade balance, import and export. Given that the USA started the war, it can be assumed that the first quantity affected will be the USA import from the PRC. Retaliatory measures from the side of the PRC are expected to cause the decrease of the USA export to the PRC. The time series of this variable will thus show fluctuations of an extraordinary character. This makes it an interesting object for the investigation of time series, or their machine learning prediction.

The dataset demonstrates the time series course at monthly intervals between January 2000 and July 2019. The course of the time series is shown in Graph 1.

Graph 1: Development of USA export to PRC between January 2000 and July 2019



Note: The values (in the whole text) are given in USD billion.

Source: Authors.

The graph clearly shows the fluctuations within the individual years of the monitored period. However, the question is whether these are regular seasonal fluctuations or random events caused by poor long-term trade relationships between American and Chinese business partners. Although the USA export to the PRC is realized, it seems as if it is random rather than planned activity, or even long-term planned activity. However, only when the time series is examined, it will be clear whether it is a seasonal fluctuation in the development of the time series. However, the increase in the development of the variable is particularly evident. Taking into account the highest value achieved before the outbreak of the trade war, the USA export to the PRC achieved the amount of USD 13,644.8 billion USD. At the beginning of the monitored period, the value was USD 863.1 billion. The difference is thus nearly sixteen times higher. When the trade war burst out, the USA export to the PRC decreased from the aforementioned USD 13,644.8 billion USD to USD 7,134.4 billion. Although there has been a slight increase, the return to the values achieved before the launching of the trade war cannot be expected. Table 1 shows the basic statistical characteristics of the dataset.

Tab. 1: Basic statistical characteristics of the examined dataset

Statistics	Date (input variable)	Month (Output variable)	Year (Input variable)	Export (Output variable (target))
Minimum (Training)	36,556.00	1.00000	2000.000	863.10
Maximum (Training)	43,646.00	12.00000	2019.000	13,147.80
Mean (Training)	40,050.47	6.45455	2009.115	6,415.19
Standard deviation (Training)	2,001.16	3.50688	5.473	3,382.42
Minimum (Testing)	36,585.00	1.00000	2000.000	972.70
Maximum (Testing)	43,677.00	12.00000	2019.000	12,382.10
Mean (Testing)	40,130.09	6.00000	2009.371	5,918.11
Standard deviation (Testing)	2,418.96	3.38683	6.691	3,492.76
Minimum (Validation)	36,646.00	1.00000	2000.000	1,227.50
Maximum (Validation)	43,373.00	12.00000	2018.000	13,644.80
Mean (Validation)	40,412.86	6.71429	2010.086	7,025.04
Standard deviation (Validation)	3,403.28	3.44159	9.284	5,528.71
Minimum (Overall)	36,556.00	1.00000	2000.000	863.10
Maximum (Overall)	43,677.00	12.00000	2019.000	13,644.80
Mean (Overall)	40,116.30	6.42553	2009.298	6,431.99
Standard deviation (Overall)	2,069.19	3.45140	5.669	3,429.19

Source: Authors.

There will be carried out a regression using neural structures. We will generate multilayer perceptron networks (MLP). Three sets of artificial neural networks will be generated that will differ according to the lag in time series considered:

1. One-month lag in time series,
2. Five-month lag in time series,
3. Ten-month lag in time series.

Time series lag indicates the number of data used for the calculation of a following value (that is, in the first case, it is based on the value for one preceding month, in the second case it is based on the five preceding values, in the third case, based on the outcomes of ten preceding months). Larger time series lag can indicate averaging values, while small lag can result in extreme fluctuations of a smoothed time series. Each lag entails greater demands on the complexity of artificial neural network structure, specifically the neurons in the input layer (in Experiment 1, the input layer will contain 3 neurons, in Experiment 2, there will be 15 neurons, and in Experiment 3, 30 neurons). Other settings will be the same for all three experiments.

The continuous variable will be time. Seasonal fluctuations will be represented by a categorical variable (month and year in which the value was measured). We will thus work with possible monthly seasonality of the time series. However, it is also important to capture the overall trend of the time series. The dependent variable will be the USA import from the PRC.

The time series will be divided into three sets - Training, Testing, and Validation dataset. The first dataset will contain 70% of the input data. Based on the training dataset, neural structures will be generated. The remaining two datasets will contain 15 % of the input information each, and both sets will be used for the verification of the reliability of the found neural structure, or model. A total of 10,000 neural networks will be generated, out of which 5 with the best characteristics¹ will be retained. The hidden layer will contain from 2 to 12 neurons for Experiment 1, 1-15 neurons for Experiments 2 and 3. In the hidden and output layers, the following distribution functions will be considered: Linear, Logistic, Atanh, Exponential, Sinus.

Other settings will remain default (according to ANS tool – automated neural structures).

The expected outcomes of the analysis will be the following ones:

- The overview of retained networks: it will always contain the structures of five retained neural networks, performance of datasets, errors, error function, activation function of hidden and output layer of neural network.
- Correlation coefficients: they characterize the performance of the network in individual data subsets.
- Basic statistics of smoothed time series.
- Graph of smoothed time series.
- Predicted values for the period between August 2019 and December 2020.
- Graph of the development of actual time series connected with predictions, i.e. a possible course of the time series between January 2000 and December 2020.

Finally, the results of three experiments carried out will be compared and it will be decided whether the chosen methodology of machine learning is appropriate in terms of the direction. Also, the time lag closest to the correct result will be identified.

¹ The least squares method will be used. Generation of networks will be finished if there is no improvement, i.e. no reduction in the sum of squares. We will retain the neural structures whose sum of residuals squares to the actual USA export to the PRC is as low as possible (zero ideally).

Results

Experiment 1 (1-month lag in time series)

Table 2 shows the overview of neural networks retained from Experiment 1.

Tab. 2: Retained neural networks from Experiment 1

Index	Network	Training perform.	Testing perform.	Valid. perform.	Training error	Testing error	Valid. error	Training algorithm	Error function	Activation of hidden layer	Output activation function
1	MLP 3-8-1	0.978219	0.977584	0.972223	240497.8	265214.2	361000.2	BFGS (Quasi-Newton) 206	Sum of squares	Exponent.	Exponent.
2	MLP 3-7-1	0.980139	0.978288	0.974421	219420.0	256942.3	319577.7	BFGS (Quasi-Newton) 9999	Sum of squares	Exponent.	Logistic
3	MLP 3-8-1	0.982555	0.976820	0.976856	192860.0	272205.3	289849.3	BFGS (Quasi-Newton) 318	Sum of squares	Tanh	Identity
4	MLP 3-10-1	0.978333	0.975024	0.972400	239137.9	293338.6	361366.5	BFGS (Quasi-Newton) 154	Sum of squares	Exponent.	Exponent.
5	MLP 3-8-1	0.977693	0.973863	0.973028	246149.5	307303.0	349478.2	BFGS (Quasi-Newton) 168	Sum of squares	Exponent.	Exponent.

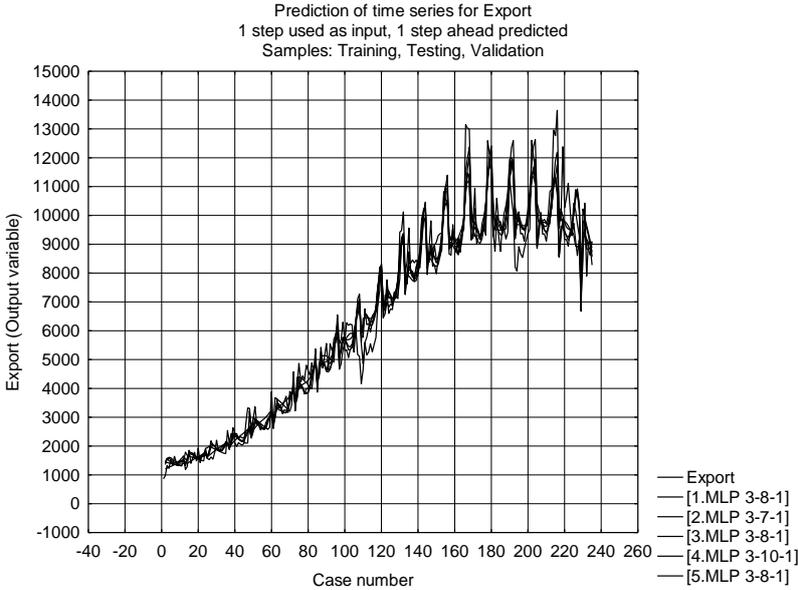
Source: Authors.

It results from the table that the neural networks with 7-10 neurons in the hidden layer were retained. The input layer of the neural networks contains always three neurons (date, month, and a year in which the values were measured). For the activation of the hidden layer, the exponential function and hyperbolic tangent are used. The output layer of neurons is activated using the exponential, identity and logistic functions. The neural networks performance is also important. It is expressed by a correlation coefficient, which achieves very high values in all datasets of all neural networks. In the case of Training dataset, the correlation coefficient achieves the values of more than 0.97 to more than 0.98. The correlation coefficient is high also in the case of the testing dataset (always nearly 0.98). Optically weakest performance is shown by the Testing dataset, although achieving always more than 0.97. This indicates a high level of direct dependence. This parameter shows that the retained neural structures are a reliable model of an actual time series and should have the ability to forecast the future development of the time series very accurately (if it does not suffer from overfitting²). It shall also be noted that the errors calculated using the method of least squares are acceptable.

Graph 2 shows the comparison of the actual course of time series and smoothed time series.

² Overfitting is characterized by the fact that neural networks smooth the time series relatively well, show perfect performance, minimum error, but the prediction of the time series future development is factually nonsensical.

Graph 2: Smoothed time series of retained networks in Experiment 1



Source: Authors.

Graph 2 clearly shows that all smoothed time series are able to follow the actual development of the USA export to the PRC quite well. With some small exceptions (or relatively small deviations), all are able to capture the development trend as well as time series fluctuations.

In order to be able to determine whether the networks are applicable or not, we will focus on their application in forecasting. We will forecast the development of the USA export to the PRC for the period between August 2019 and December 2020. The specific data can be seen in Table 3.

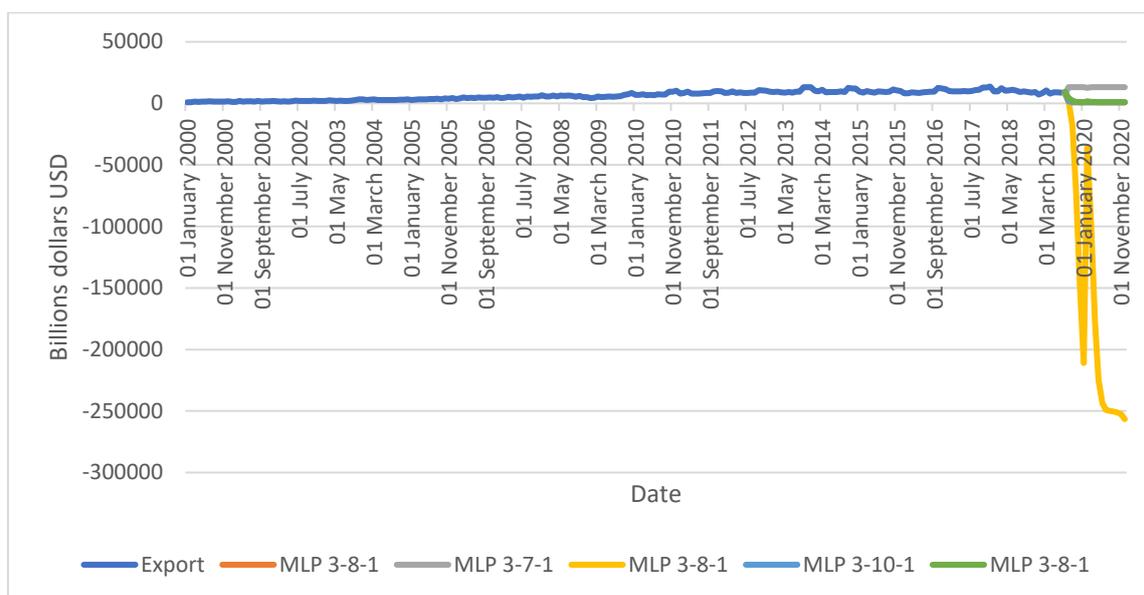
Tab. 3: Development of predictions for August 2019-December 2020 by networks retained in Experiment 1

Date	MLP 3-8-1	MLP 3-7-1	MLP 3-8-1	MLP 3-10-1	MLP 3-8-1
31 August 2019	9,311.689	7,453.37	7,554	9,170.906	9,347.852
30 September 2019	863.100	13,147.80	2,081	1,755.334	4,243.840
31 October 2019	863.100	13,147.80	-18,531	939.437	2,127.092
30 November 2019	863.100	13,147.80	-70,749	866.953	1,260.583
31 December 2019	863.100	13,147.80	-147,143	863.217	967.389
31 January 2020	863.100	13,147.80	-211,085	863.101	881.727
29 February 2020	863.100	12,684.06	-36,108	863.273	1,574.304
31 March 2020	863.100	13,143.35	-99,156	863.115	1,283.547
30 April 2020	863.100	13,147.80	-177,556	863.101	1,092.410
31 May 2020	863.100	13,147.80	-224,838	863.100	982.952
30 June 2020	863.100	13,147.80	-243,667	863.100	921.501
31 July 2020	863.100	13,147.80	-249,076	863.100	890.145
31 August 2020	863.100	13,147.80	-249,795	863.100	874.573
30 September 2020	863.100	13,147.80	-250,490	863.100	867.543
31 October 2020	863.100	13,147.80	-251,150	863.100	864.654
30 November 2020	863.100	13,147.80	-252,516	863.100	863.557
31 December 2020	863.100	13,147.80	-256,609	863.100	863.209

Source: Authors.

Obviously, the network 3. MLP 3-8-1 predicts further development of the monitored variable nonsensically. It even shows negative values of import, which is not actually possible. The network obviously suffers from overfitting. There are also significant differences between other neural networks (or between 2. MLP 3-7-1 and other retained networks). For choosing the most successful neural network, Graph 3 (development of time series and predictions) will be used.

Graph 3: Development of time series and predictions by networks retained in Experiment 1



Source: Authors.

Now it is time for expert estimate. Other networks might evidently also suffer from overfitting, and a significant one. In spite of this, one network will be selected for the final comparison of the individual experiments results. 1. MLP 3-8-1, 4. MLP 3-10-1, and 5. MLP 3-8-1 show almost the same results. We will thus choose one of them. Taking into account the statistics of the smoothed time series, it can be concluded that the most successful and most accurate artificial neural network is 5. MLP 3-8-1.

Experiment 2 (5-month lag in time series)

Table 4 shows the overview of neural networks retained from Experiment 2, where the assumed time series lag is 5 months.

Tab. 4: Retained neural networks from Experiment 2

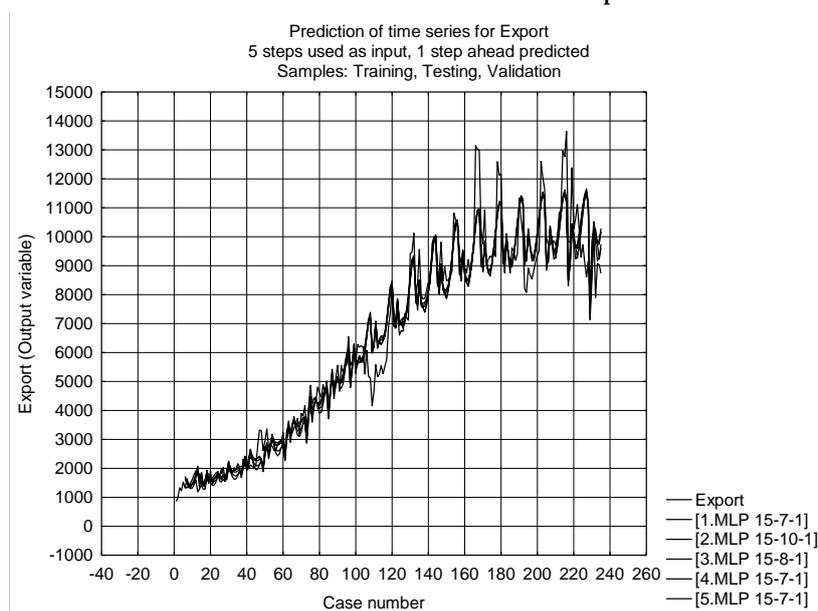
Index	Network	Training perform.	Test. perform.	Valid. perform.	Training error	Testing error	Valid. error	Training algorithm	Error function	Activation of hidden layer	Output activation function
1	MLP 15-7-1	0.973572	0.966155	0.972225	286349.4	338708.9	333663.0	BFGS (Quasi-Newton) 67	Sum of squares	Exponential	Logistic
2	MLP 15-10-1	0.973730	0.963486	0.972162	284104.3	360204.8	317915.7	BFGS (Quasi-Newton) 77	Sum of squares	Exponential	Logistic
3	MLP 15-8-1	0.974078	0.962645	0.973662	280208.0	366654.9	303239.0	BFGS (Quasi-Newton) 93	Sum of squares	Exponential	Logistic
4	MLP 15-7-1	0.973724	0.963440	0.973038	283899.5	362903.6	308651.9	BFGS (Quasi-Newton) 80	Sum of squares	Exponential	Logistic
5	MLP 15-7-1	0.973842	0.961769	0.972307	282599.9	371616.4	323001.7	BFGS (Quasi-Newton) 74	Sum of squares	Exponential	Logistic

Source: Authors.

In Experiment 2, the input layer contains 15 neurons. The table shows that the neural networks with 7-10 neurons in the hidden layer of the neural network were retained. For the activation of the hidden layer, exponential function is used. The output layer is always

activated by means of the logistic function. The performance of artificial neural networks measured by means of the correlation coefficient is above 0.97 in the training dataset, above 0.96 in the testing dataset, and above 0.97 in the validation dataset. This indicates a high level of direct dependence in all cases. Based on this parameter, it could be said that the networks (if not suffering from overfitting) will be able to forecast further development of the USA export to the PRC very accurately (since they smoothed the time series in the past very well). For the calculation of the error, method of least squares was used. In the case of export, the error is not big, and it also gives a quality prediction of the time series. Graph 4 shows the comparison of the actual course of the time series and smoothed time series.

Graph 4: Smoothed time series of networks retained in Experiment 2



Source: Authors.

It is evident from Graph 4 that all smoothed time series are able to capture the development of the actual development of the USA export to the PRC. The course of all smoothed time series is very similar to each other. The neural networks were able to capture the development trend as well as the seasonal fluctuations. However, they do not follow some extreme fluctuations completely. This refers mainly to the cases around the case No. 115, specifically from November 2008 to August 2009.

Also, in the case of export we will deal with the forecast of the future development of the monitored variable. We will forecast the development of the USA export to the PRC for the period between August 2019 and December 2020. Concrete data are shown in Table 5.

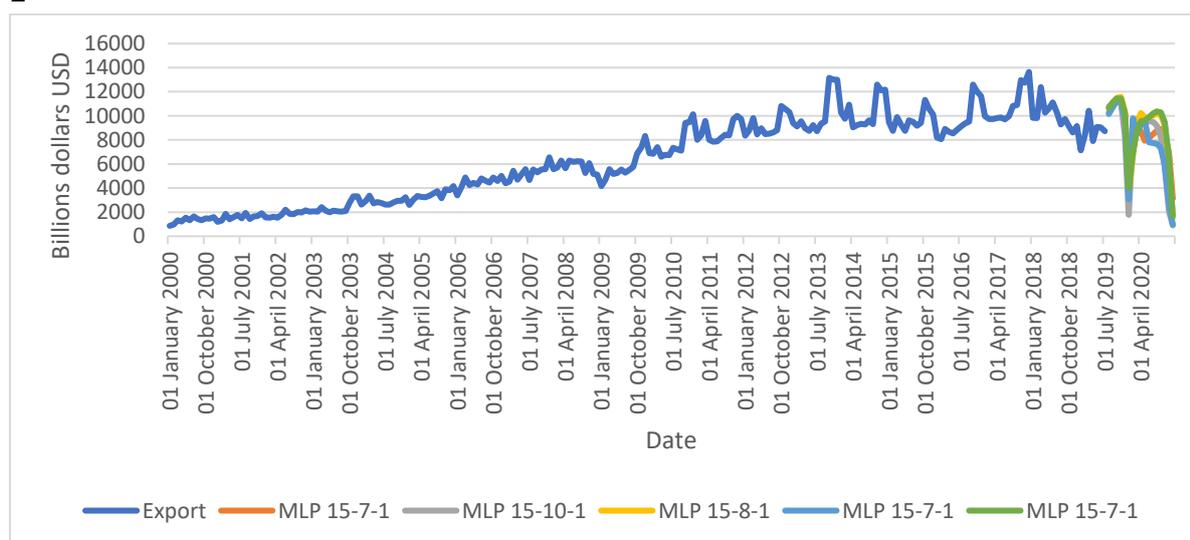
Tab. 5: Forecasts development between August 2019 and January 2020 by networks retained in Experiment 2

Date	MLP 15-7-1	MLP 15-10-1	MLP 15-8-1	MLP 15-7-1	MLP 15-7-1
31 August 2019	10,279.81	10,739.16	10,617.62	10,166.11	10,654.85
30 September 2019	10,814.64	11,132.83	11,098.27	10,731.32	11,111.66
31 October 2019	11,242.17	11,337.84	11,492.52	11,230.89	11,446.66
30 November 2019	11,295.93	11,009.44	11,566.69	11,264.85	11,425.88
31 December 2019	10,259.31	8,417.86	10,360.17	9,751.11	10,235.95
31 January 2020	5,031.43	1,788.88	3,628.02	3,083.52	4,019.12
29 February 2020	7,959.24	8,028.68	6,683.97	9,776.34	6,899.30
31 March 2020	9,160.78	9,694.63	9,285.55	8,493.03	8,691.60
30 April 2020	8,703.29	9,826.61	10,223.28	9,339.56	9,543.56
31 May 2020	7,939.71	9,665.11	9,824.08	9,601.72	9,605.19
30 June 2020	8,155.12	9,539.10	9,897.51	7,796.75	9,894.66
31 July 2020	8,455.32	9,508.48	10,030.46	7,752.58	10,175.60
31 August 2020	8,756.21	9,206.95	10,148.73	7,700.18	10,365.98
30 September 2020	8,906.66	8,228.94	10,044.15	7,316.84	10,290.13
31 October 2020	8,566.82	5,725.59	9,195.68	5,868.67	9,469.96
30 November 2020	6,921.72	2,075.81	6,110.72	2,740.77	6,474.23
31 December 2020	3,128.68	897.84	1,536.10	956.15	1,707.44

Source: Authors.

The results in the table represent a possible development of the time series. This is partly confirmed by the graph in Graph 5.

Graph 5: Development of time series and predictions by networks retained in Experiment 2



Source: Authors.

If we compare the actual development of the USA export to the PRC and the assumed development of the variable over time forecast by artificial neural networks retained in

smoothing the export time series, it could be concluded, that the best predictions of the networks future development are provided by 1. MLP 15-7-1.

Experiment 3 (10-month lag in time series)

Within Experiment 3, 10,000 artificial neural networks were generated as well, and out of them 5 with the best characteristics were retained (for more detail, see Table 6).

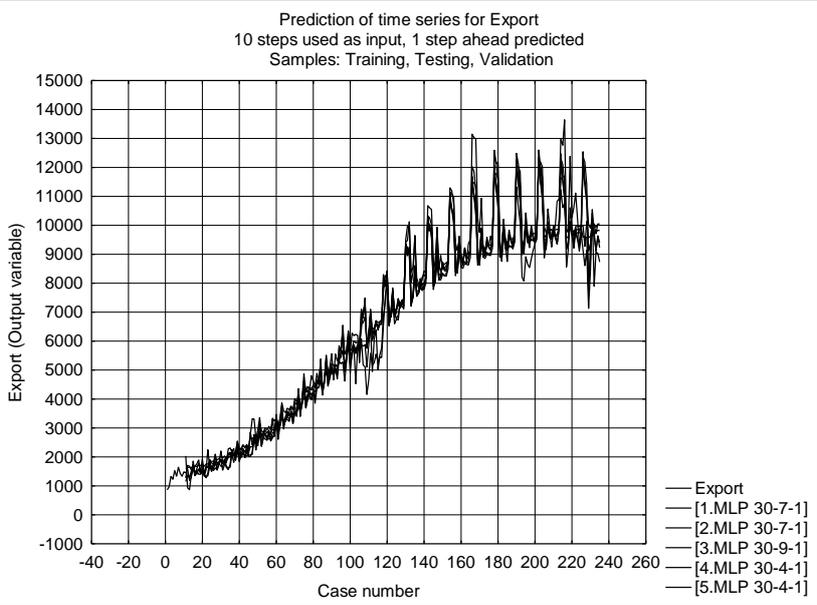
Tab. 6: Retained neural networks from Experiment 3

Index	Network	Training perform.	Test. perform.	Valid. perform.	Training error	Testing error	Valid. error	Training algorithm	Error function	Activation of hidden layer	Output activation function
1	MLP 30-7-1	0.985091	0.971938	0.973574	127979.9	256473.4	295789.7	BFGS (Quasi-Newton) 115	Sum of squares	Tanh	Exponential
2	MLP 30-7-1	0.973185	0.963315	0.974023	249204.1	375681.7	307967.3	BFGS (Quasi-Newton) 56	Sum of squares	Exponential	Logistic
3	MLP 30-9-1	0.971367	0.958293	0.971346	266211.7	427132.6	354171.7	BFGS (Quasi-Newton) 54	Sum of squares	Tanh	Tanh
4	MLP 30-4-1	0.974992	0.961217	0.971614	230192.7	382435.6	348428.8	BFGS (Quasi-Newton) 78	Sum of squares	Exponential	Exponential
5	MLP 30-4-1	0.977887	0.971500	0.972325	200683.0	262408.4	349029.4	BFGS (Quasi-Newton) 57	Sum of squares	Tanh	Exponential

Source: Authors.

The results of this experiment show that the input layer contains 30 neurons (date, month, year with 10-month lag). It results from the table that the neural networks with 4-9 neurons in the hidden layer were retained. For the activation of the hidden layer, neural networks use the function of hyperbolic tangent, logistic function, and exponential function. The output layer of neurons is activated by means of the exponential function, logistic function, and the function of hyperbolic tangent. The performance of the neural networks is also important. The correlation coefficient achieves very high values in all datasets: always nearly 0.98 or even 0.99 in the training dataset, above 0.97 in the testing dataset, as well as in the case of the validation dataset. Here we can also state a high degree of direct dependence. On the basis of this parameter, it is evident that the retained neural structures are a reliable model of the actual time series, and are thus able to predict the future development of the time series. For the calculation of the error, the method of least squares was used. But even here, the error is not big, and gives assumption of quality prediction of the time series. Graph 6 shows the comparison of the actual course of time series and smoothed time series.

Graph 6: Smoothed time series retained in Experiment 3



Source: Authors.

Graph 6 shows that all retained neural networks are able to follow the course of the actual development of the USA export to the PRC; moreover, the course of all smoothed time series is very similar to each other. The neural networks are able to capture the development trend as well as the local extremes (in very reliable way!).

In the case of 10-month lag, we will also deal with the prediction of the future development of the monitored variable. We will forecast the development of the USA export to the PRC for the period between August 2019 and December 2020. Concrete data are shown in Table 7.

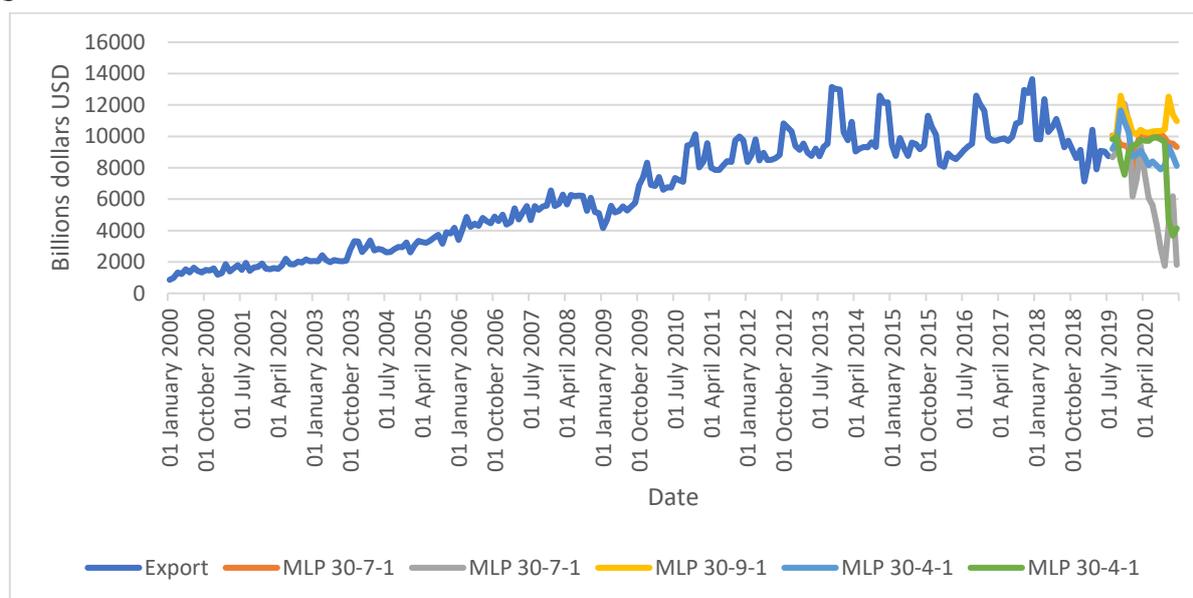
Tab. 7: Development of predictions for August 2019-December 2020 by networks retained in Experiment 3

Date	MLP 30-7-1	MLP 30-7-1	MLP 30-9-1	MLP 30-4-1	MLP 30-4-1
31 August 2019	10,058.88	8,663.91	9,980.19	9,199.18	9,814.631
30 September 2019	9,980.44	9,025.32	10,146.20	9,639.07	9,991.784
31 October 2019	9,449.71	12,209.91	12,589.54	11,649.85	8,427.897
30 November 2019	9,432.04	12,071.29	11,615.31	10,929.22	7,552.713
31 December 2019	9,287.95	10,904.09	11,063.09	10,254.92	9,024.839
31 January 2020	7,522.85	6,174.31	10,241.32	8,714.76	9,430.280
29 February 2020	9,462.77	7,310.10	10,139.62	8,833.07	9,474.664
31 March 2020	10,144.73	9,422.99	10,428.04	9,087.77	9,771.404
30 April 2020	10,161.47	7,722.10	10,247.71	8,683.64	9,722.581
31 May 2020	9,873.73	6,063.00	10,243.50	8,166.54	9,716.360
30 June 2020	10,184.83	5,626.68	10,325.84	8,414.12	9,905.207
31 July 2020	10,191.02	4,356.64	10,334.27	8,144.17	9,926.569
31 August 2020	10,204.51	2,889.16	10,343.70	7,896.86	9,806.443
30 September 2020	9,890.54	1,752.53	10,431.99	8,132.15	9,655.198
31 October 2020	9,566.93	4,331.46	12,533.29	9,365.36	4,656.181
30 November 2020	9,549.53	6,182.45	11,398.10	8,760.23	3,673.030
31 December 2020	9,313.62	1,809.09	10,965.42	8,119.01	4,125.885

Source: Authors.

As already stated above, smoothed time series are very similar to each other. The table, however, shows that some of the neural networks suffer from overfitting, which is partly confirmed by the graph in Graph 7.

Graph 7: Development of time series and predictions by networks retained in Experiment 3



Source: Authors.

The graph shows that 2. MLP 30-7-1 and 5. MLP 30-4-1 suffer from overfitting. They can thus be excluded from the further consideration. When comparing the remaining three neural networks (based both on their graphical course and the characteristics of all networks), it can be concluded that the network 4. MLP 30-4-1 shows the best predictions.

Discussion

Within this research, three experiments were carried out, where the development of the time series represented by the USA export to the PRC were investigated. It was primarily observed how multilayer perceptron networks are able to smooth time series, mainly with regard to the development from 2018 (when the trade war of the two countries was launched). In each experiment, 10,000 artificial neural networks were generated, out of which five best structures were retained. Some of them evidently suffered from overfitting. This refers to the neural networks from the Experiments one and three. Others are applicable for forecasting the future development of the USA export to the PRC. In all cases, the performance of the networks was high, while the error was small. In each experiment, the best network was identified and it was subject to further comparison (for more details, see Table 8).

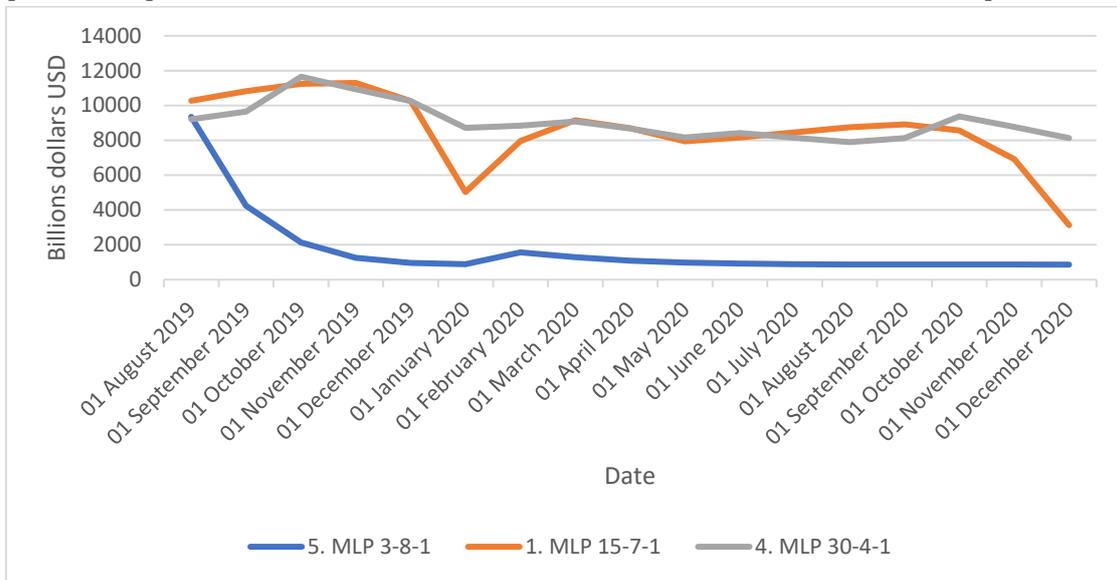
Tab. 8: Comparison of most successful neural networks from all three experiments

Date	Experiment 1	Experiment 2	Experiment 3
	5. MLP 3-8-1	1. MLP 15-7-1	4. MLP 30-4-1
31 August 2019	9,347.852	10,279.81	9,199.18
30 September 2019	4,243.840	10,814.64	9,639.07
31 October 2019	2,127.092	11,242.17	11,649.85
30 November 2019	1,260.583	11,295.93	10,929.22
31 December 2019	967.389	10,259.31	10,254.92
31 January 2020	881.727	5,031.43	8,714.76
29 February 2020	1,574.304	7,959.24	8,833.07
31 March 2020	1,283.547	9,160.78	9,087.77
30 April 2020	1,092.410	8,703.29	8,683.64
31 May 2020	982.952	7,939.71	8,166.54
30 June 2020	921.501	8,155.12	8,414.12
31 July 2020	890.145	8,455.32	8,144.17
31 August 2020	874.573	8,756.21	7,896.86
30 September 2020	867.543	8,906.66	8,132.15
31 October 2020	864.654	8,566.82	9,365.36
30 November 2020	863.557	6,921.72	8,760.23
31 December 2020	863.209	3,128.68	8,119.01

Source: Authors.

Table 8 indicates the differences between the neural networks, and indicates that the differences are significant. This is even better shown by Graph 8.

Graph 8: Comparison of most successful neural structures from all three experiments



Source: Authors.

The figure shows a very different course of the neural network from the first experiment and other neural networks. However, the neural network from the first experiment was included only formally, as it was clear at the beginning that the network suffers from overfitting. As for the neural networks from the other two experiments, their course is less different from each other. However, it is evident that the neural network retained in the second experiment assumes a very extreme development – a fall in the USA export to the PRC. If we considered the unbalanced development of this time series, we would probably choose the network from the second experiment as the most successful one. However, due to the law of large numbers, it is not likely that the development of the network at the end of the monitored period would be as extreme as the prediction of the network retained from the second experiment indicates. We thus choose the network retained from Experiment 3 – 4. MLP 30-4-1. It is thus evident that 10-month lag was positive for the structure of the network and its predictions.

Conclusion

The objective of the article was to forecast the export of the United States of America to the People’s Republic of China.

It can be stated that the objective of the contribution was achieved:

1. Multilayer perceptron networks appear to be an excellent tool for forecasting the USA export to the PRC.
2. MLP networks are able to capture both the trend of the whole time series and its fluctuations. Despite of this, it must be stated that in the area of the USA export to

the PRC, there are no long-term mutually beneficial and stable relationships. The time series thus show unexplainable fluctuations.

3. Time series lag has to be applied. Acceptable results have been shown in the case of a 10-month lag.
4. The reciprocal sanctions of both countries significantly affected the USA export to the PRC but they did not affect significantly the result of machine learning forecasting. This is mainly due to the fact, that only some artificial neural networks are subjected to analyses and subsequently tested. This eliminates the probability that the suitable neural network will not suffer from overfitting. However, it can be assumed that in the case of the research of time series, overfitting was caused by the gradation of the trade war between the USA and the PRC.

Further research shall be focused on the elimination of overfitting in time series forecasting.

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Methods of formulating business goals implemented in ERP accounting systems

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Abstract

The importance of technological innovations is gaining in intensity with the growth of production, distribution and expansion abroad, together with the development of the potential of knowledge workers. The use of automation in robotic processes is used in business processes, which allows increasing productivity in individual parts of processes. The ERP system can accelerate and support efficiency in the supplier and customer process, e.g. in conjunction with Customer Relationship Management. The aim of the paper was to implement an ERP accounting system for a specific project of a company in an international corporation. The aim of the project was to increase the efficiency of accounting operations, simplify the process of recording invoices in the system, and increase the security of the system so that it meets the requirements of accounting audit and IFRS. The primary method used was the logical framework method, which dealt not only with setting business objectives, but also with project management in general, taking into account project management and measurable project outputs, albeit with low / minimum added value and gross time risk.

Keywords: business goals, methods SMART & CLEAR, Objective Key Results, Logical Frame Logframe, ERP accounting system

Introduction

In project management, there is a dynamic development thanks to new information technologies, the development of software designed for project managers and rapidly changing trends responding to the basic and specific needs of non-traditional companies. Partial work activities and orders can be recorded in projects implemented in project management with the ability to monitor budgets, including the use of resources, assign tasks, check deadlines, report (Ploder, Dilger and Bernsteiner, 2020). The ERP system

automates and integrates key business processes, such as receiving customer orders (Reisenwitz and Fowler, 2019), planning operations, keeping inventory records (Wei et al., 2020) and financial data (Astanakulov, 2019). It offers parametrization of functions, as well as space for the development and integration of specific customer/company/employee requirements, as well as the introduction of new approaches in production with regard to innovations in Industry 4.0. ERP systems help improve organizational efficiency by helping to define business processes throughout the supply chain (Bing, Yang and Kang, 2020), protect business data through specified roles and provide access (Nývlt, 2018) allow to plan work time based on existing orders and forecasts, and provide tools implemented in basic and specific customer services, transform data for managerial decision making purposes (Erskine, Khojah and McDaniel, 2019).

The formulation of objectives plays an irreplaceable role in project management during the entire project life cycle, but also in terms of a future contract with a supplier or service provider in cooperation with the development of outsourcing and the role of external teams cooperating on remote projects. The goals of a corporate project influence the planning processes of the project (Huikku, Hyvönen and Järvinen, 2017); define its timing, financial framework (Andreeva et al., 2019) selection of methods and procedures used for project implementation. Furthermore, they play an irreplaceable role in control processes (Wu et al., 2019) as they provide a framework for measuring indicators, including the informative value of the results achieved (Głodziński, 2019). The exact formulation of business goals is partial for communication between the project manager, the sponsor and the project team (Pearson, 2019). If third parties are also involved in the project, a contract with a detailed description of business objectives, time frame for achievement and the budget defined above is a necessary parameter, which also serves as legal support across the life stages of the project. The contract, which confirms the binding nature of the wording of corporate goals, determines the conditions for a good level of project communication during the life of the project and is the bearer of the formulation of final, evaluation and monitoring reports.

In the first part of the paper, the author points to the methodology of formulating business objectives implemented in the ERS accounting system (Enterprise Resource Planning) from a theoretical point of view (Izhar et al., 2018) and with the help of literature sources interprets methods of formulating business objectives, including evaluation of benefits/expectations, advantages/disadvantages, risks/limitations (Bočková, Gabrhelová and Vaníčková, 2017). She takes into account technological possibilities in the formulation of business goals through the application of computer modules as support tools for project managers applied to accounting systems (My Le, Hoang Tran and Thuy Tran, 2018) and (Sankaran and O'Brien, 2018).

The analytical part is devoted to a case study of the project of implementation of a new accounting system (Pan, Teoh and Seow, 2014), including a comparison of theoretical and application presumptions of the researched topic of business objectives formulation with an emphasis on critical and analytical thinking, strategic approach to defining goals

(Kitsios et al., 2019) and systematic decision-making (Colapinto, Jayaraman and La Torre, 2020), which was not entered into a contract with the service provider at the beginning of the project, there was no inaccurate description of business goals and methods used to formulate business goals, which had a major impact on the project life cycle (Martínez-Blanco, Forin and Finkbeiner, 2020), as it could cause project failure. The author of the paper asked herself the question: "How would the possible use of a higher number of research methods adversely affect the course and time of implementation of a project that was classified as successful, even though it lasted twice as long as planned and led to the departure of several key employees?"

One of the basic methods to help formulate business goals was the SMART method, which defines the basic parameters of business goals.

SMART method for formulating business goals

S: Specific – Goals should be specific and concrete. Specification of the goals can be determined using the 5 W method, i.e.: "WHO, WHAT, WHERE, WHEN, WHICH and WHY".

M: Measurable – goals must be measurable. Based on measurable parameters, it is possible to determine whether the goal has been achieved. The value must be repeatedly measurable using the same methodology. The KPI (Key Performance Indicators) method measures the time, quality and budget of a project that is part of the company's goals.

A: Assignable – goals can be assigned to someone and the responsibility for achieving them can be defined.

R: Realistic – goals should be feasible and achievable with the help of available resources.

T: Time-bound – goals should be time-bounded.

The benefit of the SMART method is the design of specific objectives of the organization with the definition of procedures how to achieve the objectives. The advantage is the decision on the choice of alternatives for future ways of performing activities and the possibility of project management within the strategic management. The disadvantage is to a large extent subjectivity and error in the formulation of goals in relation to the external and internal environment (Bershadsky et al., 2019). The KPI method is beneficial from the point of view of setting indicators and performance indicators in the process, service, department and the whole company in relation to quality, efficiency (Akhanova et al., 2018) and economy. The advantage of the method is measurable value, which interprets the achievement of the level of effectiveness of key business goals within the evaluation of processes in individual departments, such as sales, marketing (Feng et al., 2020) and human resources. The disadvantage and risk is the formulation of inappropriate indicators that do not have a positive effect on a positive change in the organization, may limit the sharing of information between business processes (Mousaei and Gandomani, 2018).

Objective Key Results (OKR) method

The OKR objective setting system is based on the MBO (Management by Objectives) method and their interpretation was advocated by John Doerr from Google. The OKR method is similar to the KPI method, as both methods are used to measure the company's performance and goals; however, they differ in their intended use. The KPI is applied to show the performance of teams with respect to the set business goals, as it takes more account of the quantitative side and reflects the current state of fulfilment of business goals in relation to individual team members. OKR displays the general comprehensive goals of the organization, including priorities at the strategic level, while KPI is integrated into the individual performance of the employee / teams for regular inspections and feedback in order to achieve key results according to project success / failure.

The following rules apply to the OKR method:

The main objectives should be a maximum of 3-5, each of which should have about 5 measurable and clearly defined Key Results. Specifically, defined Initiatives should lead to the fulfilment of Key Results. OKR should be divided according to the following pyramid within the whole organization/individual departments/individuals. The ideal state can be achieved on the assumption that each employee fulfils 3-5 formulated objectives, then the success of fulfilling the objectives moves along the vertical axis upwards to meet the complete/global goal of the organization/company. The OKR method is an ideal project management tool because it simply shows which activities are to be performed in summary. The benefit of the OKR method is the systematic assessment of the company's mission and vision of all employees who contribute to the company's goals. The disadvantage is the formulation of smaller objectives, for which only individual departments are responsible, not individuals, which is a limitation mainly for larger companies with more than 25 employees.

CLEAR method for formulating business goals

A newer method of goal setting, which takes into account the rapidly changing turbulent environment of international companies reflecting challenges and taking into account the human factor in the business environment, is a method for formulating business goals called CLEAR.

C: Collaborative – Objectives should encourage employees to work together and support team spirit.

L: Limited – Objectives should be limited in scope and time so that it is clear that the limit values are realistic.

E: Emotional – Objectives should motivate employees; evoke a certain enthusiasm and emotions that have a positive effect on the quality of work performed.

A: Appreciable – The generally defined objective should be divided into smaller sub-objectives, for the achievement of which the employee should be provided with adequate remuneration.

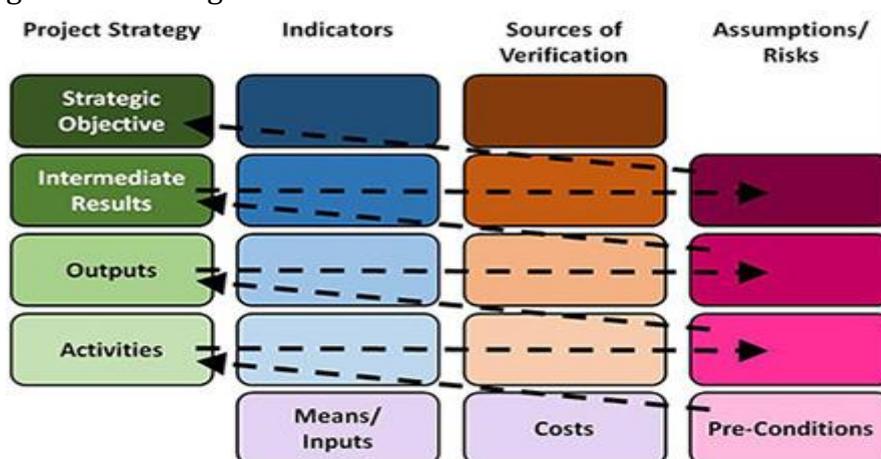
R: Refinable – Objectives should be easily achievable to respond flexibly to unexpected changes and accidental, often unpredictable situations, according to the needs of the dynamics of a changing environment and working conditions.

Logical framework method

Logical Frame Logframe or LFA is a methodology of project management, which not only solves the setting and formulation of goals, but uses all project stages within the entire project, i.e. the planning, implementation and evaluation phases of the project (American University Washington, 2020). The method defines a logical framework of conditions for meeting the objectives of a complex project. The matrix of the logical frame contains a table with about 16 components (15 to 17 fields), which are interpreted in columns or rows in terms of the vertical axis of the logic of the frame with respect to the horizontal logic of the frame – see figure 1.

The advantage of the logical framework method is the formulation of key project parameters before starting the project in the pre-project phase. The form of output is a logical frame called a document. The outputs of the project are not added value or justification for the actual implementation of the project. The risk is a rough estimate of the time required, which can be defined as the interval with the implementation of partial activities.

Figure 1: Logical Frame Logframe



Source: American University Washington, 2020.

It is important to take a closer look at Czech-English terminology, as the terms goal and objective are often confused:

The Goal/Overall objective/Development objective, e.g. general, global, overall goal/intention, benefit of the project.

The Purpose/Immediate objective, i.e. the purpose/partial, immediate objective of the project.

The Outputs; The Activities of the project.

The general goal of the project is to define the main goal of the project, which determines the direction of the project and the final result of the complex project. The global goal refers to the strategic need of the company and the main purpose of business development, which is to be fulfilled by the implementation of the project. The overall goal is often elaborated in more detail into a hierarchical structure of immediate objectives, which are the bearers of the requirements of the contracting authority and the future project implementer. A project logical framework is a type of matrix that interprets logical relationships in a project. In terms of the vertical dimension, it reflects the relationships between global goals and specific objectives, project outputs and sub-activities. It points out the assumptions and risks of the project, but also the causes and consequences. The horizontal line consists of 4 columns with verifiable indicators, key indicators and data sources. In terms of logical links, each column on the horizontal line has information from the previous column, which dissimilates, while on the vertical axis when reading the table upwards, each row encourages activities to achieve a higher level of objectives and global/overall goal. Logical links, vertical or intervention logic should be an integral part of the logical framework in the cause/effect/consequence line. The relationships in the table can be verified by the so-called *if-then* method.

Methods and Data

The aim of the project was to increase the efficiency of accounting operations, simplify the process of registering invoices in the system, increase the security of the system to meet the requirements of accounting audit and international financial reporting standard, but also reduce operating costs. The ERP accounting system was presented in the theoretical part as a suitable system for formulating business goals. The interconnectedness of theoretical and practical knowledge in connection with the new accounting system played an important role. The premise of the new accounting system was to ensure higher efficiency and effectiveness compared to the original system in order to improve the transfer of information by testing the system itself. The output was a comparison of the original accounting system with the new ERP accounting system. The methods of formulating business goals, which were described in detail in the theoretical part, were applied to the ERP accounting system. The logical framework method enabled the identification of the main benefits, objectives, outputs and activities of the project in relation to the business goals. The OKR method was interpreted based on project criteria and parameters in the time interval of September 2019. The SMART and CLEAR methods designed to formulate business goals were formulated as a unified system, the aim of which was to define business goals related to the performance of individual employees.

In connection with the planning and management of resources, it was necessary to ask basic questions when choosing an ERP system:

Q1: Why do I need a better business management system?

Q2: What resources do I have available in the company?

Q3: Which of these resources do I need to plan and manage?

Q4: In which localities do I carry out business activities?

Q5: What predictions do I expect in the future in the field of business?

Q6: Do I have a qualified workforce to implement the accounting system in operation?

Q7: Do I have a sufficient technological base for the operation of the accounting system or I am not currently interested in implementing information technology in the production process and do I use cloud storage?

To fulfil the defined goals, it was assumed:

H1: The total processing time of one incoming invoice by the application programme does not exceed the average period of 10 minutes.

H2: The number of staff required for routine accounting operations may be reduced by 30% if the quality of the work performed is the same.

H3: Each step implemented in the accounting system will be traceable and determine which employee performed the operation and when.

H4: The implementation of the system, the so-called Go Life, will take place no later than 1 year from the actual life of the project itself.

H5: Individual employees will not be involved in testing a new version of the accounting system for more than 20% of the daily working time.

H6: Budget will not exceed \$ 500 per month (\$ 1,000 with license).

H7. The implementation of the ERP system will require increased communication during training and testing of employees.

Results and Discussion

Formulation of business goals implemented in the ERP accounting system

In the analytical part of the paper, research methods interpreted in the theoretical part were applied to the new accounting system. The project was currently evaluated as completed, however, the analysis of the author pointed to new findings that affected the life cycle of the project in all stages. Based on the findings, the author of the paper asked a hypothetical question: "How would the unsuccessful expectations of the project be addressed if the corporate goals were formulated differently and in a different way depending on the theoretical knowledge of these research methods?"

Before the actual analysis, it is necessary to mention the specifics of the project, i.e. replacement of the Navision system with Dynamics D365 system, where for the purpose of analysis it is called ERP system, in which most middle and senior management staff participate in cooperation in partial processes of approving invoices and financial expenses including budgeting. The system is most often used in the finance and

accounting departments in the scope of all-day work, but also in other departments, where it is used, for example, for archiving for audit purposes. The reason for replacing the original system was insufficient capacity and performance in the dynamic development and growth of the selected company, inability to consolidate accounting internationally in situations where the company has a parent company located on two continents, but also the fact that the old system did not meet internal and external audit requirements including higher security system, which seemed less reliable. Four teams collaborated on the complete testing and implementation process, two of which were external, the others internal, which operated at the company's headquarters (financial testing teams and corporate IT teams). The method of communication outside the company was implemented through the JIRA tickets system with the help of the Microsoft Teams application, whose task is to apply the technical solution to the accounting system. The main challenge was to ensure the interface of the new ERP accounting system with the existing extensive MXP database, which was used for the purpose of the ordering system and its processing took place in individual departments of a selected company specializing in tourism, specifically shipping. Given that the purpose of the new ERP system was to replace the current system, the formulation of business goals depended on technical parameters and KPI indicators measurable in the old system. In comparison with the previous situation, a comprehensive improvement of the current situation was expected for all output values with regard to increasing the efficiency of accounting operations, simplification of the invoice registration process, including ensuring greater security with regard to accounting audit requirements.

Logical Frame Logframe

On the example of the logical framework method – see attachment Tab. 1 shows the implementation of an ERP accounting system with the absence of the formulation of general business objectives.

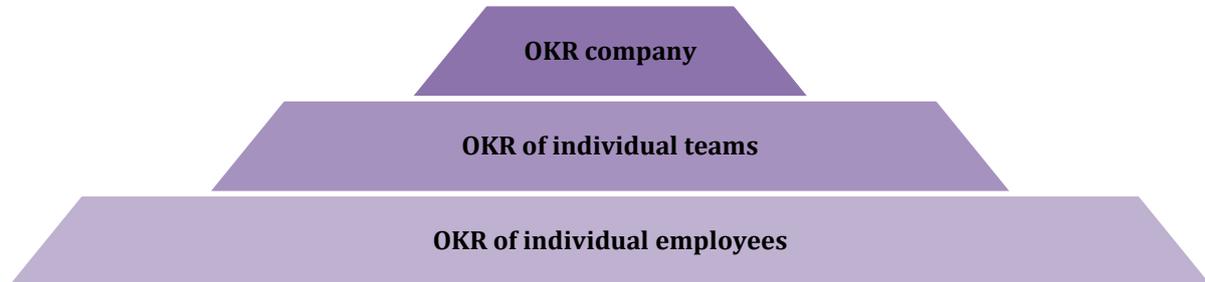
The method of logical framework is suitable for complex implementation of projects, especially of large scale, because they can define the project strategy and partial project activities. The disadvantage of the logical framework method is the non-complex evaluation of the influence of socio-economic, financial or personnel factors, therefore it is recommended to combine the method with other supporting tools of project planning, including the formulation of corporate goals.

Objective Key Results

The Objective Key Results method was selected based on project parameters, e.g. international long-distance teams, project duration, 150-200 actively involved employees, application of a new ERP system, which is intended for almost all permanent staff as a suitable method to complete the logical framework and SMART method. , which offers a brief and quick overview of individual activities in the company / team / individual employees. Its advantage is the possibility of setting small objectives for individual employees, which support the team goals to fulfil the overall / general / global

goals through a pyramid structure. Through partial, gradual steps, it is realistic to monitor individual employees and test their roles in the team. An example of setting business goals for a given project for a sub-period is shown in figure. 2.

Figure 2: OKR Company for the period 09/2019



Source: Author.

To close the testing process by posting PO - purchase order invoices to the accounting system.

Objective of the financial team for the period 09/2019: Testing of all available variants of PO invoices in the accounting system.

The key results of the financial team at the end of the time period were:

Created a clear breakdown of variants of all POs and the distribution among individual employees according to testing capacities prepared at the end of the period.

Meeting with IT teams, support in individual accounting operations with argumentation of requirements in the accounting system.

Testing the system interface with the existing database on specific cases of PO on a sample of 80 invoices.

General manual for accounting of special cases.

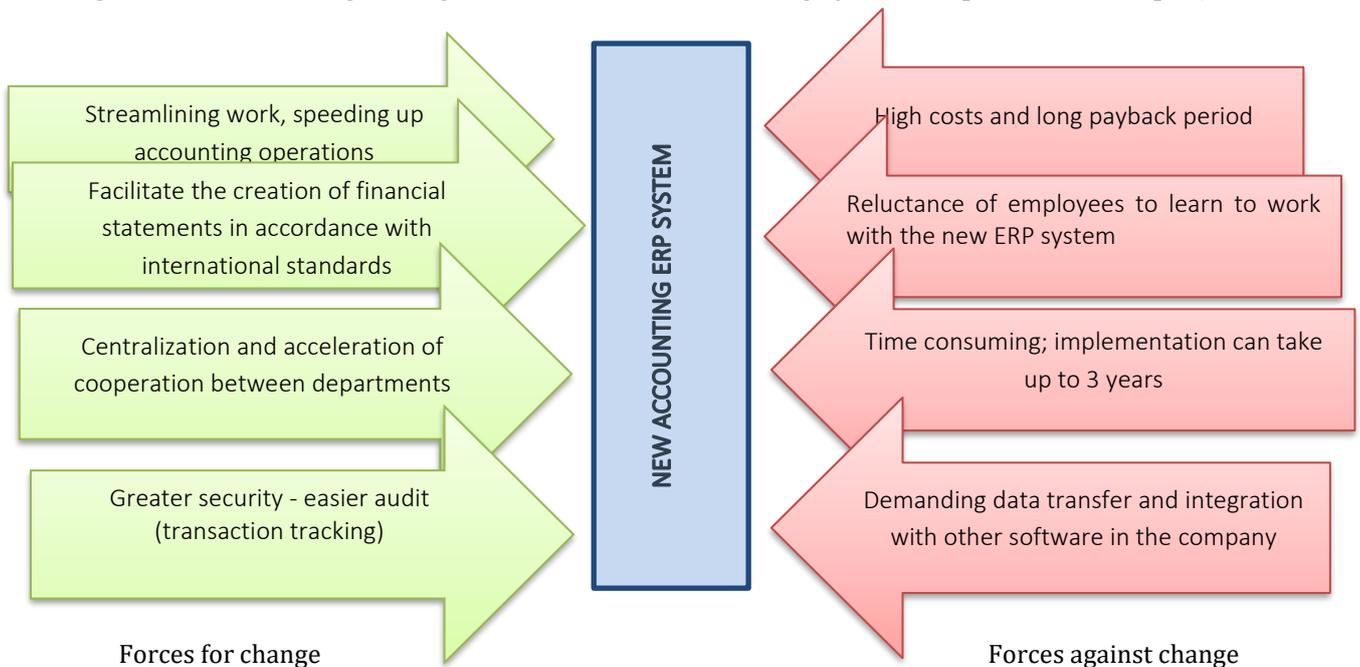
The goals of permanent staff were set in the individual tasks assigned to them. The team manager via a shared spreadsheet file managed the ongoing performance of the financial testing team goals.

SMART & CLEAR

The ERP system implementation project was going through a bad patch from the very start due to growing resilience of the staff involved in the testing process. The staff was not properly paid during the testing phase and did not understand the context and interfaces of the project due to closed communications. The only chance was to operate the system based on the acquisition of new knowledge and behavioural skills. The correct implementation of the ERP accounting system can be seen in figure 3. If the corporate goals and objectives were clearly formulated at the beginning of the project and integrated with the CLEAR method reflecting Appreciable, Collaborative, Emotional and Refinable there would be higher motivation, commitment and satisfaction, and teamwork

that is more effective and the individual sub-goals would not seem distant and unattainable. The application practice of a subproject showed the project was threatened and unsuccessfully finalized although the business goals and KPIs were carefully measured in the quantitative dimension due to the underestimated motivation and commitment of permanent staff, which resulted in complete project failure with Go life postponed nearly by one calendar year.

Figure 3: Field strength diagram of the ERP accounting system implementation project



Source: Author.

Conclusion

Cloud and cloud services are nothing new as ERP and CRM software run in the cloud is the current trend. They can also be understood as the delivery of services or programs (ERP, CRM) stored on web servers. Users can access and use them remotely via a web browser. Desktop applications that require installation are slowly becoming outdated as the technological and business model of enterprise systems changes and simple registration via an Internet browser that can be purchased for any number of calendar months a year is sufficient. The operational efficiency of the system is supported by mobile applications available from Android, or Windows based operating systems, etc. It is easy to use cloud applications because you can access and retrieve information via a PC, tablet or mobile application having access to computer networks. Application solutions are affordable and regularly managed and updated by the software provider. The benefit of the ERP system implementation consisted in detailed real-time monitoring of events in the company with central data available and stored at one point with regard to data security, more efficient process management, more suitable working environment for employees, monitoring of material movement between centres, e.g. production and

warehouse, finished products and products after warranty, etc. by exchanging data (export and import) with other systems enabling simple global integrations, e.g. exchange rates, language mutations, etc. adapted to user interface, including the access rights of individual employees. The process basis for the operation of an accounting system and the implementation of information technologies are more useful and efficient than using cloud storage. The SMART method, which allows planning, and defining business goals can be considered for implementation of an ERP accounting system. Using multiple research methods in different project phases of the project life cycle considering a number of variables challenging the actual implementation during the project life will cause discrepancies and create space for risks across all phases of the project. In view of these facts, it is desirable to innovate research methods, techniques and scientific procedures and redefine the situation with small and partial objectives to promptly respond to challenges and allow coming up with specific measures for members of the international design team operating in different foreign cultures of the Group. The drawbacks of the ERP system implementation included high investment costs, long-term ROI; financial challenges of software modifications, high license fees, and the implementation schedule which averaged 6 to 18 months, or continuous supervision.

The aim of the paper was to implement an ERP project management system for a specific company project in an international corporation. The objective of the project was to increase the efficiency of accounting operations, simplify the process for posting invoices in the system, and improve the system security to meet the requirements of IFRS and accounting audit as well as reduce the operating cost of the accounting department. In the analytical part of the paper, the Objective Key Results method was analysed by the author in more detail. It was suitable for the project as an additional method for work in individual project teams because it is more straightforward and has a simpler structure. The OKR method with a focus on a specific employee was used to confirm the total processing time of one incoming invoice by an application program not exceeding the time average of 10 minutes. The number of staff needed for routine accounting operations could be reduced by 30-35% if performance quality is maintained and each completed step can be traced to the employee who performed the operation. The deadline for the implementation of the accounting system was set for a calendar year in order to improve the quality of activities and business processes in the accounting system. The original project goals could be improved by setting small, partial project goals for individual employees to monitor the fulfilment of team goals more accurately, including the deployment of goals for individuals. The key point about choosing a method for formulating business objectives was the fact that several international teams from different continents, of which two external teams of suppliers, were involved in the project. The real life of the project was two years and approximately 200 employees were involved in it at various levels of the testing process, therefore using only the OKR method seemed insufficient. The application of the CLEAR method proved to be useful for the given object. Looking back at the life path of the implemented project to explain the reasons for the time lag, the disincentives of the individual employees involved in testing and implementation of the project should be mentioned. The lack of motivation tended to

burnout as it was caused by the insufficient remuneration of permanent staff for their performance where testing of the new system accounted for 20-40% of daily working hours beyond routine work and activated stressors leading to emotional instability and mental fluctuations, and frustrations, or intolerance in the team, etc. As a result, the quality of teamwork, interaction and relationships in the workplace, and the corporate culture, or internal communication were affected. Long-term high commitment and working in parallel in the test environment of the new system and the real environment of the old system triggered termination of employment contracts and dismissal of several key employees. Because of this absence, the Go live process slowed down significantly. The situation would have not necessarily had such consequences if more account had been taken of the importance and impact of the CLEAR method on formulating business objectives for project teams with a view to Appreciable goals, Emotional goals, Collaborative and Refinable goals that are disregarded by quantitative methods such as OKR or Logical Frame Logframe because they strictly focus on the staff performance and KPIs without considering the hazards / risks associated with the fact that the project may fail due to lack of staff motivation and inability to work as a team, not the achievement / output of a measurable indicator. Labour intensity, complexity, and commissioning is a very time-consuming and manually challenging activity, which requires logical, strategic, and systematic thinking, and competent decision-making. The general recommendations for the implementation of an ERP and CRM system in application practice are to analyse the needs of the company, select software and modules, implement the system, provide training and testing, develop guidelines and a communication plan, motivate employees, evaluate and present the system benefits and make the system ready for everyday use. Any technical change in the ERP accounting system will require qualified workforce for the implementation and commissioning of the accounting system. The author of the paper recommends combining the ERP system with other information systems, e.g. CRM, which in many cases can run independently to meet the overall benefit expectations. Large companies most commonly use systems such as SAP, Oracle, etc. while small and medium-sized companies in the Czech Republic most often use the Czech Helios system. The SME sector has experienced a number of positive / negative changes in recent years with certain limitations / risks that should be avoided, e.g. for business stability in terms of undercapitalized business, unpredictability of external effects on business operations, failure to meet the project expectations which does not create a competitive advantage, over-optimistic visions of the company sales, unrealistic choice of business objects, and industry, or location where supply exceeds demand, and low or limited response to acceptance of a change.

The scientific literature does not provide positive references on the ERP system implementation. Just about half of the ERP implementations will fail and almost 90% of all implementation projects will not meet the schedule or exceed the planned project budget. The main reasons for failure to meet the plan included, for example, unexpected obstacles in the system functionality, which necessitated a larger scope of implementation work, or lack of technical support and the company's inability to adapt internal processes to the new ERP system. In the case of ERP, the adherence to a time schedule and financial

plan caused deterioration in the quality and complexity of the system in relation to business processes and sub-processes and adverse consequences in the end. For successful implementation of the ERP accounting system, it was necessary to communicate with end users and support the project in all phases of the life cycle, and provide training for end users and detailed testing of all system components before go live, and work together with the specific departments, set implementation strategies as a team mission and not just as new user software. It was necessary to emphasize accuracy and diligence when entering transactions or events and to be responsible and encourage open communication when entering data into the ERP system in terms of strategic decision-making.

A controlled survey was conducted to identify facts providing answers to research questions as to why companies need a better system like ERP:

- ERP should better integrate the key business processes.
- The system should facilitate the invoice approval process.
- The new system should reduce the need for IT support.
- Reduction of accounting costs.
- Facilitate consolidation and reporting in line with IFRS.
- Accurate and immediate audit data recording.

The development of industrial automation and globalization towards customers/companies/employees leads to the need for continuous innovation of processes, products/services. The implementation of such innovations is associated with additional costs beyond the scope of current operating expenditure invested in purchasing advanced automated control systems and information technologies with the application of innovative techniques, scientific procedures, research methods and professional training and learning to achieve the expected results. The ERP system implementation is a challenging milestone for most domestic and foreign companies in today's automation era with requirements for processing large volumes of data and transactions. If corporate goals and objectives were formulated other than in the interpretation of research methods this could lead to an incorrect definition of the very essence of the ERP accounting system and influence key results. Using a higher number of research methods could adversely affect the flow of information during the implementation of partial operations for a given project. It was necessary to consider innovations of the ERP system such as graphical outputs responding to real-time data changes, data visualization and their connection with arbitrary data sources, graphical redesign especially applicable to the values, mission and goals of the company. All the above values represent resources that are indispensable for a company. Research methods, data and staff training play an important role. They would be inefficient without planning and subsequent management of the output operations. Small and medium-sized enterprises should continuously pursue the improvement of business activities through innovations in all areas, including management, research and development, and production or sales. Predicted future expectations can be seen in innovative business and knowledge transfer partnerships, especially for SMEs, and integration toward customer

satisfaction, creation of a competitive advantage, product / service cost reduction, market margin increase, compliance with corporate goals and objectives, but also the integrity and professionalism of company managers, owners and executives whose managerial decision-making is influenced by their resilience, well-being and mental hygiene.

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Attachment

Tab. 1: Logical Frame Logframe

	Project description, content requirements	Objectively verifiable indicators	Sources of information for measuring indicators	External assumptions and risks
The main benefit of the project	Reducing the costs of accounting and auditing administration in the company.	Thanks to the new system, a lower number of workers with a higher volume of work will be needed.	The company's budget and the annual report of the finance department within the financial documentation	The cost of implementing the new accounting system will outweigh the economies of scale.
Project goal	At the end of the fiscal year, have a functioning ERP accounting system that is more efficient than the previous system and complies with IFRS ¹ .	Number of posted invoices/time, posting time of 1 invoice, result of external and internal audit.	Accounting system report for the number of operations/1 minute, Statistics of the time required for 1 automatically posted invoice. Audit error report.	During the test period before Go life, turnover of key employees is expected due to overwork, burnout and insufficient motivation, commitment and dissatisfaction.
Project outputs	The time of each accounting operation is reduced. Thanks to the automation of the system, there will be no overtime for employees, reducing the number of permanent staff. The individual steps in the system will be clearly documented for audit and further monitoring purposes.	Posting time of one invoice. The number of employees needed to work in the previous system and now. Test audit team reports.	IT reports reported by the system, reports from the existing ERP system as a comparison of efficiency. Employee timetables.	The interface with the existing database will work. Employees will not feel threatened by the full automation of the system and will cooperate in testing it (automation will reduce the number of jobs).
Project activities	Testing the new system on a daily basis. Filling in test protocols. Collaborate with IT to improve system performance and eliminate deficiencies. Preparation of an error report.	Installation of a test version of the new ERP accounting system into the PC of permanent staff. Training and manual for the new accounting system. Pre-prepared protocols for completion. Preparation of written statements by the manager.	Comparison tables of time intensity of individual accounting operations in the old and new system.	The test version of the system will not work at the same speed as in real time, i.e. it is not possible to objectively compare the obtained results. Removal of the weaknesses will be formal.

Source: Author.

¹ IFRS (International Financial Reporting Standards).

Millennials as a Target Segment of Socially Responsible Communication within the Business Strategy

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Abstract

The topic of corporate social responsibility is currently very up-to-date and is gradually becoming the focus of stakeholder's attention, mainly consumers. Especially, one generation of consumers, Millennials, is considered to be the driving force behind the demand for socially responsible brands and products. The key factor to achieve the positive attitudes of Millennials towards the socially responsible brand is the appropriate communication targeted particularly on this segment. The article is aimed on Millennials as a target segment of socially responsible communication within the business strategy and the determination of the most efficient tools of socially responsible communication with Millennials. This includes the literature review on the issue and analysis focused on the perception of socially responsible communication by Millennials. The secondary data for the analysis were obtained from scientific researches, statistical tables and published professional publications. In order to determine the most efficient tools of socially responsible communication, a questionnaire survey was conducted among Millennials. Based on this, measures for the efficient implementation of socially responsible communication with Millennials are proposed, and its benefits are highlighted, such as strengthening the company's image, improving its reputation, building customer relationships and gaining the customers loyalty to the socially responsible brand.

Keywords: Corporate Social Responsibility (CSR), socially responsible communication, marketing communication, consumers' generations, Millennials, sustainability, business strategy

Introduction

Currently, the concept of corporate social responsibility is becoming a mantra for companies around the world (Sroka and Szanto, 2018). Its essence lies in the fact that companies focus not only on profit but above all on sustainable growth and development. In addition to their economic activities, they also pay attention to the social and environmental aspects and emphasize that these interests do not have to be contradictory, but conversely, they can work together and thus increase their efficiency (Moravcikova et al., 2017). Around the world, the number of companies that apply CSR principles in their business strategy is growing rapidly (Krizanova and Gajanova, 2016).

One of the motivations for socially responsible business is to improve reputation as well as brand awareness (Kliestikova, Kovacova and Radisic, 2018). The company may achieve this goal only by informing about its activities (Gajanova and Podhorska, 2019). When it invests time and money in CSR, it is indisputable that it should also invest in communication about these activities. Socially responsible communication raises general awareness of CSR, encourages other companies to reconsider their strategies and finally represents a way to raise the level of the entire business environment. However, this requires a sophisticated strategy of socially responsible communication to all stakeholders. The company should first segment its stakeholders and "customize" the communication to these target segments, i.e. adapt the message content and communication channel.

One of the consumers' generations, so-called Millennials, is currently considered to be the driving force behind the demand for socially responsible brands and products. It is a generation that has already reached adulthood, and therefore it is economically active and increasingly important in the market of workforce as well as consumers (Bucic et al., 2012; Fry, 2016). Many authors and studies claim that this is a generation educated in the field of CSR and thanks to their representation in the traditional market as well as the labour market with the power to require companies to be socially responsible (Nielsen, 2018). The main reason for focusing this generation is mainly its growing importance and the power of its impact on companies.

For the reasons mentioned above, the article is aimed on Millennials as a target segment of socially responsible communication within the business strategy and the determination of the most efficient tools of socially responsible communication with Millennials. It includes a literature review on the issue of socially responsible communication from the perspective of foreign as well as domestic authors and analysis focused on the perception of corporate social responsibility and its communication by Millennials. Based on the analysis and questionnaire survey results, measures for the efficient implementation of socially responsible communication with Millennials are proposed, and its benefits are highlighted.

The issue of the socially responsible communication has been researched and analysed by many foreign and domestic authors, and remains actual.

The main goal of socially responsible communication is to make the CSR activities of the company visible through a variety of communication tools. According to Morsing and Schultz (2006), through socially responsible communication, companies want to report that they are ethically and socially responsible. In order to achieve the desired results, they have to involve stakeholders in this process. In particular, they draw attention to the importance of engaging stakeholders in long-term value creation, and in order to achieve this goal, a company have to develop CSR communication from a monologue to dialogue and dialogue-based relationships.

Scholder et al. (2006) claim that CSR communication is essential to create and maintain the desired reputation effects.

McWilliams and Siegel (2011) consider socially responsible communication as an important part of successfully achieving the CSR's strategic objectives and an essential part of particular CSR activities.

Luo and Bhattacharya (2009) emphasize the right timing of socially responsible communication as well as the fact that it needs to be designed and perceived as a coherent concept, since companies investing to CSR can create intangible assets in the form of brand loyalty, customer loyalty, reputation, improving sales performance and stakeholder identification.

According to Wagner et al. (2009), the communication strategy for the CSR plays a key role and influences stakeholders' attitudes towards the business.

Goluchowski et al. (2015) state that the use of gamification and gaming features (mechanisms) in the socially responsible communication is a good way to improve the communication process. They focused on how gamification can be used to improve social media-based CSR communication of companies with their stakeholders.

It is obvious, that the CSR concept requires more than any other business strategy. It needs a credible and consistent communications policy. Companies can plan socially responsible communication as a strategic communication concept and implement it as a more content-based approach, by targeting specific groups or using special CSR teams (Bruhn and Zimmermann, 2017).

Over the years, several authors have dealt with the issue Millennials as a target segment of CSR including socially responsible communication.

Millennials, born in 1981-1996, are considered the first global and technologically capable generation in the world and is also known as Generation Y, Generation Next, Digital Generation, Nexters, Echo Boomers, Google Generation, Why Generation, etc. These terms are commonly used as synonyms and are derived from the logical context and continuity of segmentation stratification according to the Pew Research Center (McCrinkle, 2014; Fry, 2016).

Fry (2016) state that Millennials are currently the most numerous adult generations thanks to which they are considered the most consumer-oriented generation with the greatest impact on the world economy. At the same time, according to a Euro RSCG

Worldwide survey of 3,000 respondents from around the world, they are so socially responsible that they see themselves as the generation which can change the world (Bucic, Harris and Arli, 2012). It is thus a generation that does not like the way previous generations have treated the planet and that sees an urgent need to reduce its carbon footprint by changing its approach to consumption and thus contribute to a healthier life (Arnold, 2018). Aware of their strength, they demand that companies behave socially responsibly and become active creators of long-term social sustainability on a global scale. They focus not only on the most current issues, but also seek solutions to optimize the possible future impacts of their activities (Landrum, 2017). This means that they put pressure on companies so that their production meets not only the basic conditions regulated by legislation, but also to accept higher social commitments in the form of switching to products that are ecological, natural or do not burden the environment in any way (Nielsen, 2018). Up to 83% of Millennials believe that even small changes that they can make themselves can have a major impact on improving the environment (Glass Packaging Institute, 2011). And it is the transition to environmentally responsible and sustainable production that can be one of such changes.

Such an approach to social responsibility significantly distinguishes Millennials from other consumers' generations. It is characteristic not only for consumption, but also for the personnel dimension of the interaction between the company and whole society. Millennials also prefer socially responsible companies as promising employers.

Escareno et al. (2018) examine the knowledge level of Millennials about CSR in determined companies, as well as the way they are influenced by social marketing in their purchase intent.

Lee and Haley (2019) find out, that younger consumers, including Millennials, are more likely to form favourable attitudes toward socially responsible communication (mainly socially responsible ads) and products compared to older consumers.

Methods and Data

The article is aimed on Millennials as a target segment of socially responsible communication within the business strategy and the determination of the most efficient tools of socially responsible communication with Millennials. This includes providing a literature review on the issue of socially responsible communication from the perspective of foreign and domestic authors as well as analysis focused on the perception of corporate social responsibility and its communication by Millennials. Based on analysis and questionnaire survey results, measures for the efficient implementation of socially responsible communication with Millennials are proposed, and its benefits are highlighted, such as strengthening the company's image, improving its reputation, building customer relationships and gaining the customers loyalty to the socially responsible brand.

The secondary data for the analysis were obtained from scientific researches, statistical tables and published professional publications. In order to determine the most efficient tools of socially responsible communication, a questionnaire survey was conducted among Millennials.

The aim of the questionnaire survey was to analyse the perception of corporate social responsibility and its communication by Millennials. The sample size was determined using the Sample Size Calculator that forms part of Creative Research Systems' survey software and which is provided as a public service. The calculator determines how many respondents need to be interviewed in order to get results that reflect the target population as precisely as possible. This is necessary to avoid any distortion in the survey information. The process requires a base file to work from, which in this case consisted of population data for the Slovak Republic, and in particular data on those born in 1981-1996. The confidence interval was set at 5%, with a confidence level of 95%. This means that for the questionnaire survey a 5% margin of error is assumed. The sample size calculated by the calculator was determined to be 384 respondents. In total, 515 respondents participated in the questionnaire survey.

The questionnaire survey was conducted during the second half of 2019. The selection of the respondents in the sample set took place at random and was based on the number of Slovak inhabitants born in 1981-1996 that belong to Millennials. The quantitative assessment method was applied to the processing of the information obtained from the questionnaire survey. The data were processed empirically in the form of percentages, with additional written comments and comparisons.

General scientific methods were applied for the processing of the data, such as data collection, excerption, description, comparative analysis, deduction, induction, analysis and synthesis, as well as mathematical methods to evaluate the data collated from the results of the questionnaire survey and to statistical hypothesis testing.

In order to achieve the aim of the article, research hypotheses were set:

Hypothesis 1: More than 50% Millennials know the concept of CSR.

Hypothesis 2: More than 50% Millennials consider the use of CSR in the company to be a factor of improving company's reputation.

Hypothesis 3: More than 50% Millennials consider information on CSR activities in Slovak companies to be sufficient.

Hypothesis 4: More than 50% Millennials obtain information about CSR in Slovak companies through company websites.

Hypothesis 5: In future, more than 50% Millennials would like to obtain information about CSR in Slovak companies through social media.

Statistical hypothesis testing is one of the most important statistical inference procedures. The role of statistical inference is to decide on the basis of information from the available choice whether we accept or reject certain hypotheses regarding the basic set. In verifying

the correctness or incorrectness, we proceeded in accordance with the methodology of statistical hypothesis testing, which consists of the following steps (Rimarcik, 2007):

1. Formulation of the null hypothesis (H_0).
2. Formulation of the alternative hypothesis (H_1).
3. Determining the level of significance (α).
4. Calculation of test statistics and probability.
5. Decision.

Significance level α was determined at 0.05. To calculate the test statistic, we used the method testing a single proportion.

Results

Results of secondary research focused on the perception of corporate social responsibility by Millennials

Most of the previously realized researches point out the active involvement of Millennials in the process of achieving sustainable development of the whole society (Wheeler, 2018). A survey by Cone Communications shows a significant interest of this generation in participating in socially responsible activities:

- 87% respondents are willing to buy a product that brings benefits to society or the environment.
- 74% respondents are willing to volunteer at events with a philanthropic dimension.
- 91% respondents are willing to substitute a previously preferred brand for another if its higher contribution to building sustainable development of society is demonstrated (Cone Communications, 2015).

Similar conclusions are formulated on the survey results carried out by the Nielsen Agency, where even up to 90% of respondents preferred ecological products in terms of a real purchasing decision. At the same time, based on the survey, it has been estimated that by 2021, up to a quarter of all products on the market will be sustainable and organic (Nielsen, 2018).

Other researches also show that, in addition to changes in consumption preferences, there are changes in the generation of Millennials in favour of the overall greening of their lifestyles. Such an attitude is typical in the case of almost 75% of Millennials members.

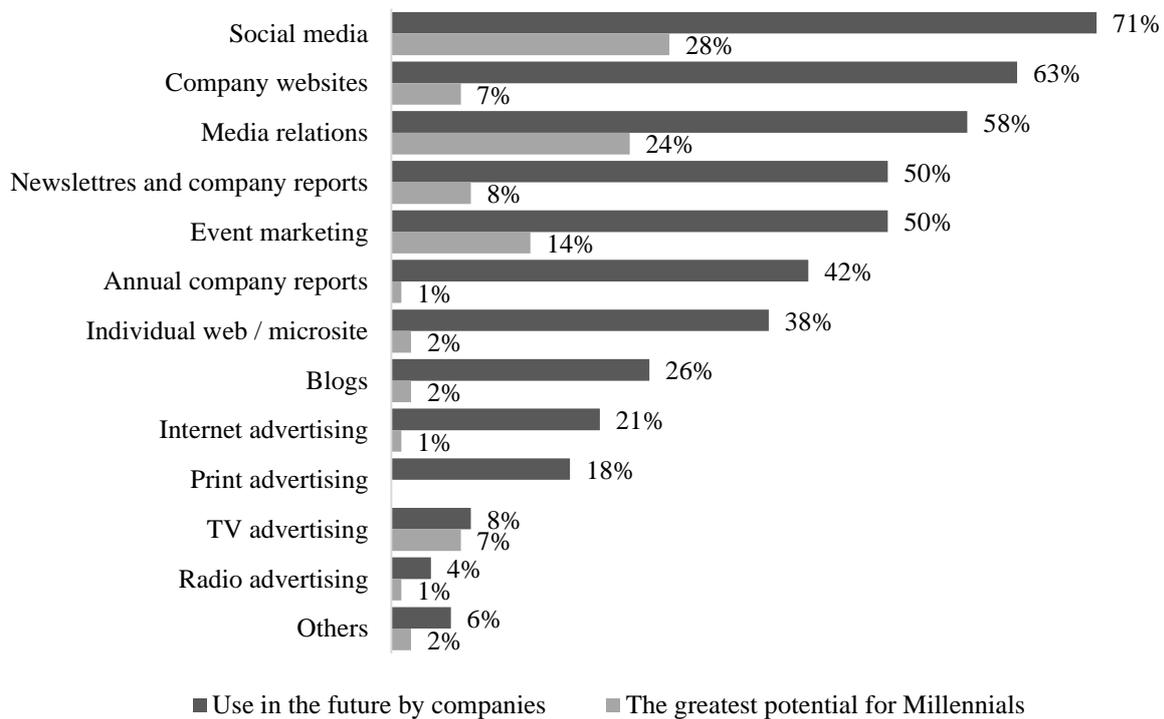
However, the paradox is that in specific activities, such as waste sorting or energy saving, other generations are in fact more involved than millennials (Glass Packaging Institute, 2011). From the survey of Shelton Group, it is also clear, that Millennials are much less involved in day-to-day sustainable behaviour activities compared to other generations. The results of this survey show that Millennials delegate socially responsible behaviour to companies in whose activities they participate, either in the form of volunteering or by deciding to buy their products (Shelton Group, 2017).

These findings thus contradict the conclusions of the Euro RSCG study (2011), according to which Millennials believe they are the generation that can change the world, even at the level of individual efforts of each one. Hume (2010) also draws attention to the discrepancy between the internal beliefs and external manifestations of Millennial; it means by identifying the declared strong emphasis on environmental protection, recycling, saving resources and eliminating environmental damage on the one hand, but a real lack of own initiative on the other hand.

It follows from the above mentioned, that although Millennials declare their willingness to contribute to socially responsible activities, this is mainly reflected secondarily in their purchasing preferences for socially responsible products than primarily in their environmental behaviour such as waste sorting or energy saving (Buss, 2012). The issue of social responsibility thus overlaps with the ecological dimension of production, while the social and economic pillars represent only marginal areas of interest for Millennials, who often do not even identify these two pillars with corporate socially responsible behaviour (Berthiaume, 2015).

According to a survey by NMS Market Research, companies currently use for promotion their socially responsible projects mostly their websites (85%). However, most of them think that this has only minimal benefit for the resulting effectiveness of marketing communication. On the contrary, the greatest potential lies in social media. Currently, social media are used in socially responsible communication activities by 56% of companies, and it is expected this share will rise to two-thirds soon and surpass the dominant position of the website (MEDIAGURU, 2015). An important tool of socially responsible communication of companies continues to be PR, in the form of media relations, which are implemented by up to 70% of the surveyed companies. Almost 20% of the surveyed managers see the potential in this communication tool. Graph 1 shows the future trends in the use of marketing communication tools by socially responsible companies and their potential to reach Millennials.

Graph 1: Future trends in the use of marketing communication tools by socially responsible companies and their potential to reach Millennials.



Source: Own processing according to NMS Market Research (MEDIAGURU, 2015).

Results of questionnaire survey focused on the perception of corporate social responsibility and its communication by Millennials

Of the 515 respondents in the sample set, 321 (62%) were female and 194 (38%) male. The results of the questionnaire survey show that 73% respondents know the CSR concept. 68% respondents consider the involvement in social responsibility as a necessary part of corporate strategy. According respondents, the most important benefits of implementation CSR in companies is improving company's reputation (89%), strengthening its image (74%), building customer relationships (55%) and gaining the customers loyalty to the socially responsible brand (42%). As the most important area of CSR, most of respondents (52%) identify the environmental pillar, next it is the social pillar (36%) and the least important area is the economic pillar (12%). As the best-rated activities in environmental responsibility, they indicate eco-friendly behaviour, such as an investment in green technologies, reduce emissions, and support projects to restore nature. The best-rated activities in social responsibility include a strong stance against child labour, employee care, their safety and education as well as corporate philanthropy. As the most important activities in economic responsibility, respondents consider making profit in an honest and ethical manner, compliance with legal standards and payment of taxes, quality products at a reasonable price, and vigorously rejecting corruption. From the results it is clear, that 85% of respondents are satisfied with the amount of information on CSR activities in Slovak companies. They obtain this information from company websites (62%), social media (51%), annual company reports (45%), CSR

reports (33%) and newsletters (25%). In terms of content, they prefer videos, written report and interactive web sites. In future, they recommend companies to focus their socially responsible communication on social media (86%), company website (56%), newsletters (42%) and media relations (20%).

Verification of statistical hypotheses

To verify the statistical hypotheses, we used the method testing a single proportion.

The hypothesis testing for a single proportion includes the following steps:

1. Determination of the null hypothesis:

$$H_0: \pi = \pi_0 \quad (1)$$

2. Determination of the alternative hypothesis:

$$H_1: \pi > \pi_0 \quad (2)$$

3. Selection of the significance level

$$\alpha = 0,05 \quad (3)$$

4. Calculation of the sample proportion:

$$p = \frac{m}{n} \quad (4)$$

where m is the number of respondents which indicate the particular option and n is the total number of respondents.

5. Satisfaction of the condition

$$n * \pi_0 * (1 - \pi_0) > 5 \quad (5)$$

Application of the test criteria:

$$T = \frac{p - \pi_0}{\sqrt{\frac{\pi_0 * (1 - \pi_0)}{n}}} \quad (6)$$

6. Critical field of the test:

Use the tables of the normalized normal distribution to find the critical value for the right-tailed test $z_{2\alpha}$.

$$T > z_{2\alpha} \quad (7)$$

7. Decision on the test result:

If the inequality does not apply, do not reject the hypothesis H_0 .

If the inequality applies, reject hypothesis H_0 , i.e. accept the alternative hypothesis H_1 .

Results of verification of statistical hypotheses are shown in Table 1.

Tab. 1: Verification of statistical hypotheses

Calculation of the sample proportion: $p = \frac{m}{n}$	Satisfaction of the condition $n * \pi_0 * (1 - \pi_0) > 5$	Test criteria	Critical field	Inequality	Acceptance or rejection of the hypothesis
Hypothesis 1: H ₀ : 50% Millennials know the concept of CSR. H ₁ : More than 50% Millennials know the concept of CSR.					
p = 0.73	128.75 > 5	10.4391	1.6449	10.4391 > 1.6449	H ₀ rejected
Hypothesis 2: H ₀ : 50% Millennials consider the use of CSR in the company to be a factor of improving company's reputation. H ₁ : More than 50% Millennials consider the use of CSR in the company to be a factor of improving company's reputation.					
p = 0.89	128.75 > 5	17.701	1.6449	17.701 > 1.6449	H ₀ rejected
Hypothesis 3: H ₀ : 50% Millennials consider information on CSR activities in Slovak companies to be sufficient. H ₁ : More than 50% Millennials consider information on CSR activities in Slovak companies to be sufficient.					
p = 0.85	128.75 > 5	15.8855	1.6449	15.8855 > 1.6449	H ₀ rejected
Hypothesis 4: H ₀ : 50% millennials obtain information about CSR in Slovak companies through company websites. H ₁ : More than 50% millennials obtain information about CSR in Slovak companies through company websites.					
p = 0.62	128.75 > 5	5.4465	1.6449	5.4465 > 1.6449	H ₀ rejected
Hypothesis 5: H ₀ : In future, 50% millennials would like to obtain information about CSR in Slovak companies through social media. H ₁ : In future, more than 50% millennials would like to obtain information about CSR in Slovak companies through social media.					
p = 0.86	128.75 > 5	16.3394	1.6449	16.3394 > 1.6449	H ₀ rejected

Source: Authors.

As is obvious from Table 1, in all cases, the inequality applies, so we reject the hypothesis H₀, we accept the alternative hypothesis H₁.

Discussion

Based on the analysis and survey results, we can claim, that if socially responsible company wants to communicate effectively with Millennials (whether as prospective employees or customers), it needs to have a clearly defined social responsibility and sustainability of production, not only formally but especially realistically. For Millennials, it is important to know whether their purchasing behaviour or their direct role as employees contribute to solve societal problems and help them meet their long-term sustainability commitments. The implementation of the CSR concept into corporate strategy and its subsequent interaction with Millennials may have many benefits and positive feedback. Thus, companies achieve their economic goals by accepting societal commitments that represent the competitive advantage, and consumers actively

contribute to the sustainable development of society while maintaining their consumer stereotypes and lifestyles.

In order to optimize the effectiveness of their socially responsible communication, companies have to define the range of their stakeholders and their position. The purpose of marketing communication is then to conduct a dialogue with them in order to find out their expectations in relation to the company and its CSR activities, as well as to improve mutual relations (Lizbetinova et al., 2019; Vetrakova et al., 2018). In this process, both participating sides may confront their views and try to understand the values and attitudes of the other side. However, first it is necessary that companies have to effectively communicate their socially responsible activities in one-way to their stakeholders. Only then stakeholders may know that the company is aware of its socially responsible commitment, and they have space for dialogue. So, the logical consequence of this monologue then becomes a mutually enriching dialogue.

Even with regard to the dual definition of the relationship between Millennials and socially responsible companies in the level of perspective employees and consumers, the basic criterion for the analysis of socially responsible communication is its division into internal and external.

Into basic tools of internal communication with Millennials belongs employee involvement, that is justified by one of their basic characteristics, i.e. delegating responsibility for sustainable social development and subsequent activation only within the created possibilities to other entities, which in this case is a company. Another important tool is regular meeting of all employees due to their significant tendency to adopt the lifestyle of the aspiration group. Collective meetings of all employees in the members of this generation may evoke the desired effect of belonging and acceptance of common values. The indisputable importance for Millennials has trainings and job interviews, especially with regard to the specifics of this generation in relation to education. However, the potential of this tool needs to be supported by the application of progressive educational methods, which have proved their worth in the formal education of members of this generation. Other tools of internal socially responsible communication with Millennials include notice boards, posters, banners, internal press (newsletter, magazines and annual reports), circulars or e-mails, internal videos, brochures, virtual publications on CSR and intranet, which may play a role as a support tools for above mentioned.

For external communication with Millennials, the modern forms of marketing communication represent an extremely effective tool. These are tools that are characterized by the use of state-of-the-art information and communication technologies and which appeal to the creativity of Millennials. Such tools are mainly product placement, guerilla marketing, buzz marketing, mobile marketing, viral marketing or even neuromarketing, enabling to understand and then optimally use relevant consumer decision-making mechanisms in favour of socially responsible products and activities. Based on the survey results, as a separate tool, it is necessary to highlight social media (in

the conditions of the Slovak Republic, especially Facebook, Instagram and YouTube), blogs and podcasts, where younger millennials are mainly involved. Also, events created on social media are very popular with Millennials. For the above reasons, we can state, that social networks provide companies with a space for effective communication of their CSR activities, while it is necessary to take into account the correct targeting of content with respect to the selected segment. A great benefit is the possibility of using analytical tools in evaluating and monitoring the success of socially responsible communication through social networks and obtaining the necessary feedback from the company's stakeholders. It is also necessary to highlight the communication of CSR activities through company websites, which are very popular with Millennials and thus represent one of the most important tools of socially responsible communication. As mentioned in survey results, millennials prefer to search for information on the Internet, so companies should regularly update information on all their CSR activities.

Traditional communication tools, such as, advertising, public relations, sale promotion and direct marketing, are effective in case they are communicated in online environment. The personal sale is relevant for Millennials, if the products are supported by a pricing policy at the level of the upper limit of reference prices. Millennials identify the real social awareness of the company with higher prices of its products, giving them a mark of premium quality. Thus, it is appropriate to use this tool as a premium communication and distribution channel appealing to the importance of the individual in the process of participating in the sustainable development of society.

Conclusion

In global, Millennials currently have a significant representation and thus form the predominant generation in both the consumer and labour markets. Although the situation in the Slovak Republic is relatively different than in the countries of Western Europe or the USA, Millennials nevertheless have a significant impact on both markets and require companies to behave socially responsibly and to become active creators of long-term social sustainability. For this reason, Millennials represent the target segment for the socially responsible communication.

The most visible benefits of efficient socially responsible communication customized to the target group, i.e. Millennials, includes strengthening the company's image, improving its reputation, building customer relationships and gaining the customers loyalty to the socially responsible brand.

The results from the analysis and survey can have a significant application in practice, especially in predicting purchasing behaviour based on attitudes and behaviour of target segments, but also appropriate targeting of socially responsible communication based on generational stratification. They also provide space for further discussions on CSR in relation to consumers and other stakeholders.

The issue of Millennials as a target segment of socially responsible communication has, therefore, the potential for deeper research in the future - both qualitatively and quantitatively. To obtain statistical relevance, it would be appropriate to investigate the findings of qualitative research quantitatively. A further qualitative investigation would be appropriate for expanding knowledge and comparing the impact of particular tools of socially responsible communication on Millennials, possibly exploring the socially responsible behaviour of another potential target segment – Post-Millennials – and its comparison with Millennials.

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The Analysis of Legal Environment and Administrative Burden of SMEs as an Obstacle to Business

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Abstract

The paper outlines the problematic areas of legal environment and administrative load that are identified especially by the means of research of SME. The theoretical part deals with the issue of administrative burden of businesses. The part of methodology presents the basic systems of statistical calculations and hypothesis. Attention is paid to the assessment of the intensity of business administration in the area of small and middle-sized enterprises. The businesses are divided in accordance of various criteria (business size in accordance of the number of employees, the size of achieved turnover, sector, tax burden) and hypothesis are set, confirmed or rejected by using t-tests and other criteria, subsequently, the results are compared. The main purpose is to prove that small and medium-sized enterprises are overloaded by demanding business administration and taxation, and that it is important to examine the issue in greater depth. The aim of the paper is to determine, by the means of statistical methods, whether the businesses are excessively taxed by demanding business administration and, eventually, to compare the achieved results.

Keywords: legal environment, administrative burden, administrative intensity, small and middle-sized enterprises, one-sample t-test

Introduction

The issue of legal base in businesses and the related administrative burden attracts the attention of many experts. The legal base and administrative burden of businesses were significantly influenced by joining the European Union by the Czech Republic on 1st May 2004 (Kmecova and Bilek, 2020).

It was a threat for some SMEs on one hand, while it meant new opportunities for other businesses on the other hand. The reason was the ongoing changes in Czech legal rules and other sources, the competitive arrangement and the new legislative arrangement. Businesses have to deal with this situation and struggle with it. The business environment is one of the summary aspects for the development and existence of business activity. We can understand it as a set of tools and factors whose effect on the business improves its competitiveness and growth potential. It is still difficult for SMEs to adopt the principles of a new business environment on a European scale. These businesses must respect the same legislative and administrative requirements as large businesses. Unfortunately, small and medium-sized enterprises cannot sufficiently cope with it, because large enterprises solve problems by delegating activities to a number of internal specialists. A good solution for small and medium-sized enterprises in the future could be, for example, cooperation with external experts or the application of an effective information system to reduce the administrative burden by creating a manual. It is necessary to create favourable conditions for business, because the importance of the small and medium-sized enterprise sector is obvious for the Czech economy (MIT, 2018). For some SMEs this posed a threat on the one hand and new opportunities for other businesses on the other.

Theoretical Background

Business in the Czech Republic is legislatively regulated at the general level by numerous pieces of legislation and rules. Administrative burden imposed on the businesses gradually grows every year. The issue of administrative burden is dealt with by numerous authors not only in the Czech Republic but also abroad.

Braunerhjelm and Eklund (2014) examine the tax administrative burden and its impact on the creation of a new business. Moynihan et al. (2015), offers two theoretical perspectives. The first perspective: the administrative burden, as an important variable in understanding how citizens experience the state. Administrative burden is conceived as a function of the costs of learning, psychology and compliance that citizens experience in their interactions with the government. The second perspective: the authors argue that the administrative burden is a place of politics.

Veiga et al. (2016) examined the impact of administrative burden on costs for businesses, citizens and the administration itself related to the compliance with the decrees of the government and procedures. The results showed that the burden tends to increase with new forms of public administration. Hodinkova and Svirak (2014) focused on the development of small and medium-sized enterprises (SMEs) operating in the Czech Republic. The main goal was to evaluate the current situation of SMEs in the Czech Republic, identify the main obstacles to their development and propose measures to eliminate them. Zarova (2010) deals with the current revisions of the Fourth and Seventh EC (European Community) Directives, which are taking place as part of the process of simplifying accounting rules for small and medium-sized enterprises. The author mentions that the aim of the revision of the accounting guidelines is to modernize and

simplify reporting requirements, as well as their comprehensibility and accessibility. The revision follows the motto "think small units first". The Commission's regulatory strategy aim is to measure administrative costs and reduce administrative burden. Ropret, et al. (2018) present the results obtained from a comprehensive analysis of the key administrative barriers that SMEs face in Slovenia. These include three activities: (1) identifying the main areas where obstacles occur; (2) determining what performance means; and (3) providing guidance for policy makers adapted to different groups of SMEs. Empirical results on a sample of 925 SMEs show differences in the different groups of SMEs mentioned above. The results show that it is appropriate to address administrative barriers through an in-depth approach that focuses on specific groups of companies and is reflected in the guidelines for responsible policy makers. Sarah et al. (2018) identified administrative barriers to inland waterway transport on the Danube and developed solutions for improved procedures and processes. National focus groups were set up to analyse procedures and administrative processes within the inland waterway transport and to identify administrative barriers. Therefore, many administrative barriers were identified in the countries along the Danube. Then Port Community Systems was presented as a possible solution to overcome administrative barriers.

According to Ntaliani and Costopoulou (2018), reducing administrative burdens is part of the political agenda in European countries and international organizations. The aim of the research was to measure the administrative burden of rural businesses. The main finding was that rural businesses do not perceive the administrative burden on business very positively; public administrations could introduce semantic eGovernment services to reduce the administrative burden on rural businesses; and future policies to reduce administrative burdens should take into account the type and location of businesses in order to achieve an efficient business environment.

The governments practice policies to reduce administrative burden especially for small businesses in order to increase their flexibility and vitality. The aim is the reduction of administrative burden. The paper by Ntaliani and Costopoulou (2017) presents a European initiative that uses a method of measuring the costs incurred on SMEs that occur in the course of seeking information for the public service. The research results provide guidance to policy makers and decision-makers in dealing with the administrative burden on businesses in the information phase of public services. Cepel (2018) defined and quantified significant factors that shape the quality of the business environment in the SME segment and created the quality index of business environment. A part of the aim was to compare defined factors in the Czech Republic and in Slovakia. With regard to the defined aim, a research was conducted on the basis of a previous research in businesses operating in the SME segment. The results showed the fact that the Slovak businesses do much better in every factor of the research than the businesses in the Czech Republic.

The state can help the entrepreneurs in their activities by a business environment or it can impose a burden on them. The aim of the research (Vieglerova et al., 2016) was to find out how the entrepreneurs of small and middle-sized enterprises (SME) in the Czech

Republic perceive the role of the state and its influence on business. It was discovered that small and middle-sized enterprises perceive the assistance of the state more than microbusinesses. More than 53% of entrepreneurs came up against patronage. The results further confirmed that the issue of corruption intensifies with the size of a business. Fighting corruption and patronage can be significantly more affected by the length of doing business than the size of a company.

There is another research stating that excessive bureaucracy, administration and frequent legislative amendments are some of the current factors deterring people from becoming entrepreneurs. The main aim was to present scientific evidence that gender is one of the factors with a significant impact on the management of administrative activities of a company and on the company's perception of administrative burden such as bureaucracy and frequent tax changes and legal amendments. The results were as follows: young men and women consider various areas of bureaucracy to be excessive; women entrepreneurs spend more time monitoring changes in legislation affecting the business environment, and women spend almost twice as much time on administrative activities. (Kljucnikov and Majkova, 2016).

According to Fifka and Adai (2015), CSR reporting has recently received full attention in the business community thanks to the implementation of CSR reporting at the EU level. In this context, there is an intense debate about whether companies should not be forced to report on their social and environmental results. This response clearly reflects the widespread notion that CSR reporting is an administrative and financial burden, and supports the need for laws to implement it.

All businesses are inseparably linked to the business environment, which significantly influences their performance. In this respect, the state is one of the most influencing factors. It also has many other roles that can appear useful or harmful in the eyes of the business owner, for instance, setting the legislative framework for business, setting the conditions for starting business and regulating competition. It was found, according to Kamil et al. (2017), that entrepreneurs are very critical of the role of the state in business environment; in particular, 60% of respondents do not agree that the state creates favourable conditions for business in the Czech Republic.

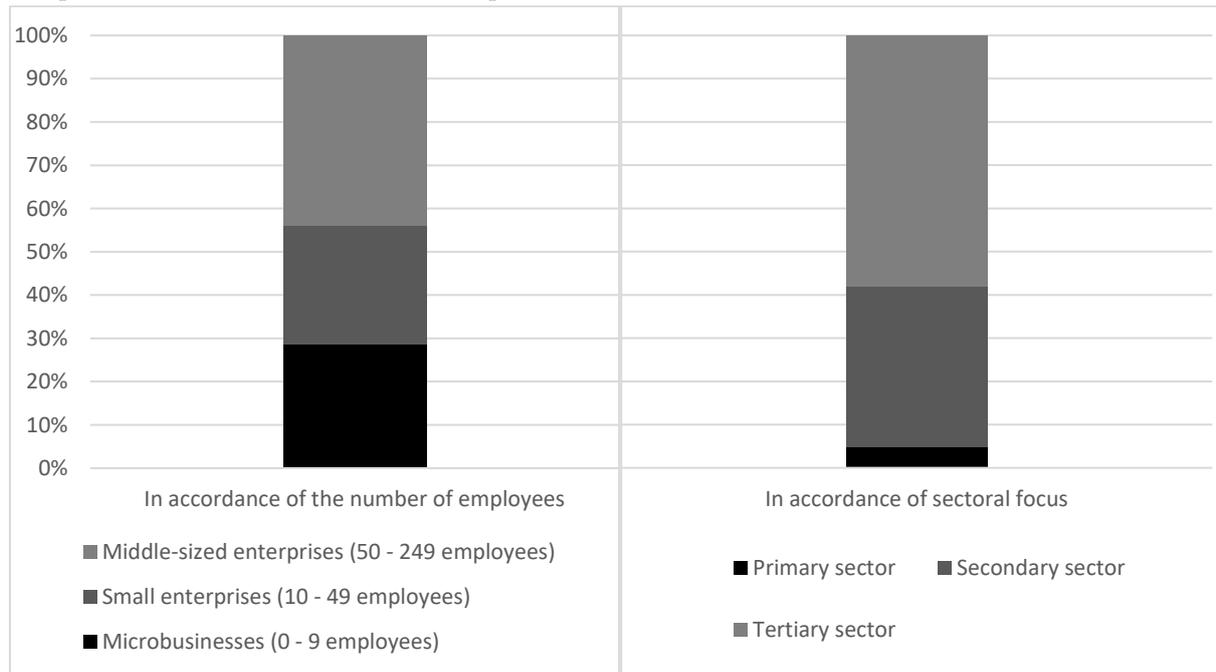
Methods and Data

In this paper, we aim to confirm or reject the claim that small and medium-sized enterprises are overburdened with administrative obligations in their business and to compare the results of intensity of business administration according to various measures (company size, turnover, sector of operation, etc). The research is based on a questionnaire survey.

The methods of data collection

Primary data for legal area and for the intensity of administration were obtained by the means of questionnaire survey in SMEs. It was an online questionnaire: legal and administrative intensity of business. The questionnaire was created by using the tool of Google Apps – Questionnaires. The return rate of the questionnaires was 35% (out of 500 SMEs). It was 175 questionnaires in total. The structure of research sample is summarily shown in graph 1.

Graph 1: Structure of research sample



Source: Authors.

The data for the processing of the research were divided. The main criteria were the base from which the practical part was developed. The main criterion was the division of SMEs into small enterprises (less than 50 employees) and middle enterprises (from 50 employees to 250 employees). Further division was based on the achieved SMEs’ turnovers the last divisional group was based on the sectors where the businesses operate. Due to the small number of businesses operating in the primary sector, we merged these businesses into one group, together with the secondary sector. The second group was the tertiary sector; businesses providing services.

The Methods of Data Assessment

For the analysis of the obtained data set, for our paper, we chose a one-sample t-test. This calculation tests, or compares, the mean values of one file that contains data on the same principle. This means that the data must be equally distributed, for example from one measurement but from various respondents (Dalgaard, 2008).

It is important to set the essential indicators for basic statistical assessment. The first main indicator is a simple arithmetic mean. The calculation of this quantity is as follows (Budikova et al., 2010).

$$\bar{x} = \frac{1}{n} * (x_1 + x_2 + x_3 + \dots + x_n) \quad (1)$$

Where:

\bar{x} = arithmetic mean,

n = number of values of the selection set,

x = individual values of the set.

The value of arithmetic mean enables to calculate the value of standard deviations. For this calculation, however, it is necessary to know another value, namely the sample variance. The value of this calculation tells you how varied the values are from the mean of the sample data set. The sample variance can be calculated by the following relation (Neubaeur et al., 2016).

$$s^2 = \frac{1}{n} \sum_{i=1}^n (x_i - \bar{x})^2 \quad (2)$$

Where:

s^2 = sampling variance,

x_i = individual values of the set,

\bar{x} = arithmetic mean.

The next important value, which must be found out for the calculation, is the standard deviation of the set. This is actually the average deviation of the set from the average value. The standard deviation can be calculated in the following manner (Neubaeur et al., 2016).

$$\sigma = \sqrt{s^2} \quad (3)$$

Where:

σ = standard deviation,

s^2 = dispersion of the set.

In the case that the above-mentioned characteristics are known and the basic null hypothesis H_0 and its counterpart, the alternative hypothesis H_a (μ_0), were set, it is possible to commence the calculation of the one-sample t-test. It tests whether the mean value of the given sample is equal to the set null hypothesis. Before testing, it is necessary to determine the level of significance of the one-sample t-test. In this case, the significance level of 95% will be used. The specific relation of the one-sample t-test is as follows (Dalgaard, 2008).

$$t = \frac{\bar{x} - \mu_0}{\sigma} \sqrt{n} \quad (4)$$

Where:

t = value of one-sample t-test,

\bar{x} = arithmetic mean,

μ_0 = set null hypothesis,

σ = standard deviation,

n = number of values of selection set.

The next step is comparing the resulting value of one-sample t-test with the table of critical values for dividing one-sample t-test. If the resulting value of the one-sample t-test in absolute value is outside a certain range of the 95% significance level, the value of which was obtained from the tables of critical values, the null hypothesis can be rejected.

Results

Null hypothesis μ_0 : Small enterprises, less than 50 employees, find the administrative intensity in business demanding at the rate of 70%. Middle-sized enterprises find the administrative intensity in business demanding at the rate of 70% (comparison).

During verifying the hypothesis simple arithmetic mean must be primarily calculated. There was a total of 95 companies with less than 50 employees and they are classified as small, and the sum of the values of their answers was 291. Enterprises answered on a point scale of 1-4, where a value of 1 means approximately 25% intensity and a value of 4 indicates the highest intensity, i.e. 100%.

$$\bar{x}_1 = \frac{1}{95} (291) = 3.06 \text{ point} = 76.6\% \quad (5)$$

The enterprises having 50 employees and more, therefore, they are regarded as middle-sized, were 76 in total. The sum of the responded values by them was 235.

$$\bar{x}_2 = \frac{1}{76} (235) = 3.09 \text{ point} = 77.3\% \quad (6)$$

In the next step, it is necessary to calculate the sampling variance of both variables s_1^2 and s_2^2 .

$$s_1^2 = \frac{1}{95} * (x_1 - 3.06)^2 + (x_2 - 3.06)^2 + \dots (x_n - 3.06)^2 = 0.65 \quad (7)$$

$$s_2^2 = \frac{1}{76} * (x_1 - 3.09)^2 + (x_2 - 3.09)^2 + \dots (x_n - 3.09)^2 = 0.5 \quad (8)$$

If there is available a value informing about the dispersions of both sets, it is possible commence calculating the standard deviation for both sets.

$$\sigma_1 = \sqrt{0.65} = 0.81 \quad (9)$$

$$\sigma_2 = \sqrt{0.5} = 0.71 \quad (10)$$

At this point, all the necessary information for calculating the t-test itself are known. The hypothesis stating that enterprises find administrative intensity demanding at the rate of 70% must be transfer to a point evaluation. 70% will be 2.8 points in this case.

$$t_1 = \frac{3.06 - 2.8}{0.81} \sqrt{95} = 3.18 \quad (11)$$

$$t_2 = \frac{3.09 - 2.8}{0.71} \sqrt{76} = 3.56 \quad (12)$$

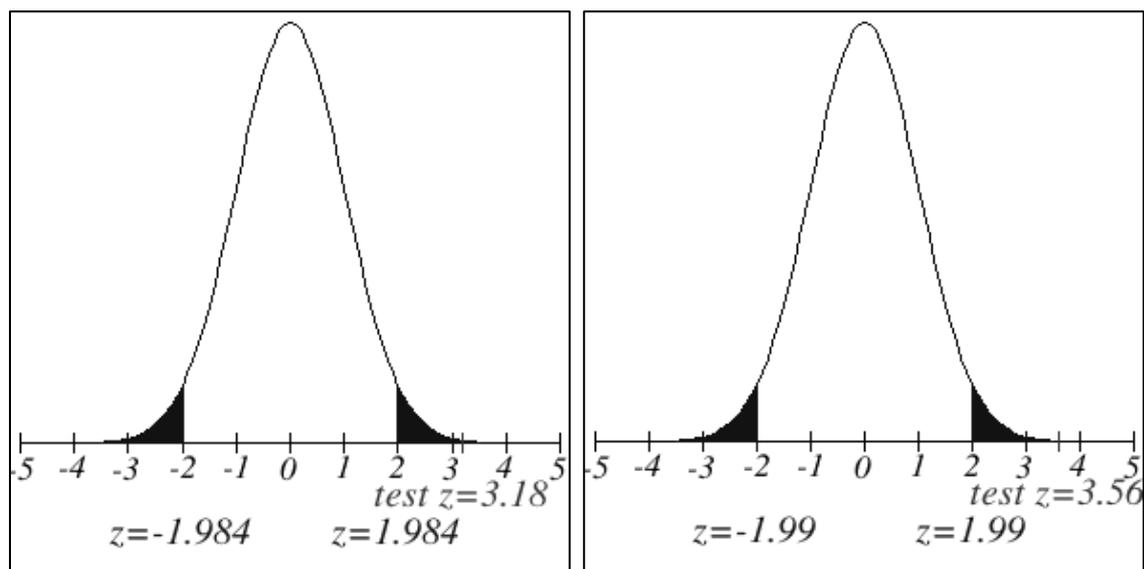
Critical values were selected from the tables for the selections that are calculated. In the first case, the tested set has 96 values. In the tables only the values for the sets with either 90 or 100 samples can be found. Since the value for 100 samples is closer to the set of 96 samples, this will be selected. The critical value for 100 samples is 1.984. The critical value for the second set of the size 76 values is 1.99. The values of the calculated t-tests are 3.18 and 3.56. Given that both values are greater than the critical value of 1.984 and 1.99, respectively, both hypotheses at the 95% level of significance can be rejected, with the proviso that companies do not find the administrative intensity of business as demanding as 70%. This result is confirmed by p-values of the tests that were obtained by the statistical R Commander software as well.

$$p - value_1 = 0.002071 = 0.2\% \quad (13)$$

$$p - value_2 = 0.0006459 = 0.06\% \quad (14)$$

Both p-values are smaller than 5% and that is why the rebuttal of each hypothesis is confirmed. Another confirmation is the 95% quartile obtained by the software, which for the first hypothesis is from 2.9 to 3.23 and for the second hypothesis from 2.93 to 3.26. These hypotheses, 70%, i.e. 2.8 points, do not fall within these ranges, and so the hypotheses can be disproved in this way. In addition, in the final assessment, it can be stated that businesses with more employees find the administrative intensity of business more demanding than businesses with fewer employees. The results are also confirmed by graph 2.

Graph 2: Hypothesis 1 – Gaussian curve of normal division



Source: Authors, imathas.com.

Null hypothesis μ_0 : The enterprises with a turnover of CZK 52 million or less find the administrative intensity of business demanding at the rate of 70%. The enterprises with a turnover more than CZK 52 million find the administrative intensity of business demanding at the rate of 70%. (comparison)

$$\bar{x}_1 = \frac{1}{108} (331) = 3.06 \text{ point} = 76.62\% \quad (15)$$

$$\bar{x}_2 = \frac{1}{58} (180) = 3.1 \text{ point} = 77.59\% \quad (16)$$

$$s_1^2 = \frac{1}{108} * (x_1 - 3.06)^2 + (x_2 - 3.06)^2 + \dots (x_n - 3.06)^2 = 0.62 \quad (17)$$

$$s_2^2 = \frac{1}{58} * (x_1 - 3.1)^2 + (x_2 - 3.1)^2 + \dots (x_n - 3.1)^2 = 0.54 \quad (18)$$

$$\sigma_1 = \sqrt{0.62} = 0.79 \quad (19)$$

$$\sigma_2 = \sqrt{0.54} = 0.73 \quad (20)$$

$$t_1 = \frac{3.06 - 2.8}{0.79} \sqrt{108} = 3.42 \quad (21)$$

$$t_2 = \frac{3.1 - 2.8}{0.73} \sqrt{58} = 3.13 \quad (22)$$

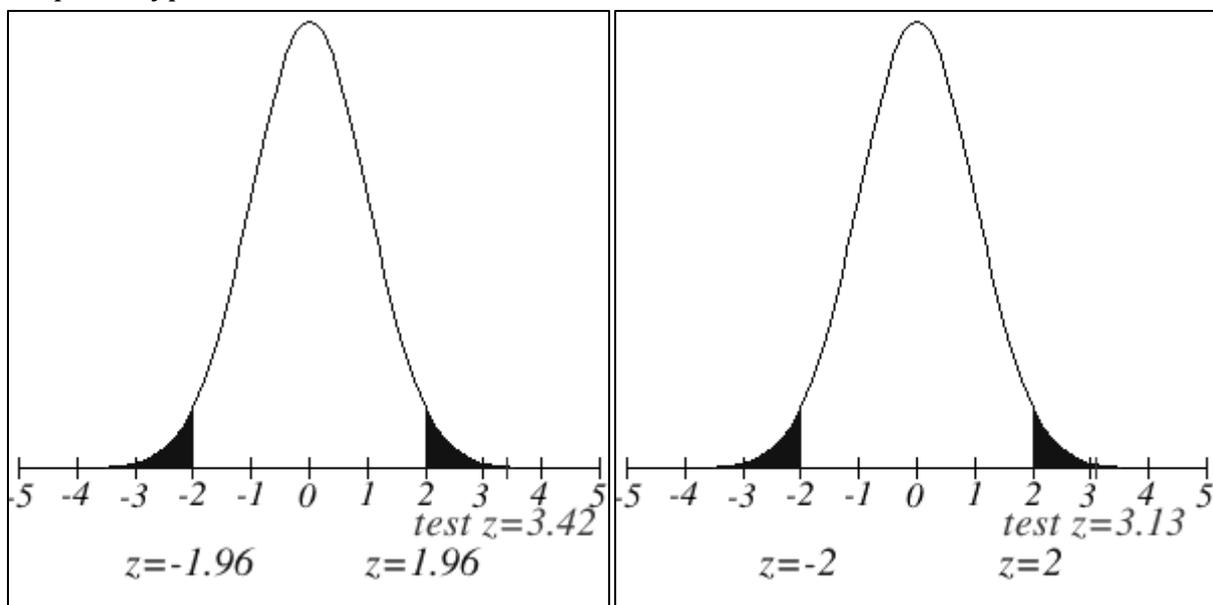
Now, it is necessary to compare the test values with the critical values from the tables. The critical value for the sample of 108 enterprises is 1.96. The critical value for the sample of 58 enterprises is 2. Both test values are higher than the given critical values; therefore, it is possible to disprove both hypotheses again.

$$p - value_1 = 0.0007 = 0.07\% \quad (23)$$

$$p - value_2 = 0.002 = 0.2\% \quad (24)$$

Considering the fact that both p values are less than 5% it is possible to confirm in this manner as well that both null hypotheses were disproved and are invalid. This fact can also be proved by checking 95% of the quartiles of both selections. The 95% quartile for the first selection is from 2.91 to 3.22 and the 95% for the second selection is from 2.91 to 3.3. These hypotheses, i.e. 2.8 points, do not fit into the quartile, so it is possible to decide on their invalidity in this way. Moreover, it is possible to deduce from the test values that enterprise with a turnover over CZK 52 million find the administrative intensity more intensive than the enterprises with a turnover of CZK 52 million or less. The results are also confirmed by graph 3.

Graph 3: Hypothesis 2 – Gaussian curve of normal division



Source: Authors, imathas.com.

Null hypothesis μ_0 : Small and middle-sized enterprises in the primary and secondary sectors find the administrative intensity of business demanding at the rate of 70%. Small and middle-sized enterprises in the tertiary sector find the administrative intensity of business demanding at the rate of 70%. (comparison)

$$\bar{x}_1 = \frac{1}{69} (216) = 3.13 \text{ point} = 78.26\% \quad (25)$$

$$\bar{x}_2 = \frac{1}{97} (297) = 3.06 \text{ point} = 76.55\% \quad (26)$$

$$s_1^2 = \frac{1}{59} * (x_1 - 3.13)^2 + (x_2 - 3.13)^2 + \dots (x_n - 3.13)^2 = 0.49 \quad (27)$$

$$s_2^2 = \frac{1}{97} * (x_1 - 3.06)^2 + (x_2 - 3.06)^2 + \dots (x_n - 3.06)^2 = 0.64 \quad (28)$$

$$\sigma_1 = \sqrt{0.49} = 0.7 \quad (29)$$

$$\sigma_2 = \sqrt{0.64} = 0.8 \quad (30)$$

$$t_1 = \frac{3.13 - 2.8}{0.7} \sqrt{69} = 3.92 \quad (31)$$

$$t_2 = \frac{3.06 - 2.8}{0.8} \sqrt{97} = 3.2 \quad (32)$$

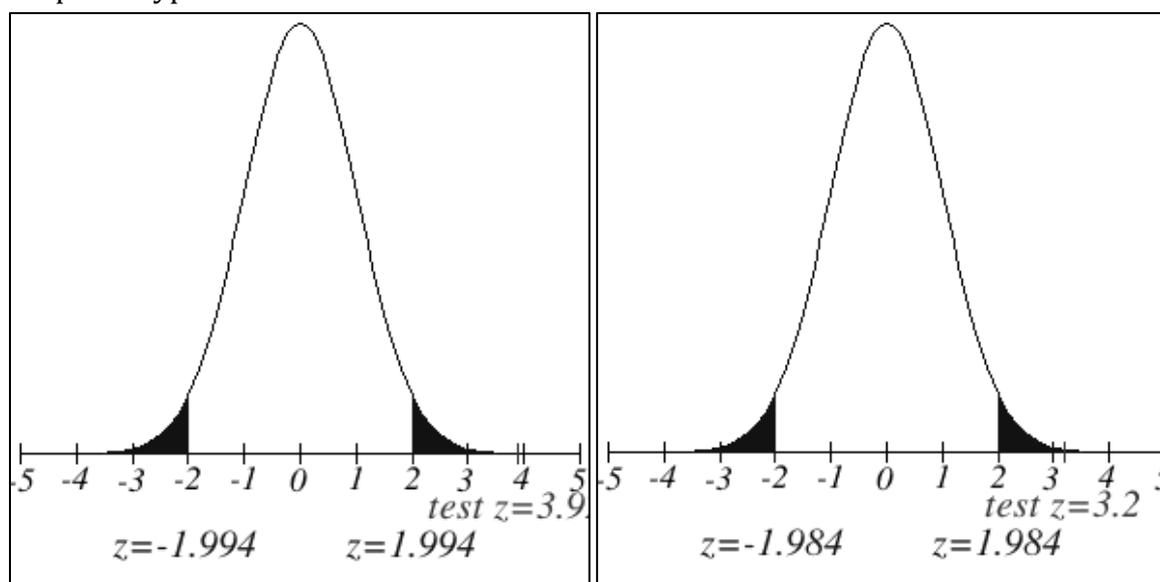
At this moment, it is necessary to compare the test values with the critical values from the tables. The critical value for the sample of 69 enterprises is 1.994. The critical value for the sample of 97 enterprises is 1.984. Both test values are higher than the given critical values; therefore, it is possible to disprove both hypotheses again. In addition, this statement can be verified by examining the p-values of both samples, which were obtained by the use of software.

$$p - value_1 = 0.0002 = 0.02\% \quad (33)$$

$$p - value_2 = 0.002 = 0.2\% \quad (34)$$

Both given p-values of the sample sets are less than 5%, therefore, it is possible to confirm the refusal of both hypotheses. This statement can be confirmed by another method, i.e. with the use of 95% quartile selections. The 95% quartile for the first selection, i.e. the enterprises operating in the primary and secondary sectors, is from 2.96 to 3.3 and the 95% quartile for the second selection, i.e. the enterprises operating in the tertiary sector, is from 2.9 to 3.22. It is obvious that the examined value of hypothesis, i.e. 2.8 points, does not fit into any quartile; therefore, both hypotheses can be deemed invalid. There is a further finding; the enterprises in both the primary and the secondary sector find the administrative intensity of business more demanding than the enterprises in the tertiary sector. The results are also confirmed by graph 4.

Graph 4: Hypothesis 3 – Gaussian curve of normal division



Source: Authors, imathas.com.

Null hypothesis μ_0 : The enterprises with a turnover of CZK 52 million or less find the tax burden (income tax, value added tax, excise duty, road tax) demanding at the rate of 60%. The enterprises with a turnover over CZK 52 million find the tax burden demanding at the rate of 60%. (comparison)

In this case it will be an assessment and comparison of hypothesis examining tax intensity. The enterprises responded on the scale from 1 to 4 points, where 1 point equalled a slight intensity and 4 points equal an inappropriate intensity. The given hypothesis examines a 60% intensity, which equal the value of 2.4 points. Various points of the responds of the individual types of taxes were made average.

$$\bar{x}_1 = \frac{1}{110} (276.5) = 2.51 \text{ point} = 62.75\% \quad (35)$$

$$\bar{x}_2 = \frac{1}{58} (138.25) = 2.38 \text{ point} = 59.5\% \quad (36)$$

$$s_1^2 = \frac{1}{110} * (x_1 - 2.51)^2 + (x_2 - 2.51)^2 + \dots (x_n - 2.51)^2 = 0.57 \quad (37)$$

$$s_2^2 = \frac{1}{58} * (x_1 - 2.38)^2 + (x_2 - 2.38)^2 + \dots (x_n - 2.38)^2 = 0.47 \quad (38)$$

$$\sigma_1 = \sqrt{0.57} = 0.75 \quad (39)$$

$$\sigma_2 = \sqrt{0.47} = 0.69 \quad (40)$$

$$t_1 = \frac{2.51 - 2.4}{0.75} \sqrt{110} = 1.54 \quad (41)$$

$$t_2 = \frac{2.38 - 2.4}{0.69} \sqrt{58} = -0.22 \quad (42)$$

If both values of statistical t-tests are calculated, the last step to determine the hypothesis to be valid or invalid is absent; it is the comparison of the resulting values from the t-tests with the critical values from the tables. The critical value for the selection of 110 samples, like in the case of the first hypothesis, is 1.96. Considering the fact that the critical value of 1.96 is greater than the calculated value of the t-test of 1.54, it is possible to state that the first hypothesis is valid. In the second case, the critical value of the set of 58 samples equals 2. Even in this case, the critical value of 2 is higher than the value of the t-test, i.e. 2.22; therefore, the second hypothesis can be deemed as valid as well.

The statement that both hypotheses are valid, can be confirmed by another way; it is with the values found by the software.

$$p - value_1 = 0.11 = 11\% \quad (43)$$

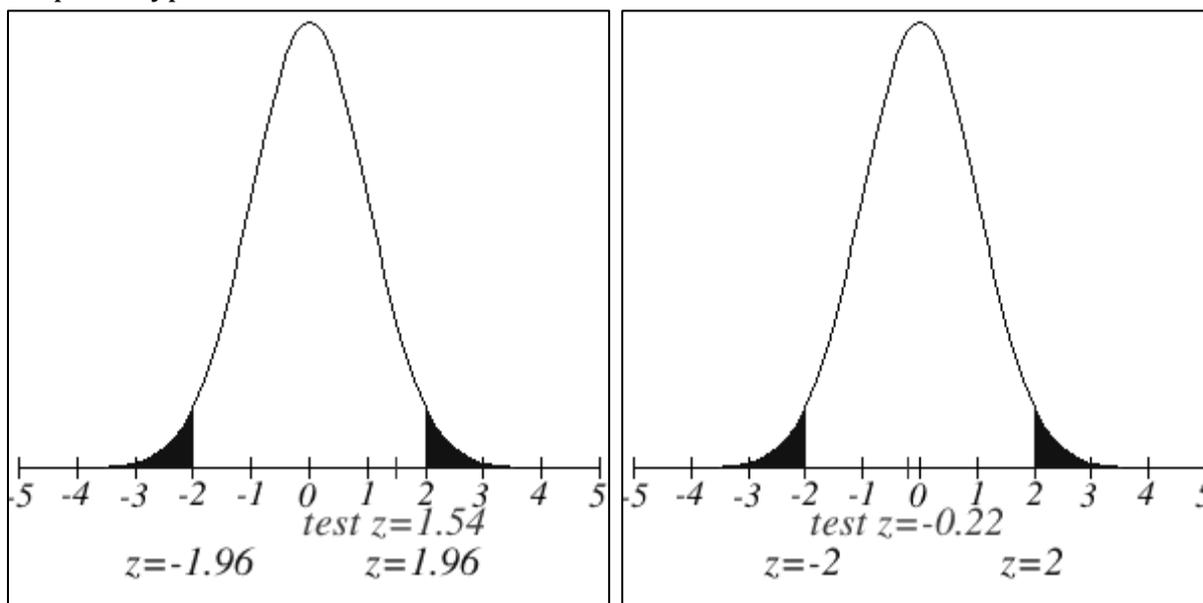
$$p - value_2 = 0.86 = 86\% \quad (44)$$

As expected, both p-values are higher than 5 and it is possible to confirm the validity of both hypothesis in this way as well.

The validity of the hypothesis can be verified by yet another method, i.e. by a 95% quartile of the sets. It was found out by the software. The 95% quartile for the first selection, i.e.

for the enterprises with a turnover of CZK 52 million, is from 2.37 to 2.66. The above given calculated arithmetic mean at the value of 2.21 fits into this range and the validity of the hypothesis is confirmed in this way as well. The 95% quartile for the second selection, the enterprises with a turnover over CZK 52 million, is from 2.2 to 2.56. The above calculated value of the arithmetic mean for this selection was 2.38. This value, like in the case of the first selection, fits into the 95% quartile and, therefore, the accuracy of the statement is confirmed for the second selection as well. The results are also confirmed by graph 5.

Graph 5: Hypothesis 4 – Gaussian curve of normal division



Source: Authors, imathas.com.

Discussion

All results of the paper, which are clearly shown in table 1, were further verbally commented.

Tab. 1: Summary assessment of the hypothesis

Hypothesis	t-test value	Critical value	Result
H ₁	3.18 and 3,56	1.984 and 1,99	Hypothesis disproved
H ₂	3.42 and 3,13	1.96 and 2,0	Hypothesis disproved
H ₃	3.92 and 3,2	1.994 and 1,984	Hypothesis disproved
H ₄	1.54 and -0,22	1.96 and 2,0	Hypothesis proven

Source: Authors.

Null hypothesis μ_0 : Null hypothesis μ_0 : Small enterprises, with less than 50 employees, find the administrative intensity in business demanding at the rate of 70%. Middle-sized enterprises find the administrative intensity in business demanding at the rate of 70% (comparison).

The first hypothesis examined, whether the enterprises, which were divided, in accordance to the number of the employees, into the small (50 employees or less) and middle-sized (250 employees or less), bear the administrative intensity in business at the rate of 70% and, subsequently, it was planned to compare the results and find out, if there is a difference depending on the size of the enterprise in terms of administrative intensity. It was found out that none of the given selections bear the administrative intensity in business at the rate of 70%. The administrative intensity was in much higher numbers, slightly above 75%. It was discovered during the comparison that although the administrative intensity is demanding for the enterprises, the size of the enterprise does not mean a difference.

Null hypothesis μ_0 : The enterprises with a turnover of CZK 52 million or less find the administrative intensity in business demanding at the rate of 70%. The enterprises with a turnover over CZK 52 million find the administrative intensity in business demanding at the rate of 70%. (comparison)

The second hypothesis had a task to examine, whether the enterprises, divided in accordance to the size of turnover, specifically of CZK 52 million or less and over CZK 52 million, are taxed slightly or significantly; subsequently it was necessary to compare both detected results and state, whether the size of turnover means a difference at this rate. The given results show that the enterprises, divided in accordance to their turnover, do not bear an administrative burden at the rate of 70%, but much higher, specifically of 76.6% and 77.6%. Both hypotheses were, therefore, disproved. During comparing the enterprises with a turnover of CZK 52 million or less and over CZK 52 million, it was found out that the criterion of turnover is not substantially significant in terms of their administrative burden.

Null hypothesis μ_0 : Small and middle-sized enterprises in the primary and secondary sectors find the administrative intensity of business demanding at the rate of 70%. Small and middle-sized enterprises in the tertiary sector find the administrative intensity of business demanding at the rate of 70%. (comparison)

The third hypothesis examined the administrative intensity in business and the standard was a type of sector that they operated in. Specifically, the enterprises were divided into two groups. The first group involved the enterprises operating in the primary and secondary sectors. The second involved the enterprises operating in the tertiary sector. It was found out that the enterprises divided in accordance to a sector do not bear the administrative intensity at the rate of 70%. The burden is higher for the enterprises, specifically 78.3% and 76.6%. It was found out during the comparison that the enterprises operating in the primary and secondary sectors show a slightly higher burden than the

enterprises operating in the tertiary sector. This may be caused by the mode and complexity of production, which does not exist in the tertiary sector.

Null hypothesis μ_0 : The enterprises with a turnover of CZK 52 million or less find the tax burden (income tax, value added tax, excise duty, road tax) demanding at the rate of 60%. The enterprises with a turnover over CZK 52 million find the tax burden demanding at the rate of 60%. (comparison)

The last hypothesis dealt with the tax intensity of enterprises. The enterprises were divided again, in accordance to their turnover this time, and the extent of their tax burden was examined; as well as whether the turnover meant any difference in the burden. It was found out that the enterprises, divided in accordance to a turnover, are taxed at the rate of 62.8%, or at 59.5% respectively. In this case, the hypothesis stating the enterprises, divided in accordance to a turnover, are taxed at the rate of 60%, was proven in both selections. Surprising results were provided by the following comparison. It was discovered that the enterprises disposing of a turnover of CZK 52 million and less are taxed more than the enterprises disposing of a turnover over CZK 52 million, the difference is about 3%.

Conclusion

Finally, we can conclude: There was a set of enterprises. They were divided in accordance to several standards and underwent a statistical analysis; statements were set by the use of hypothesis and it was necessary to prove or disprove them. The hypothesis related to the administrative intensity in business of small and middle-sized enterprises. The specific divisions were formed by the standards based on the size, number of employees, size of turnover and the sector in which the enterprise operated. The additional hypothesis related to the tax intensity of small and middle-sized enterprises. It was recommended to prove or disprove the hypothesis on the base of comparing the test values with the critical values. This recommendation was verified by other ways; i.e. the setting of hypothesis on the basis of p-value and a 95% quartile. The hypothesis were set that the administrative intensity in business of small and middle-sized enterprises is demanding for them at the rate of 70%, however, they were disproved in every case; it was found out that the intensity is much higher and oscillates roughly around 75-80%. The purpose of the paper was fulfilled, it was proven and shown that small and middle-sized enterprises bear excessive administrative intensity and it is necessary to deal with this problem more in the future to find appropriate measures which will ease the administration for the enterprises and allow them to conduct their business more. The additional hypothesis related to tax intensity stated that small and middle-sized enterprises bear the tax burden at the rate of 60%. This hypothesis was proven. All the statements were displayed in the appropriate graph depicting a Gaussian curve.

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The Assessment of the Economic Disparities in the Slovak Republic

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Abstract

The exploring of regional disparities is at the center of researchers' interest in relation to socio-economic changes and globalization processes. The paper is focused on evaluation of regional disparities among eight Slovak regions with the focus on economic indicators. The evaluated indicators will be: employment rate, unemployment rate, long-term unemployment rate, average nominal monthly wage, net money income, labor productivity, gross fixed capital formation on GDP, foreign direct investment per capita, the R&D expenditure per capita, road network density (motorways and expressways), regional gross domestic product per capita. The study was realized by creation of Composite indicator (CI) and Gini Index (GI) calculation and provide framework for regional development assessment. The results of our study could contribute to the more effective implementation of regional policy instruments.

Keywords: disparities, region, indicators, economic indicators

Introduction

The term of regional disparities is often used but its explanation is understood in different ways. In general, the regional disparities are understood as the inequalities or the differences, while their difference is measurable. In the case of regional development, the term of disparity is understood as the different degrees of economic and social development, which create inequalities between the compared units. The term of disparity is necessary to understand in wider context, due to the fact, that disparities doesn't cover only social and economic dimension, but also the spatial, geographical political, social and ecological disparities. This confirmed Výrostová (2010), who argued that the disparities have economic, social and political character. Various literature sources present, that disparities are seen in positive as well as the negative ways. The

positive disparities represent the determining force for the development of the region. They determine and differentiate the regional development. From the negative perspective, the disparities represent socially undesirable differences. The regional disparities could be caused by economic as well as the non-economic factors: the low mobility of labor and capital, insufficient use of production factors and many others. As Betáková et al. (2015) stated, the increasing of the efficiency and complexity of land use and targeted process of sustainable development also entails increasing attention. When dealing with regional disparities, we must take into account: the causes of their origin and development, their impact on the population, economic development and the environment, the ways of disparities' measuring and the possibility how they could be influence by regional policy instruments. The research in this paper is focused on economic disparities, measured by several indicators, which represent the differences between the quality and quantity of regions' output.

Regional disparities by constantly changing and evolving can be measured, as well as evaluated. Koziak et al. (2014) stated that the application of various statistical tools and measures to measure disparities can be found in the literature: standard deviation, coefficient of variation, the Lorenz curve, Gini Index, Theil index, cluster analysis and others. To gain main aim of this paper, for the assessments of regional disparities, the cluster analysis and Gini Index will be use. By using of the cluster analysis, we will identify the regions, which are similar from the point of view of compared economic indicators. Gini coefficient is probably the most popular summary inequality measure, used vastly in individual-level income studies, but also for purposes of regional inequality analysis (Puljiz and Maleković, 2007).

The paper is organized as follows. In next chapter, the literature review focused on issues of regional disparities is presented. The part of Methods and Data provides a brief of realized analysis. This part contains the explanation of applied disparities measures and data sources. The results of realized analyses are presented in part Results and Discussion. The last chapter presents the conclusions with implications for future research.

Literature Review

Some authors refer unified name for regional disparities, as the social and economic disparities. Social disparities are very closely linked to economic. Regional inequalities that occur are mostly in the form of unequal social and economic opportunities, as well as marked disparities in prosperity levels among regions (Mavraki et al., 2020). The economic disparities are one of the main regional problems. They are the focus of regional economic researches, but also the precondition and starting point for governments to formulate regional economic policies (Li and Guo, 2017). Their origin is influenced by: the economic, social and rural development problems; "dual economy" in regions with high level of foreign investors, where is an isolated development of foreign and domestic companies; regional innovation backwardness, the lack of research excellence, low level

of creativity, poor innovation support and lack of strategic direction for regions; the partial support of regions, fragmentation of support into a wide range of activities (Buček et al., 2010). Habánik (2016) identifies different historical, geographical, natural, socio-economic and other conditions as the causes of different levels of regions, as well as having basic development factors: skills and qualifications of the workforce, financial capital and assets, land, natural and raw material resources. Many researchers pointed mainly on their negative form as uneven development of the region. Uneven socio-economic development, which is observed at all levels – from the global to the municipal – is one of the most important issues in the world economy (Gubanova and Kleshch, 2019). The economic disparities results in a reduction of the economic growth, a decrease in production, a decreasing of living standard and the increasing of unemployment. The positive perception can be seen as a means of increasing the competitiveness and sustainability of regional development. In this context, it is necessary to take into account also the interpretation of term “region”. According Gubanova and Kleshch (2019) region, on the one hand, is a complex system with the properties of openness, nonequilibrium and nonlinearity, and on the other hand, a part of space with its inherent properties (density, location, mutual arrangement of space objects, structurality, hierarchy, etc.). The economic disparities consist of: the economic potential that include the economic performance, productivity and external relations; the economic structure, which includes the economic branches’ structure and the structure of entities; the development potential, which includes R&D, foreign capital and investment; the human potential that is created by the economically active population, employment, unemployment and mobility.

There are a number of indicators to assess the regional disparities. In general, we can divide them according to their nature into economic, socio-economic, demographic and infrastructure equipment indicators. At present, multi-criteria assessment of regions is preferred. This assessment is a more objective approach than an assessment based on the single indicator. The key role of regional disparities research is the correct selection of indicators, the way of their integration into one indicator (composite indicator) and the subsequent correct interpretation of the results (Michálek, 2014). For the determination of differences among regions, it is necessary to choose the appropriate indicator or group of indicators. The most widely used indicator is the gross domestic product per capita, which is also a key indicator of regional economic performance. Next, often used indicator is the average monthly wages. Both indicators have the potential to describe except the performance of economy, also the living standards in regions. The value of work means a positive work-life balance for employees (Mura et al., 2019). Various research studies are focused on observation of economic indicators from several points of view, while explain their value for research. Kutscherauer (2011) used ten relevant indicators for assessment of affecting the development of the economic sphere of regions: net disposable income of households per capita, the gross domestic product of whole region, the gross domestic product per capita, the gross fixed capital formation per capita, the export share in the region’s gross domestic product, the number of entrepreneurs (registered units) per 1,000 inhabitants, R&D expenditure per capita, gross value added per capita, registered unemployment rate, the share of the region in total foreign direct investment. Kebza et al.

(2019) used five indicators that represent economic level of regions: gross domestic product per capita, average monthly wages, unemployment rate, the share of workforce employed in agriculture and transport infrastructure. All the economic indicators were set in such a manner that their highest significance reached the positive poles. According Czirák et al. (2006), there are several different approaches to regional development level assessment in the literature, the bridge often some form of classification and data reduction is employed, but they also pointed on the multivariate methodological framework based on multiple indicators of regional development assessment. Pittau et al. (2010) investigated the role of economic variables in predicting regional disparities in reported life satisfaction of European Union citizens. They used as the group-level predictors, the regional per capita gross domestic product and regional unemployment. They argued that these two economic variables, along with the rate of inflation, have been most thoroughly investigated and recognized as the most influential.

Based on the literature review, Ohlan (2013) recommends to follow main properties of good socio-economic development indicators used for assessments: firstly, a good indicator must be relevant to the process or component of development and should be as much as possible representative of the component of development it reflects; secondly, an indicator should be comprehensive in the sense that it should reflect as many aspects of the component of development, which it represents, as possible; thirdly, a good indicator should have the same direction of change as the process being measured, in our case, economic development; fourthly, the indicator should be quantifiable; fifthly, a good indicator according a point of reference against which the value of the indicator can be assessed, must be scaled; sixthly, the indicators being restricted or unrestricted.

In our analysis, we focused on a narrower selection of indicators, but we assume that this will also provide a sufficient picture of the development of regional disparities in Slovakia. A very important prerequisite for the economic performance and success of an individual region is the favorable situation on the labor market. Employment, unemployment, long-term unemployment and average wage are important labor market indicators. The employment rate represents the share of employment in the total economically active population. In the identification of regional employment disparities, the methods of finding a hidden structure is widely applied. The application of these methods is determined by variability and relationships between them (Vojtková, 2010). Unemployment rate may indicate potential structural problems in the region or, on the contrary, accentuate its high economic performance. The main distinctive features of unemployment are regional disproportions, risk of increasing long-term unemployment, risk of structural unemployment, insufficient link of the education process with the needs of the labour market, burden of unemployment, insufficient innovation capacity that would support employment, and employability of excluded groups including the young. It is a general interest to tackle the unfavorable state of unemployment in all age groups (Kordoš and Krajňáková, 2018; Svabova et al., 2019). Employment and unemployment are one of the most prevalent concepts in the economy and point to the complex challenges of the market economy. They do not only express the problems of the economic

direction, they often express the imbalance of the social and political problems of the given economy in the country (Petrušová et al., 2018). Long-term unemployment is a particular problem within unemployment. The long-term unemployment rate expresses the percentage of persons unemployed for more than one year in the number of economically active persons. Average nominal monthly wage is one of the basic socio-economic indicators by which we can assess the differentiated development of regions. This is the average monthly wage in enterprises with 20 or more employees (Matlovič et al., 2008). The average monthly wage is the average level of gross monthly wages of employees and it is an important factor in living standards (Koišová, 2015). It is the largest part of household income. The indicator net money income becomes to another descriptors of the living standard. Net money income consists of net labor income (excluding tax income and compulsory contributions), social income, other income (property income, income from institutions and income from private persons, including income in kind, income sales of agricultural products and incomes from abroad), positive difference between collected savings and deposited deposits and positive difference between collected and paid loans (Matlovič et al., 2008). As Škrovánková et al. (2018) stated, the society is moving forward, raising living standards, increasing income, declining unemployment, but the problem is that these conditions are not equally accessible for everyone across the regions. As we mentioned above, human resources are an important factor in the development of the region, and the effectiveness of their using is reflected in labor productivity. The labor productivity indicator is another indicator by which the efficiency of the use of the labor factor can be expressed. Productivity is a source of intense economic growth and at the same time creates conditions for future employment growth if the rate of labor productivity growth is higher than that of wages (Němec et al., 2010). The next important prerequisite for economic development are investments. Investments (gross fixed capital) significantly determine the dynamics of economic development, long-term economic growth and thus also the overall economic level of a given country and its individual regions. Foreign direct investment is of particular importance for regional development. Foreign direct investment is a global phenomenon whose share in international business is steadily rising and generates large capital injections. They have been and continues to be an important factor also in regional development. They help create new jobs, which can lead to an influx of new technologies, and in total they provide the necessary capital to restore a successful transition to the market economy (Shuyan and Fabuš, 2019). As mentioned by Ivanová (2013), their localization in under-economically and socially developed regions brings a synergistic effect for the whole economy. Through the transfer and introduction of new technologies, FDI ensures the creation of new jobs (Krajčo, 2014) and increases the production potential of the region (Sochuláková, 2014). It is precisely the rapid and efficient acquisition of new knowledge and its application in new products, technologies and services that require sufficient expenditure on science and research. The intensity of R&D expenditures in value-added emerge as the most effective factors enhancing the growth of GDP per capita (Sterlacchini, 2008).

Prerequisite for economic growth and sufficient foreign direct investment is built infrastructure. An indicator with the function of some sort of economic catalyst is transport infrastructure or major roads density (Kebza et al., 2019). In the Slovak Republic, transport infrastructure is included among eight identified significant critical infrastructure sectors that are strategically important for the maintenance of vital societal functions, health, safety, security, economic or social well-being of people, and the disruption or destruction of which would have a significant impact in the state as a result of the failure to maintain those functions (Luskova et al., 2016).

All the above factors affect the overall performance of the region, which is expressed by indicator of gross domestic product. It is the value of the final products and services produced in the territory of the region in a given year. Its level depends on regional resources and the effectiveness of used sources.

Methods and Data

This paper evaluates the economic regional disparities based on 11 officially stated indicators (by the Statistical Office of the Slovak Republic) for the period 2006-2017. There is the overview of indicators, their designation, type and unit in the table 1.

Tab. 1: The list of indicators

sign	Indicator	Abbreviation	Type	Unit
$y_{1,r}$	employment rate	1_ER	max	%
$y_{2,r}$	unemployment rate	2_UR	min	%
$y_{3,r}$	long-term unemployment rate	3_LTUR	min	%
$y_{4,r}$	average nominal monthly wage	4_ANMW	max	€
$y_{5,r}$	net money income	5_NMI	max	€
$y_{6,r}$	labour productivity	6_LP	max	€
$y_{7,r}$	gross fixed capital formation on GDP	7_GFC	max	€
$y_{8,r}$	foreign direct investment per capita	8_FDI	max	€
$y_{9,r}$	the R&D expenditure per capita	9_RDE	max	€
$y_{10,r}$	road network density (motorways and expressways)	10_RND	max	km/km ²
$y_{11,r}$	regional gross domestic product per capita	11_RGDP	max	€

Source: Authors.

The construction of Composite indicator (CI)

Based on the indicators stated in the Tab. 1, for the main aim of this paper's achieving, the Composite indicator (CI) was constructed. In general, the CI is indicator, which is constructed from several sub-indicators, which are often non-directional, have different levels and variability, and exhibit different degrees of interdependence in pairs. Sub-indicators assess the region from different, often ambiguous, perspectives. The CI, constructed from these sub-indicators, should allow a more comprehensive, coherent and synthesizing view of the level of regions in the country (Minařík et al., 2013). The OECD (OECD, 2008) published a detailed methodology for construction of CI. The OECD's

Handbook on Constructing Composite Indicators describes different methodologies that can be applied to combine varied information into this index and the difficulties associated with each part of the process. Methods for the compilation of CIs include direct aggregation techniques, methods used for data purification, their modification, statistical processing and control of the obtained results and their presentation. A well-designed composite indicator should always include sub-trends but also contradictory developments of individual sub-indicators and factors. When constructing the composite indicator, it is important to follow the correct definition of the measured characteristics and also from the knowledge of the essential links of the problem (Hrach and Mihola, 2006).

The following steps can describe the construction of CI: creation of a theoretical framework, selection and combination of input indicators, assessment of their material significance, statistical characteristics, weighting, normalization, aggregation, relation to input indicators, visualization of results. Summary indicators have both advantages and disadvantages. Saisana and Tarantola (2002) discuss them in detail.

In this paper we will use the following designation: $y_{i,t}^r$ - the original value of the indicator i , of the region r ; $r = 1, \dots, R$, in year t (2006 - 2017), where $i = 1, \dots, n$; ($n = 11$), I_i^t is normalized indicator value i in year t , using method Min-Max. Formula for computation of value CI_t^r over time t is:

$$CI_t^r = \frac{\sum_{i=1}^n I_i^r}{\frac{\sum_{i=1}^n \sum_{r=1}^R I_i^r}{R}} \quad (1)$$

where R is number of analyzed regions, in our study is $R = 8$. The CI takes values around an average of 1. The value of $CI_t^r > 1$ means that the regions is ranked better.

The construction of Gini Index (GI)

For the assessment of regional disparities in the Slovak Republic in the paper, the concept of the Gini Index (GI) is also used. The GI is used to measure the inequality of CI distribution, which comprehensively characterizes the socio-economic situation (potential) in the regions and points to the distribution of this potential across the assessed region.

The value of $GI=0$ can be interpreted as an even distribution of the socio-economic potential of regions in the Slovak Republic. The value of GI converging to 1 is interpreted as a totally uneven distribution of the CI value, which represents the socio-economic potential of the region. The GI value in the reference year t can be calculated according to the following relationship (Zvára, 2013):

$$GI(CI_t^1, \dots, CI_t^R) = \frac{1}{2R \sum_{i=1}^R CI_t^i} \cdot \sum_{1 \leq i, j \leq R} |CI_t^i - CI_t^j| \quad (2)$$

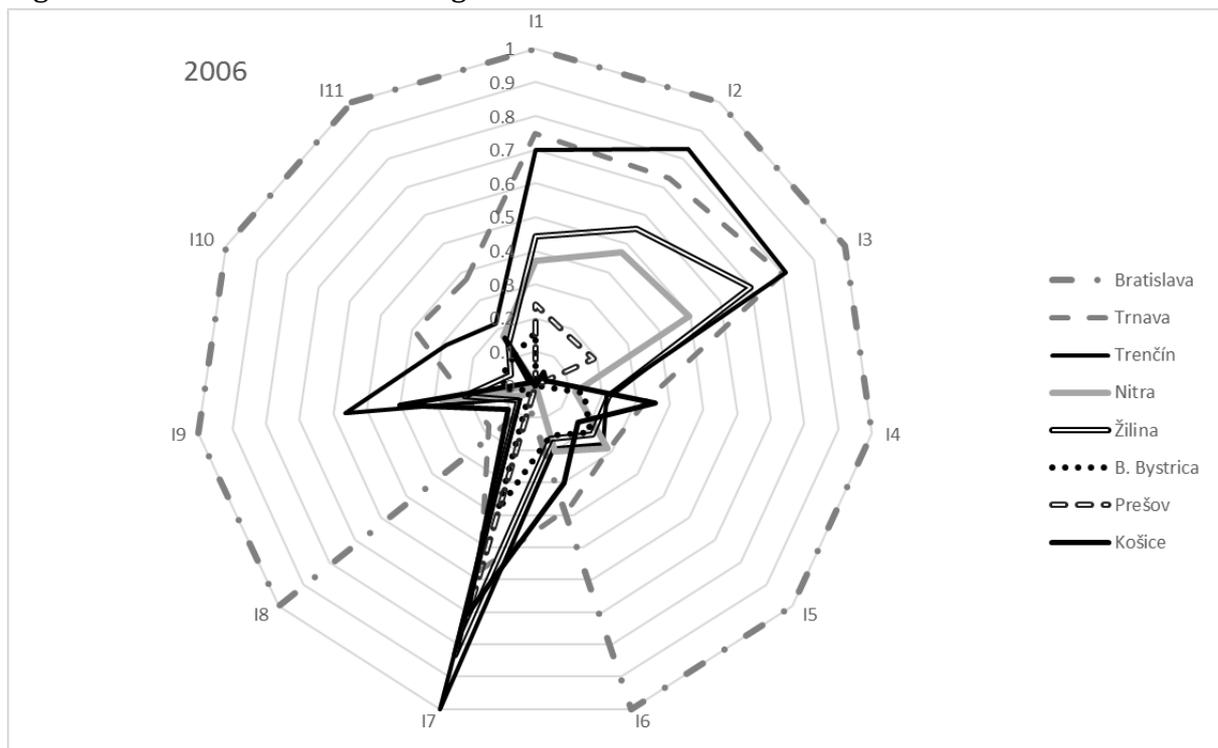
The sequence (CI_t^1, \dots, CI_t^R) is non-decreasing after re-indexing. For the resulting value of GI it applies: $0 \leq G(CI_t^1, \dots, CI_t^R) < 1$.

Results

Within the observed period 2006-2017, the development of indicators stated in Tab. 1 was analyzed. The observed period we can divide into three sub-periods. Years 2006-2008 were characterized by favorable economic development when the situation at the labor market is improved. In 2009, the development of selected indicators was affected by the economic crisis, which worsened the development of all monitored indicators. Although the economic indicators have already developed positively in 2010, the indicators of the labor market continued to deteriorate, some of them until 2013. In next years, the favorable development was recorded. The positive trend was observed in case of economic performance and social indicators. Within the monitored indicators, the best evaluation was achieved by Bratislava region and the worst by Prešov region. The Bratislava region significantly differs from other regions in the evaluation of indicators e.g. regional gross domestic product per capita, foreign direct investment per capita and motorways and expressways density.

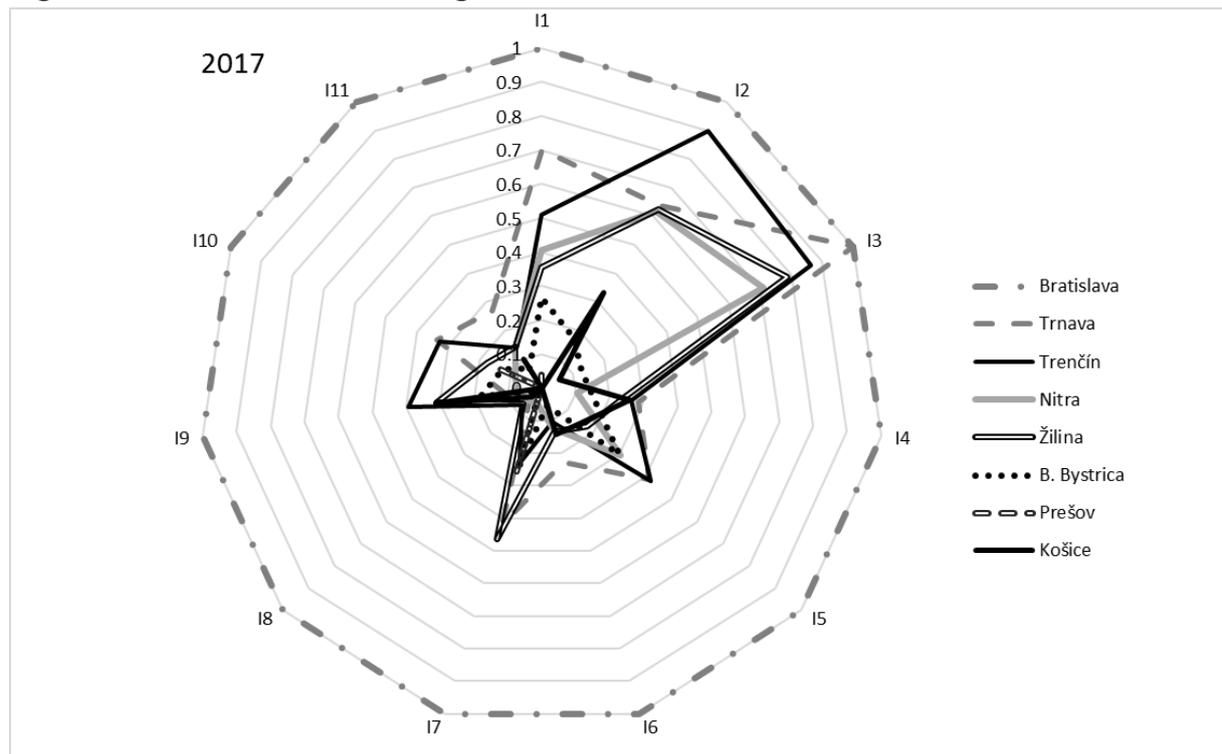
The monitored indicators have different units of measure. For analysis, their data were transformed by using Min-Max method. The comparison of regions by the monitored indicators in years 2006 and 2017 are depict by Figure 1 and Figure 2.

Figure 1: Evaluation of Slovak regions in 2006



Source: Authors, based on data of the Statistical Office of the Slovak Republic.

Figure 2: Evaluation of Slovak regions in 2017



Source: Authors, based on data of the Statistical Office of the Slovak Republic.

Figure 1 and Figure 2 show a significant distance of the Bratislava region from the rest of Slovak regions, while the lagging of these regions increased in 2017. The calculated standardized values of monitored sub-indicators were used for calculation of composite indicator CI_t^r . The value of the composite indicator CI_t^r was calculated from the analyzed indicators for each region r , in year t . There are the results for each Slovak region in the Tab. 2.

Tab. 2: The results of CI_t^r and Gini Index

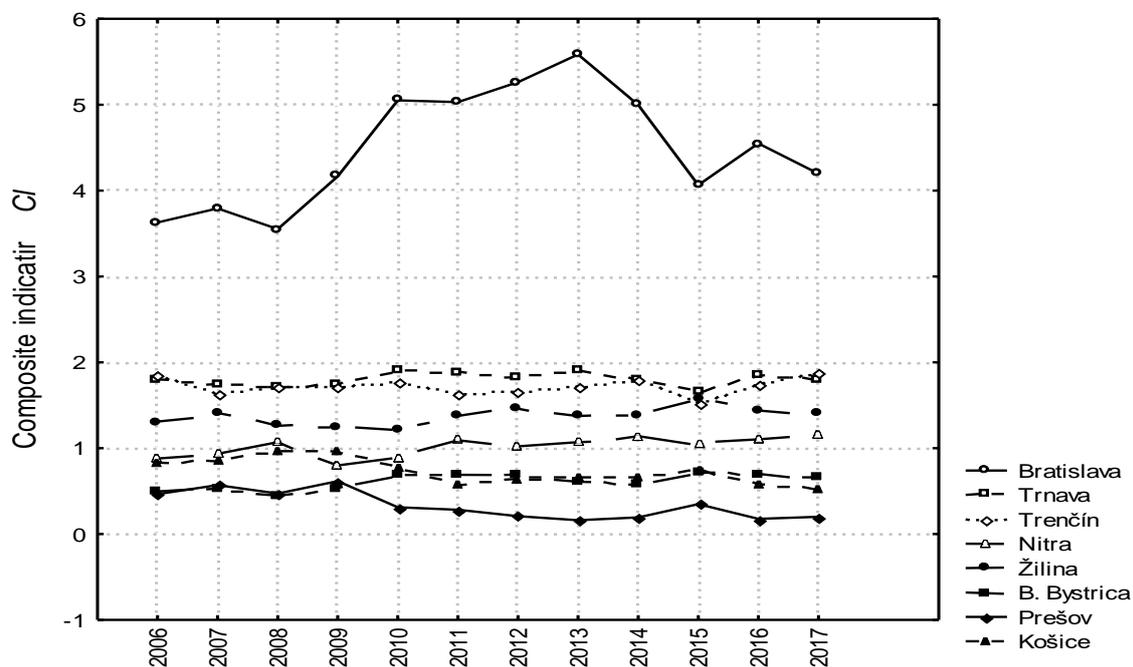
Region	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Average CI
Bratislava	3.63	3.79	3.55	4.17	5.05	5.03	5.26	5.59	5.00	4.06	4.55	4.20	4.49
Trnava	1.80	1.75	1.71	1.73	1.91	1.89	1.83	1.90	1.79	1.67	1.84	1.80	1.80
Trenčín	1.85	1.62	1.73	1.72	1.77	1.64	1.67	1.73	1.80	1.51	1.75	1.87	1.72
Nitra	0.88	0.93	1.07	0.80	0.89	1.09	1.02	1.07	1.14	1.05	1.10	1.16	1.02
Žilina	1.31	1.40	1.26	1.24	1.22	1.38	1.46	1.37	1.39	1.58	1.44	1.40	1.37
B. Bystrica	0.50	0.53	0.45	0.54	0.68	0.69	0.70	0.61	0.57	0.73	0.70	0.66	0.61
Prešov	0.47	0.57	0.47	0.62	0.31	0.28	0.21	0.16	0.20	0.35	0.18	0.20	0.33
Košice	0.83	0.85	0.95	0.96	0.76	0.57	0.64	0.65	0.66	0.75	0.58	0.52	0.73
Gini Index	0.58	0.56	0.64	0.62	0.65	0.72	0.65	0.64	0.64	0.64	0.62	0.64	

Source: Authors, based on data of the Statistical Office of the Slovak Republic.

There is also the calculated value of GI in each observed year across all regions in Tab. 2. As it is stated above, the value of $CI > 1$, represents the above-average region. The highest recorded value is $CI_{2013}^{BA} = 5,59$. The lowest value of the composite indicator was $CI_{2013}^{PO} = 0,16$. The overall overview of the constructed CIs' development for each region in the observed period 2006-2017 is illustrated in Figure 3.

The regions, which are evaluated as below average in whole observed period are: Banská Bystrica, Prešov and Košice. The Nitra region could be evaluated as average in observed indicators. The regions of Žilina, Trenčín and Trnava appear to be above average. Special attention should be paid to the region of Bratislava, which is assessed as highly above average, while $\overline{CI}_{2006-2017}^{BA} = 4,49$.

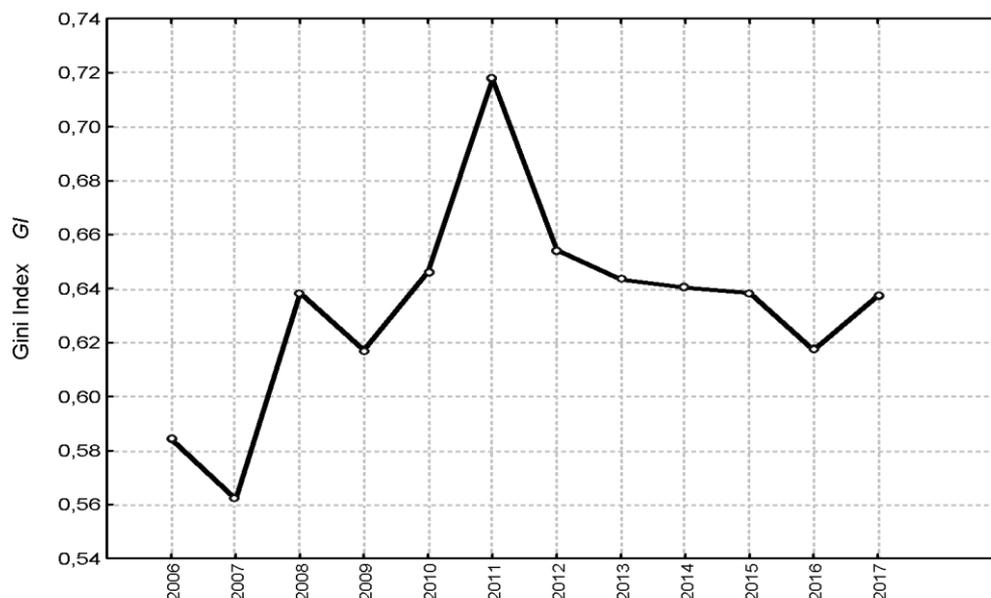
Figure 3: The development of CI



Source: Authors, based on data of the Statistical Office of the Slovak Republic.

After analysis of regions from the perspective of CI , the situation of the regions specified by the GI was found, in order to confirm the assumption of unequal distribution of socio-economic "potential" of the regions. The Figure 4 shows the development of GIs value. The most even distribution was observed in 2007, when $GI_{2007} = 0.56$. The most uneven distribution of the socio-economic potential of the regions was in 2011, when $GI_{2011} = 0.72$.

Figure 4: The development of GI



Source: Authors, based on data of the Statistical Office of the Slovak Republic.

Conclusion

Although the concept of regional disparities is often elaborated, their understanding and interpretation are inconsistent and largely diversified. This is mainly in terms of basic types of territorial disparities, attributes, user value and basic aspects of system classification and decomposition. Correct identification and measurement of regional disparities seems to be a decisive factor for solving of regional disparities. Regional disparities are characterized by a wide range of phenomena and processes that can be identified, structured, measured and evaluated.

As the results of our research based on analysis of selected economic indicators showed, years 2006-2008 were characterized by favorable economic development, but in 2009 the positively development was affected by the economic crisis and in the next years the favorable development was recorded again.

We also pointed on differential development in individual regions. The calculation of CIs for each region showed, that the best ranked regions except Bratislava are Trnava (1.80), Trenčín (1.72) and Žilina (1.37). The worst results of CI in observed period (2006-2017) achieved the Prešov region (0.33). The results of GI for eight Slovak regions calculated for each year showed the total uneven distribution of CI in 2011 (0.72).

In this paper, we proposed a methodological basis for regional economic disparities' assessment based on Composite Indicators' construction supplemented by calculation of Gini Index.

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The Nature of Startup Development: Concepts, Theories, Trends, Conditions

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Abstract

The article investigates topical issues of startup development through the prism of the possibility of implementing the entrepreneurial activity. The basis of the study was the generalization of the development of the theory of startups through the prism of the theory of management, entrepreneurship, innovation, and theory of organizations. Understanding the nature of startups allows us to determine the conditions for intensifying their development. The article also systematized the existing methods of analyzing the effectiveness of startups. The main trends in the development of the startup movement in different regions and countries of the world were identified based on the analysis of the international experience of startups. The article also researches the interaction between startups and corporations in the context of advantages for both parties. It is emphasized that an essential condition for the development of startups is the formation of the entrepreneurship ecosystem.

Keywords: startup, business, entrepreneurial activity, indicators, complex process

Introduction

In the XIX-XX centuries, the leading role in the economic development held by the material production sectors, in particular oil, metallurgy, machine building, and others, but in current conditions, the most dynamically growing business is formed based on knowledge and innovations. A convenient way to start a business for those who want to implement their creative ideas and set up a successful and fast-growing enterprise is to create a startup. Unexpected ideas, which in most cases are very difficult to develop due to lack of resources, can not only be transformed into a real growing business through seed financing but also reach the level of global players, especially in the sector of information technology, pharmacy and others.

On the other hand, existing companies, lacking innovation, actively support the startups. Startups as an element of market infrastructure play an increasing role. Large firms are, on average, more productive than smaller ones, especially in the manufacturing sector, but some small firms often superior to larger companies by taking competitive advantage in high-brand or highly intelligent niche, with intellectual property activities. An essential factor in the development of startups in modern conditions is the rapid development of information and communication technologies, digitalization of the economy. Both universities and public authorities pay attention to stimulating the development of startups in modern conditions. The search for ideas and the creation of conditions for their implementation are the key phases of the innovation process, which has become a driver of economic development. Every entrepreneur in the initial stages aims to make a profit, but only 1 in 12 succeed in doing so.

That is why the processes of developing startups from the standpoint of creating conditions and transforming into real enterprises in the context of the formation of practical recommendations for initiation need to be studied. Various aspects of startup management are presented in the works of Mrykhin (2015), Lalu (2017), Til (2015), Ivashova (2013), Blank (2013), Ris (2012).

Thus, Watson and Hogarth-Scott (1998) are studied the creation and the survival of small and micro enterprises, as well as the role of public authorities to support their development. The focus is also on the viability and the importance of startups to ensure the development of developing countries, emphasize Okrah, Nepp, and Agbozo (2018). Researchers note that the critical conditions for activating the startup movement are the internal market openness and government policies that highly influence the financing of startups.

Cheah, Ho, and Lim (2016), Zilgalvis (2014), Dolfsma and Seo (2013), Minniti (2008) reveal differences in the processes of startups formation in different regions of the world. The content of the public policy of promoting entrepreneurial activity in the country and creating systemic conditions for the development of startups are studied by Minniti (2008), Patanakul and Pinto (2014).

Methods and Data

The purpose of the article is to investigate the theoretical, organizational, and methodological issues of activating the processes of startups creating, the practice of managing them, and to justify the measures necessary to enhance entrepreneurship, which is essential for any country.

For this goal, the following main tasks would be considered:

- to generalize existing approaches to understanding the nature and features of startups;
- to explore holistic models of startups and stages of their formation;
- to establish the critical trends of startups' development in different countries;

- to substantiate the fundamental conditions and measures to intensify the processes of creating startups.

Research methods were used: quantitative and qualitative, analytical and comparative, statistical information processing, analysis and synthesis, economic and mathematical modeling, etc.

Scientific novelty and practical significance lie in the systematization of methodological approaches to the analysis of the development of startups and the development of proposals for activating the startup movement.

For understanding the nature of the startup movement, it is advisable to research at the macro level, at the regional level and, directly, individual startups.

The main indicators used to study the development processes of startups are: the number of startups in terms of regions of the world, countries, per capita; investments in startups in various forms; the share of the population covered by entrepreneurial activity and involved in the creation of startups.

International organizations use the following indicators:

Entrepreneurial employee activity (EEA) it is a share of the population between the ages of 18 and 64 that is now actively involved and plays a leading role in developing an idea or preparing and implementing a new activity for its employers, such as developing or launching new goods or services or creating a new business unit or subsidiary (Europe's Hidden Entrepreneurs Entrepreneurial Employee, 2016).

The indicator of the total early-stage entrepreneurial activity (TEA) of the economy is defined as the level of prevalence of people of working age who are actively involved in business startups, or on the pre-birth phase of the firm (startup entrepreneurs), or the phase that covers 42 months after the birth of the firm (owners or managers of new firms). That is to say; it is the percentage of the population aged 18-64 who is either a nascent entrepreneur or a new business owner-manager.

The indicator can be divided into two parts: TEA based on an opportunity (easiest to explain as entrepreneurs who could find a job but decided to do business on their own) and TEA based on need (easiest to explain as entrepreneurs who could not find a job and started their business to survive).

In the US, calculate **the Kaufman Startup Activity Index** (The Kauffman Index of Startup, 2016), which integrates and bases on three components: the fraction of new entrepreneurs in the economy (calculated as the percentage of adults becoming entrepreneurs this month), the possibility of new entrepreneurs (calculated as the percentage of new entrepreneurs), motivated by "opportunity" rather than "necessity" the density of startups in the regions (the ratio of the number of new employers based on the number of economic entities).

It is far from being a full list of metrics used for startups. All indicators can be divided into two groups: indicators that characterize the results of startups and indicators that reflect

the conditions and motives for doing business. Some of the presented indicators will be used in the process of further analysis.

Results

The concept of "startup" has recently become widespread and influential. Creating startups is relatively new and requires a systematic understanding, in the context of activation and, therefore, in the theoretical, methodological, and applied way.

The most common concept of a startup is considered to be the definition formulated by the successful American startupper Stephen Blank, namely: "a startup is a temporary structure aimed at finding and implementing a scalable business idea" (Blank, 2013).

In general, it is a term used to describe a business that works to create products or provide services to solve modern problems or meet current requirements, because the solution is not clear and success is not guaranteed (Heyets, 2015). A startup is a process for implementing an utterly young project with minimal investment in a short space of time. This form of business's main characteristics are based on the very definition: start – as the beginning, "up" – as a rapid rise, growth. Scientific approaches to understanding the concept of "startup" are presented in table 1.

Tab. 1: The essence of the concept «startup»

Author	Definition
Blank, 2013	Startup (from the English. Start-up – start, run) – is a temporary organization created to find a repetitive, scalable, and sustainable business model.
Kashirin and Semenov, 2008	A startup is a new company at the initial stage of its development, which is created to implement a promising idea to receive high profit.
Greham, 2012	A startup is a growth.
Ris, 2012	A startup is a newly created organization that develops new products or services in conditions of extreme uncertainty.
Mrykhina, 2015	Startup – the market entry process of a newly created enterprise with an innovative project, usually in the short term and with minimal investment.
Pikul, 2008	A startup is a newly created company (sometimes not even a legal entity), which is on the development stage and builds its business either based on new innovative ideas or newly invented technologies.
European Network of Startups, 2018	A startup is an independent organization that is less than five years old and aims to create, improve, and expand a scalable, innovative, technological product with high and rapid growth.

Source: Authors.

In general, this term is used to describe a business that works to create products or provide services to solve modern problems or meet current requirements, because the solution is not clear, and success is not guaranteed (Mansfield, 2018).

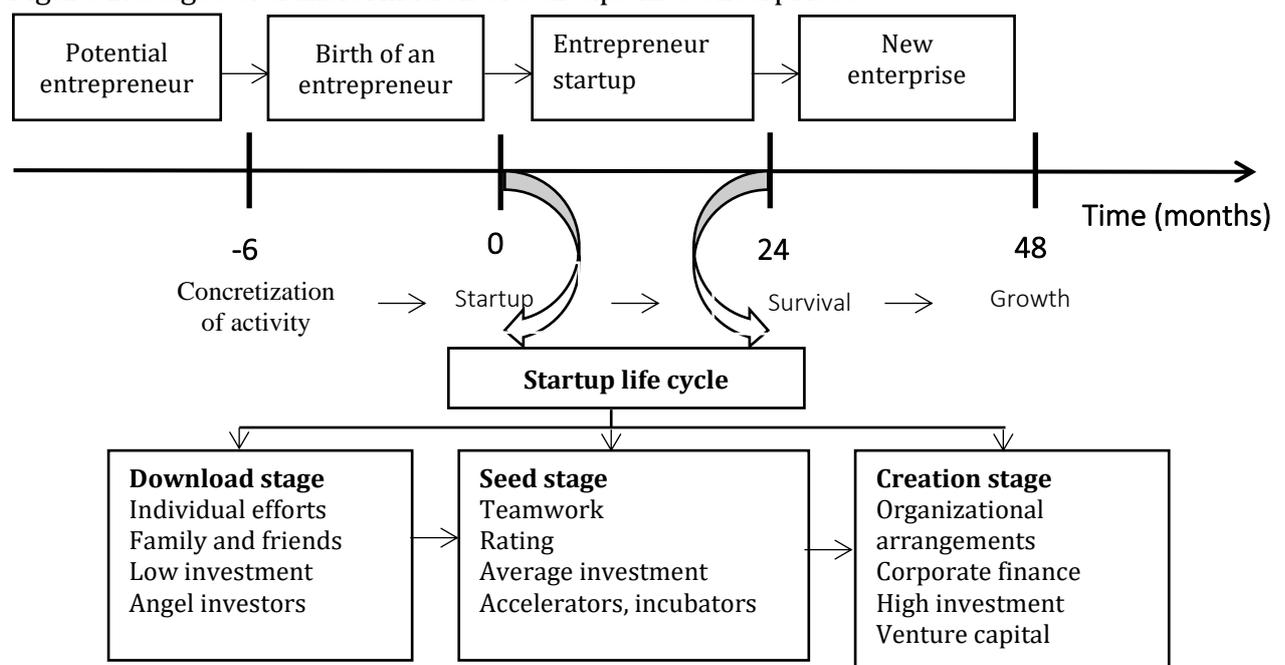
The presented definitions testify to this concept's capacity and scope: from the appearance of the idea to the enterprise at the initial stages. Also, studying the nature of startups makes it advisable to focus on comparing the concepts of "startup" and "entrepreneur." Thus, for a startup in the first place – attracting investment to realize his idea, he spends much effort to realize dreams and ideas, and his main priority is not business, but the commercialization of ideas. Entrepreneur, at the same time, is most often engaged in traditional business, can run startups, and the main priority is business.

Startups should be explored from positions of organizational theory, management theory, and entrepreneurship. In terms of the theory of organizations, it is essential to study the issue of the rapid transformation of an idea into a growing enterprise, management theory is enriched by the study of modern management methods of small teams, and business theory focuses on studying the nature of ideas and entrepreneurial initiatives. Startups also play an important role in innovation theory as part of the innovation infrastructure.

Startup as the original form of enterprise existence is an important area of study of **the organization's theory**. Given the characteristics of this form of starting a business to understand the mechanisms of "start," it is advisable to take into account the stages of the life cycle, which is proposed in the paper (The Kauffman Index of Startup Activity, 2016).

The process of transforming startups into enterprises with the specification of stages, their content, forms, and time horizons are presented in figure 1.

Figure 1: Stages of transformation of startups into enterprises



Source: Built by the authors based on Bosma, Meijaard and van Popta, 2002; Salamzadeh, and Kesim, 2015; Kasych and Dzhura, 2019.

At the loading stage, efforts are made to turn the idea into a profitable business by positioning the idea, justifying the feasibility of the product or service, the implementation of "sowing" financing. In the second stage, a team is created, and average investments are provided, in general, an attempt is made to enter the market. Stage of organizational separation of ideas through the creation of a real enterprise – it is at this stage that entrepreneurship ceases, as the established enterprise proceeds to production. This process can take up to two years.

Since a startup is a rather complex process in terms of initiation and traditional management models and methods do not work, the main focus in management theory should be on managing the factors of startup development and finding management tools in conditions of high uncertainty. The most common in such conditions are (Voloshin, 2017):

The Blanc-Dorf model (the concept of consumer development) does not involve closing the startup after failure, but finding new ways to implement it through consumer orientation and interaction with him.

Osterwald model (9-block model of startup monitoring), include key partners, key activities, benefits and offers, customer relations, user segments, essential resources, supply channels, cost structure, and revenue sources, in order to find weaknesses and find competitors benefits of the idea.

Esh Maurya's (lean canvas) model focuses on eliminating the causes of losses by involving the whole team in the process.

Another critical area of research of startups within the management theory is the search for the optimal business model in startup projects (Lalu, 2017). Bringing an idea to market requires knowledge of management, respectively, scientists are exploring the most appropriate methods to promote a startup project.

Innovation theory systematically investigates, among other things, the development of innovation infrastructure, an essential element of which is a startup. The developed innovation infrastructure ensures the full functioning of the chain "idea generation – development of innovative products – development of innovative capabilities of companies – production of innovative products – sales of innovative products." To innovation intensify through startups, infrastructure elements are needed that: first, will help finance startups (venture funds, seed funds, pilot centers for commercialization and technology transfer); secondly, they will provide organizational and technological conditions (technology parks, science towns, business incubators, clusters, centers for collective use of unique scientific equipment, etc.).

The theory of entrepreneurship focused on examining the conditions for individuals' initiative-taking activities, able to concentrate efforts not only on finding and justifying the idea but then on attempting to implement it independently. That is why in the theory of entrepreneurship startups are studied in the context of studying the processes of initiation of creative and creative activity of individuals and market testing of the formed

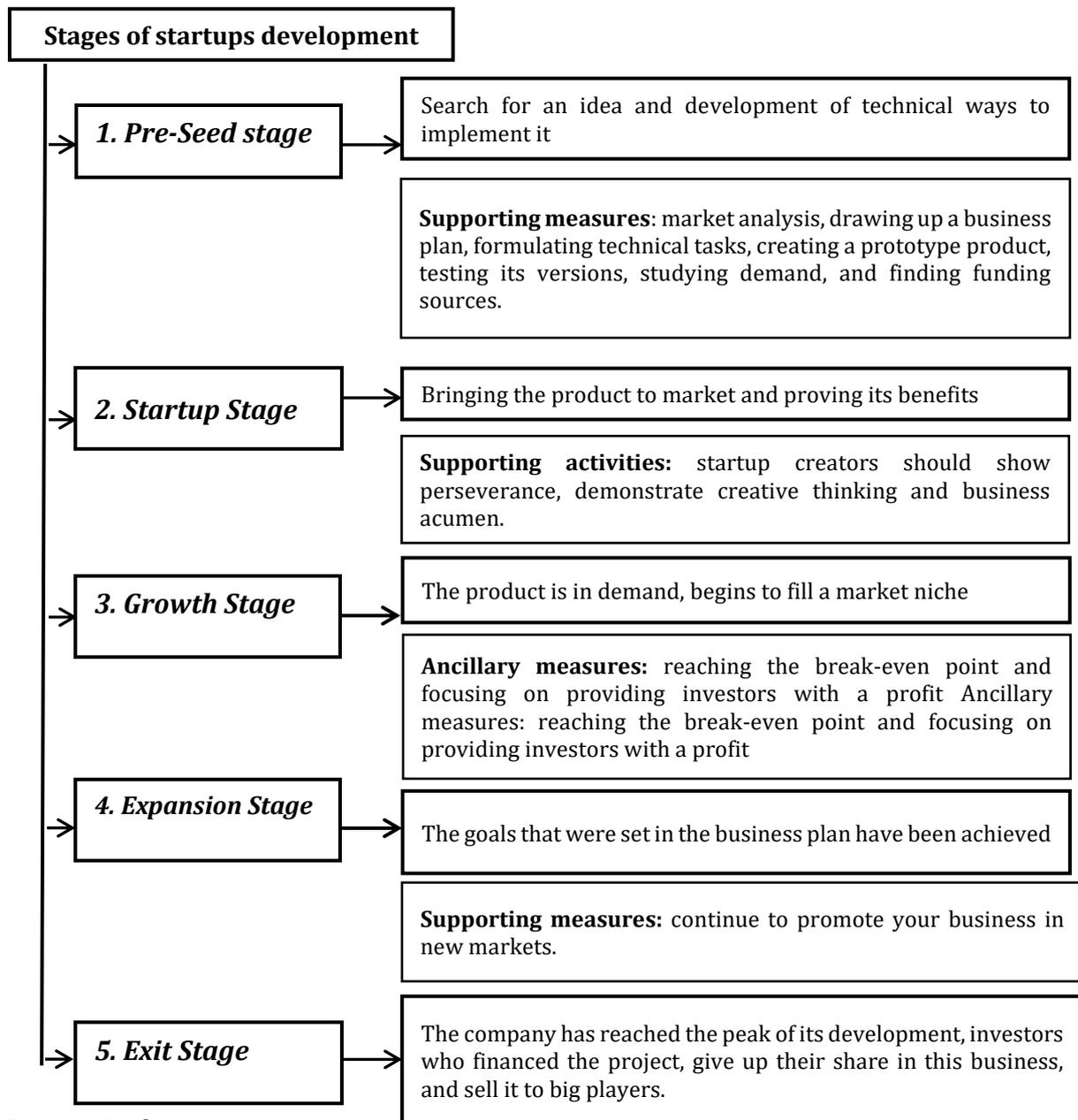
ideas. For this, a startup culture must be formed in the country, which would ensure the spread of the desire to start a business to implement their own ideas. However, it should be taken into account that in the conditions of developed market systems the accents of corporate culture have changed: from the ideas of "success through development" there has been a transition to the idea of "success through sales" (meaning the sale of successful businesses).

In the context of startups' nature study and determining the characteristics of this form of business organization, it is worthwhile to compare with another form of innovation, in particular with small businesses. They have some standard features: they are usually created by startup entrepreneurs and are small in scale. The startup team consists of 2-10 people, and the average number of employees in small businesses up to 50 people. Startups, as well as small businesses, operate at risk, have a volatile market position, need investment for successful development. Despite the common features, there are also some differences regarding product innovation, the scope of activity, successful development trajectory, the scale of activity, infrastructure, investment mechanisms, etc. Startups arise for the implementation of new innovative products, while small businesses focus on new or existing business models.

Thus, the main characteristics of startups are the presence of a creative idea, entrepreneurial initiative, short implementation period of the idea, the minimum amount of investment, continuation in the form of a new enterprise.

For the effective management of the startups' development process, it should be clearly understood not only their main stages of development but also measures to ensure the introduction of new ideas through the startup into the market and production through powerful enterprises (figure 2).

Figure 2: Key stages of functioning of old-timers



Source: Authors.

Indeed, the role of startups in modern conditions is to bring innovation in the form of participants' ideas to the market and bring it to the user, able to ensure the commercialization of them systematically. A startup is a temporary infrastructure element that seeks a scalable, cost-effective business model that can deliver reproduction. The main limitations that destroy startups are the lack of demand and a large amount of startup investment. That is, startup combines the characteristics that allow today to operate in the complex conditions of today's market. The convergence of interests of startup ensures the development of this form of innovation and entrepreneurship.

The authors of the idea and the investors are equally interested in the financial success of the startup. Each of them, in case of victory, will receive the benefit. The

investor always risks more, but if we talk about profit, it will also be higher than the profit of the startup. It is the investor, who receives most profits because he provides financial support and risks in case of failure. The developer has an interest in this business: he invests his opportunities in the startup – seeks to implement their ideas, gain success and recognition, does his favorite thing, and hopes to be rewarded for their efforts. The investor's interest is to increase capital. It happens in two ways, through an investment in a growing business or selling your share at a higher price (also could keep it and receive passive income).

Thus, startups are an effective form of strengthening the innovative business activity and entrepreneurship of creative people. Given the slowdown of scientific progress dynamics, the role of startups is growing and therefore requires more systematic research to ensure targeted management of these processes.

The startups' development, based on their role in economic development in current conditions, is given great attention around the world and is monitored accordingly. Next, we should focus on the study of international experience and identify the main trends in startups development:

1. In recent years, the world is experiencing a startups revolution; the amount of capital invested in startups through venture funds reached the largest in ten years the value of 140 billion **U.S. dollars** in 2017. The total value of the created global startup economy for 2016-2018 increased compared to the 2015-2017 period by 20.6% and reached 2.8 trillion U.S. dollars (Graham, 2012).

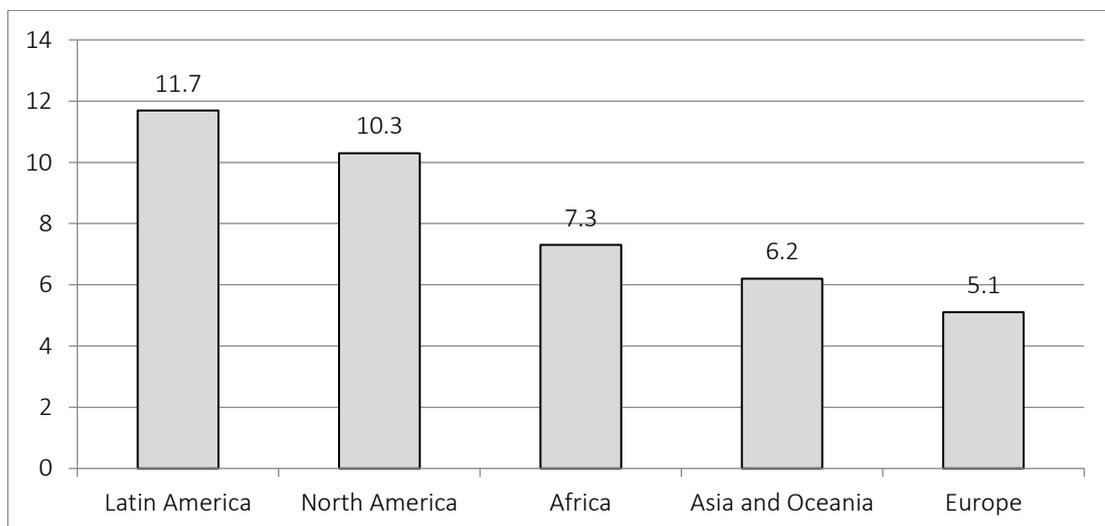
2. In the process of startups establishing, there are some regional differences, even though there is a total increase in their number in the world, as well as improving the general conditions for development (Table 2, figure 3).

Tab. 2. Indicator of the general initial stage of entrepreneurial activity (TEA)

Countries	2005	2010	2013	2014	2015	2016	2017	2018	2019
World	6.2	7.8	10.7	10.9	10.2	10.2	10.3	10.2	10.3
Brazil	11.3	17.5	17.3	17.2	20.9	19.6	20.3	18.5	23.3
Mexico	5.9	10.5	14.8	18.9	21.0	9.6	14.1	13.6	13.0
USA	12.4	7.6	12.7	13.8	11.9	12.6	13.6	15.4	17.4
Canada	9.3	8.8	12.1	13.0	14.7	16.7	18.8	18.5	18.2
Great Britain	6.2	6.4	7.1	10.7	6.9	8.8	8.4	8.2	9.3
Germany	5.1	4.2	4.9	5.2	4.7	4.6	5.3	5.0	7.6
France	5.4	5.8	4.8	5.3	5.3	5.3	3.9	4.2	4.6
Estonia	m.d.	m.d.	13.1	9.4	13.1	16.2	19.4	18.9	18.6
Poland	8.8	8.9	9.2	9.2	9.2	10.7	8.9	7.8	5.4
Japan	2.2	3.3	3.7	3.8	4.1	4.2	4.7	5.1	5.4
China	13.7	14.4	14.0	15.5	12.8	10.3	10.2	9.8	8.7

Source: Compiled by the authors according to The Startup Europe Ecosystem (2018); Global Startup Ecosystem Report (2019).

Figure 3: Indicator of the general initial stage of entrepreneurial activity (TEA)



Source: Compiled by the authors according to The Startup Europe Ecosystem (2018).

Although most valuable startups are located in the United States or China, Latin America and the Caribbean are currently the world's most active region for startups. About a third of Ecuador's population is involved in starting a business, compared to 13% in the United States. Lebanon, Vietnam, and Estonia also have high levels of new business. The Latin American and Caribbean region had the highest level of startups worldwide in 2017: about 11.7 percent of the working-age population is involved in new entrepreneurial activities. Even North America has a lower rate. The lowest level of entrepreneurial

activity in Europe is entirely indicative, which allows us to emphasize the potential problem of the region in terms of innovation and sustainability of economic development. In Europe, only post-socialist countries show an increase in entrepreneurial activity, and in developed EU countries, this figure is at the level of 4% - France to 8% in the UK. It should be noted that it is the United Kingdom that has taken unprecedented steps in recent years to intensify entrepreneurial initiatives.

3. The efficiency of entrepreneurial activity in terms of the number of successful startups differs significantly in different countries. The indicator of the relative level of population entrepreneurial activity is the total number of startups that are created (Table 3).

Tab. 3: Indicators that characterize the development of startups in different countries in 2017

Countries	Number of startups	TEA	Good career choices	Entrepreneurial intentions	Funding problems
USA	46377	13.6	63.1	14.5	5.2
India	6028	9.3	53.0	10.3	37.9
Great Britain	4871	8.4	55.6	7.3	8.4
Canada	2454	18.8	65.6	14.1	11.9
Indonesia	2012	7.8	70.0	28.1	39.5
Germany	1965	5.3	51.3	7.2	5.7
France	1383	3.9	59.1	17.6	16.6
Brazil	1069	20.3	m.d.	15.3	17.8
China	545	9.9	66.4	15.3	31.2
Ukraine	238	m.d.	m.d.	m.d.	m.d.
Estonia	157	19.4	54.2	18.1	10.7
Latvia	70	14.2	57.5	17.3	9.3
Slovakia	59	11.8	47.6	9.0	12.2

Source: Compiled by the authors according to The Startup Europe Ecosystem (2018).

The undisputed leader in creating successful startups is the United States. Startups in this country have good conditions: infrastructure, interest from companies, significant financial opportunities. Thus, the total amount of venture capital invested in startup companies, at an early and late stage (also known as investment growth stage), in 2016 was \$ 33 billion compared to \$ 41 billion in the previous year.

Interesting in the context of results is the ratio in some countries of a relatively low level of the total initial stage of entrepreneurial activity (TEA) and the number of successful

startups. Thus, a relatively low level of activity gives in India, Indonesia quite significant results. In some countries, such as Canada and Brazil, the basis for high productivity is to stimulate a high level of entrepreneurial activity.

Another important indicator of the effectiveness of startups is their profitability. However, only 40 percent of small businesses are profitable, and 30 percent are constantly losing money (Mittal, 2014). That is why, first of all, financial conditions are necessary for the intensification of entrepreneurship.

4. Development conditions of entrepreneurial activity differ significantly in different countries. The presented indicators (Table 3) and the identified trends testify that the studied processes are very complex; therefore, international analytical agencies are very carefully studying the development conditions of entrepreneurship in the early stages. Among the most important conditions: availability of entrepreneurial capital, government policy, support and government programs for entrepreneurship development, entrepreneurship education, opportunities for technology transfer, access to international markets and domestic regulations, available infrastructure (market, commercial, transport, other), cultural and social conditions, etc.

Here are the indicators that characterize the development conditions of startups and are presented in table 3.

Good career choices are the percentage of adults between the ages of 18 and 64 who believe that entrepreneurship is a good career choice.

Fear of failure – the percentage of the population aged 18 to 64, who perceive excellent opportunities to start a business, which indicates that the fear of failure prevents them from starting a business.

Entrepreneurial intentions – the percentage of the population aged 18 to 64 (persons involved in any stage of exclusion of entrepreneurial activity), who are hidden entrepreneurs and who intend to start a business within three years.

Yes, as shown in the table 3 in the vast majority of countries, the percentage of the population who perceive entrepreneurship as a good choice exceeds 50%, which means that every second person can try themselves in this area under certain conditions. The indicator of entrepreneurial intentions for three years is much lower.

5. The issue of funding is the second after the initiative in importance in the implementation of startups. Eighty percent of failed businesses do so because of cash flow problems. Moreover, although startups, by definition, do not require significant financial resources, their absence can be an insurmountable obstacle. The vast majority of startup funds (82%) are formed at the expense of the entrepreneur, family, and friends. Seventy-seven percent of small businesses rely on personal savings for their initial funds (Mittal, 2014).

6. The process of creating startups has specific age characteristics of entrepreneurs. Thus, 51 percent of small business owners are people aged 50-88, 33 percent - 35-49 years old, and only 16 percent to 35 years.

The table 4 provides an overview of the ranking of industries by TEA indicator and by region.

Tab. 4: Ranking of industries by TEA indicator by region, 2017

Regions	Branches									
	Agricultural	Mining	Industry	Transport	Trade	ICT	Finance	Prof. services	Health education	Other
Latin America	2.6	3.7	9	3.4	55.7	2.8	1.1	4.1	12.2	5.4
North America	4.2	4.9	6.2	2.2	21.6	8.5	7.6	16.1	17.1	11.6
Africa	12.6	3.6	11.8	3	53.5	1	1.6	0.7	8.1	4.1
Asia and Oceania	3.4	4.2	7.2	2.1	52.5	3.3	3.1	4.4	13.8	6
Europe	7.1	6.6	8.3	2.8	27	5.5	3.9	11.6	17.6	9.6

Source: Compiled by the authors according to Global Entrepreneurship Monitor (2017).

Thus, startups in agriculture and industry are most actively created in countries of Africa, due to the low technological development of most of them and the need to address the problems of food security. The largest in countries of North America and Europe is the share of startups in the information and communication technologies field and professional services. Startups in trade are more active (at more than 50) in Latin America, Africa, and Asia. Such important sectors of the economy as education and health care in all regions are characterized by the relatively similar activity of startup processes, with a predominance in Europe and North America. In general, on the global market in the conditions of global competition, the advantages are those who have an effective mechanism of innovation and have a developed infrastructure for the creation and implementation of innovations. When the innovation infrastructure is sufficiently developed, it increases the pace of economic development and increases the population welfare.

In the study of international experiences of the startup movement revitalization, we should focus on the United Kingdom's practice, which revolutionized after the crisis of 2009-2010 and now, except for the United States, has no similar conditions for starting and developing a business. Thus, in 2015, 608 thousand companies were founded in the UK, and 2016 – 660 thousand (Number of UK start-ups, 2017). Government initiatives included regulatory support for innovative high-tech industries, tax simplification, and reduction of corporate tax rates to boost investment directly in the early stages of the innovation process. As a result, in a few years, and especially in London, there has been a breakthrough in innovation and finance, and the main idea is gaining new momentum –

"from local startups to international markets". The experience of the United Kingdom has also become famous for dissemination in other EU countries.

In recent years, policies to promote the startups' development have significantly intensified in the EU (The Startup Europe Ecosystem, 2018). The European Commission has launched the Startup Europe initiative, which aims to strengthen the European business ecosystem. It is determined that the EU policy should be aimed at the support three phases of entrepreneurship: buffering, support of ideas at the initial stage of entrepreneurial activity, a combination of startups with external entities in the ecosystem; implementation of measures aimed at accelerating the growth of promising enterprises. Both financial and non-financial support tools should be used. Among the financial instruments, the most important are: bank loans for "start" with the support of the government; co-financing funds and partnerships set up by banks and industrial enterprises; regional development funds; introduction of financial support programs for the unemployed; tax benefits for corporate and individual startup investors.

International experience shows that the development of startups is essential and needs systematic support at the national and regional levels. The startups' development in the country can and should become a mechanism that will increase the attractiveness of the investment climate, ensure the development of innovation and support for small and medium-sized businesses. The consequence of this will be an increase in the overall level of production and sustainability of the country's economy.

Based on the fact that the startup's life cycle's most important and complex phases are the idea initiation and financial support at the riskiest moment, the task of their development should be considered in this context. Among the primary fields where changes are needed are growing importance of universities, intensifying the interaction of startups and large corporations, creating favourable conditions for enterprise development in certain regions through the formation of clusters, and forming state policy to support startups.

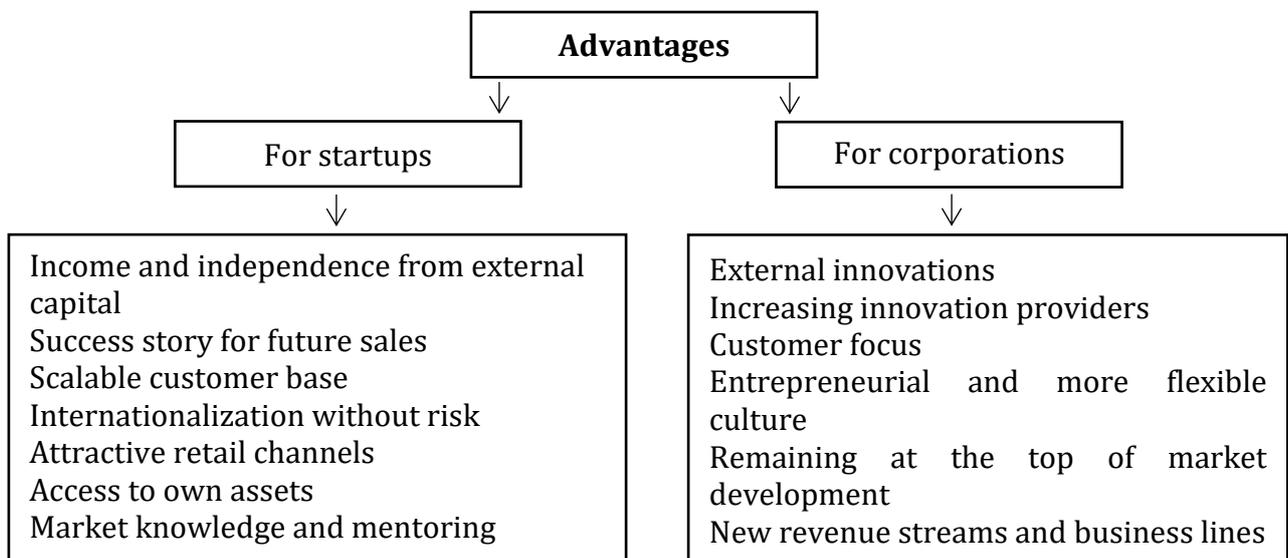
1. The ideas' initiation largely depends on the formation of creative and creative thinking in young people, which determines the role of universities in these processes. Universities, with their experience, infrastructure, and significant investment in research, are a "fertile ground" for innovation that can be used potentially to create new products and services. Universities also have experience in protecting intellectual property rights, technology transfer, etc. Universities are the growth point of startups in developed countries, as they ensure not only the intellectual potential development of the younger generation, but also create infrastructural, informational and, to some extent, financial conditions.

It takes a lot of time and resources to bring ideas to the market because new technologies and products do not guarantee success. Successful technology transfer allows university research programs to be more influential and concretely improve the lives of our citizens while generating income that can support future research programs and provide returns or stakeholders such as inventors, research programs, and taxpayers who initially supported the research.

Universities play a crucial role in the development of entrepreneurial culture by intensifying the inclusion of educational activities (programs, teaching/learning methods) related to the development of entrepreneurial competencies and initiatives in all educational institutions, especially higher education.

2. Support and implementation of the startups' idea largely depend on cooperation between technology startups and big corporations. Such cooperation can be crucial to stimulate the initiative of new startups and provide support for corporate innovation. Mutual understanding of the risks and problems faced by each party allows not only to minimize their impact but also to provide mutual support in the most critical areas of operation (figure 4).

Figure 4: Effectiveness of interaction between startups and corporations



Source: Authors.

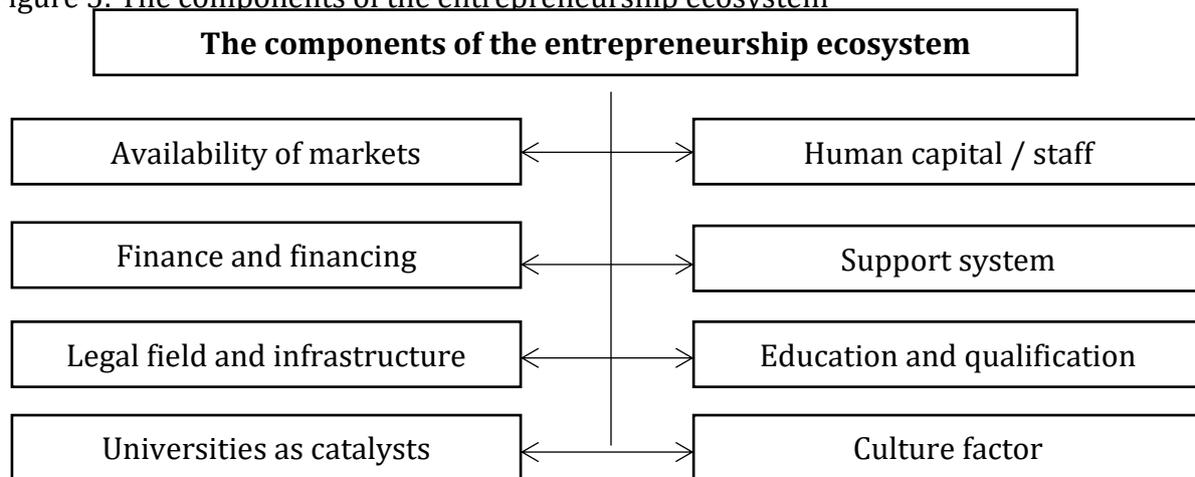
Cooperation between corporations and startups is a challenge for both parties. Corporate employees seek to follow standardized processes and, at the same time, challenge the creative behavior of entrepreneurs. Many entrepreneurs are starting their companies with the intention of disrupting corporations' status quo and challenging the players whose monopoly they seek to break.

3. The regional clusters' development promoting. Formed in some regions (cities), innovation and financial infrastructure are becoming an influential factor in the development of startups. There is even competition between individual regions for the formation of regional business ecosystems. Infrastructure, culture, i.e., the ecosystem as a whole, is crucial for the movement of enterprising people in such regions. According to international experience, the startups' ecosystem is being launched in some regions, which eventually becomes an example in the country. Leading startup hubs such as Silicon Valley, London, and New York continue to dominate at the highest level and maintain top-level status for most subsectors. Cities support a culture of creativity and innovation that allows new companies to be born and thrive and to create more significant opportunities

for people to grow and develop. In fact, in the world, there is a competition between different cities, districts of the city, many cooperative spaces, accelerators, and incubators for the conditions of starting a business, the development of startup culture. In foreign science, even a new scientific direction is being formed – the science of startup ecosystem assessment.

4. Business ecosystem formation. The startup movement has a very complex nature, which cannot be initiated by purely formal conditions. That is why we are talking about the formation of the ecosystem as a whole. The World Economic Forum in 2013 defined the internal components of the ecosystem (figure 5).

Figure 5: The components of the entrepreneurship ecosystem



Source: World Economic Forum.

Michael Libes gives a more accurate definition of an ecosystem for startups. According to his definition, the ecosystem consists of 6 components: talent, education system, financing system, incubators and accelerators, mentoring, places, and events.

Conclusion

Startups' supporting is a complex process and to implement it you need to: increase investment by the state; to support the social orientation of innovative projects; to develop entrepreneurial culture; strengthen the intellectual property regime; develop state bills that will promote the development of innovative entrepreneurship; strengthen information opportunities for innovators to participate in international programs.

The priorities for any country are: to promote the effective functioning of startups; to create mechanisms to increase the effectiveness of their activities; to recognize the importance of innovative technologies for the successful development of enterprises.

The activity will be beneficial if you use the following agglomeration: to create a system of guarantees and investment insurance; to maintain a state register of structures in the field of venture investment; to organize training systems for innovation managers; to

provide guarantees of companies' intellectual property rights – some forms of intellectual property rights are essential to prevent competitors from copying products and services; to develop an effective mechanism for the formation and use of venture funds; to develop a regulatory framework for regulating legal relations in the field of investment in innovation; to develop procedures for admission to the foreign capital market; to develop a methodology for assessing market prospects within the implementation of startups.

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The Wage Impact on the Net Value-Added in the Agricultural Sector

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Abstract

Entrepreneurship in the area of agriculture is subject to various factors, such as nature risks (hydrologic, pests and diseases) or recently notable economic hazards with disastrous consequences for a lot of enterprises. A grave issue is, for example, a vast wage rise to which the agricultural sector fails to respond, thus threatening the existence of these companies. The article aims at analysing the way wages influence the net value-added (NVA) in the agricultural sector of V4 and identifies components with a significant impact on NVA thereof. The data set from 2004-2017 of V4 provides the relevant data, using statistical methods – Maddala-Wu Test, Akaike Information Criterion and Engle and Granger two-step method to detect the relation between the average and minimum wage of NVA. The average wage increase positively influences NVA, as contrasted with minimum wages harming MVA.

Key words: market value-added (MVA), average and minimum wage, agriculture, performance and productivity of the enterprise

Introduction and Literary Research

The agricultural sector is at risk abiding by important decisions of social-individual character due to factors concerning weather, pests and diseases or economic issues such as changes in market conditions or government policies relating to the primary sector (Iyer et al., 2018), considering the artificial intelligence development and follow-up effective strategy as a possible solution to predict these risks (Stehel, Horák and Vochozka,

2019). Vrbka and Rowland (2020) observe in artificial neural networks a variety of applications in all spheres of life, mostly given their ability to perceive behavioural archetypes and learning abilities, leading to correctly predicting future developments and making crucial decisions.

According to Aleknevicien, Stareviciut and Aleknevicien (2018) earlier EU member states more effectively manage the risk reduction to agricultural enterprises. Employers face hazards and follow-up problems by counter-balancing missed opportunities and lost employees, jobs such as managers, qualified farmers, foresters and fishers being at a higher risk of leaving, as contrasted with less-mobile professions like technical workers, technical experts, professionals, associated professional workers, business workers, mechanics, machine maintenance workers and sale and after-sale workers (Bachmann et al., 2020). The development and application of information and computing technologies have highly contributed to changing the labour-market structure in the last four decades, mostly in fixed-routine positions (Bachmann, Cim and Green, 2019). Some experts reflected on this influence as unfavourable regarding holding down steady jobs, fearing automation trimming the workforce. On the contrary, Autor (2015) considers the development in robotics and artificial intelligence as an opportunity to offer comparative advantages of human capital.

Agriculture must take into account a rather uncomfortable situation of the respective enterprises resulting from enormous economic influences, often pushed to purchase a land of their former competitors, which leads to reducing numbers of their employees (Beckers et al., 2018). The European employment rate in the agrarian sector decreases, the trend being the most apparent in companies focused on livestock, except for Spain and The Netherlands (Houstiou et al., 2020). Bojnes and Ferto (2020) observe the integration of agricultural corporations into developmental activities in Slovenia and Hungary, demonstrating the overwhelming dominance of small-scale organizations within these activities including without limitations Hungary. McKillop, Heal and Kinsela (2018) classify agrarian enterprise owners by age, indicating a relative scarcity of fresh businessmen involved in agriculture throughout Europe. Duesbergová, Bogue and Renwick (2017) point out the critical importance of supporting new farmers, as seasoned producers without successors are less productive and open to new environmental methods. Cassidy and McGrath (2015) observe the trend of young people from rural areas of Ireland to migrate outside their home community. Bernues et al. (2011) see the same decline in fresh farmers in the Mediterranean area. The fiscal policy of the European Union responds to the situation by giving loans with different maturity deadlines or grants to follow young people's tendency towards long-term planning and help them with entrepreneurship (Davis, Caskie and Wallace, 2013). Work and business in the agricultural sector are not attractive for the youth, the trend needing a change to ensure the sustainability of the primary sector.

Acemoglua and Autor (2011) observe the decline in real wages for unqualified posts including without limitations unskilled men. Thanks to rapid technological development, the machinery can substitute workers with secondary education in various tasks. Abbritti

and Fahr (2013) analyse the relationship between the wage increase and creating job vacancies, arguing that an enormous wage increase in OECD results in job vacancy decline. Deutch and Himmelreicher (2020) state that high average wages in the national economy pose a risk to low-income jobs, leading to threatening the existence of agricultural companies, as such low wages make workers leave the primary sector for missed opportunities (Spicka et al., 2019). Kühl, Flach and Gauly (2019) seek the correlation between hourly salaries and the value of data of agrarian companies, stating that greater inputs generate higher wages. Batyr et al. (2019) argues that grants provided to agricultural corporations in Germany and France significantly affect worker marginal income. Braun et al. (2019) assess the influence of the imposition of minimum wages on the employment rate, considering the implemented government measures leading to stabilizing the labour market as ineffective. Low-wage sector thereby incurs risks of the negative impact on the employment rate. Rather unclear consequences of inadequate-wage influences require further research.

The article focuses on analysing the influence of wages in the agricultural sector of V4 on net value added (NVA) and identifying specific factors affecting NVA thereof. The indicator helps measure the contribution of the personnel capital to the performance and productivity of the enterprise, formulating two plausible hypotheses. The first one concerns the average wages swaying NVA, whereas the second presumes the minimum income impacting NVA.

The hypotheses are as follows:

Hypothesis 1 H0: the average wages do not influence NVA vs. H1: the average wage influences NVA,

Hypothesis 2 H0: the minimum wages do not influence NVA vs. H1: the minimum wages influence NVA.

Data and Model

The research analyses annual data of four countries from 2004-2017: the Czech Republic, Slovakia, Poland and Hungary, using variables such as Net Value-Added (NVA), Wages (W), Total Assets (TA) and Minimum Wage (MW) in EUR and Total Utilized Agricultural Area (TUAA) in hectares. All these variables relate to the Total Employment Rate assessed by AWU¹, designated per worker by lowercase letters. The data were amassed from FADN² and Eurostat³ databases.

The analysis follows the intensive form of the production function with NVA being a dependent variable, while TUAA approximates the land factor of production, TA doing the same to the capital: both activities relate to workers. The analysed formula is as follows:

¹More about variables on https://ec.europa.eu/agriculture/rica/methodology3_en.cfm.

² <https://ec.europa.eu/agriculture/rica/>.

³ <https://ec.europa.eu/eurostat>.

$$nva_{it} = \alpha_i + \beta_1 tuaa_{it} + \beta_2 ta_{it} + \beta_3 w_{it} + \beta_4 mw_{it} + \epsilon_{it}, \quad (1)$$

Where $i = 1, 2, 3, 4$ represents individual states in time t , for $t = 1, 2, \dots, 14$. Parameter α_i presents unobserved heterogeneity of country i . A random element is presumed to $\epsilon_{it} \sim iid(0, \sigma^2)$ ⁴. Unobserved heterogeneity results, for example, from different socio-political situations of a specific country.

Empirical part

Maddala-Wu method from 1999 tested unit roots for variables in equation (1), while Akaike information criterion estimated the delay. Table 1 proposes the test results.

Tab. 1: Manddala-Wu unit root test

Variable	t-test	p-value
<i>nva</i>	0.3930	1
<i>tuaa</i>	4.116	1
<i>ta</i>	0.077	1
<i>w</i>	0.131	1
<i>mw</i>	0.019	1

Source: Authors.

The table suggests that neither variable can reject zero hypotheses on the presence of the unit root, which leads to testing first differences on the unit root presence. Table 2 illustrates the achieved results.

Tab. 2: Manddala-Wu unit root test – the first difference

Variable	t-test	p-value
Δnva	98.527	0.000
$\Delta tuaa$	41.544	0.000
Δta	56.475	0.000
Δw	50.628	0.000
Δmw	42.699	0.000

Source: Authors.

⁴ iid- independent and identically distributed.

Now we can reject zero hypotheses in behalf of alternative hypotheses predicting the integration of all variables in the order of one.

The testing on the presence of the co-integration relation follows Engle and Granger two-step method from 1987, the first step calculating equation (1) by *within* estimator (e.g. Woolridge, 2010). Table 3 depicts the computed results. The second step deals with testing the residua from the first step on the presence of the unit root by Maddala-Wu method. Line I (1) suggests the achieved test results, revealing the possibility to reject zero hypotheses on the existence of the unit root. The residua integrate in the order of zero, showing a co-integration relation between variables from equation (1). The robust estimator by Arellan (1987) assesses the variation-co-variation matrix, while critical values by MacKinnon (1991) comprehensively evaluate t-test.

Tab. 3: Estimated equation (1) and co-integration testing

Variable	Estimate	Standard deviation	p-value
<i>tuaa</i>	-303.110	47.647	0.000
<i>ta</i>	0.097	0.031	0.000
<i>w</i>	2.785	0.211	0.000
<i>mw</i>	-1.378	0.355	0.000
I(1)	57.808		0.000

Source: Authors.

The estimation results from Table 3 show the average wages in the agricultural sector have a positive influence on generating the net value added; suggesting average wage increase by 1 EUR will produce NVA growth by 2.785 EUR. Significant changes in total assets per worker favourably influence NVA, when an extraordinary surge in the total asset by 1 EUR raises the dependent variable by 0.097 EUR. TUA variable demonstrates the rise in the amount of utilized land adversely affects NVA, the reason being the analysed data set involves Poland, which presents a heterogeneous unit given its size and a large number of people employed in agriculture. Minimum wages also harm NVA, causing the minimum wage increase by 1 EUR but cutting NVA by 1.378 EUR.

Discussion and conclusion

Accepting important decisions in the agricultural sector always incurs potential risks, mostly from factors related not only to weather, diseases and pests but also to economic circumstances such as changes in market conditions, government policies towards the primary sector or other prevalent economic influences. A marked decline of fresh farmers and falling employment rate in the respective division also bring serious problems. A veritable wage explosion leads to shedding jobs, posing a considerable threat to the

existence of agricultural enterprises, forcing poorly paid workers to leave the primary production sector.

The article mostly focused on exploring wage circumstances in agriculture with the view to analysing salaries in the respective field of V4 and their influence on NVA, identifying critical factors contributing to NVA in the agrarian section by formulating two hypotheses. The first one concerned whether the average wage radically affects NVA, while the second predicted the impact of minimum salaries on NVA. Annual data from 2004-2017 of V4, i.e. the Czech Republic, Slovakia, Poland and Hungary reflected the required information, using net value-added, total wages, total assets, minimum wages, total utilized agricultural area for variables which related to the overall employment rate. The paper proceeded from the intensive form of the production function, considering NVA as the dependent variable. Maddala-Wu method tested the unit root for variables, while Akaike information criterion estimated the delay. The testing on the presence of the co-integration relation followed Engle and Granger two-step method. The results suggested the average wage increase positively influenced NVA, generating the growth of NVA by 2.785 EUR, as contrasted to the rise in minimum wages negatively affecting NVA. In this case, the minimum wage explosion by 1 Euro results in NVA decline by 1.378 EUR. Although not necessary to interpret, other variables help verify the robust relation. The change in total assets per employee also favours NVA, while the increase in the amount of the utilized land per worker has a damaging impact on NVA. Both constructed hypotheses thereby proved true – the average and minimum payments significantly influence NVA – the average wage positively, while the minimum salary sees a rather adverse impact.

The presented article identifies factors determining MVA, aiming at future research focused directly on declining employment in agriculture influenced by salaries within this sector. Of interest might also be to analyse growing agricultural subsidies compared to average wages.

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Validation of the Prediction of ČEZ Stock Prices

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Abstract

Stock price developments are a nonlinear and dynamic process. Stock price prediction is one of the most important issues in stock markets. The aim of this paper is to verify the prediction of the stock prices of ČEZ, a. s. on the Prague Stock Exchange. The main goal is decomposed into two sub-goals: evaluate the accuracy of the prediction using neural networks on stock price data that followed the time series used to calculate neural networks in the contribution of Vrbka and Rowland (2017) and generate new neural structures. 1,442 records of price data on stock are used. Multilayer Perceptron Neural Networks and Neural Networks of Basic Radial Functions are generated. The original neural networks are inappropriate to predict the evolution of ČEZ stock prices. Optically, two new neural structures can be used in practice. The practical use of new networks is not tested on data that did not enter the calculation. New networks show lower performance in all three sets of data.

Keywords: Artificial neural networks, prediction, stock prices, time series, Czech Republic

Introduction

Stock prices evolve in a non-linear way and therefore stock price prediction is one of the most important issues in stock markets. In view of this, Etemadi et al. (2015) insist that earnings per share are seen by managers, investors and financial analysts as

one of the most important financial indicators. A number of Several methods and technologies are devoted to predicting these prices (Groda and Vrbka, 2017). Basic characteristics of stock prices are sensitivity, stationarity, asymmetry and volatility. Investors, of course, want to fully predict the movement of stock prices, it is a stochastic process (Vrbka and Rowland, 2017). Stock price developments are a nonlinear and dynamic process, and there are a number of some macroeconomic, industrial and corporate factors that can affect stock prices. These include, for example, global stock price indices, total economic activity, exchange rate, interest rate, and more (Wang and Nguyen, 2015). According to Sheelapriya and Murugesan (2016), it is essential to provide a reliable method that overcomes the complex forecast and allows to capture the development of stock prices in the financial market. However, successful price prediction can be very useful. It is no surprise, that the most accurate prediction attracts analysts from around the world (Klieštík et al., 2018).

Methods and Data

As already mentioned above, there are currently a number of applications and new technologies for stock price prediction such as neural networks, the ARIMA method, etc. Groda and Vrbka (2017) used the ARIMA (Box-Jenkins) method to analyze and predict stock prices. ARIMA, the AutoRegressive Integrated Moving Average model, is one of the most widely used models in time series prediction. At present, the ARIMA model is often used for its unique predictive ability as well as for predicting stock price developments (Pai and Lin, 2005). Frances (2000) favours the claim that ARIMA models are the most frequently used models for predictions of time series that can be statically transformed. Models are mainly used for short-term prediction if there are no explanatory data for the variable or if the model has poor predictive power. Predicting future stock market values based on both past and present data lines isare, therefore, one of the most demanded financial applications (Stehel and Vochozka, 2016).

The fact that the financial prediction is one of the most important areas of research where the investor's money is at stake due to the rise or fall in stock prices that are unpredictable and vague is also mentioned by Mohapatra et al. (2018). Furthermore, using neural networks in the prediction of stock price developments says that, essentially, because the demand for stock markets grew unprecedentedly, its predictions are even more exciting but at the same time more demanding. In the prediction of future stock prices, the models based on the artificial neural network (ANN) are taken into account. ANN development led investors to hope for the best predictions, as networks involved large machine learning abilities such as classification and prediction (Horák et al., 2018). ANNs have many advantages compared to ordinary methods. They are able to analyse complicated patterns fast and with high accuracy. ANNs are flexible in their use itself (Vochozka and Krulický, 2018). The disadvantage of neural networks is their request for large data about the sample because to create such a huge amount of data it is necessary to carry out a lot of sample observations, which is very uncomfortable for the users. The next main

disadvantage is the topology optimization process in hidden layers, which is time-consuming, and complicates the computing process (Rowland and Vrbka, 2016). Neural networks are therefore considered to be a highly effective method for collecting, analyzing and predicting data, and therefore their use is possible in a number of complex situations or in solving complex problems (Vochozka and Machová, 2018). The artificial neural network is capable of fully detecting the complex relationship between investors and price fluctuations and, therefore, these networks are also being used to predict the share prices of individual companies (Wu et al., 2015). Other research approaches in the area of financial application are also explored by other models such as Bio-inspired Computing, fuzzy network model, etc. With regard to statistical measures, technical indicators and basic indicators (Vochozka et al., 2018).

Golamaryami et al. (2016) deal with the use of ANNs, which can deal with data and nonlinear parameters to predict the price of stocks the next day. The described research has taught the proposed ANN a meta-heuristic bat algorithm that has rapid and strong convergence. The recommended method was used to predict prices for the first time. This contribution used a seven-year data set from private banks to prove the effectiveness of the proposed method. After pre-processing, three types of ANN (backpropagation – ANN, particle swarm optimization – ANN and bat-ANN) were used to be able to predict the stock price. Another example of using neural networks to predict the development of stock prices is research focusing on the design and optimization of artificial neural networks (especially nonlinear autoregressive networks) and their subsequent use in predictive application in time series of stock markets. Hortai (2016) demonstrates that a properly constructed artificial neural network can support trading in financial markets through the ability to predict stock price trends.

The prediction of stock prices on the Czech market is interesting to Svoboda (2016), who deals with stochastic modeling and short-term prediction of stock price developments on the Czech stock market. The aim of his research is to create such models that can be used to create automated business strategies that will defeat the market. As Svoboda (2016) explains, the reliability of these models is validated on three highly liquid stocks on the stock exchange, those of O2, ČEZ and KB, for seven years during 2006-2012. The so-called Markovov chain analysis was used for modeling. Svoboda (2016) also describes that in these models, the state space is defined based on cumulative daily changes in stock price and the so-called state space model with eight states is used. The state space is parametrically defined as a multiple of the standard deviation of daily returns for each stock. Altogether, a total of 14 parameters were calculated and for each parameter, nine business strategies for all stocks were used. This means that 378 business strategies have been calculated.

Long-term and, first of all, accurate predictions of stock price developments are very difficult due to the impact of economic, environmental and other factors (Vochozka, 2017). This is taken into account by Nie and Jin (2016), who have taken advantage of the effective prediction of long-term time series to plan an investment strategy and gain more profit. In his article, the so-called Exponentially Segmented Formula (ESP) is introduced

and used to predict volatility of the different stock data over five future prediction intervals. The new characteristic of stock price formation over a sub-fund, called the interval gradient, can characterize stock price fluctuations over a certain period. MSE Cumulative Distribution Function (CDF) was compared to MMSE-BC and SVR values. During the research, it was concluded that the developed interval gradient may capture the more complex dynamics of stock price trends. The average stock price can then be predicted relatively accurately at certain time intervals, with multiple average values in time intervals being used over long-term intervals. Thus, the prediction of the long-term stock price becomes more accurate and prevents the development of cumulative errors (Nie and Jin, 2016).

Guo et al. (2015) propose and implement a hybrid model that combines two-way analysis of two component elements ((2D) 2 PCAs) and the Radical Base Functional Neural Network (RBFNN) to predict the behavior of stock markets. Guo et al. (2015) explain that 36 technical variables are first selected as input elements and a sliding window is used to obtain model input data. Furthermore, the (2D) 2 PCA is used to reduce the range of data and extract its own properties. Finally, the aforementioned RBFNN receives data processed by (2D) 2 PCAs to predict the price or movement of stocks the following day. The proposed model is used on the Shanghai stock market index and experiments show that the model is at a good level.

This contribution is based on the article of Vrbka and Rowland (2017). The aim of this article was to predict the future development of the stock prices of ČEZ, a.s. on the Prague Stock Exchange using neural networks.

In the methodology, the author described the main activity and position of ČEZ, a.s. in the energy market. He also dealt with the data used to calculate the neural structure able to predict the future development of ČEZ stock prices. Price data on stock prices was used from between February 2, 2012 and October 9, 2017, amounting to a total of 1,442 records. The data came from the Prague Stock Exchange database. These were the final prices of each day on which the stocks of the company were traded during that period. To determine the neural structure, the Statistica software in version 12 by DELL was used. Multilayer Perceptron Neural Networks and Neural Networks of Basic Radial Functions were generated. A detailed description is provided by Vochozka et al. (2017).

This article has the ambition to work further using the contribution of Vrbka and Rowland (2017):

1. Since the publication of the paper, information about the development of ČEZ's prices is already known within the time period of 62 trading days of the prediction. We can therefore assess how accurate the prediction of future stock price developments in the paper is.
2. We will generate new neural structures that will take into account stock price developments in the 62 trading days following 9. October 2017.

The methodology of this article will be identical to that of Vrbka and Rowland (2017). However, the data file will be different. For this article, we will use data from the Prague

Stock Exchange on ČEZ stock prices for the period from February 2, 2012 to January 8, 2018, namely 1,504 final price data entries for each trading day. In addition, the results of Vrbka and Rowland (2017) will be used.

Results

Statistics of the data file are listed in Table 1.

Tab. 1: Data input statistics for the data file

Statistic	Stock price (Output)
Minimum (Training)	364.1
Maximum (Training)	840
Average (Training)	549.2319
Standard deviation (Training)	113.5939
Minimum (Testing)	372
Maximum (Testing)	838.7
Average (Testing)	542.9668
Standard deviation (Testing)	117.6344
Minimum (Validation)	376.1
Maximum (Validation)	815
Average (Validation)	552.0947
Standard deviation	203.2175
Minimum (Overall)	364.1
Maximum (Overall)	840
Average (Overall)	548.7184
Standard deviation (Overall)	114.4234

Source: Authors.

Validation of the results in the article by Vrbka and Rowland (2017)

In order to make a comparison, we need to summarize the results achieved in the contribution by Vrbka and Rowland (2017). The contribution presents five preserved neural structures of 10,000 generated (see Table 2).

Tab. 2: Overview of preserved neural networks (2017)

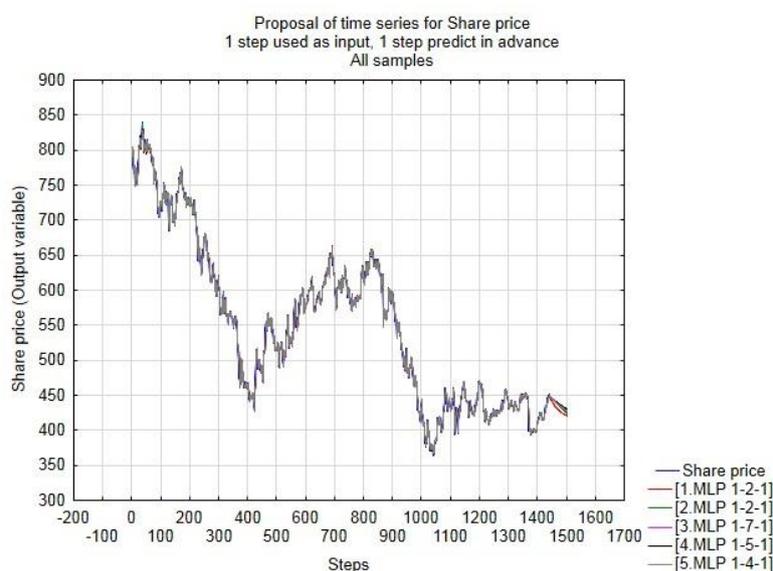
Network name	Training perform.	Testing perform.	Validation perform.	Training error	Testing error	Validation error	Training algorithm	Error function	Activ. of hidden layer	Output activ. function
MLP 1-2-1	0.997742	0.997614	0.997649	30.86339	31.51797	27.94235	BFGS (Quasi-Newton) 86	Sum of squares	Tanh	Identity
MLP 1-2-1	0.997759	0.997617	0.997649	30.62266	31.4799	27.91572	BFGS (Quasi-Newton) 504	Sum of squares	Tanh	Identity
MLP 1-7-1	0.997778	0.997605	0.997648	30.36993	31.63007	27.95397	BFGS (Quasi-Newton) 123	Sum of squares	Logistic	Tanh
MLP 1-5-1	0.997778	0.997597	0.997648	30.37189	31.74181	27.91681	BFGS (Quasi-Newton) 143	Sum of squares	Tanh	Tanh
MLP 1-4-1	0.997774	0.997603	0.997649	30.41342	31.67233	27.89103	BFGS (Quasi-Newton) 88	Sum of squares	Logistic	Tanh

Source: Vrbka and Rowland (2017).

The paper presented neural structures that showed the best characteristics – i.e. the best performance at minimum error. All retained networks are multilayered perceptron artificial neural networks. They use two to seven neurons in the hidden layer. Their performance is characterized in all datasets (training, testing and validation) with a correlation coefficient higher than 0.997. This is an excellent result. The networks were created based on the Quasi-Newton training algorithm. The sum of smallest squares was used as the error function. The networks use the logistic function and hyperbolic tangens to activate hidden neurons. To activate the output layer of the neural network, they use hyperbolic tangents or an identity function.

Based on the results described, it is clear that the time series alignment (ČEZ stock prices) should be almost perfect. Time series alignment using neural networks is the subject of Graph 1.

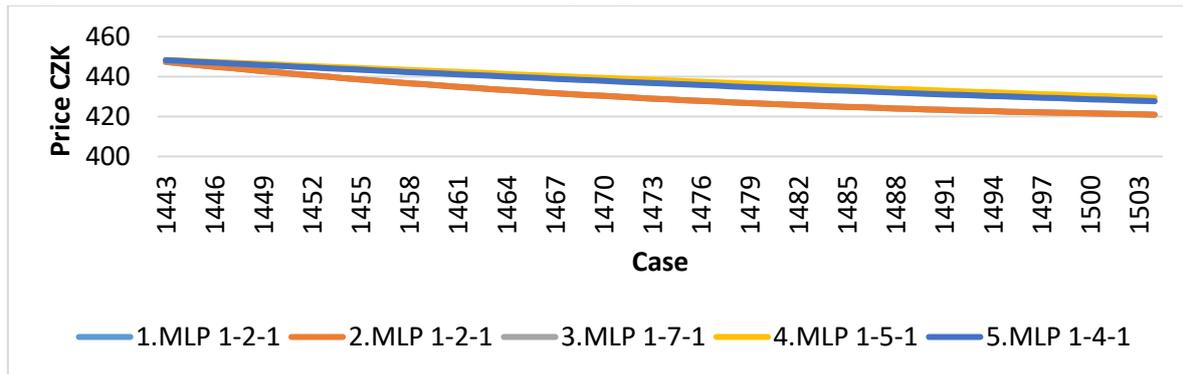
Graph 1: Time series with prediction for 62 trading days



Source: Vrbka and Rowland (2017).

The figure shows the time series alignment using neural networks and then the prediction of the stock price of the assessed company over the next 62 trading days. In the time series alignment interval, the differences between actual price developments and time series alignment results are totally indistinguishable. In addition, all retained neural networks show approximately the same results. They begin to appear different only at the time interval of prediction (see Graph 2).

Graph 2: Prediction of the next 62 trading days



Source: Vrbka and Rowland (2017).

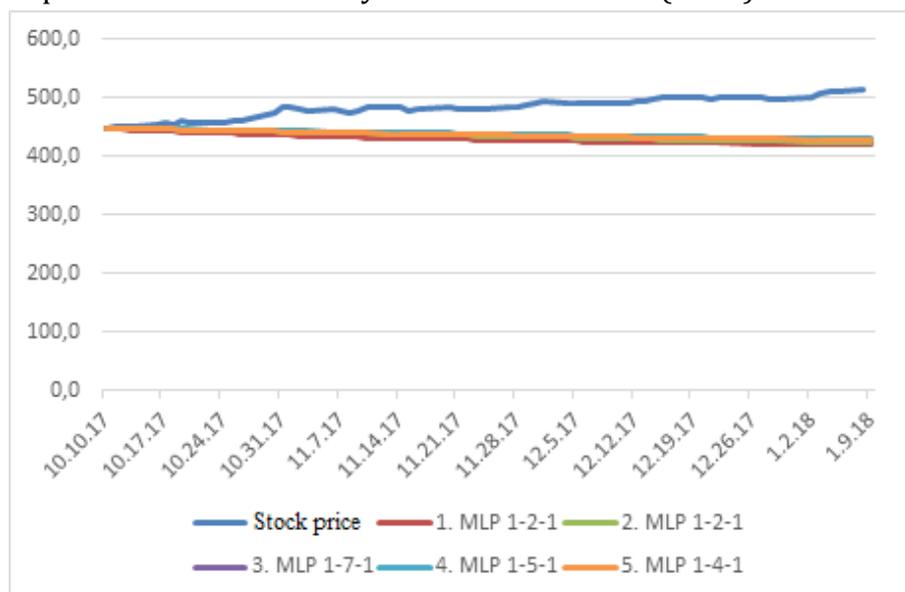
Graph 2 provides the development of predicted prices for 62 future trading days. The results do not differ much at the time of the first prediction. After 62 business days, the prediction differs by less than 10 CZK, which can be considered as a great result.

Vrbka and Rowland (2017) summarize the result as follows: "By statistical interpretation of the results, it has been found that they are all usable in practice. The differences are entirely minimal at the value of one stock. Nevertheless, with the greatest difference between the maximum and minimum predictions, the deviation is 2.26%. This may not be significant at the price of one share. However, when you buy or sell a large number of stocks, the difference may appear to be significant. I therefore recommend that two networks be used in practice: MLP 1-2-1 (first network) and MLP 1-5-1 (fourth network). The first neural network always represents a pessimistic, minimal prediction (as does the second neural network). The fourth network then corresponds to an optimistic, maximum prediction. The reality should be that of the difference between the optimistic and the pessimistic prediction."

Comparison of actual price development and results of the contribution by Vrbka and Rowland (2017)

Graph 3 provides a comparison of the development of ČEZ stock price predicted by neural networks by Vrbka and Rowland (2017) and actual stock price developments.

Graph 3: Comparison of time series by Vrbka and Rowland (2017) and actual stock prices



Source: Vrbka and Rowland (2017).

It can be seen from the graph that the prediction of development using artificial neural structures was very pessimistic. In fact, the stock price is approaching the prediction only in the early days, let's say in the first trading week of the predicted period. In the next period, the imaginary scissors became more and more open. On 5 December 2017, the price of one ČEZ share was close to CZK 500 each. On the 62nd day of the forecast, i.e. 8 January 2018, even the value of CZK 500 was significantly exceeded by the share price of ČEZ. In detail, but only on selected days, Table 3 shows the development of predictions and actual stock prices.

Tab. 3: Comparison of actual price developments of stock prices and neural networks by Vrbka and Rowland (2017)

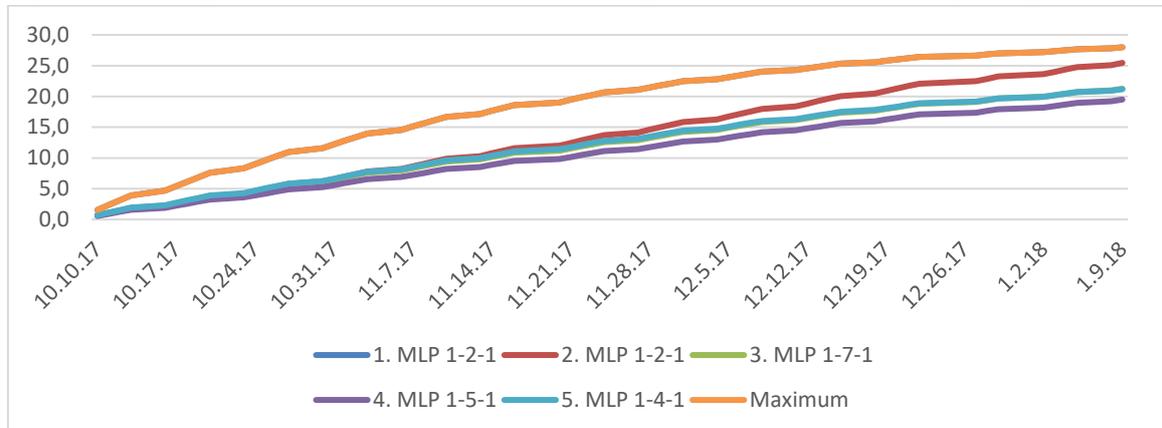
Date	Stock price	Stock prices					Residue					Max. residue
		1. MLP 1-2-1	2. MLP 1-2-1	3. MLP 1-7-1	4. MLP 1-5-1	5. MLP 1-4-1	1.	2.	3.	4.	5.	
10.10.17	448.9	447.36	448.24	448.21	448.34	448.20	1.5	0.7	0.7	0.6	0.7	1.5
24.10.17	458.2	439.91	444.35	444.33	444.99	444.22	9.0	4.6	4.6	3.9	4.7	9.0
07.11.17	477.7	433.80	440.27	440.58	441.67	440.39	15.1	8.6	8.3	7.2	8.5	15.1
22.11.17	480.0	429.03	436.04	437.02	438.43	436.79	19.9	12.9	11.9	10.5	12.1	19.9
06.12.17	490.4	425.46	431.77	433.69	435.31	433.50	23.4	17.1	15.2	13.6	15.4	23.4
20.12.17	499.0	422.88	427.61	430.65	432.38	430.55	26.0	21.3	18.2	16.5	18.4	26.0
08.01.18	513.0	421.06	423.80	427.92	429.66	427.96	27.8	25.1	21.0	19.2	20.9	27.8

Source: Vrbka and Rowland (2017); Authors' calculations.

The table shows the actual price development of the ČEZ share in the column "Stock price". Then, prediction is displayed using the generated neural networks by Vrbka and Rowland (2017). Five columns below "Residue" are used to calculate the difference between the actual stock price and the predictions, each for each neural network

separately. The last column shows the biggest difference between the actual share price and the prediction. In all cases, this is the difference between the actual stock price and network number 1, i.e. MLP 1-2-1. The development of residues is evident from Graph 4.

Graph 4: Development of residues of networks by Vrbka and Rowland (2017)



Source: Vrbka and Rowland (2017); Authors' calculations.

The picture shows a growing residue development in time. The absolute minimum difference between the predictions and the actual price of the share is 10 October 2017. On the other hand, the largest residue is observed on 9 January 2018, when the maximum residue is at a limit of CZK 28 per share, which is approximately 5.46% of the share price. On the contrary, the minimum residue is below 20 CZK per share. This difference amounts to less than 3.9%. This difference is offered by a prediction using the 4th neural network, i.e. MLP 1-5-1. It is therefore a question of whether such a difference is sufficient. On the one hand, the difference seems to be minimal. On the other hand, if we imagine the role of an investor (or perhaps a speculator) who works with a change in the stock price each day, i.e. even a tenth of a CZK, it is a fairly large difference. From my point of view, however, the directives of the development curves are absolutely essential. In fact, the stock price grew. However, all retained neural networks assumed a fall in stock prices. Therefore, if we disregard the difference between reality and predictions, we can not rely even on the basic prediction of the future price – growth or decline.

Newly generated neural structures

The aim of this paper, along with the evaluation of the outputs by Vrbka and Rowland (2017), is, following the same methodology, to generate new neural networks that will align the time series of stock prices. The results are shown in Table 4.

Tab. 4: Newly generated neural structures

Network name	Training perf.	Testing perf.	Validation perf.	Training error	Testing error	Validation error	Training algorithm	Error function	Activ. of hidden	Output activ.
RBF 1-30-1	0.9867	0.9860	0.9889	168.6022	196.947	146.1548	RBFT	Sum of squares	Gauss	Identity
RBF 1-28-1	0.9876	0.9863	0.9894	157.2429	188.4303	139.0066	RBFT	Sum of squares	Gauss	Identity
RBF 1-28-1	0.9898	0.9892	0.9897	130.0019	150.9605	135.9292	RBFT	Sum of squares	Gauss	Identity
RBF 1-29-1	0.9861	0.9858	0.9890	175.7906	198.9865	145.1187	RBFT	Sum of squares	Gauss	Identity
MLP 1-20-1	0.9876	0.9880	0.9889	156.7676	165.9484	146.8933	BFGS (Quasi-Newton) 603	Sum of squares	Tanh	Exponential

Source: Authors.

For the calculation of neural structures, the original data set was extended by 62 further trading days. The result is completely different at first glance. Of the 10,000 generated neural structures, five artificial neural structures with the best characteristics were preserved. Among these are four structures based on fuzzy logic, namely artificial neural networks of basic radial function (RBF). Only one is a multilayer perceptron neural network (MLP). All preserved networks use the sum of smallest squares as the error function. RBF networks were generated using the RBFT algorithm, MLP using Quasi-Newton. RBF networks use the Gaussian curve to activate the hidden neuron layer, and also use the identity function to activate the output layer of the neurons. MLP activates hidden neurons using hyperbolic tangens, the output layer of neurons is then activated by exponential function. Table 5 provides a summary of the performance of preserved neural structures.

Tab. 5: Correlation coefficients of newly generated neural structures

Neural network	Stock price		
	Training	Testing	Validation
1.RBF 1-30-1	0.9867	0.985978	0.988928
2.RBF 1-28-1	0.987601	0.986325	0.989411
3.RBF 1-28-1	0.98976	0.989157	0.989721
4.RBF 1-29-1	0.986129	0.985746	0.988945
5.MLP 1-20-1	0.987639	0.988043	0.988877

Source: Authors.

The table shows that the performance measured by the correlation coefficient ranges across all networks and all data sets (training, test, validation) are at a value of nearly 0.986 and higher. For the interpretation of correlation coefficients results, see Table 6.

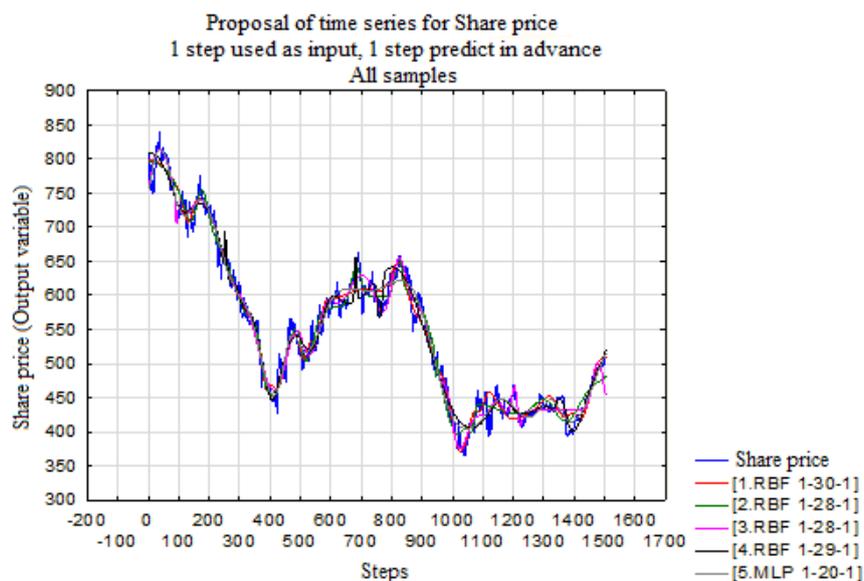
Tab. 6: Data set statistics (stock price)

Statistic	1.RBF	2.RBF	3.RBF	4.RBF	5.MLP
	1-30-1	1-28-1	1-28-1	1-29-1	1-20-1
Minimum prediction (Training)	371.5924	397.453	375.1882	400.8816	404.6215
Maximum prediction (Training)	799.6237	796.9626	813.9006	808.7179	814.2319
Minimum prediction (Testing)	371.7026	397.493	376.1742	400.8925	404.9563
Maximum prediction (Testing)	799.4127	796.8768	813.901	808.5803	814.2064
Minimum prediction (Validation)	371.4968	397.6789	375.1709	401.1822	404.6574
Maximum prediction (Validation)	799.6393	796.9603	811.7112	808.4986	812.8466
Minimum residue (Training)	-63.2352	-52.0334	-57.1139	-59.6718	-63.2495
Maximum residue (Training)	55.4007	47.6043	55.6073	67.0185	54.7311
Minimum residue (Testing)	-54.1029	-51.5238	-56.2782	-49.8032	-46.1096
Maximum residue (Testing)	51.5022	47.3868	51.3216	47.2056	44.3409
Minimum residue (Validation)	-54.0977	-52.6699	-49.8544	-44.6101	-46.4877
Maximum residue (Validation)	49.1433	41.5352	40.3405	51.3943	48.1361
Minimum standard residue (Training)	-4.87	-4.1495	-5.0092	-4.5006	-5.0516
Maximum standard residue (Training)	4.2666	3.7963	4.877	5.0547	4.3713
Minimum standard residue (Testing)	-3.8552	-3.7535	-4.5805	-3.5306	-3.5794
Maximum standard residue (Testing)	3.6699	3.4521	4.177	3.3464	3.4421
Minimum standard residue (Validation)	-4.4748	-4.4673	-4.2761	-3.7031	-3.8356
Maximum standard residue (Validation)	4.065	3.5229	3.4601	4.2663	3.9716

Source: Authors.

The table presents basic statistics of all data sets of stored neural network data. The table shows minimal differences between individual neural networks. We would optically see that all preserved neural networks are usable in practice. Probably better to help us identify the best neural network will be Graph 5.

Graph 5: Time series alignment using newly generated neural networks



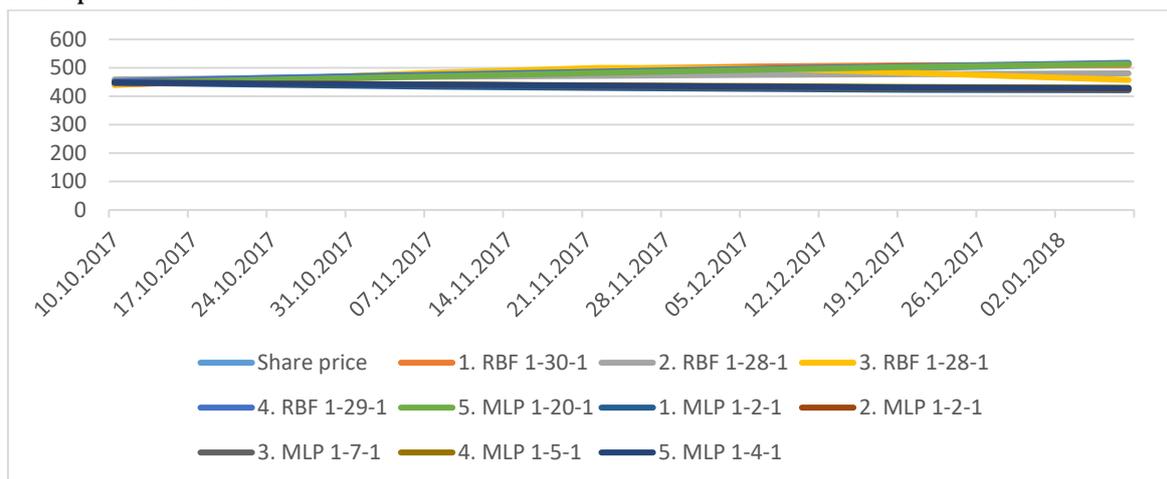
Source: Authors.

The figure shows the actual development of the stock prices (blue curve) and the aligned time series using preserved neural networks. In this case, the development is not as clear as in the case of Vrbka and Rowland (2017), where the pattern of aligned time series almost coincided with the development of the real stock prices. Since we know the actual development of the stock prices, we will leave the decision of which of the preserved neural networks predicts the stock price best on the next part of the contribution.

Comparison of newly generated structures and structures by Vrbka and Rowland (2017)

In the next part of the paper we will focus on the last 62 trading days of the data file. This is a period used for prediction of the development of the stock prices of ČEZ by Vrbka and Rowland (2017). Graph 6 shows stock price developments over the monitored period, as well as predictions using networks by Vrbka and Rowland (2017) and newly generated networks (however this is not a prediction, but an aligned time series in that period).

Graph 6: Comparison of development predicted by neural networks and actual stock price developments of ČEZ



Source: Authors.

It can be seen from the figure that the networks from the contribution of Vrbka and Rowland (2017) have the time series directive as decreasing. From the preserved new neural networks, the third network, ie RBF 1-28-1, has the directive first as growing and then decreasing. Other newly generated and preserved networks have a growing directive. This means they are following the development of the real stock prices. Specific values of individual networks by Vrbka and Rowland (2017) and new networks, are offered by Table 7.

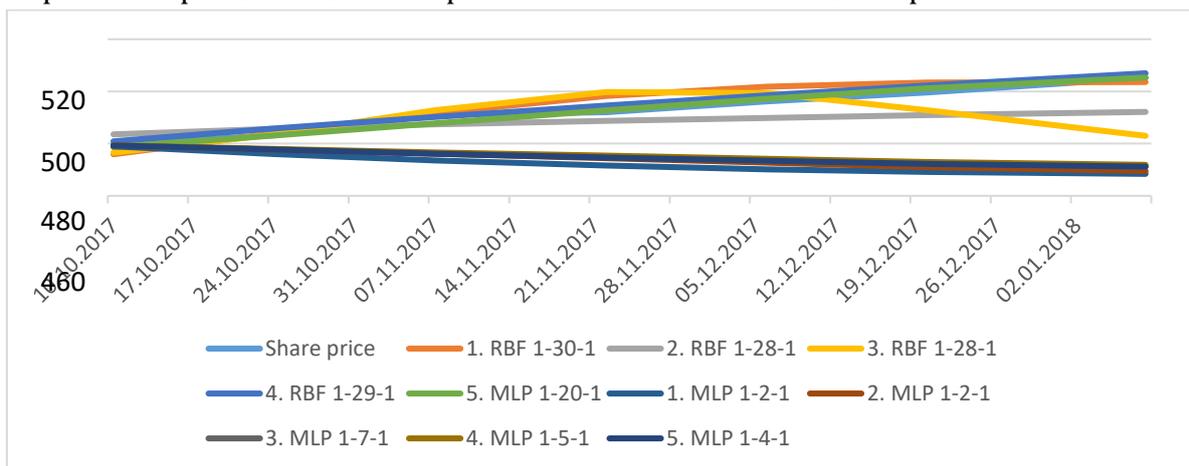
Tab. 7: Selected values of prediction and actual stock prices

Date	Stock price	1. RBF 1-30-1	2. RBF 1-28-1	3. RBF 1-28-1	4. RBF 1-29-1	5. MLP 1-20-1	1. MLP 1-2-1	2. MLP 1-2-1	3. MLP 1-7-1	4. MLP 1-5-1	5. MLP 1-4-1
10.10.17	448.9	439.84	458.91	441.47	452.23	446.75	447.36	448.24	448.21	448.34	448.20
24.10.17	458.2	459.46	464.15	458.84	464.49	457.82	439.91	444.35	444.33	444.99	444.22
07.11.17	477.7	479.28	468.33	481.87	475.52	469.46	433.80	440.27	440.58	441.67	440.39
22.11.17	480.0	495.67	471.88	499.45	486.42	481.88	429.03	436.04	437.02	438.43	436.79
06.12.17	490.4	504.66	474.65	498.39	496.21	492.88	425.46	431.77	433.69	435.31	433.50
20.12.17	499.0	508.46	477.21	482.04	505.86	502.86	422.88	427.61	430.65	432.38	430.55
08.01.18	513.0	508.99	480.37	457.39	517.38	513.24	421.06	423.80	427.91	429.66	427.96

Source: Authors.

It can be seen from the table that the original neural networks almost accurately predicted the development on October 10, 2017. The differences between the networks and the reality were within the range of single-digit CZK to tenths of CZK (at least 0.6 CZK per share). On the contrary, new networks predicted the price higher than even by more than 10 CZK, respectively about 9 CZK lower. On October 24, 2017 the situation is changing. Original neural networks predict a decline in ČEZ's stock price. New networks predict a rise in price. Even the new network number 3. RBF 1-28-1 is approaching the correct value of the difference of 0.6 CZK. Further development is fairly unambiguous. The original neural networks are moving away from the actual value. From the new neural networks, in particular RBF 1-29-1 and MLP 1-20-1, can track the actual development. Both these networks are more or less able to copy the actual development. Graph 7 provides a detailed view of actual price and predicted development using original neural networks and time series alignment using new neural networks.

Graph 7: Comparison of selected predicted values and actual stock prices



Source: Authors.

It is clear from Graph 7 that we can only consider the use of new networks 4 and 5 in practice. The original networks have completely failed. For new networks, the other structures differ in each prediction.

Conclusion

The aim of this paper was to verify the prediction of the stock prices of ČEZ, a.s. on the Prague Stock Exchange. The main goal was decomposed into two sub-goals:

1. Evaluate accuracy of the prediction using neural networks of Vrbka and Rowland (2017) on stock price data that followed the time series used to calculate neural networks in the contribution of Vrbka and Rowland (2017).
2. Generate new neural structures that take account of stock price developments in the 62 trading days following 9 October 2017.

The aim of the paper was fulfilled. For sub-goal 1 we can state that:

1. The original neural networks predicted future development correctly for only the following day.
2. Over a longer period of time, the gap between predictions using the original networks and the actual stock prices increased over time.
3. The maximum difference between the prediction and the actual price was up to 5.46% of the share price.
4. The original neural networks were also wrong in the case of the curve of the future development of the share price of ČEZ.
5. We can summarize that the original neural networks are inappropriate to predict the evolution of ČEZ stock prices, even though they presented themselves with high performance in the training, testing and validation data sets.

For sub-goal 2 we can state that:

1. Optically, two new neural structures can be used in practice. Networks 4. RBF 1-29-1 and 5. MLP 1-20-1 can align time series to track actual price developments.
2. The practical use of new networks was not tested on data that did not enter the calculation. Therefore, it can not be estimated to what extent the predictions will be correct.
3. New networks show lower performance in all three sets of data using the same methodology.

It is certainly good to return to the lower performance of new networks. Since the same methodology for calculating neural structures has been applied, it can be assumed that lower performance can be due to two causes:

1. The construction of neural networks in Statistica is the result of estimation, iteration and, to some extent, even coincidence. It may be the result of the fact that neural structures can have many variants with given rules, and the software simply does not have to choose the appropriate structure because it simply does not test its parameters. If this fact were true, it would mean that we will reach different results even with the same data. The situation can be solved by higher computational power and by specifying a parameter about the number of generated neural networks at the level of all possible variants that may arise

(including the most unlikely ones). However, it is a question of whether such a number is final.

2. We can assume that the development of ČEZ's stock prices before 9. October 2017 is extraordinary and, in fact, a turbulent in comparison to previous developments.

What should be the next step? Again three options are offered. All of them, however, assume a living artificial intelligence capable of learning with every next piece of information received:

1. We select the most successful preserved neural structure (in this case, either the structure 4 or 5). Subsequently, we will modify the weight of each neural link, by synapse, with each additional share price, so that we can get the best results each following day.
2. With each new piece of data, we will generate new neural structures able to predict stock price developments in the short term.
3. We will use neural structures only to predict the basic price, which will be subsequently corrected using causal prediction methods.

Finally, I would like to remind you that each model (i.e. the neural structure) is a simplification of reality, but we try to bring ourselves as close to reality as possible.

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