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FINANCIAL MANAGEMENT

INTEGRATION AND REGIONAL POSITION OF STOCK MARKETS: A CASE OF SOUTH EAST EUROPEAN COUNTRIES

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Abstract: *The study examines short and long run dynamics in the relationships between six emerging South East European stock markets applying a Markov Switching Vector Error Correction Model (MS-VECM). The long run dynamics are confirmed by a cointegrating vector which relates the stock indices of observed markets. The nonlinearity of the estimated model is justified by the Log-likelihood Ratio test and the information criteria. The MS-VECM with two regimes provides an adequate illustration the of level of market integration and stability from the perspective of a regional market position. Furthermore, the model shows an ability to capture every change in the financial time series data. Also, modeling the shifts can be encouraged by the fact that the change in and between regimes should be considered as a random, unpredictable event. Finally, the study have implications regarding market efficiency hypothesis which impacts international or regional portfolio diversification and the long term economic growth prosperities. Moreover, the results show that the diversification benefits for international investors with long horizon strategy in the stock markets are quite limited.*

Keywords: *vector error correction model, markov switching, integration, stock market*

1. INTRODUCTION

Along with the beginning of the financial crisis during the 2008, it became clear that financial markets worldwide are no longer national. Stock indices were falling dramatically, while market participants were desperately seeking for better investment opportunities by following information from other stock markets. In this way, mentioned investors are trying to find new ways to yield higher returns and better risk diversification of investment portfolio.

As capital becomes borderless, the improvements in allocation efficiency and reductions in volatility have elevating the benefits of economic growth (Masood et al., 2010). Furthermore, appearance of liberalization of financial markets promotes market integration with serious consequences on efficient implementation of investment politics. One should not be ignored that an increase of market integration and its openness could lead to an increase of volatility and exposure to unwanted market equilibrium disturbances. Therefore, a transmission of market turbulences is likely higher if international financial markets are well integrated (Assidenou, 2011). Emerging financial markets are becoming less isolated to main world market movements and economic growth created by efficient financial allocation and decreases of macroeconomic volatility (Baele et al., 2004).

A financial market cointegration becomes crucial not only to the economic theory, but to an active investment portfolio management. According to the financial theory, if there is a confirmation of accepting any of three versions of the efficiency market hypothesis, than returns, yielded by investment activity, can not be predicted using any kind of public financial data. Such a phenomenon disqualifies any adjustment among financial markets over time. Hence, with existence of cointegrating relations between financial markets, the market efficiency hypothesis is rejected since mentioned markets poses relevant information about each other. On the other hand, a lack of cointegrating relationships creates investment opportunities through better risk diversification of international investment portfolio.

With the development of first methods of measuring long-run relations among financial markets, there has been made several studies that helped in decision making process. Anyway, the stable equilibrium relationships conceived by the cointegration methodology are not appropriate for modeling the dynamics of stock market integration. The traditional linear model does not allow the parameters to adjust for the structural changes. Therefore, many previous works have adopted Markov switching framework in analyzing the relationships between markets. Allowing the involvement of regimes, the mentioned methodology is well suited to domestic and international cycling shifts that affect domestic market. Moreover, it allows for changing relationships among the stock market variables across different time phases. Linked with the basic Markov switching vector autoregression model created by Hamilton (1989), a Markov Switching Vector Error

Correction Model (MS-VECM) has recommended in case of unknown regime shifts of stock market prices. In other words, the model introduce state variable generated by the Markov chain, where the market state of tomorrow is driven only by the present market state (Krolzig, 1997).

Using similar methodology, Scheicher (2001) considers financial markets of Hungary, Poland and Czech Republic and finds that mentioned markets are more influenced by the regional movements. The same author, beginning with the assumption that mentioned markets have no significant long-run connection with major world financial markets, infers that global integration of three markets remains at the same level, while regional integration is significantly high. Comparable results are confirmed by Maneschiold (2006) and Masood et al. (2010) in case of countries from Baltic region. Also, Keneurgios and Samitas (2011) examined cointegration of five emerging Balkan markets through involvement of developed financial markets. These markets show higher integration during the period of financial market breakdown in 2008. Consequently, main goal of this study is to examine short and long run integration of financial markets in region of south east European countries with the attention on the position of Serbian financial market. Also, the focus remains on convergence level of domestic stock markets to new tendencies in the region.

2. METHODOLOGY

The methodology of measuring cointegration between economic variables (Engle and Granger, 1987; Johansen, 1988) is accepted in numerous studies of long-run co-movement among international financial markets. However, long-run equilibrium of cointegration given by the basic methodology is not appropriate in case of modeling dynamic processes of market cointegration. Due to the incomplete procedure which continues to generate strong variations in results over time, it is inevitable to upgrade previous procedure emphasizing the nature of time variations. To fulfill mentioned assumption, this paper contains three supplementing methodology segments:

- Unit root testing,
- Cointegration testing and
- Markov switching vector error correction modeling.

2.1. Unit root testing

In first step, the study examines a stochastic structure of time series by applying the Augmented Dickey-Fuller test (ADF test). The test performs in order to determine the stationarity of time series. The term of stationarity implies the mean reversion in long term and avoids imposed relations in regression. In other words, the presence of these time series leads to a biased implementation of regression analysis. The ADF test begins with the equation:

$$\Delta Y_t = \alpha + \mu T + \omega Y_{t-1} + \sum_{i=1}^p \delta \Delta Y_{t-i} + \varepsilon_t \quad (1)$$

Based on equation (1), one tests the null hypothesis about random walk of variable Y, which implies the presence of unit root versus stationary process with trend.

2.2. Johansen's cointegration test

According to cointegration theory, it is possible to determine a cointegration relationship between time series if their first differences are stationary. Such an analysis uses Johansen's procedure of maximum likelihood as a framework for estimation and testing of cointegration relations. Therefore, mentioned procedure incorporates different short and long-run dynamic relations in the multiple variable system, as follows:

$$\Delta Y_t = \mu + \Pi Y_{t-p} + \sum_{i=1}^{p-1} \Gamma_i \Delta Y_{t-i} + \varepsilon_t \quad (2)$$

Where Π is a matrix of the coefficients with lagged variables and Γ_i is a matrix of coefficients with first difference lagged variables. The cointegration test is calculated using ranks of eigenvalues λ . The rank of matrix Π is equal to eigenvalues different from zero. Eigenvalues are sort ascending $\lambda_1 \geq \lambda_2 \geq \dots \geq \lambda_g$. Using Johansen's approach, it is possible to form test statistics of the following form:

$$\lambda(r) = -T \sum_{i=r+1}^g \ln(1 - \hat{\lambda}_i) \quad (3)$$

Where r is the number of cointegrated vectors based on the null hypothesis, while $\hat{\lambda}_i$ is an estimated value of the i -th eigenvalue from matrix Π . $\lambda(r)$ is a mutual test where the null hypothesis represents the number of cointegrated vectors less than or equal to r versus an alternative hypothesis that the number is greater than r .

2.3. Markov Switching Vector Error Correction Model

A vector error correction model (VECM) means a type of vector autoregressive model (VAR) with cointegration constraints installed the model specification. The model design itself is made for estimating relations between nonstationary time series. Therefore, limited application of the model demands previous cointegration testing. Although a vector error correction model is considered as an alternative to basic vector autoregressive model in cointegration relations estimation, it also has numerous limitations (Phoong et al., 2014). In such a model, the constancy of variance and covariance over time can significantly affect a reliability of model estimation. Besides, the presence of autocorrelation becomes sensitive matter in terms of number of lags include in the model. All of this guides to the introduction of the new type of a model with Markov chains, where variance and covariance are followed by the probability (state) variable.

A MS-VECM represents a special form of model in different time series regimes. This model is specially recommended in cases when the price changes (price regimes) are unknown. Thus, price changes in this model have stochastic feature. In other words, the state variable is introduced and it generates by the Markov chains, where tomorrow state of market is driven only by the today's state (Krolzig, 1997). The form of a Markov switching vector error correction model can be presented as follows:

$$\Delta Y_t = \nu(s_t) + \alpha(s_t)(\beta(s_t)'Y_{t-1}) + \sum_{i=1}^{p-1} A_i(s_t)\Delta Y_{t-i} + \varepsilon_t \quad (4)$$

Where Y_t denotes a vector of stock market indices values, $\nu(s_t)$ is a vector of intercept term, $\alpha(s_t)$ denotes a vector of the speed of adjustment coefficients, $\beta(s_t)$ is a long-run cointegrating vector and A_i is a matrix of short-run parameters, capturing the autoregressive part of price movements. One should emphasized that the main segment of equation (4) is state variable $s_t = 1, \dots, M$. All parts of the model specification involving this variable. Therefore, the probability of being in state s in period t is presented in expression (5).

$$P(s_t | s_{t-1}, \Delta Y_{t-1}, \beta' Y_{t-1}) = P(s_t | s_{t-1}, \Pi) \quad (5)$$

Where the square matrix Π contains probabilities π_{ij} for switching from the regime in row i to the regime in column j , conditioned on the regime in the previous period.

3. EMPIRICAL ANALYSIS

This paper studies the relationships among six emerging stock markets of South East European Countries (Bulgaria, Bosnia and Hercegovina, Croatia, Romania, Serbia and Slovenia). We decide to study these markets separately from global financial trends, since the stock markets in this region remain small in terms of capitalization, turnover and liquidity compared to developed countries. Also, this paper uses the period of time after the financial crisis, i.e. from the first moment of an obvious positive trend of stock indices. Therefore, the sample of six major stock exchange indices in mentioned stock markets (SOFIX, SASX-10, CROBEX, BET, BELEX15 and SBITOP) is collected from August 15, 2009 to December 31, 2015 or 1610 daily observations of stock index values. Table 1 presents descriptive statistics of stock indices returns in observed period of time.

Table 1: Descriptive statistics

Stock index	BELEX15	SASX-10	CROBEX	SBITOP	SOFIX	BET
mean	0.00016	-0.00035	0.00000	-0.00007	0.00022	0.00038
st deviation	0.01134	0.00942	0.01024	0.00999	0.01602	0.01910
maximum	0.08317	0.05938	0.08563	0.03721	0.18171	0.15188
minimum	-0.07580	-0.06940	-0.07020	-0.06059	-0.13741	-0.13709
skewness	0.43307	0.21968	0.26851	-0.20866	-0.25598	-0.25621

kurtosis	10.19771	9.58702	13.05516	5.37702	11.60195	11.63244
$\rho(1)$	0.25156	0.11682	0.10412	0.08303	-0.01674	-0.00104
$\rho(2)$	0.11627	0.01205	-0.01613	-0.00911	0.06025	0.01670
$\rho(3)$	0.03600	0.01401	0.06805	-0.02782	-0.03048	-0.00926
$\rho(4)$	0.10170	-0.01088	0.03001	-0.00577	0.04637	-0.01435

Table 1 shows daily mean value of stock index returns in observed period of time where only SASX-10 and SBITOP had negative average of returns. Standard deviation of mentioned time series of returns is similar in case of markets from former Yugoslav Republics (BELEX15, SASX-10, CROBEX and SBITOP). First three observed indices had positive skewness, while next three had negative skewness in mentioned period. According to several authors, negative skewness is a feature of developed financial markets, although it brings higher risk of potential investment. All observed indices had leptokurtic distribution (kurtosis>3), which is one of the main characteristics of financial data. Finally, autocorrelation coefficients $\rho(i)$ did not show any sign of significant correlations between current index return in time t and lagged return in time $t-i$.

After a brief analysis of descriptive statistics, the next phase is to test the existence of unit root in time series of index returns using ADF test.

Table 2: Unit root testing

Stock index	ADF test
BELEX15	-2.1341***
SASX-10	-2.9014***
CROBEX	-2.5453***
SBITOP	-1.1819***
SOFIX	-1.7901***
BET	-2.1612***

Table 2 presents the results of ADF test in case of all six indices. *** denotes the level of significance below 1%. Hence, all six time series of index values are nonstationary or integrated in first order $I(1)$. Considering the results, the study takes the following step by testing cointegration of nonstationary time series with λ_{trace} Johansen's test.

Table 3: Testing cointegrating relations

No. of CE(s)	Eigenvalue	Trace Statistic	Critical Value	Prob.
None	0.0367	129.4103	95.7537	0.0000
At most 1	0.0184	69.3414	69.8189	0.0545
At most 2	0.0131	39.5366	47.8561	0.2395
At most 3	0.0048	18.2677	29.7971	0.5463
At most 4	0.0036	10.4927	15.4947	0.2447
At most 5	0.0029	4.6413	3.8415	0.0312

According to the mentioned procedure of cointegration testing, the results from Table 3 notice one cointegrated vector (equation) with significance level below 1%. It infers that there is some long-run integration among observed time series.

Mentioned results encourage the application of a vector error correction model. This study applies two different model specification: linear and Markov switching vector error correction model. Both models are estimated and compared by Likelihood-ratio (LR) test and Akaike information criteria. The tests show superiority of nonlinear model, MS-VECM with two regimes. Consequently, the next sequence of the paper will contain only the results of MS-VECM in case of BELEX15.

Table 4: Transition probabilities matrix

From Regime to Regime	Regime 1	Regime 2
Regime 1	0.97636	0.02365
Regime 2	0.52516	0.47484

Table 4 represents the results of transition probabilities between regimes in case of index BELEX15 returns as a dependent variable in estimated model MS(2)-VECM(1). The regime 1 is the standard regime where the volatility of returns is not to high, while the regime 2 is an extreme one where the volatility of returns is high.

At the intersection of row and column in Table 4 are the probability results of transition between regimes. Regime 1 keeps the high level of probability if it stays in the same regime. On the other hand, regime 2 has smaller probability of staying in the same regime. The following Table 5 will present the estimated model MS(2)-VECM(1).

Table 5: Estimated model MS(2)-VECM(1) in case of BELEX15

Variable		Parameter	t - statistics
regime dependent intercept	v_1	0.03699	15.2174
	v_2	-0.00055	-1.68979
short run dynamics	$\Delta BELEX_{t-1}$	0.27759	9.81806
	$\Delta CROBEX_{t-1}$	0.07550	3.13114
	$\Delta SOFIX_{t-1}$	-0.02375	-1.83588
	$\Delta SBITOP_{t-1}$	0.08630	3.59641
	$\Delta SASX_{t-1}$	0.08474	3.12833
error correction	ecm_{t-1}	-4.65868	-235.252
long run dynamics	Regime 1	0.11095	4.66905
	Regime 2	0.18593	3.48221

Estimated Markov switching vector error correction model is presented in Table 5. There are three main components that could be identified by interpreting the results from the model: short and long-run market integration, market stability and average regime duration.

The market integration will be investigated by the estimated parameters, presented in Table 5. Regime dependent intercepts v_1 and v_2 are the model starting point coefficients. These coefficients are significantly different between regimes. The parameters estimated with $\Delta BELEX_{t-1}$, $\Delta CROBEX_{t-1}$, $\Delta SOFIX_{t-1}$, $\Delta SBITOP_{t-1}$, $\Delta SASX_{t-1}$ represent the autoregressive parts of the model in short-run with non-switching parts. The index BET is excluded from the model due to the statistical significance. Therefore, we noticed some weaker linkage between BELEX15 index and BET index in short-run. In addition, the model shows a potential problem with the significance level in case of SOFIX index. Hence, in short-run the strong connections are noticed in case of four observed market indices from former Yugoslav Republics. The error correction term is highly statistically significant, which means that BELEX15 is able to adjust to new trends in the mentioned region. In other words, the region of South East European financial markets is highly integrated in long-run and partly in short-run. Long-run dynamics parameters show strong long run integration of BELEX15 in region of south east European stock markets in both regimes. These two parameters are also represented as elasticity parameters which show long run transmission of the price changes from the mentioned region to Serbian financial market. There is no significant difference in elasticity parameters between regimes.

The stability of the national financial market is investigated using filtered probabilities of dependent variable being in one of two mentioned regimes. Applying estimated MS(2)-VECM(1), Figure 1 represents distribution of those probabilities in observed sample period.

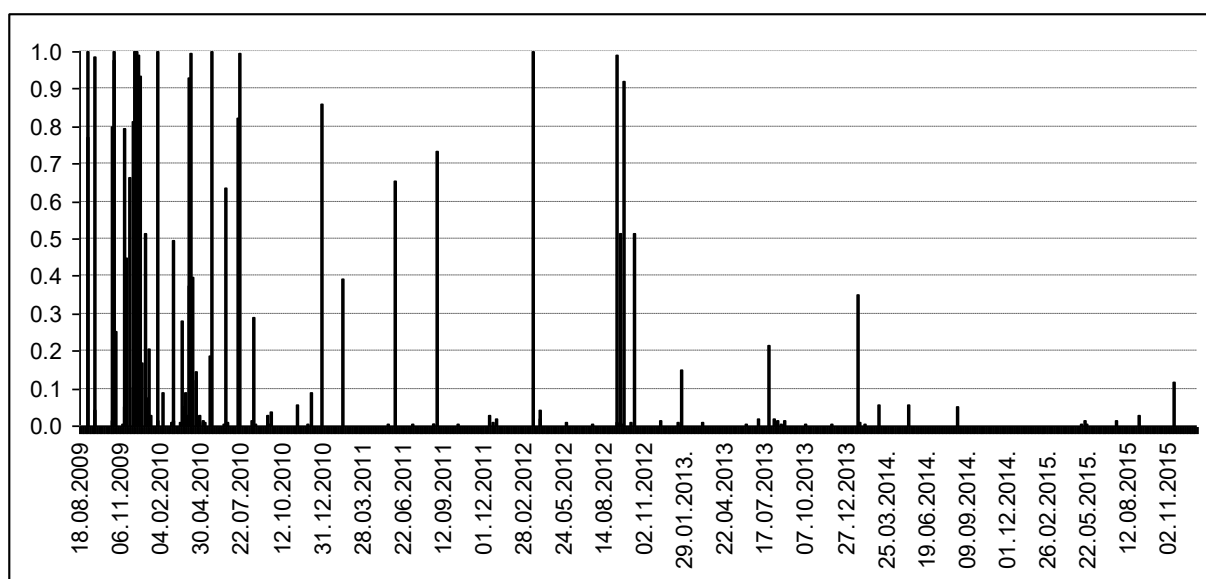


Figure 1: Filtered probabilities of being in regime 2

Figure 1 presents filtered probabilities of state variable being in regime 2 (regime of extreme changes). The most of the sample time the state variable was in regime 1. This figure points out that BELEX15 is in period of stable price changes, especially in last 4 years where extreme regime appeared in only few observations and, what is even more important, it does not retain in following daily observations. Moreover, only 32 of 1610 daily observations, involved in the analysis, have the probability of being in regime 2 more than 50%.

To support the fact about market stability, the estimated MS(2)-VECM(1) provide the average time duration of each regime. Accordingly, dependent variable (BELEX15 index) retains in the period of stable price changes for 42.2917 daily observations in average, while the period of extreme price changes last for 1.9042 daily observations in average.

4. CONCLUSION

Serbian financial market and other observed market due to their size and volume of trade belong to the category of small emerging markets in global scale. Therefore, it is inevitable to analyze international, as well as regional, financial effects before any investment decision making. Such an approach brings an opinion about the level of market integration and stability from the perspective of a regional market position. From the estimated results, it is obvious that the movement of BELEX15 index is highly connected with the signals from the neighboring financial markets. However, price stability in observed market shows that they became less immunized to external movements. For that reason, the results of the estimated MS(2)-VECM(1) indicate that both domestic and external factors shape the long-run equilibrium of mentioned stock markets.

According to growing integration between neighboring markets, the results have implications regarding market efficiency hypothesis which impacts international or regional portfolio diversification and the long term economic growth prosperities. In other words, the diversification benefits for international investors with long horizon strategy in the stock markets are quite limited. However, small number of significant extreme regime appearance probabilities in last three years creates favourable conditions to attract many domestic and foreign rational investors.

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IMPACT OF THE EFFICIENCY OF THE TAX ADMINISTRATION ON THE MACROECONOMIC STABILITY

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Abstract: *In this paper, we analyze the performance of the system for the administration of public revenues by mathematical modeling. Due to the economic crisis, the governments in many countries implement radical fiscal measures. Fiscal consolidation is a key element for creating a stable macroeconomic environment. In this regard, the establishment of an efficient tax administration is one of the key factors for creating macroeconomic stability and attractive business environment. The quality of a business environment has strong positive influence on the level of direct investments in every country. The obtained results have showed that the countries in which the tax administrations are efficient, resulting in a more stable macroeconomic environment, which leads to a higher levels of foreign direct investment. Strong institutions and a high level of foreign direct investments are the way to improve economy and to increase standard of living in countries.*

Keywords: *tax administration, data envelopment analysis, foreign direct investments*

1. INTRODUCTION

Tax Administration is essential for every country. In the situation with full tax compliance, which is extreme and an ideal situation, the role of the Tax Administration would be restricted to the provision of facilities for citizens to discharge their responsibilities to the society. In the case of non-compliance, the Tax Administration will have to play the role of policeman. Due to lack of resources and in the situation that it cannot play the role of a policeman to all taxpayers, one of the solutions is to support a voluntary compliance. In that sense, the fundamental role of the Tax Administration is to render quality taxpayer services and to encourage voluntary compliance of tax laws, to detect and penalize non-compliance. The extent of success of the Tax Administration in its role should be reflected through a higher revenue growth. Only with collected taxes, governments are able to provide all public services and to implement welfare programs. In addition, the level of grey economy is one of the parameters of a state in economy. It can be said that there is a connection between business environment regulations and the level of grey economy. Better environment regulations lead to a lower level of the grey economy because enterprises do not have incentives to go in the grey economy on one side and going into the grey economy is punishable on the other side. Adequate environment in which enterprises operate will encourage them to stay in formal economy. In other words, the level of grey economy is lower and enterprises are more responsible to pay taxes in a more regulated business environment. That creates culture where cheating the government is not acceptable and even more than that, it is punishable. In addition, quality of business environment has strong influence on the level of direct investments into every country. Having this in mind, a better regulated business environment will attract more foreign direct investments. In that sense, countries have to strive to attract direct investments in order to increase quality of their economies. To establish pro-business environment and to increase investments, an effective and efficient Tax Administration is a necessary element. The increasing efficiency and effectiveness of Tax Administration will surely be followed by decreasing level of the grey economy and a more friendly business environment for foreign investments.

The taxpayer's decision to comply, or not to comply, with his fiscal obligations has been the subject of considerable literature on the themes of tax evasion (Bird, 2004). There are two different paradigms that are used in order to encourage tax compliance, each with different implications for tax compliance behaviour. The first paradigm is a standard economic model of tax evasion based on the economic theory of crime that emphasizes repression of illegal behaviour through frequent audits and rigid penalties. The second paradigm recognizes the role of enforcement strategy (audit and penalties), but also emphasizes the role of tax administrators as facilitators and a providers of services to taxpaying. It stresses the role of social norms in tax compliance, in the sense that the government can change tax compliance by changing the social norm of tax compliance (Bird, Martinez-Vazquez & Alm, 2003: 156). Regarding Tax theory, focus will be on the services provided by the tax administration to increase tax compliance (second paradigm) but we should have to bear in mind that enforcement elements are the second very important part to increase tax

compliance (first paradigm). This paper aims to compare the efficiency of the systems for the administration of public revenues among different develop and developing countries. Similar attempt is made by Savić et. al (2015) who tried to establish the linkage between the tax administration efficiency and tax evasion in 17 European union members and non-members. They proposed two stage methodology consists of the data envelopment analysis for the tax administration efficiency evaluation and regression model defined to find out the relation between a level of grey economy and level of the tax administration efficiency, GDP level and other characteristics of economy. The results have shown the strongest impact of tax administration efficiency on the decreasing the level of grey economy. This paper is organized as follows. A DEA based methodology is given in the second chapter. A DEA efficiency measurement of the tax administration systems is given in the chapter 3, followed by conclusion remarks and literature.

2. METHODOLOGY

The idea of efficiency measurement was developed by Farrell (1957) when he used non-parametric efficiency limits approach to measuring the efficiency of the relative distances from the efficient frontier. This measure, which is well known as empirical or relative efficiency was later expanded in the work of other researchers. Data Envelopment Analysis (DEA) was introduced by Charnes, Cooper and Rhodes (1978). Their model is known as CCR model. Business units, their activities or processes in the DEA terminology are seen as Decision Making Units (DMU). DMU is the unit that actually make business decisions, and whose performance is characterized by a set of inputs and outputs, and their interdependence. It operates with constant returns to scale (CRS) which implies that a change in the amounts of the inputs leads to the same proportional change in the amounts of the outputs. Efficiency ratio is scaled between 0 and 1, and all efficient units have the same ratio equal to 1. Following this model, Banker, Charnes, and Cooper (1984) have extended the original CCR model by introducing the assumption of variable returns to scale (VRS). In the literature this model is known as a BCC model. The VRS efficiency scores measure pure technical efficiency excluding the effects of scale operations. They are greater than the corresponding CRS efficiency scores. BCC model is able to distinguish between technical and scale inefficiency. Technical inefficiency is calculated by measuring how well the unit uses its inputs to create outputs, while scale inefficiency identifies whether increasing, decreasing, or constant returns to scale exist. There are two main orientation of DEA model: input and output orientation. Input-oriented DEA model aims to minimize the input with given level of output. On the other side, in output-oriented DEA model aim is to maximize the output with given level of input. In the envelopment model, the number of degrees of freedom will increase with the number of DMUs and decrease with the number of inputs and outputs. A rule of thumb which can provide guidance is as follows (Cooper, Seiford, and Tone, 2000): $n \geq \max \{m \times s, 3 \times (m + s)\}$; where n is number of DMUs, m is number of inputs and s is number of outputs. This pre-condition has been fulfilled by the analysis in this paper.

Consider a set of n DMUs, with each DMU_j, $j = 1, \dots, n$, using m inputs x_{ij} ($i = 1, \dots, m$) and generating s outputs y_{rj} ($r = 1, \dots, s$). Then the primal linear program for the (input-based) CCR model, that gives optimal efficiency score θ^* for DMU₀, can be written as:

$$\theta^* = \min \theta \quad (1)$$

s.t.

$$\sum_{j=1}^n \lambda_j y_{rj} \geq y_{r0}, \quad r = 1, \dots, s \quad (2)$$

$$\sum_{j=1}^n \lambda_j x_{ij} \leq \theta x_{i0}, \quad i = 1, \dots, m \quad (3)$$

$$\lambda_j \geq 0, \quad j = 1, \dots, n \quad (4)$$

where θ is the efficiency score for the particular DMU, x_{i0} and y_{r0} are, respectively, the i -th input and r -th output for DMU₀ under evaluation, while λ_j represent unknown value assigned to DMU_j, $j = 1, \dots, n$. The efficient frontier consists of DMUs with $\lambda_j \neq 0$. The dual linear program to model (1)-(4) is

$$\max \sum_{r=1}^s u_r y_{r0} \quad (5)$$

s.t.

$$\sum_{i=1}^m v_i x_{i0} = 1 \quad (6)$$

$$\sum_{r=1}^s u_r y_{rj} - \sum_{i=1}^m v_i x_{ij} \leq 0, \quad j = 1, 2, \dots, n \quad (7)$$

$$\begin{aligned}
u_r &\geq 0, \quad r = 1, \dots, s \\
v_i &\geq 0, \quad i = 1, \dots, m
\end{aligned} \tag{8}$$

where u_r is the weight assigned to output r , $r=1, \dots, s$ and v_i is weight assign to input i , $i=1, \dots, m$. A DMU₀ is said to be CCR efficient if and only if $\theta^* = 1$ and all optimum slack values obtained by solving model (1)-(4).

In this paper DEA is used for comparative analysis of tax administration efficiency in the selected countries. Procedure of DEA method applying could be divided into following steps (Popović, and Martić, 2005):

1. Choosing and definition of DMU's,
2. Defining relevant inputs and outputs,
3. Choosing adequate DEA model, and
4. DEA model solving, analysing and interpretation of results.

At this point, we will emphasize the importance of choosing the adequate DEA model. This choice will depend on the context of research, and the previous two phases in its implementation. A set of countries that are assessed in this research consists of countries classified in the group of high income and countries with upper-middle income according to the World Bank classification. Therefore, it can be said that they belong to distinguish a group and adequate DEA models for the comparison between different systems and bilateral DEA model are going to be used.

Efficiency comparison between different systems is achieved by solving the mixed integer linear programming model (Cooper, Seiford & Tone, 2000). The set of n DMUs is divided into a set A and set B and model is defined as follows:

$$\begin{aligned}
\theta^* &= \min \theta \\
\text{s.t.} &
\end{aligned} \tag{9}$$

$$\sum_{j \in A} \lambda_j^A y_{rj}^A + \sum_{j \in B} \lambda_j^B y_{rj}^B \geq y_{r0}, \quad r = 1, \dots, s \tag{10}$$

$$\sum_{j \in A} \lambda_j^A x_{ij}^A + \sum_{j \in B} \lambda_j^B x_{ij}^B \leq \theta x_{i0}, \quad i = 1, \dots, m \tag{11}$$

$$0 \leq \lambda_j^A \leq z_j^A, \quad j \in A \tag{12}$$

$$0 \leq \lambda_j^B \leq z_j^B, \quad j \in B \tag{13}$$

$$z_j^A + z_j^B = 1, \quad j \in B \tag{14}$$

$$\lambda_j^A \geq 0, \quad z_j^A \in \{0, 1\}, \quad j \in A, \quad \lambda_j^B \geq 0, \quad z_j^B \in \{0, 1\}, \quad j \in B, \tag{15}$$

where z_j^A and z_j^B are binary variables define that production possibility set consists of DMUs belongs to the set A ($z_j^A = 1, z_j^B = 0$) or to the set B ($z_j^A = 0, z_j^B = 1$). For example, the reference set for DMU₀ $\in A$ can be consists of DMUs in set A or B (*inter* and *within* comparison) and *vice versa*. The model can be solved as a sequence of two linear models and choosing an optimal value $\theta^* = \min \{ \theta_A, \theta_B \}$. Strict *inter* comparison (the reference set for DMU₀ $\in A$ can be consists exclusively of DMUs in set B and *vice versa*) can be done with by solving the following model:

$$\begin{aligned}
\theta^* &= \min \theta \\
\text{s.t.} &
\end{aligned} \tag{16}$$

$$\sum_{j \in B} \lambda_j^B y_{rj}^B \geq y_{r0}, \quad r = 1, \dots, s \tag{17}$$

$$\sum_{j \in B} \lambda_j^B x_{ij}^B \leq \theta x_{i0}, \quad i = 1, \dots, m \tag{18}$$

$$\lambda_j \geq 0, \quad j = 1, \dots, n \tag{19}$$

The two systems A and B can be compared by observing efficiency of each DMU in each system. For that purpose, nonparametric Wilcoxon Mann-Witney rank-sum is used to identify weather the difference between

two groups is significant. Presented models are used for the efficiency evaluation of tax administration systems in 94 countries.

3. DEA EFFICIENCY MEASUREMENT

In the DEA analysis the following input and output parameters have been used. The parameters are determined by goal definition that is measuring the efficiency of the tax administration. All input and output parameters relating to the year 2013. The following inputs are used:

- Time to comply – corporate income tax (I1)
- Time to comply – labour tax (I2)
- Time to comply – consumption tax (I3)
- Tax payment - profit tax (I4)
- Tax payment – labour tax (I5)
- Tax payment - other taxes (I6)
- Tax rate - profit tax (IN7)
- Tax rate - labour tax (IN8)
- Tax rate - other taxes (IN9)

Tax rates are non-discretionary variables, considering that management cannot influence the decision on their size, and they are out of reach decision makers. On the other hand, the output parameters are:

- The level of foreign direct investment, in dollars (O1)
- Gross domestic product in dollars (O2)

Tax administration plays an important role in ensuring overall macroeconomic stability, which has a positive impact on foreign direct investment (Barthel et al, 2008; Shahzad and Al-Świda, 2013). On the other hand, foreign direct investment is an important element of economic growth (Lim, 2001). Selected input and output parameters are important for tax administration businesses and they are derived on the basis of the existing models for assessing the performance of tax administration (European Commission, 2007; the International Finance Corporation, 2015; International Monetary Fund, 2012; World Bank, 2012). Input parameters represent the efficiency of the tax administration in establishing a stable macroeconomic and fiscal environment, while output parameters represent the level of development of the country and attractiveness for foreign direct investments. In this model, the tax administration has the role as a key factor for attracting foreign direct investment through the creation of preconditions for their attraction. The value of the input and output parameters is given in Table 1 in Annex. DMUs have been selected on high income countries and countries with upper-middle income defined by the World Bank classification. The total number of countries is 94, out of which 48 countries with high-income countries, and 46 countries with upper middle income.

Table 1. Descriptive statistics of results

		DEA CRS		Bilateral DEA CRS					
		#	%	High-Income Countries		Upper-Middle Income Countries		Total	
Efficiency Score	Range	#	%	#	%	#	%	#	%
	< 0.2	38	40.43%	4	8.33%	34	73.91%	38	40.43%
	0.2 - 0.4	17	18.09%	8	16.67%	9	19.57%	17	18.09%
	0.4 - 0.6	15	15.96%	12	25.00%	3	6.52%	15	15.96%
	0.6 - 0.8	4	4.26%	4	8.33%	0	0.00%	4	4.26%
	0.8 - 1.0	3	3.19%	3	6.25%	0	0.00%	3	3.19%
	1.0	17	18.09%	17	35.42%	0	0.00%	17	18.09%
Total	94			48		46		94	
Average	0.797			0.634		0.157		0.401	
Min	1			0.319		0.013		0.013	
Max	0.349			1		0.514		1	
SD	0.216			0.091		0.109		0.339	

The efficiency assessment and comparison between two groups is done by CCR DEA (1-4) and (5)-(8) and system DEA model (9)-(15). A descriptive statistics of results is given in the Table 1. The models are solved using DEA Solver Pro software (Cooper, Seiford, & Tone K, 2000). The basic results show that there are 17 efficient out of 94 countries no matter if they are compared within or inter group. The second analysis, which compares efficiency of two groups, shows that all efficient countries are in the group 1 of high-income countries. Furthermore, based on descriptive statistics high-income countries with average efficiency scores of 0.634 performs better than upper-middle income countries, which will be checked later by comparing efficiencies of two groups and performing rank-sum test.

Afterwards, countries are inter-compared ranked by a bilateral DEA model, and efficiency scores of tax administration are shown in the Table 2.

Table 2. DEA Bilateral Efficiency scores

Rank	DMU	Score	Rank	DMU	Score
1	Bahrain	657.030	49	Chile	0.514
2	Hong Kong SAR, China	276.321	50	Botswana	0.506
3	Netherlands	74.290	51	Iraq	0.459
4	Argentina	50.210	52	Kazakhstan	0.277
5	Croatia	49.668	53	Palau	0.259
6	Luxembourg	40.651	54	Namibia	0.246
7	Saudi Arabia	35.107	55	Libya	0.220
8	Singapore	32.497	56	St. Lucia	0.220
9	Oman	20.844	57	South Africa	0.218
10	Brunei Darussalam	19.861	58	Brazil	0.215
11	United States	19.708	59	Grenada	0.212
12	Australia	19.336	60	Mexico	0.212
13	Bahamas, The	19.273	61	Lebanon	0.200
14	Equatorial Guinea	15.343	62	Turkey	0.196
15	Canada	14.428	63	Romania	0.177
16	Ireland	12.725	64	Belize	0.160
17	Estonia	12.022	65	Thailand	0.157
18	Cyprus	9.901	66	St. Vincent and the Grenadines	0.151
19	France	6.334	67	Azerbaijan	0.139
20	United Kingdom	6.146	68	Bulgaria	0.134
21	Germany	5.827	69	Colombia	0.132
22	Seychelles	5.779	70	Macedonia, FYR	0.130
23	Iceland	5.472	71	Algeria	0.129
24	Spain	5.227	72	Maldives	0.129
25	Austria	5.214	73	Malaysia	0.128
26	Russian Federation	4.853	74	Tonga	0.125
27	Korea, Rep.	4.262	75	Peru	0.123
28	Italy	4.046	76	Dominica	0.117
29	Slovak Republic	3.848	77	Ecuador	0.112
30	Israel	3.762	78	Montenegro	0.111
31	Malta	3.683	79	Costa Rica	0.103
32	Portugal	3.502	80	Belarus	0.100
33	Greece	2.849	81	Gabon	0.095
34	Latvia	2.838	82	Fiji	0.094
35	Japan	2.786	83	Bosnia and Herzegovina	0.088
36	Czech Republic	2.514	84	Panama	0.083
37	Lithuania	2.417	85	Jordan	0.079
38	Slovenia	2.093	86	Marshall Islands	0.075
39	Trinidad and Tobago	1.597	87	Dominican Republic	0.074
40	Poland	1.546	88	Iran, Islamic Rep.	0.067
41	Barbados	1.540	89	Jamaica	0.056
42	St. Kitts and Nevis	1.385	90	Paraguay	0.051
43	Uruguay	1.105	91	Serbia	0.047
44	Venezuela, RB	1.020	92	Mongolia	0.046
45	United Arab Emirates	1.000	93	Albania	0.036
45	Chile	1.000	94	Mauritania	0.013
45	Kuwait	1.000			
48	Grenada	0.969			

Based on the results, the null hypothesis is rejected that the two groups have similar distribution of the results, with the test statistic 6.813. As it is expected efficiency of the group 1 prevailed efficiency of group 2. Tax administrations in high-income countries are more efficient than the tax administrations in upper-middle income countries.

Special attention is paid on tax administration efficiency in Serbia. Serbia belongs to a group of upper-middle income countries as 91 out of 96 countries. The input-output values, projections and reference set are given in Table 3. Obviously, all inputs, regardless of whether they are related to time to comply, tax payment or tax rate, should be reduced for more than 90% in order to become efficient tax administration with current level of outputs. On the bottom of the Table 3, last two rows show that average changes need for achievement of full efficiency is between 63% and 79% in group 1, while the average required changes for the group 2 are from 86% to 95%. Therefore, the required changes in Serbia are above average for the group 2.

Table 3. Serbia - efficiency results

Countries		Score	Reference set								
Serbia		0.0467	. Hong Kong, Ireland, Luxembourg, Singapore								
		I1	I2	I3	I4	I5	I6	I7	I8	I9	
	Values	48.00	126.00	105.00	12.00	12.00	43.00	16,2	20,2	2,2	
	Projection	2.24	1.72	1.29	0.25	0.56	0.36	0.76	0.94	0.03	
	Change	-95.33%	-98.63%	-98.77%	-97.88%	-95.33%	-99.17%	-95.33%	-95.33%	-98.43%	
High-income	Average projection	-72.88%	-78.29%	77.99%	65.29%	-64.87%	78.99%	68.95%	63.63%	77.00%	
Upper-middle income		-90.92%	-92.53%	95.44%	88.99%	-87.98%	93.32%	92.18%	86.56%	94.44%	

4. CONCLUSIONS

In the paper, it was assessed the efficiency of the system for the administration of public revenues by DEA methods. It was used bilateral DEA model for conducting an analysis. The results have showed that the countries in which the tax administrations are efficient, resulting in a more stable macroeconomic environment, which leads to a higher levels of foreign direct investment. Actually, Tax Administration's influence on the level of direct investments is reflected through the set up an adequate business environment and in establishing macroeconomic stability. Furthermore, these two elements are complementary to each other. Namely, macroeconomic stability has a strong positive influence on business environment, and the other way around. In addition to that, both elements have positive influence on the level of direct investments in transition countries. Strong institutions and a high level of foreign investments are the way to improve economy and to increase standard of living in countries. Decreasing the level of grey economy and increasing the level of foreign investments are possible only with a strong Tax Administration. Moving Serbia towards EU will have positive influence on the capacity of the Tax Administration on one side and on the level of the underground economy (business environment) and macroeconomic (fiscal) stability on the other side. As a result, level of direct investments will increase and that will lead to higher living standard for all citizens in Serbia. Based on previous experience of new EU members, EU membership brings improvements to the capacity of Tax Administration, lower levels of grey economy and increasing levels of foreign direct investments. Accordingly, Serbia has to follow this path in order to improve its own economy and quality of life for all citizens.

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PROGRAM BUDGETING OF LOCAL AUTHORITIES IN SERBIA – A TOOL FOR CITIZEN PARTICIPATION AND SUSTAINABLE DEVELOPMENT

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Abstract: *This paper shows challenges in process of creating and executing program type budget, as a relatively new concept for local authorities in Serbia. It aims to show importance of this concept from the perspective of citizens' participation, and its relation with the process of strategic planning. The paper shows significance of realistic and reachable strategic goals foreseen in local strategic documents as a precondition for preparation of program budget for a budget and following two fiscal years.*

Keywords: *local authorities, budget, strategic plans, citizens' participation*

1. INTRODUCTION

Regardless of the political system in any given state, local self-government (if it exists as such) performs functions that represent counter-balance of central authorities, performing along the way corrective role of central government. The other reason for having local level of government is that it satisfies the needs of local citizens, which could not be fulfilled by central authorities. In countries that have established local authorities, apart from traditional division of authorities into independent branches (legislative, executive and judiciary), there is also a vertical division into central and one or more levels of local authorities.

Adopting a number of laws after year 2000, and Adopting the Constitution of the Republic of Serbia in 2006, foundations for modern local self-governments were set, and they remain, more or less unchanged till present day. Constitution of the Republic of Serbia (2006) in article 87, guarantees property of local authorities. The fact this is stated in the Constitution tells about determination of a country to pace a road of independence for local authorities and their autonomous functioning. Through a number of adopted laws that followed Constitution, local self-government in Serbia got clear systemic foundations, financial position was improved, new competences introduced, primary steps in establishing international cooperation taken and a number of projects supported by bilateral donations initiated and conducted.

Scope of activities of local self-governments is set in Constitution and Law on Local Self-Government (2007). Applying the method of enumeration in both of these legal acts, legislators strived for precise definition of whole spectrum of responsibilities and tasks that should fall under primary scope of work of local authorities. Apart from that, there is also a number of tasks that central authorities assign to local governments. Separate (so called sectorial) laws regulate these tasks. It is important to understand that these assigned tasks still lay under responsibility of central authorities, although performed by local ones. It would be reasonable that these assigned tasks are under responsibility of those by whom they are performed, and that they are followed by transfer of funds from central budget, so tasks additionally given to local authorities could be adequately performed. It is unfortunate that is still not always the case. Transferring just tasks without appropriate funds puts towns and municipalities in rather unsuitable position, making them provide and deliver new services out of already tight budget they have on their disposal.

Significant developments and improvements in the legal and regulatory framework, including the system of local government financing, are still expected in period ahead of us. Moreover, as Serbia approaches a potential date for EU accession, the need for preparations within local authorities will grow. Higher-quality services, enhanced dialogue with stakeholders and more efficient local administrations will be essential if municipalities, and indeed the country as a whole, are to meet EU standards and make the most of the opportunities that accession will bring.

2. STRATEGIC DOCUMENTS AND PRINCIPLE OF GOOD GOVERNANCE

Serbian national government has adopted several strategic documents in past several years, with particular emphasis on good governance and public administration reform. *The national objective identified in The*

National priorities for international assistance (2014-2017 with 2020 projections) is “to achieve standards of Good Governance by creating an efficient, effective, transparent and professional public administration that fits the needs of the citizens and business and contributes to sustainable social and economic development of Serbia” (p. 85). Another strategic document Fiscal Strategy of for 2015 with projections for 2016 and 2017 recognizes that in order to establish long-term sustainability of public finances, the implementation of the structural reforms of public sector should be speeded up, referring primarily to the public administration system, the public finances management, and local public finances management (p. 82-88).

In order to respond to requirements of EU accession process and adopted strategies of National Government, local governments of Serbia started addressing one of the many requirements put in front of them- they introduced rather new approach in Serbia in regard to local budget in form of program budgeting.

3. BUDGET AND PUBLIC FINANCES

It is very often the case that budget and public finances are mixed in sense of terminology but also in sense of understanding what these terms actually represent. Unlike public finances, which represent public revenue collection and making expenditures, i.e. spending of public funds, budget is a detailed, annual, obligatory systematized plan of collection and spending of public funds for a certain period, usually for one year. The budget foresees and allocates public expenditure and revenue, connects them, as provided by law, in a rational and coherent system of public finance. However, the budget is a key mechanism in public finances and represents a financial expression of working programs of the national or local government for a given year.

Local governments, being the closest to citizens of all levels of government, should be able to recognize the needs of its citizens, and those needs should be reflected in local budgets. This would practically mean that citizens are included in decision making process and those decisions are then reflected through expenditure of finances, i.e. through local budget. This creates circle of trust among local administration and citizens, and ideally, willingness of citizens to pay even higher taxes if they understand what money is spent on and how it is spent.

4. LOCAL BUDGET AND CITIZENS' INVOLVEMENT

John L. Mikesell in publication of World Bank edited by Anwar Shah (2007) points out that “The citizenry is more inclined to accept increased tax payments when it sees a clear link between payment of the tax and improved government services. When taxes are levied and collected at the central government level, that link can be hard to see. Payments disappear into the national treasury, and the funds get used in ways that have little identifiable consequence or impact on the taxpayer. The relationship can be radically different in the local fiscal structure. The governing body levies a tax for local roads, for example: the tax is collected locally, the money is spent on the local roads, and the citizenry can see the link between the tax and the service” (p. 18). The same parallel can be drawn in process of creating a budget and participation of citizens. The more citizens are informed on budget and included in process of its creation, the more they will approve local decisions. In many cases, when local citizens were not included in process of budget creation, it has been the case that local decisions and work of local government has been obstructed. This situation is not favorable neither for local politicians nor for the citizens- it stops progress, local services can not be fully provided, dissatisfaction raises.

In last several decades in Serbia, it cannot be judged that citizens were fully and appropriately involved in process of creating of local budgets. Although the process was always public in the sense that it has been published on local web page, local authorities did not put too much effort in actual citizen participation in the process. This kind of attitude and approach, i.e. exclusion of citizens from the process, has been justified by complexity of the process, inability of citizens to comprehend complicated budget lines etc, and thus it has very often been judged that involvement of citizens will additionally confuse already challenging and demanding process. On the other hand, citizens did not show too much enthusiasm for the process, estimating their involvement will not change anything, either way.

Ebdon and Franklin (2006) point out why participation process is valuable: „ Participation can be very useful in educating the public about key trade-offs and gaining valuable input from citizens about their priorities and preferences. Working with them to make these connections encourages citizens to participate in a more knowledgeable fashion rather than simply demand that their fire station or library remain open without tax increases or other service cuts“ (p. 444-445).

Process of budget adopting without too much of citizen involvement could have occurred during times when no strategies were being prepared, and thus no citizen or participation of professionals and experts and their input was needed. But, the process of creating local strategies was imposed to Serbian local governments as a pre-requisite for entering EU, i.e. for accessing European pre-accession funds. In that line, involvement of citizens through public debates and public fora is mandatory during the process of strategies creation. In parallel to this, when citizens realized they can influence decision making process in their community, through participation in creating local strategic document and budget accordingly, situation changes in a positive direction.

5. STRATEGIC PLANNING AND PROGRAM BUDGETING

Strategic planning is an important tool for adjusting to a changing environment. This kind of planning provides a clear definition of priorities and it determines the best ways of using the resources necessary for effective and efficient development, which are always limited. As such, it allows local authorities to effectively deal with the problems of development and growth. Local governments that develop and implement their strategic plans, are in general, more successful in managing local development, especially if they create strategies through a participatory process that includes the participation of all relevant subjects in the planning of the future of the local community.

In its course to reform and improve public finance management, Serbia decided to introduce Program budgeting, initially planned for 2009. It was postponed for 2015 according to article 112 stipulated in the Law on the Budget System (2015). This rather new approach for Serbia puts emphasis on prioritization and optimization of expenditure, in order to encourage economic growth and the efficient delivery and quality services of the public administration. But, in order to achieve this, several preconditions need to be fulfilled, as stated in *Budget process in the Republic of Serbia: Deficiencies and recommendations (2014)*: "Therefore, the preconditions for establishing a more efficient and more effective budget process include adequate political support, development of human and operational capacities, as well as the adoption of a consistent reform agenda in accordance with the best international experiences and adapted to the Serbian conditions" (p. 1). Here may lay the explanation why the process of introducing Program Budgeting was postponed for more than a few years than it was originally planned - it shows that human capacities and political will were missing for this process. It is important to stress here that Program Budgeting is a process within which involvement of different stakeholders is needed, which is then leading to more transparency and easier access to information when, where and why finances were spent. Transitional countries almost by rule tend to keep budgeting process away from public eye, which leaves them a lot of space for maneuvering with public funds.

Regardless of this, Serbia showed political determination to accelerate the process of introducing Program Budgeting. As a country, Serbia judged, as literature states, program budgeting to be an effective mechanism for the implementation of public finance reform process, since it enables better performance management of public administration, greater responsibility of the budget beneficiaries, at the same time establishing a stronger link between local budget, local priorities and the implementation of public policies. In addition, Program Budget brings a greater transparency in the process of expenditure of financial resources, but is also regarded as a transparent tool in process of satisfaction of the citizens' local needs.

Budget of a certain town or municipality is considered to be one of most important acts adopted by the local assembly. Having this in mind, the process of budget creation should be approached in a serious and systematic way and with sufficient resources. Poor or inadequate budget that is not in line with local needs and development directions is a major constraint for the local community. Out of this reason, it is of high importance to have program budget aligned with strategic priorities and documents of local community. Since local strategic documents should set medium and long-term outputs in a realistic manner, it is not surprising that *Guidelines for the program budget development (2014)* say that "Program budget enables matching alignment of medium-term outcomes and allocation of budget funds in order to improve the management of public policy. Public policy is reflected in the program budget because the expenditures are directly linked with the implementation of the program, program activities and projects that lead to achievement and fulfilment of public policy. Program budget includes objectives and performance indicators and therefore allows monitoring of results of the implementation of public policies. Budget beneficiaries are expected to submit information on their programs, activities, projects and objectives, and make decisions on the allocation of budgetary funds accordingly. The aim of this type of budgeting is to improve the efficiency and budget expenditures" (p. 10). Having this in mind, it can be concluded that strategic planning and program budgeting should be viewed as two segments of one process, which processes are interlinked and determine one another. Strategic plan, as an output of strategic planning is a basis for preparation of program budget for a budget year and two following fiscal years.

Preparation and executing of the budget, accountability and transparency of the expenditure evolved over the years. Vujović (2012) says that “Traditionally, governments did little to justify the use of budget funds. They only had to provide evidence that budget resources under their control were used in line with the prevailing laws, rules and standards. The traditional accountability ended with a simple proof of (cost and input) compliance” (p. 20). Situation has changed drastically in last decades, and now citizens want to be better informed on how public budgets are spent, and if the budgets could be spent in a more efficient way. In order to satisfy this public demand, concept of Program Budgeting provides some of the answers to the demand, which includes, relatively new concepts for Serbia, such are outputs, performance indicators and performance measurement. Vujović (2012) says that “In its modern meaning, performance measurement (PM) is predominantly focused on performance monitoring in the broader context of public sector accountability. Used in conjunction with appropriately designed performance indicators (PI), they form the core of modern PM/PI systems that play a pivotal role in the evolution of performance oriented budgeting systems” (p. 18). Vujovic additionally notices that “Initially, the demand for more robust PM/PI systems originated from a desire to improve the quality of the budget process and move from input based line budgeting to output (program) based and, ultimately, outcome focused budgeting. Now advances in developing better and more robust PM/PI systems contribute to the constantly evolving quality and transparency of the budget process, help improve the efficiency of public resources in providing goods and services, as well as enhance efficacy in achieving stated objectives (i.e. immediate, intermediate and final outcomes)” (p. 22).

6. LINE - ITEM AND PROGRAM BUDGETS - MAIN DIFFERENCE

For several reasons it became obvious that line-item budget had to be replaced with a different concept. One of them is greater focusing on results (outcomes), and efficiency and efficacy i.e. demand of the citizens to be completely informed what tax money is spent on. Line-item budget in a simple manner provides information on expenditure but not on the effects of spending. Gianakis and McCue notice that “In focusing on the funds expended in specific categories, the line-item format drives policy and efficiency considerations into the background. It centers budget deliberations on the cost questions, rather than on how the work is done or what ends are to be achieved” (p. 21).

Even it is relatively easy to prepare line-item type of budget, which is why the process of program budget has been postponed in Serbia, this type of budget does not provide required information on budget beneficiaries, activities nor local government. It provides simple information on amount spent on salaries, capital outlay, maintenance, purchase of goods etc. It does not give the information of the effects of such expenditure neither of kind of services provided for citizens. This type of budget does not say how many children are enrolled in kindergartens, how many kilometers of roads are repaired or cleaned. In order to respond to these questions, and to have broader perspective of how and on what public finances are spent, expenditures in budget ought to be re-arranged through variety of programs/ program areas, focusing on expected outcomes.

6.1. Program and Performance Budget Approach

Mukdad (2013) says that “Many writers separate “performance budget” and “program budget” as in many ways the latter was an evolutionary stage of the former” (p. 90). The same author finds, as many others, that program and performance budget are two sides of different coin (p.90). In effort to define program budget, Mukdad says “In very simple words, the idea behind the program and performance budget approach is, first, to propose that money distribute—customarily—to different departments according to specific types of expenditure . . . (line item); be spent, secondly, according to the developed, detailed listing of all activities of the whole organization or department . . . (program); in order to perform—thirdly—a listing of specific work in return . . . (performance)” (p. 91). Henry (2013) says that “We call it Program/Performance Budgeting, but this kind of budget, more commonly is known as either a Program Budget, emphasizing its budgeting of discrete governmental operations, or a Performance budget, stressing its focus on agency efficiency and effectiveness and their measurement. In reality, when it was introduced to the nation in mid-twentieth century, it did both, so we call it Program/Performance Budgeting and define it as a system of resource allocation that organizes the budget document by operations and links the productivity of those operations with specific budget amounts” (p. 235).

In the program budget expenditures are classified by objectives and goals (in form of outputs and outcomes), and not by economic classification - accounts (such as salaries, costs of communication, travel, maintenance, etc.), nor by the organizational classification (by budget beneficiaries, such as: city/municipal administration, preschool institutions, directorates, cultural institutions). The primary goal of a program is to improve the prioritization of budget spending. In addition, with the increased attention paid to the

performance of budget beneficiaries, this type of budgeting aims to increase the pressure on the budget beneficiaries to improve efficiency and effectiveness.

One of the major accomplishments achieved in perusing and implementing Program budget is that it shows reasoning behind expenditures and results that are achieved by spending public money. But to achieve that, long-term outcomes are required, which are expected to be previously prepared in local strategic documents. Instead of focusing on what local government spends, the program budget focuses on the expected results in providing services to citizens. In the program budget, revenues and expenditures are connected by multi-annual programs which are defined by the local government. Program budget identifies expected results of these activities, which is its main and most important difference in comparison to other budget types.

It has been the case in many local self-governments of Serbia that strategic priorities are set too high and too ambitious, without relying on financial analyses and capabilities. In many cases, they just stayed on paper, not being followed by sufficient financial means for their fulfilment. One of the benefits of introducing program budgeting in local governments in Serbia was that it clearly showed what are the strategic objectives that are realistic and achievable, and which ones are not reasonable. Hence, program budget can serve as a tool used for reassessment of local strategic objectives. *As Mukdad clearly noticed in his paper (2013), there are several pre-conditions for establishing program budget: (a) goal has to be clearly identified; (b) objectives in order to achieve goal need to be identified; (c), programs, subprograms and units serving each goal need to be developed and classified and finally (d) inputs, i.e. money, manpower, materials etc. for each of the programs need to be determined (p. 92).* If any of these preconditions are fulfilled, or they are not realistic, sensible or achievable, program budgeting will not serve its purpose and will not be functional.

7. SUSTAINABLE DEVELOPMENT AND PROGRAM BUDGET

Underwood, Hackney, and Friesner argue that "sustainable community economic development policies satisfy three specific criteria: ecological holism, community centeredness, and institutional legitimacy. Under ecological holism, ecosystems must be managed to provide a continuous flow of resources to support provisioning without altering the structure, composition, and function of local ecosystems. Under community centeredness, development creates employment at living wages to reproduce the local institutional structure of the community. Under institutional legitimacy, all members within a community have a fair opportunity to benefit from economic development, even though benefits will not be equally distributed" (p. 1113).

Very important element of sustainable development is by all means environment and its vulnerability. *Bets (2015) says "as the scarcity of our natural resources and the fragility of our environment becomes increasingly evident and present in the minds of business and community leaders, economic development must respond by incorporating sustainability into the profession. Communities that respond quickly to this shift will be better prepared for a global economy that defaults to a triple bottom line approach. However, economic developers do not need to become geologists or transportation planners to embrace sustainability. Economic developers know how to identify and support their region's or community's cluster industries, a skill set that is crucial to the sustainability movement. One important role economic developers can play is to encourage the sustainability community to keep business-oriented solutions at the forefront when trying to meet socially-conscious end goals" (p. 49).*

If we take a closer look at two last criteria in Underwood, Hackney, and Friesner paper, they can obviously be seen and reflected in program budget. Involvement of wider community in process strategic planning and later in designing program budget creates space for economic development. Not only knowledge and expertise of different stakeholders in certain area will lead to creating strategic goals in such a manner they will exploit local advantages in highest possible level, but it is to be expected that these strategic orientation is more realistic and easier to achieve. As previously said, program budget must rely on strategic directions of certain community, and these directions (outcomes) ought to be reflected in a budget. In case strategic objectives are set too high and in unrealistic manner, which has been the case in many Serbian local authorities, their achievement is put under question. In that context, public finances are spent on goals that are not achievable or are unlikely to achieve, creating very little space for improvement of local community. Having in mind very high unemployment rates in Serbia, there is no space for mistakes and perusing the goals that are not reachable. Since local advantages are taken into account in creating strategic goals, it is to be expected that striving towards achievement of goals will lead to, among other things, increased local employment. If an employment is raised, local tax collection is at a higher stage, and local budget is augmented. Bigger local budget means more investments locally (not only for further employment and investment) in better living conditions for its citizens. And finally, if citizens are involved in creating budget and have a say in the process, it is to be expected they will have a fair opportunity to benefit from economic development.

8. CONCLUSION

Although introduced and accepted as a notion in half of 20th century, Program budget is almost completely unknown concept in Serbia. It was imposed by “outside factors” and did not come as inner need to prioritize objectives, strive towards reachable goals and in that manner create better living conditions for Serbian citizens. It was inflicted into Serbian society as a precondition for process of EU integration and reaching EU funds. Additional pressure to introduce program budgeting in Serbia was put by awareness raising of the citizens and their need to be included in planning process of their community, but also the need for their voice to be heard when it comes to say when and on what tax payers’ money is spent on. These two factors paved the road for introduction of program budgets in Serbian local self-governments.

Additional burden for success of this process was the fact that strategic goals set in local strategic documents are not compatible with possibilities of their financing, i.e. the volume of local budget. There is a lot of confusion in using and transferring set strategic objectives from existing strategic documents into program budget, since too ambitious strategic objectives in existing local strategic plans do not allow proper creation and executing of program budget.

Both these assumptions lead to a conclusion that additional time is needed for program budgets of Serbian local self-governments to be fully implemented. Strategic documents ought to be re-examined and prepared in a realistic and achievable manner. Additional period for Serbian society and local administration is required in order to fully understand importance significance of citizens’ participation, realize that inclusion of various stakeholders in process of strategic planning can only be advantage and that preparation of program budget in accordance to achievable local strategic documents only creates opportunities for future development.

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HAS THE FINANCIAL CRISIS CHANGED THE RESEARCH AGENDA ON BANKING REGULATION AND SUPERVISION?

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Abstract: *The impacts of the financial crisis, which was developed from 2007, were many e very different. In this research we study those impacts in the research agenda on banking regulation and supervision. This study, performed from a 323 article sample, reveals a change in the published investigation's volume, evident after 2011. This situation indicates a time lag between the crisis outburst and the accomplishment of its growing interest for its inherent themes. This study also allows to testify a change concerning interest focuses, emerging themes such as: Politics, Basel-III (obviously), Systemic Risk and Regulatory Capture. On the opposite side, the Keywords associated to a Value-at-risk and to the second agreements of Basel, specifically, Basel-II, Basel Capital Accord and Market Discipline, lost some ground in literature.*

Keywords: *banking regulation and supervision; crisis; research agenda; regulation; keyword analysis; bibliometrics*

1. INTRODUCTION

The crisis, which has been installed in the world economies from 2007, is certainly going to be the most relevant economic and social fact of the beginning of this century. The crisis" dimension is frequently compared to the crisis which began in 1929, and which originated the long Great Depression. The 2007 crisis" exceptionality is also observed by the singularity of its associated occurrences, being them:

- The significant volume of support which the States had to ensure to the financial system, which corresponded to an effective use of €1.7 trillion, or 13 percent of EU GDP of government support to the banks between September 2008–December 2011 only in the European Union, according to the International Monetary Fund (IMF, 2013); or
- The society's insecurity related to its banks, which has been materialized into a succession of bank runs or protests at their doors, which have been observed in Cyprus, Spain, Greece, Ireland, Portugal, United Kingdom, etc. For instance, according to Milne & Wood (2008), in 2007, the United Kingdom witnessed the first bank run with significant impact – The Northern Rock – since the reign of Queen Victoria (which ended in 1901).

This dimension and singularity of the financial crisis" events has led it to be felt and analyzed by the overall population. Therefore, the financial crises, besides the great value destruction at an economical level, and besides debilitating the bank system concerning financial stability, has also produced a collateral damage of great importance: it has significantly reduced the overall financial system and the banking system's reputation in particular (see Jones, 2015, august, 25; or Rowe, 2012). The lack of confidence which has been installed related to the banking system is so prevalent that it has become a *cliché* (Springford, 2011). Confidence is not a disposable active of the financial system. On the contrary, as Singh & LaBrosse (2011) state, it performs a very important role in the system's sustainability and, therefore, the current situation cannot stop having consequences in the definition of the collection of regulation solutions.

The idea that the regulation of the financial sector must be rethought does not deserve a great deal of protest. On the contrary, the need to reevaluate the process of regulation of the financial sector is relatively consensual, either amongst those who consider that the crisis is the result of excessive regulation (e.g.: Nichols et al. (2011) or Calabria (2009), either amongst those who consider that the crisis is the result of deregulation (e.g.: Stiglitz et al. (2009) or Chabrak & Gendron (2015)), in other words, the process of the financial markets" liberation based on the conviction that these could/should be self-regulated.

Could this appeal to reevaluate the process of banking regulation already find echo in the published investigation on this subject? Or, in a different way, could one talk about an investigation on banking regulation before and after the crisis? This is the main question of this paper, which will be answered through the analysis of the volume of the published investigation and the evaluation of the approached subjects.

2. METHODOLOGY

With this paper, it is intended to evaluate the evolution of academic production on banking regulation and supervision. In order to evaluate the published investigation, it is used bibliometric techniques. Frequently, these techniques provide a quantitative evaluation, through the counting of articles, and a qualitative evaluation through the analyses of Keywords. Similar studies in terms of goals and chosen method can be found in Romo-Fernández *et al.* (2013), Lee & Su (2010), Zhang *et al.* (2015) and Liu *et al.* (2012).

The study was divided in two parts. In the first part, it was evaluated the quantitative evolution of the published evaluation on banking regulation. In the second part, it was intended to analyze whether the crisis which began in 2007 caused changes concerning the most studied themes.

In order to perform the study, it was elaborated a sample of articles obtained through research of documents which contained the search key „Banking Regulation“ OR „Banking Supervision“ on the Topic Field (which in practical terms means that the research fell upon the following fields: Title, Abstract, Author, keywords and Keywords plus), on the Web of Science Core Collection of Thompson Reuters.

3. RESULTS AND DISCUSSION OF THE QUANTITATE ANALYSIS

The 323 articles of the original sample are classified in 40 different Web of Science categories. However, the majority of the articles is focused on five categories, presented in Table 1.

Out of the 323 articles of the original sample, 280 (86,69%) were classified into the five indicated categories. These 280 formed a subsample which will be named subsample(A).

Table 1: Sample articles by Web of Science Categories

Web of Science Categories	# of Articles ^(*)	% of articles ^(**)
Economics	162	50.15%
Business finance	123	38.08%
Law	42	13.00%
Political science	41	12.69%
International relations	26	8.05%
Subsample total (in the five categories)	280	86.69%

^(*) Several articles are classified in more than one category.

^(**) of 323 articles.

Source: Web of Science and self-made calculations.

In what concerns the years of publication, it is observed that the last years are the ones where a bigger number of articles is registered (see Table 2, 2nd column). The phenomena can have a specific component of the banking regulation theme or it can result from a global increment from newspapers and attached articles. In order to evaluate which of the two aspects is more significant to the verified growth, it was performed an auxiliary research, also on the Web of Science, with the same filters, and with the search key „Bank OR Banking“. The obtained results were filtered, and only articles in the previously mentioned five Web of Science categories were considered. It was obtained a sample of 21,486 articles. This sample is comparable to subsample(A) (280 articles).

Table 2 presents the data of the last 25 years to the three collections of articles: the original sample on banking regulation and supervision (323 articles); the subsample of the latter in the five considered Web of Science categories (subsample(A)); and the unabridged sample of articles on Banking presented on the Web of Science in the five considered categories (21,486 articles).

As it is verified, there is an increasing evolution of the number of published articles, which is visible on any one of the three considered series. However, in the article samples on regulation/banking supervision (original and subsample), it is observed an additional increase of the published investigation after 2011 (2012 and the following), besides the already mentioned evolution.

Table 2: Comparison of the sample with the total of articles in the five WoS categories indicated in Table 1

Years	Articles (#323)		Articles (#280)		Articles (#21,486)	
Previous to 1991	8	2.48%	8	2.86%	3,274	15.24%
1991	1	0.31%	0	0.00%	187	0.87%
1992	2	0.62%	2	0.71%	286	1.33%
1993	3	0.93%	3	1.07%	286	1.33%
1994	6	1.86%	5	1.79%	343	1.60%
1995	4	1.24%	3	1.07%	349	1.62%
1996	3	0.93%	3	1.07%	385	1.79%
1997	2	0.62%	2	0.71%	390	1.82%
1998	2	0.62%	2	0.71%	451	2.10%
1999	4	1.24%	4	1.43%	537	2.50%
2000	7	2.17%	6	2.14%	508	2.36%
2001	7	2.17%	6	2.14%	466	2.17%
2002	6	1.86%	6	2.14%	507	2.36%
2003	8	2.48%	8	2.86%	512	2.38%
2004	11	3.41%	8	2.86%	530	2.47%
2005	9	2.79%	8	2.86%	549	2.56%
2006	11	3.41%	11	3.93%	687	3.20%
2007	12	3.72%	11	3.93%	705	3.28%
2008	15	4.64%	14	5.00%	957	4.45%
2009	16	4.95%	14	5.00%	1.026	4.78%
2010	19	5.88%	13	4.64%	1.078	5.02%
2011	19	5.88%	16	5.71%	1.286	5.99%
2012	33	10.22%	27	9.64%	1.401	6.52%
2013	36	11.15%	31	11.07%	1.549	7.21%
2014	38	11.76%	32	11.43%	1.605	7.47%
2015	41	12.69%	37	13.21%	1.632	7.60%

Source: Web of Science and self-made calculations.

In the graphic of Figure 1, the change of the publication pace after 2011 is evident.

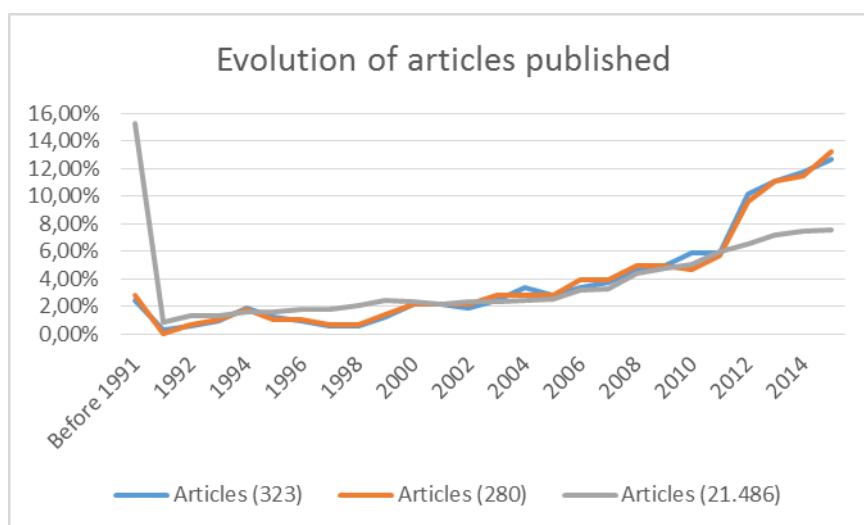


Figure 1: Evolution of the published articles

Source: Web of Science.

The increase of publications which is observed after 2011 results from the increment of investigation focused on studying the financial crisis. When one performs a research in the original sample (323 articles) and includes the expression „*Financial Crisis*“ on the Topic field, one obtains the results presented in Table 3.

Table 3: Subsample of articles on the financial crisis

Years	Articles
2000	1
2003	1
2009	2
2010	1
2011	4
2012	8
2013	6
2014	12
2015	8
Total	43

Source: Web of Science.

With this new data, it became possible to have a better perception of the mentioned global evolution. The publication of articles which fall upon the financial crisis, practically inexistent before 2011, show a meaningful presence after that year.

Therefore, it can be affirmed that the investigation on banking regulation and supervision increased the pace of publication with the advent of the financial crisis. This increase can be associated to the outburst of lines of investigation precisely focused on the debate of financial crisis related matters. It is also observed that that increment is not immediate, mediating for about four or five years since the first indications of financial crisis, until a significant increase of the number of published articles becomes visible.

On one hand, this time lag is attributed to the design and research process and, on the other hand, to the process of elaboration, edition and article publication which was taking place.

4. RESULTS AND DISCUSSION OF THE KEYWORDS ANALYSIS

Out of the 323 articles of the original sample, only in 272 there were records of Keywords. Therefore, a subsample was built, constituted by these 272 articles (here on now named subsample(B)), which will be the object of study.

4.1. Characterization of the sample and description of the procedures

The number of registered Keywords (KW) was 2,172, which means 7.99 KWs per article, in the total of the subsample(B) (272 articles). The situation is very divergent throughout the sample, considering that the number of KWs per article presents a range from a minimum of one (in 14 articles) to a maximum of 21 KWS in one single article. The most frequent situations are 4 KW per article (in 28 occurrences); 6 KW per article (in 28 occurrences); 5 KW per article (in 26 occurrences); 7 KW per article (in 25 occurrences); 8 KW per article (in 24 occurrences); and 9 KW per article (in 19 occurrences).

There were identified 1,127 different KWs, being the three most frequent: Banking Regulation, which occurred in 82 articles, Banking Supervision, observed in 32 articles, and Deposit Insurance, which occurred in 23.

As it is frequent in these situations, it is convenient to perform an orthographic standardization of the KWs. This was done in a similar way to Lee & Su (2010) and Zhang *et al.* (2015). The performed standardization included the following changes in KW: (1) singular/plural standardization (e.g. from *Bank Failure* to *Bank Failures*); (2) standardization of the use of the hyphen (e.g. from *Basel-II* to *Basel II*); (3) standardization of orthographic variations (e.g. from *Crises* to *Crisis*; from *Basle II* to *Basel II*); (4) standardization of the use of the terms bank/banking (e.g. from *Bank Regulation* to *Banking Regulation*); (5) standardization of the use of abbreviations (e.g. from *BIS* to *Bank for International Settlements*). To fulfill these criteria, 63 KWs were standardized.

Besides the described procedures, 15 other standardizations were performed which allowed the elimination of another 28 KWs.

In the performed standardizations, the rule was always to choose the most frequent KWs.

This process led to repetitions of the same KW in the same article. There were registered 42 occurrences of this sort. These repetitions were eliminated, providing the result of a final list of 1,036 different KWs used 2,130 times.

After the standardization, it was elaborated a list of the most frequent KWs, presented in Table 5. On the first column, there is the KW's code number; on the second there is the KW; on the third and fourth columns, the number of articles which possess that KW, in the period of time before 2012 and after 2011, respectively; and on the last column, the total of articles where the KW has occurred. This last column's value was used to order the table.

While creating this KW list, it was established a threshold. In other words, it is the line under which KWs stopped being considered for analysis. This threshold was defined in eight articles, which means that the KWs which only occurred in seven or less articles were not considered for analysis.

The obtained list is composed by 43 different KWs (4.15% of the total of KWs), which were mentioned 680 times altogether (31.92% of the occurrences), in 237 articles (86.81% of the articles). If the threshold were established at a lower number, seven for instance, it would implicate the analysis of more 12 KWs and the addition of only 5 new articles. The trade-off between the complexity of analysis and the KWs coverage of the sample articles justify the indicated value of the threshold.

Some of the KWs do not add any value to the analysis, either because they only reflect the theme of the study (*Banking Regulation, Banking or Financial Regulation*), either because their meaning is related to aspects which are not the object of study (*EU (European Union)*). Therefore, the following KWs were not considered for analysis: Banking Regulation, Banking Supervision, Banking, Banks, Financial Regulation, Regulation, EU (European Union) and G21 (JEL code G21: Banks, Depository Institutions, Micro Finance Institutions, Mortgages.). The list of KWs for analysis was reduced to 35 KWs.

The number of articles of the subsample(B) posterior to 2011 (2012, 2013, 2014 and 2015) was 136, and 137 of all the period before (from 1991, when an article was registered for the first time, to 2011). This inclination is fruit of the already mentioned increase of publications over these more recent few years.

Since two values are practically equal, the incidence of KWs per article in each of the periods can be evaluated by the simple comparison of the number of articles belonging to a period of time and to the other.

Table 4: Most frequent Keywords

id.	Keyword	Before 2012	After 2011	Total
	Banking Regulation	49	44	93
	Banking Supervision	15	19	34
1	Capital Requirements	18	12	30
2	Crisis	5	23	28
3	Deposit Insurance	14	10	24
	Banking	13	9	22
4	Market	10	10	20
5	Risk	11	9	20
6	Models	8	10	18
7	Value-at-Risk	13	4	17
	Banks	10	6	16
	Financial Regulation	1	15	16
8	Politics	4	12	16
9	Basel III	1	14	15
10	Competition	5	10	15
11	Financial Crisis	2	13	15
12	Liquidity	8	7	15
13	Financial Stability	6	8	14
14	Information	4	10	14
15	Systemic Risk	3	11	14
16	Governance	6	7	13
	Regulation	4	9	13
17	Basel Capital Accord	11	1	12
18	Basel II	9	3	12
	EU	4	8	12
19	Banking Crisis	6	5	11
20	Management	7	4	11
21	Policy	3	8	11
22	Market Discipline	8	2	10
23	Risk-Taking	4	6	10
24	Central Bank	5	4	9
25	Commercial-Banks	4	5	9
26	Economic-Growth	3	6	9
27	Globalization	4	5	9
28	Regulatory Capture	0	9	9
29	Basel Committee on Banking Supervision	4	4	8
30	Credit	4	4	8
31	Determinants	0	8	8
32	Financial Intermediation	3	5	8
	G21	3	5	8
33	Monetary Policy	2	6	8
34	Risk Management	5	3	8
35	Securitization	2	6	8

Source: Web of Science and self-made calculations.

4.2. Analysis of the results per KW

In this section, it will be performed the analysis of each one of the 35 most frequent, meaningful KWs to this study. Throughout all the analysis, all the investigation published until 2011 inclusive will be considered pre-crisis academic production. And the investigation published after 2011 will be considered post-crisis academic production, accordingly to what has been stated in previous sections of this paper.

While comparing the pre and post-crisis academic production, the occurrences in which there are 75% or more of the articles where a KW is particularly used in a period of time will be pointed out.

Figure 2 summarizes the obtained results. It shows the 35 most frequent KWs. Some KWs are pointed out in a particular way because they:

- **Have gained importance** over the last few years (pointed out in Bold with a solid line around it, and with an arrow (➔) before the KW);
- **Have lost importance** over the last few years (pointed out in italic with the mark (X) before the KW).

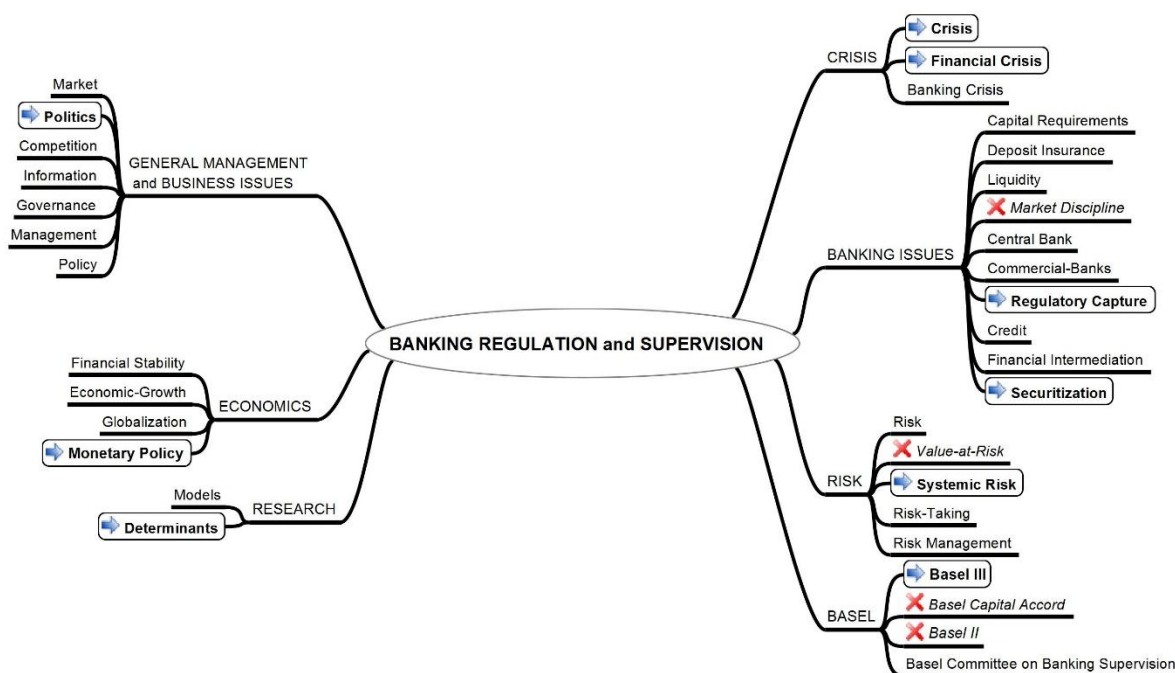


Figure 2: The Keywords map on banking regulation and supervision

This Figure could be seen as the genetic map of banking regulation and supervision. As it can be verified, recent changes in some “genes” were pointed out, as a result of changes in the “environment” in which regulation is produced and developed. Time will tell if these changes correspond to lasting mutations or just momentary adjustments; if the changes are only circumscribed to the signaled ones or if other “genes” will change as well.

A final note, not related to the presented KWs, but related to the absences or barely approached themes.

The study allowed the identification of various theme collections, whose KWs have been dominating the literature, such as: Banking issues, Risk, Basel; Crisis, Economics, Management and Research. The most surprising fact is the absence of a collection on one of the themes of banking regulation, where perhaps it could be included *Market Discipline*, *Regulatory Capture* and, for instance, *Moral Hazard* (related to this subject, the following KWs were registered: *Dynamic Moral Hazard* (once), *Moral Hazard and Bank Supervision* (once), and *Moral Hazard* (six times)) or *Self-regulation* (when it comes to this theme, there have been identified the following KW: *Enforced, Self-Regulation, Market Self-Regulation and Self-Regulation* (there is only one single occurrence for each of them), or where it could be discussed the meaning of new institutions to banking regulation, such as the Financial Conduct Authority in the United Kingdom or the already mentioned Consumer Financial Protection Bureau in the USA.

5. FINAL CONSIDERATIONS

In this paper, it was evaluated the evolution of the recent investigation on banking regulation. For that, it was analyzed the volume of production and the used KWs in published articles on the theme. The study shows a growth on the published investigation, which is evident after 2011. This indicates the existence of a time gap,

of about four or five years, between the first signs of the phenomena (crisis) and the boom of publications where the phenomena is already an object of study.

Concerning the frequency in the use of KWs, it was established a stable core of 35 most used ones. These KWs are considered to describe well the majority of the published investigation on the theme. On this most frequent KWs list, a change concerning interest focuses is verified, emerging themes such as: *Politics*, *Basel-III*, *Systemic Risk* and *Regulatory Capture*. On the opposite side, KWs associated to *Value-at-risk*, to the Basel accords, particularly, *Basel-II*, *Basel Capital Accord*, and *Market Discipline* lost some ground in literature.

The analysis proves the importance of the Basel Accords and the centrality of BIS in the process of developing banking regulation. Besides this central importance of BIS, the following were also pointed out as relevant strands:

- Banking nature, where it is possible to stand out themes such as Capital Requirements, Deposit Insurance, Risk (several dimensions), Liquidity, Credit and Securitization;
- The economical one, which includes Financial Stability, Economic-Growth, Globalization and Monetary Policy;
- Business and Management, where it is possible to find themes such as Market, Competition, Information, Governance and Management.

In order to answer the question asked in the beginning of this paper, one can, in fact, observe changes either quantitate, either in contend in the publish investigation on banking regulation and supervision before and after the crisis.

For the last decades, banking regulation has suffered profound changes. The agenda on the process of implementation of these changes, the evaluation of their impact and the establishment of new ways towards regulation were, on a large scale, defined by regulator forums or institutions of a similar nature. In this debate, the academy appeared many times to be more reactive than proactive. As a consequence, its research agenda frequently reflected themes and subjects established in other forums and other institutions. It is important to the academy to recover the role of a relevant player in the debate on banking regulation, because only the academy can provide to this debate the only contribution which derives from the diversity of points of view which exist within it, and from the autonomy with which these points of view can be expressed.

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AN APPLICATION OF NEURAL NETWORKS AND FUNDAMENTAL ANALYSIS FOR AUTOMATED TRADING: BELGRADE STOCK EXCHANGE CASE

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Abstract: *This research demonstrates an application of neural networks for automated trading using fundamental analysis on Belgrade Stock Exchange. Our main goal is not to try to predict stock prices, but rather to determine whether the process of stock market trading can be learned and performed by artificial neural network with a positive outcome. In order to train the proposed feed-forward network mechanism for market trading we use fundamental analysis ratios as inputs, while the output is a trading signal. Further, we incorporate the proposed artificial neural network into a virtual trading machine, created for the purpose of trading simulation. We test the proposed approach on the stocks from Prime Listing of Belgrade Stock Exchange.*

Keywords: *automated trading, fundamental analysis, neural networks, Belgrade Stock Exchange.*

1. INTRODUCTION

Automated trading represents a special type of trading on financial markets where a computer program or another kind of automated system is used to collect data, analyze it, make trading decisions and execute trading orders on the market. This area of finance has arisen since the end of 1980s when first fully electronic communication and execution networks were developed in financial markets. Since then, it has been developing rapidly following the expansion of information and communication technologies. Automated trading become very popular in 2000s, reaching almost 75% of total market trading volume in 2009 (Kissel, 2013).

There are two common forms of financial analysis: fundamental and technical analysis. Main focus in this research will be on the fundamental analysis and its ability to suggest the possible profitable stocks. Fundamental analysis is the cornerstone of investing. Its largest part involves delving into the financial reports. It utilizes quantitative tools, mainly the financial ratios, as well as other indicators such as management policy, marketing strategy and product innovation to determine the value which can be compared with a stock's current price (Lam, 2004).

This research represents the extend of the previous studies in a way of further use of ANNs as a trading tool. In this study, we developed a system for automated stock market trading. The proposed system combines fundamental analysis and neural networks to create a trading algorithm used for investment decision making. We use feed-forward network as well-known and most commonly used ANN structure. Fundamental analysis is used to obtain learning inputs, which are used by the ANN to understand the underlying process of the market. To obtain learning outputs we extract the historical trading signal using a ZigZag indicator of trend. Further, we create a virtual trading machine in order to simulate real market trading and test the proposed system. The proposed system is tested on BSE stock market data.

The remainder of this research is organized into four sections. In the next section we present the literature review. Section 3 describes the proposed methodology. In section 4 we present data, trading settings, trading signal extraction method and final results and discussion. The last, fifth section concludes the paper and provides further research suggestions.

2. LITERATURE REVIEW

ANNs have been widely used for financial research, especially in financial market forecasting. In their extensive research on soft computing techniques for financial forecasting, Atsalakis and Valavanis (2009) gave an considerable review of neural and neural-fuzzy techniques. Their review showed that feed-forward networks are the most commonly used networks for financial forecasting, including one-third of all surveyed articles. The most likely reasons for this are the simplicity, seed and their easy implementation. Further, the

review also showed that authors mostly use networks with one or two hidden layers. Long ago, Bishop (1994) has shown that there is no need to consider more complex structure since the ANN with one hidden layer has universal approximation capabilities.

Even though ANNs were extensively used for financial forecasting for more than 30 years, long time passed until authors started to use their forecasting power within the automated trading systems. Several authors tried to use ANN in combination with fundamental analysis in order “to beat” the market or some well known investment strategy. Eakins and Stansell (2003) used simple feed-forward structure with 2 hidden layers (6 and 3 nodes) and backpropagation learning algorithm to enhance the process of stock selection. In order to train their ANN to learn to pick stocks they use fundamental valuation ratios. Testing their system on more than 20 years of stock market data they conclude the ANN consistently outperformed 7 benchmark portfolios, among them both S&P 500 and Dow Jones Industrial Average market portfolios. Later, Krishna *et al.* (2010) replicated their research methodology on Bombay stock exchange and confirm their findings.

Olson and Mossman (2003) used ANN to forecast one-year-ahead Canadian stock returns based on 61 accounting ratios. Further, they built a trading strategy that converts these forecasts into portfolio holdings. Finally, they compare the proposed ANN approach with ordinary least squares (OLS) and logistic regression (logit) approaches. They conclude that simple backpropagation network can outperform best regression alternatives in forecasting, which translated into greater profitability of the trading strategy. Vanstone *et al.* (2012) used ANN with Aby’s filter, which incorporates 4 fundamental ratios, to create an automated trading system for the Australian stock market. Their results showed the proposed approach performs well in terms of profitability, but experienced high volatility of returns. Another important paper is the one written by Vanstone and Finnie (2009), who presented a methodology for designing and testing stock market trading systems using ANNs.

3. TRADING SYSTEM

In this research we propose an automated trading system for stock market trading. It is a complex system consisted of two components (Figure 1). The first component is used for pre-processing of stock market data. It consists of two sub-components, one for fundamental analysis and the other one for trading signal extraction. The second component represents the trading logic and is used for investment decision making. It consists of artificial neural network and the trading algorithm. The purpose of ANN is to use fundamental data to forecast trading signal which is used by trading algorithm to generate trading orders.

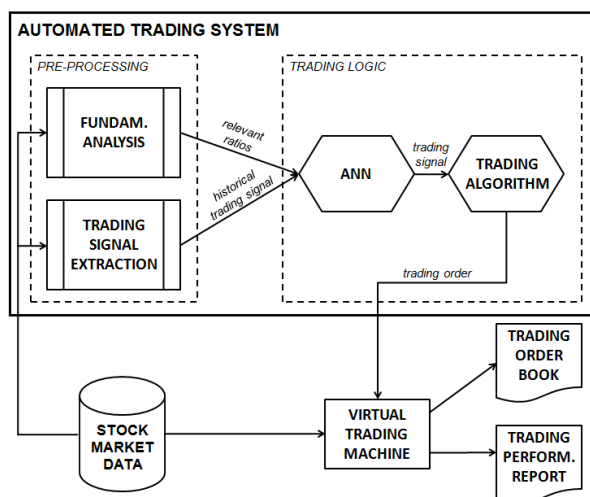


Figure 1: Automated trading system structure

3.1. Artificial neural network

The term "network" is used to refer to any system of artificial neurons. This may range from something as simple as a single node to a large collection of nodes in which each one is connected to every other node in the net. Each node first aggregates its input in a linear manner using simple weighted sum and then use activation function to make nonlinear relation between input variables and nodes output. Nodes are arranged in a layered structure, and each layer can be consisted of one or more nodes.

In this study we use the feed-forward network structure, which is the oldest and simplest type of ANN. In this network, information moves only forward and there are no loops. Each input signal has to pass through all hidden layers before reaching the output layer. To train our network we use backpropagation learning mechanism.

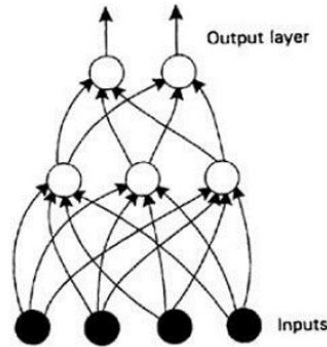


Figure 2: Neural Network architecture (Gurney, 1997)

It is important to notice that our network use tan-sigmoid function as activation function. Tan-sigmoid has the following formula:

$$\sigma(n) = \frac{2}{1 + e^{-2n}} - 1 \quad (1)$$

As Gurney (1997) suggests, it is typically used when input pattern needs to be classified into one of several classes. In the case of our trading system, output variable represent trading signal which has three classes: buy, hold and sell. The signal can take all numeric values between -1 and +1, which also perfectly corresponds to tan-sigmoid function (Fig. 3).

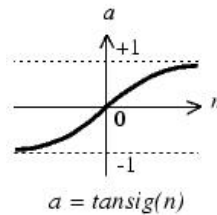


Figure 3: Tan-sigmoid function graph

Trading does not start when the system activates. Certain number of observations must be analyzed, which are used as initial trading set. Network then uses the set in order to learn underlying model of the market. Input parameters for the network are ratios gathered from the fundamental analysis. Additionally, NN uses historical trading signal extracted from special preprocessing component. When trained on initial set of data, NN starts predicting trading signals which are then sent to the trading algorithm component. It does so until actual trend changes. System then stops trading and activates retraining of neural network. Furthermore, it is retrained using all observations from the beginning until the change of trend.

3.2. Fundamental analysis

Within the fundamental analysis sub-component we use three well-known valuation ratios: price-per-earnings (PE), price-per-sales (PS) and price-per-book (PB) ratios. First of them, PE is measuring the current share price relative to its per-share earnings:

$$PE = \frac{\text{Market value per share}}{\text{Earnings per share}} \quad (2)$$

Secondly, the PS is an indication of the placed value on each monetary unit of a company's sales or revenues:

$$PS = \frac{\text{Stock price}}{\text{Revenue per share}} \quad (3)$$

Finally, the PB value compares the stock's market values to its book value:

$$PB = \frac{\text{Stock price}}{\text{Book value per share}} \quad (4)$$

3.3. Trading signal extraction

In order to learn ANN to trade based on fundamental ratios we need to provide a trading signal as the output variable. We extract trading signal from trend data obtained using modified version of ZigZag indicator. The indicator is constructed using a general definition of trend: a tendency in data that creates a positive or a negative change in data level over certain period of time. Hence, the two key parameters of a trend are its time duration and the size of the underlying change. The indicator track these two parameters measuring the change in price and duration of that change from the previous maximum/minimum value. If both parameters cross the threshold values, indicator changes its direction.

Fig. 4 shows an example of trend extraction using two sets of different threshold values on the same data set. As it can be seen from the graph, the smaller the threshold values are, the indicator is more sensitive to changes in price. Therefore, the extracted trend data will depend on the choice of threshold values.

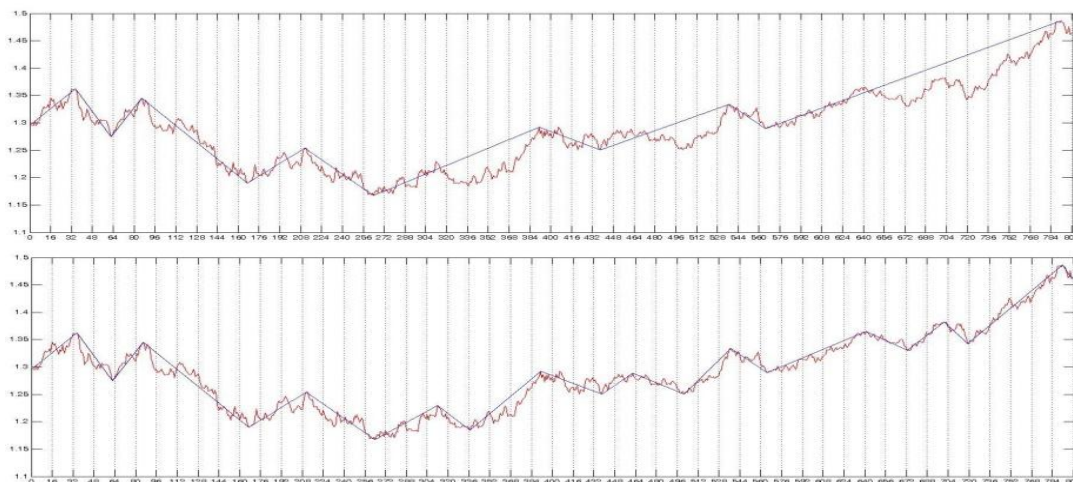


Figure 4: An example of trend extraction using modified ZigZag indicator with different threshold values

Further, to extract the trading signal we use simple linear transformation which transforms trend data into time series of values between -1 and +1. These extreme values are associated to reversal points in trend data. When trading signal takes value -1 it means that one should sell the instrument, while the opposite stands for +1.

3.4. Trading algorithm

Trading algorithm starts working when receives the forecasted trading signal from ANN. If the signal is negative and is below the determined threshold value, the algorithm sends buying order to the virtual trading machine. On the other hand, when signal is positive and above the determined threshold value, the trading algorithm issues the selling order. Trading algorithm separates the trading account value into several lots, which are calculated as the certain percentage of the current account balance. Trading algorithm keeps purchasing/selling stocks until all the lots are spent. Transaction costs are incorporated into trading orders to accomplish more realistic approach.

3.5. Virtual trading machine

The main purpose of the virtual trading machine (VTM) is to simulate stock market trading by using the real prices from the BSE. VTM manages trading orders received from trading algorithm, charges trading commission, takes care about currency and equity accounts, records transactions and calculated performance measures. Finally, when the trading simulation is done, VTM delivers the trading report which indicates how successful the trading system was.

4. RESULTS

The results of our research presented in this section are based on real stock market data. Summary results are presented in Table 3, while the individual results are discussed separately in chapters 4.4.1 to 4.4.4.

4.1. Data

As mentioned before, the proposed system has been applied on BSE stock data. Companies from Prime Listing, which is the most attractive market segment on BSE, has been selected for testing purpose. The selected companies are: „Aerodorm Nikola Tesla“ (AERO), „Energoprojekt holding“ (ENHL), „Naftna industrija Srbije“ (NIIS) and „Sojaprotein“ (SJPT). Official financial statement data are used to calculate necessary fundamental ratios used as input data to our neural network. Our dataset consists of data from different time frames, which are presented in Table 1. The price and financial statement data were obtained from official BSE website.

Table 1: Stock market data used in this research

Company	Start date	End date	Number of observations
AERO	7.2.2011.	31.12.2015.	1237
ENHL	1.10.2005.	31.12.2015.	2768
NIIS	23.8.2010	31.12.2015.	1349
SJPT	3.3.2008.	31.12.2015.	1979

The selected companies are the leading companies in different sectors. Different industry branches were used in the research to determine whether the trading algorithm is universal and suitable for application in opposite industries. For instance, NIIS is one of the largest vertically integrated energy companies in Southeast Europe. Its principal activities are exploration, production and refining, sales and distribution of a broad range of petroleum products, as well as the implementation of energy projects (NIS Official Website). Furthermore, SJPT is the largest soybean processing factory in Serbia, and thanks to the diversity, quality of its products and a processing capacity, it is ranked among the most important soybean processors in Central and Eastern Europe (Sojaprotein Official Website). In addition, AERO is the largest regional (Western Balkan) airport. Finally, ENHL is one of the leading construction companies in Serbia, with main focus on research and development, consulting and engineering, construction and designing. (Energoprojekt Official Website) As a result, the inputs into the ANN are calculated daily ratios and close prices of all the previous companies.

4.2. Experimental settings

In order to test the proposed approach we use the following thresholds: duration threshold of 10 days and price change threshold of $\pm 15\%$. Further, one eventually feed-forward structure with one hidden layer consisted of 15 neurons has been implemented.

Virtual trader initial account balance is 1.000.000 monetary units. Having in mind that the trading strategy is used on BSE, we can assume that currency is Serbian Dinar (RSD). One trading lot used in this research equals 10% of the current account balance. Trader keeps purchasing stocks until the account is spent. Trading fees were introduced to the algorithm to accomplish more realistic approach. Trading fee equals 0.5% of the transaction value, which has exceeding resemblance to the one in realistic market. Fees are calculated both in short and in long positions opened. Trading regulations of Belgrade Stock Exchange forbid entering the short position.

Table 2: Automated trading system parameters

Parameter	Value
Initial account balance	1.000.000
Initial lot size	100.000
Trading fee	0,5%
Trading signal	± 1
Duration threshold	10 days
Change threshold	$\pm 15\%$
Hidden layer size	15 neurons

4.3. Performance measures

Profit/loss (P/L) and return on investment (ROI) are relevant indicators on the precision of algorithm's trend recognition. Profit factor indicates the number of monetary units earned per ones spent. It takes values from interval $(0; +\infty)$. Values above 1,00 indicate that the final account balance is greater than the initial one, while values below 1,00 specify the opposite. Maximal drawdown represents the absolute difference between highest and lowest account balance values. Average profit per trade indicates illustratively virtual trader's successfulness.

4.4. Results and discussion

Table 3 presents summary results. Output parameters are listed along with the trading companies. Parameters are divided into three clusters. First one is regarding the total number of trades while the other two indicate on long and short trades committed respectively.

Table 3: Summary of trading results

Indicator/Company	NIIS	AERO	ENHL	SJPT
Total Trades	9	5	20	10
Trades won	44,44%	80,00%	35,00%	40,00%
Net profit	270.260	2.016.597	-715.474	127.093
ROI	27,03%	201,66	-71,55	12,70
Profit factor	1,62	13,37	0,23	1,17
Max. drawdown	-15%	-14%	-34%	-40%
Avg. profit per trade	30.029	403.319	-35.774	12.709
Long trades won	25%	100%	40%	40%
Long trades avg. profit	12591.65	798042.97	-18111.61	1.16
Short trades won	60%	66.67%	30%	40%
Short trades avg. profit	45527.2561	143661.02	-53361.85	15405.26

Total number of trades can imply on how dynamical the strategy is. The least dynamical was AERO, which was expected because of its business field. During the whole business year, airport activities are evenly distributed. That is why only 5 transactions were opened and, what is more, 4 out of 5 successful ones. The most dynamical was ENHL with 20 trades, which means that the algorithm has recognized trend variation approximately 20 times. Being a construction company, ENHL gains profit seasonally by project agreements. That is why there were many oscillations on the stock market and is quite hard to *pick up* the right trend line opportunely. As expected, ENHL total profit factor is below 1,00 and announces that the trading environment is turbulent and not likely predictive. The next two clusters represent some of the mentioned indicators, only separate long from short trade positions. Figures 6 to 9 more intuitively show the indicators.

Upcoming figures represent results of data testing. Each figure is consisted of three subplots. Topmost shows the closing price for every trading day from the beginning of the trading observations to the end of year 2015. The artificial neural network has been trained to recognize short and long position signals. The behavior of the trader will depend on the signal given, which is shown on the second subplot, and finally, the third subplot represents response to the signal.

4.4.1. AERO

The account balance is showing a significant growth and eventually, considerable profit. Despite the backward learning, trader correctly interpreted the signals on the account balance and the positive economic performance proves the accurately given signals.

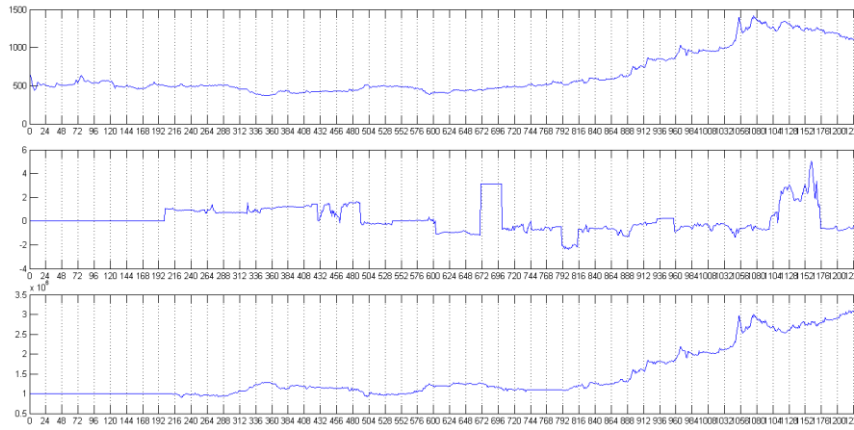


Figure 5: AERO Trading results

4.4.2. ENHL

The following Figure 6 presents the graph with trading results for ENHL. The figure presents the account balance is showing increase in the beginning and then the momentous fall at the end. Final results suggest that neural network is unable to read the market behavior.

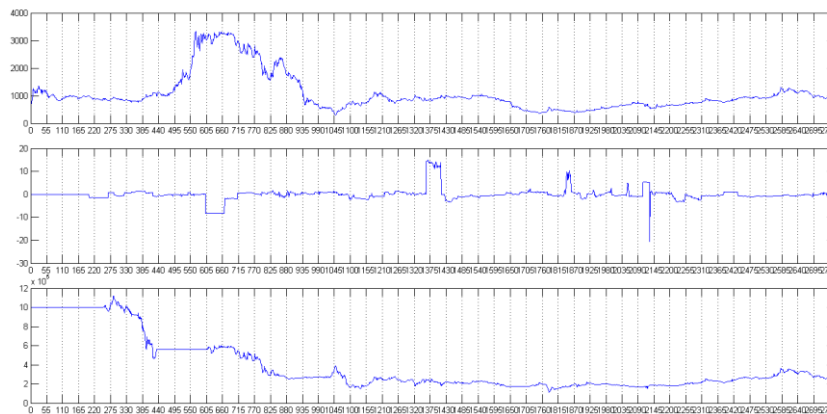


Figure 6: ENHL Trading results

4.4.3. NIIS

In NIIS example, neural network trades with variable success, but mostly profitable. This is an example of successful learning process in which neural network is able to discover underlying market fundamentals.

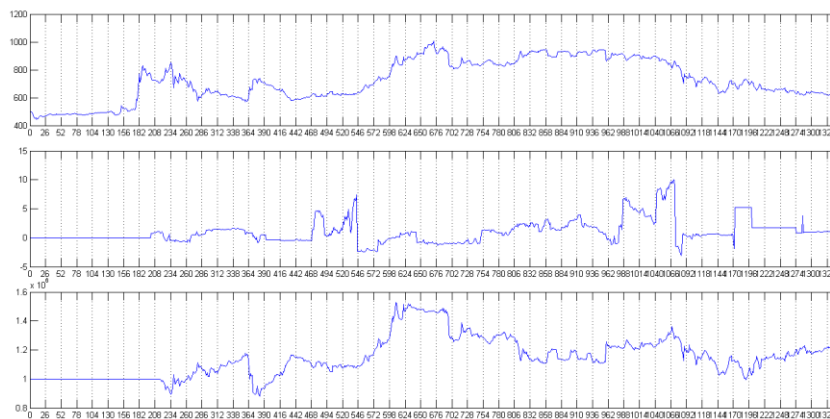


Figure 7: NIIS Trading results

4.4.4. SJPT

SJPT is tested using relatively longer time series within our sample. The obtained results are not very good, indicating the network is not a stable solution. The system starts well, but in some point become very unprofitable. Finally, very close to the end of test period it regain its profitability and recover losses.

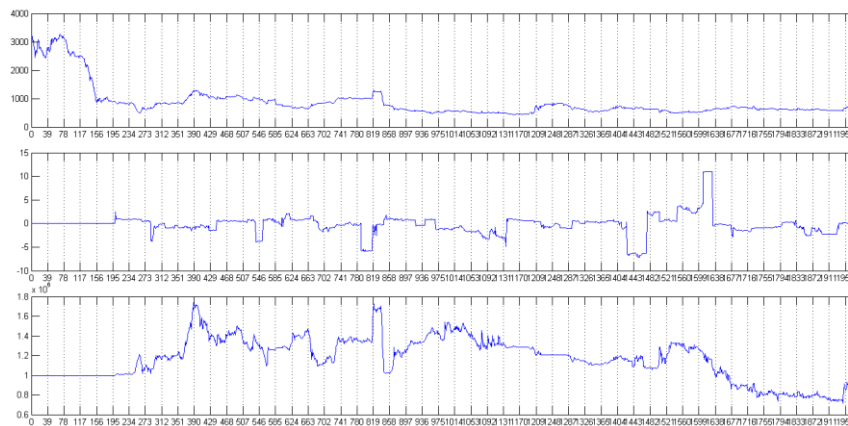


Figure 8: SJPT Trading results

5. CONCLUSION

In this research, the information available in the financial market were gathered and the variables that drive stock prices were taken into account. On the basis, of the fundamental analysis, the calculation of the investing ratios has been made. Thus, the neural network parameters consist of the data from official financial reports from companies of different sectors. Having in mind the results, it is possible to apply neural network algorithm to Belgrade Stock Exchange and obtain satisfying results. However, the network has not provided us with the wanted results in more turbulent trading environment. ENHL's stocks prices are vaguely foreseeable and neural network was not able to predict its trend in the right time. It was always *one step behind*. Moreover, that total account balance was positive in 3 out of 4 trading attempts; therefore, it is acceptable to say that the trader performed well overall and that the algorithm is applicable but not completely accurate.

To conclude, by using the real data to evaluate the trading signal neural network may show satisfying results on the data given with a room for improvement. The neural network tested in this paper has been using fundamental data and closing price generated every day on the stock exchange. It was applied only once on each dataset. To gain more accurate results, network should be executed for at least one thousand times, so that the middle value could be extracted. In that way, more relevant results could be gathered. To further improve its performance, a neural network should be using more complex algorithm. Therefore, the next step is to train a neural network to behave with a positive outcome in more complex environment as well as with more sophisticated algorithm. The step further is to demonstrate its performance on expanded stock market data. Besides that, the methodology presented may also be adapted to other enterprises and their stocks. This is the future research direction.

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PERFORMANCE OF EVENT-DRIVEN HEDGE FUNDS' STRATEGIES

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Abstract: In our days hedge funds represent the fastest growing group within the alternative investment. The hedge funds are usually defined by the investment strategy they implement. There is variety of different hedge funds" investment strategies. Having in mind, the consistency and use of different hedge funds" classification, the paper was based on HFR classification of hedge funds because it enables to examine one special group of hedge funds, i.e. event-driven hedge funds. These funds represent probably the most challenging and promising hedge funds due to their specific character that enables the performance enhancement when and if specified event occurs. The aim of paper is to analyze and evaluate performance of event-driven hedge funds against the performance of hedge fund industry performance and traditional investing.

Keywords: *hedge funds, strategy, event-driven, performance, Sharpe ratio*

1. INTRODUCTION

Although hedge funds originated from the end of 1940s, there is no precise definition of hedge funds until today, instead numerous definitions exists. Originally, hedge funds were private partnerships that took long and short equity positions to reduce net market exposure by accepting a lower return on investments. However, today the term hedge fund has a much broader meaning because of different portfolio characteristics. Hedge funds represent a type of alternative investment and their activities have a substantial share in trading volume in many traditional markets. Structures of hedge funds commonly enable them to be widely regulated although the pressure toward adequate regulations has grown since the financial crisis in 2007. Hedge funds are usually private pools that can avoid reporting and other requirements as well as restrictions in fees. However, the majority of hedge funds have a certain number of common characteristics, such as: unusual legal structure (e.g. limited partnerships or limited liability companies in the U.S.A.), active management (that affect their performance), flexible investment policy (that enables the fund managers to take positions according to their perceived return or risk expectations), limited transparency, limited liquidity (funds are focused to daily liquidity), orientation to specific investors (e.g. high net worth individuals) and, strategies are not adjustable (but depend on manager"s skill and the investments availability). This could cause problems with transparency and liquidity, low rate of attrition (measured by number of survived funds over specified period of time) (Gregoriou (2002)), exposure to asset risk (because of investing in illiquid asset and use of leverage), tax inefficiency and biases in reported data.

Hedge funds are the fastest growing group within the alternative investment over the last fifteen years. At the end of 2014, the assets under management of the global hedge fund industry was \$2.25 trillion and the number of hedge funds exceeded 11,000 (EurekaHedge (2016)). This remarkable growth led to substantial differentiation among hedge funds (especially in investment styles used). So, it was impossible to create hedge fund classification. Hence, the special characteristics of a specified hedge fund are mostly result of investment strategy that is implemented. Consequently, the hedge funds can be classified based on investment strategy. In this regard many different hedge fund classifications created by a number of companies exist (e.g. Morningstar, Hedge Fund Research (HFR), Morgan Stanley Capital International (MSCI), Center for International Securities and Derivatives Markets (CISDM), Credit Suisse/Tremont etc.). Regardless the hedge fund classification used, each hedge fund manager will pursue his/her own strategy, which will be developed and changed over time due to fast development of hedge fund industry. In fact, the hedge fund classification by using investment strategy criterion is a result of hedge funds" fast development. The goal of hedge funds classification is to create the funds that will satisfy the investors" needs. Besides this, over time emerged vendors of hedge funds" performance monthly and daily data. These companies collect data of thousands of hedge funds can sell the information to those investors interested in monitoring and/or evaluating hedge funds" performances. The hedge fund managers could be interested in the use of data provided by specific company because in this way they can show their performance within the industry and may attract new investors. Of course, hedge funds are free to provide or not to provide reports to vendors, and this may result in lack of information in situations when they are preparing for new investment or when they returns are deteriorating. Namely, hedge fund data (or the lack of data) are of the key

significance for hedge fund indices creation as well as their reliability. The creation of hedge fund indices enabled the measurement of performance of hedge funds.

Because the aim of paper is to analyze and evaluate performance of event-driven hedge funds against the performance of hedge fund industry performance and traditional investing, we decide to use Hedge Fund Research (HFR) hedge fund classification with a focus to event-driven strategies only. According to HFR hedge funds or hedge fund strategies are classified as (HFR (2016)): equity hedge, event-driven, macro, relative value and fund of funds. Equity hedge funds are oriented in investing in equities by using market neutral strategy, fundamental growth or value strategies, quantitative directional strategy, sector investing strategy, short bias strategy and multi strategy. Event-driven hedge funds are engaged in investing in companies that became attractive for investment because of specific event(s) has happened. The event-driven strategies are: activist, credit arbitrage, distresses/restructuring, merger arbitrage, private issue (regulation D), special situations and multi strategy. Hedge funds that use macro investing may apply: active trading, commodity investing, currency investing, discretionary thematic investing, systematic diversified investing and multi strategy. Relative value hedge funds implement: fixed income– asset backed investing, fixed income–convertible arbitrage, fixed income–corporate investing, fixed income–sovereign investing, volatility investing and multi strategy. In addition, the performance of event-driven strategies is examined by using HFR indices, i.e. Global Hedge Fund Index, HFR Event-driven Index and HFR Event-driven subindices (HFRX Indices (August 2015)).

2. CHARACTERISTICS OF EVENT-DRIVEN HEDGE FUND STRATEGIES

Event-driven hedge fund strategies are loosely defined. Regardless this, event-driven hedge funds try to achieve return on investments in companies that might experience occurrence of specific events over their lives. Such events may include recapitalizations, reorganizations, restructuring, mergers and acquisitions, initial public offerings, buybacks of shares and bankruptcies. The probability of these events occurrence creates an opportunity for hedge funds to make correct anticipation. Hedge funds usually use different types of securities (common shares, preferred shares, bonds etc.) which prices are considered mispriced. These strategies could be considers non-directional ones because they greatly dependent on company-specific situations that are low correlated or not correlated to market movements. Hedge funds managers commonly allocate their assets on distressed securities, merger and acquisitions and other special situations. Advantages of event-driven strategies are: possibility of achieving returns with limit market risk; returns are based on specific events of the company; less correlation with equity markets because of possibility to invest in different securities. Although the event-driven strategies attractiveness to investors, they can have certain disadvantages, such as investing in relatively illiquid securities which may affect the returns, as well as their broadly and imprecisely definition that requires the time for identifying the potential investment opportunity.

When the event has been announced (e.g. in press), hedge funds managers would analyze what is happening and would try to anticipate the outcome of an announced event (and not the event occurrence). Managers will perform fundamental analysis by combining strategic, operational, financial and legal effects in order to estimate what will happen and to take appropriate position. In this regard, managers may decide to invest in events with favourable outcome expectations, but they can also take positions in events with unfavourable outcome by betting on non-occurrence of the events. Besides this, managers have to determine an investment horizon and to select the securities that can be used to profit from event occurrence/non-occurrence. The securities analysis will be related (is related) to securities" prices analysis and risk analysis. Finally, managers will have to specify the securities in which the positions will be taken (partial or full) as well as the ways in which the taken positions could be closed. Before investment decision is made, event-driven hedge fund managers will determine the spread between the market value of a security and their own estimation of the value of the security. They will search the event that could change the attractiveness of the company because of its market value change. Managers will assess the time necessary for both event visibility and company"s market value change. The key risks of event-driven strategy implementation are related to the uncertainty of events outcomes, i.e. inability of foresight the occurrence of the events, outcome, time necessary to achieve the goal and, the change in securities" prices. Because of that the managers will try to diversify their portfolios and to combine positions in equities, bonds and derivatives (to hedge equity or bond portfolios).

The analysis of event-driven hedge funds strategies is based on Hedge Fund Research, Inc. classification (HFR (2016)) that divides all event-driven strategies into following substrategies: activist, credit arbitrage, distresses/restructuring, merger arbitrage, private issue (regulation D), special situations and multi strategy. Their markets are cyclical, which means that each substrategy will achieve the best performance at certain periods over cycles. While the hedge funds involved in special situations could be active at any phase of the cycle, the hedge funds oriented to active investing and/or mergers and acquisition would be the most active during the during expansion. Finally, the distressed companies as well as non-distressed ones may become attractive after the recession. Apart from cyclical nature of event-driven substrategies, most hedge funds" managers are specialized in particular substrategy according to their risk-return profiles.

2.1. Characteristics of activist hedge funds

The number of activist hedge funds is increasing because of the successful development of hedge fund industry. Activist hedge funds do not exist in many countries, and the largest funds are those that operate in the U.S.A. and the United Kingdom (Brav et al. (2008)). The goal of activist hedge funds is to invest in companies that may have better performances if a specific event happens. Activist hedge funds may be friendly (work with the company's management in order to make necessary changes) or unfriendly (work with the company's large shareholders in order to make necessary changes). Regardless this, these hedge funds will analyze the companies so that can identify the most promising ones if some changes were to be performed (e.g. strategic reorientation, change in management, sale of business units etc.). The financial strength of particular hedge fund will influence on whether to invest in medium-sized or small companies.

In order to accomplish the goal, activist huge fund manager would have to identify the market(s) in which the funds are to be invested by focusing on specific sectors and specific companies within the chosen sector and to value them (absolutely and relatively). Usually, the hedge funds would invest in undervalued companies, companies that have been profitable over the enough long period of time but in which the cost need to be reduced or cash management has to be improved. Besides this, hedge funds would be interested to invest in low profitable companies (to make them more profitable), smaller fast growing companies that need financing or expertise knowledge and in undervalued companies that are leaders in particular sectors (because their real values are difficult to estimate). Usually, the hedge funds would invest in underpriced companies, companies that have been profitable over the enough long past period of time but in which the costs need to be reduced or cash management has to be improved, low profitable companies (to make them more profitable), smaller, fast growing companies that need financing or expertise knowledge and, undervalued companies that have leading positions in sectors (because of problems in estimate their real values). Thus, by improving the company's inefficiency and by eliminating the market price discount, hedge funds receive a premium (Boyson, and Mooradian (2011)).

After the sectors and companies are identified, the managers would have to analyze the companies' management and to find the tools to create the value of the company which may require time (up to two or three years). That's why managers would take limited number of active positions and would have a certain number of so-called sleeping positions in their portfolios. Moreover, the value of a company could be changed because of many global factors influence, which may lead to hedge fund's risk exposure. Hence, the hedging is not advisable because this can even increase the overall risk of the portfolio (e.g. company's management opposite view to what has to be changed). So, the key source of risk is the portfolio concentration (large positions relative to the company's size). Besides this, the funds might be exposed to risk of investing in low profitable companies, risk of strategy implementation etc. In reality, hedge funds could earn desirable return from investing in just one company. Hence, the most important factor of this strategy success is to have specialized and experienced fund manager capable to improve the value of the chosen company.

2.2. Characteristics of credit arbitrage

Credit arbitrage strategies try to identify the return potentials in corporate debt securities, such as bank loans, senior and subordinated bonds issued by the company and structured position with quite low credit risk exposure. Hedge funds „managers commonly use fundamental credit analysis to evaluate the probability of issuer's credit rating improvement. The market of corporate debt securities is liquid, which enables the manager to use general hedging techniques in order to reduce the credit risk exposure.

Credit arbitrage hedge funds seek to have minimal monthly volatility along with acceptable return. Managers of these funds will commonly take both long and short positions in different corporate debt securities. In other words, managers want to take advantage of any perceived mispricing in capital structure related to the corporate debt securities issuance.

2.3. Characteristics of distress/restructuring investments of hedge funds (hedge funds)

Distressed securities are securities of companies which are in financial distress (involved or to be involved in restructuring, reorganization, bankruptcy or liquidation) which means that companies cannot fulfil their credit obligations (cannot make interest payments or cannot repay the loans or face value of bonds). Company may fall into distress for a number of reasons, such as overleveraged, liquidity problems, credit rating downgrade, poor operating performance etc. Distressed securities are commonly have low credit rating (CCC and below). Because of distressed market inefficiency, distressed securities are selling with significant discounts. Types of distressed securities are: trade claims and receivables, common shares, preferred shares, private investment in private equities, rights and warrants, high yield bonds, corporate bonds, municipal bonds, below par bank loans, debtor in possession loans, mezzanine loans, bridge loans, collateralized debt, second lien notes, real estate assets, futures, options, swaps and indices. Investors in

distressed companies" securities are specific compared to investors in non-distressed securities because some investors are not allowed to own securities below a certain credit rating or to own post-reorganization securities or just because they cannot provide fresh capital to the company. In this respect, the investors in distressed securities are: hedge funds, money managers, mutual funds and private equity firms. However, hedge funds represent the largest buyers of distressed securities.

Distressed securities hedge funds „managers combine the fundamental analysis of a company of interest with knowledge of restructuring and bankruptcy in order to identify whether to investment in distressed company or not. In other words, managers would try to forecast and, if necessary, to influence the outcome of the bankruptcies and reorganizations. In general, hedge funds can profit from investing in distressed company by estimating the intrinsic value of the company. Namely, if the market value of a security is significantly below the estimated intrinsic value and managers expect that the security's market value will increase and reach the intrinsic value hedge funds will take position in distressed securities or will increase the already taken position. On the other hand, hedge funds can have combined positions in securities that are considered relatively mispriced (buying cheap securities and taking short position in more expensive securities). Hence, distressed securities hedge funds" managers will commonly invest long and short in the distressed securities of companies undergoing financial rather than operational distress (i.e. good companies with bad figures in their balance sheets). According to their expertise knowledge, hedge funds" managers will be concentrated on certain sectors and will implement active or passive investment approaches. Active investment approach means that managers will attempt to influence the restructuring through active participation in a creditor committee, while the passive investment approach is oriented to buying and holding distressed securities until they appreciate.

Distressed securities hedge funds can provide relatively high returns regardless the current market conditions because the returns are the result of managers" skills. The main disadvantage of distressed securities investments is illiquidity (i.e. it's hard and sometimes impossible to liquidate the positions taken by the hedge funds). Hedge funds" managers" decision to invest when the financial distressed emerged or to wait and invest later is based on expectations of company's recovery. The greater the likelihood that the company will be recovered, the hedge fund will invest earlier.

Distressed securities hedge funds are exposed to risk. Because of this, managers of hedge funds have to manage the portfolio risk by diversifying across various industries, companies and securities. Managers can use different hedging instruments.

2.4. Characteristics of merger arbitrage

Merger arbitrage hedge funds are funds that are investing in companies undergoing mergers and acquisition in order to achieve arbitrage returns. In other words, managers take a long position in equity of a target company and simultaneously take short position in equity of an acquirer. Managers of these hedge funds strive to profit from the uncertainty of the announced event (e.g. bid announcement). Merger arbitrage (or risk arbitrage) can be realized by friendly takeover (return is a difference in the buy and sale share prices) or hostile takeovers (hostile public offerings of shares that requires the probability that target company's shareholders will be forced to sell their shares) or partial sale (of a company which price is either below market value or intrinsic value).

The main advantage of this strategy is that it offers achievement of attractive returns with a relatively limited market risk exposure (returns dominantly depend on company events). The strategy has a much shorter investment horizon compared to other event-driven strategies. Finally, the investing decisions are based on available information only. On the other hand, merger arbitrage strategy disadvantages are inability to offer the same return over investment period and relatively high volatility.

Before the investment decision is made, manager of hedge fund has to identify the company of interest and to analyze it so that can estimate the probability of event success as well as the market reaction to the specific event. Based on this, hedge fund manager will try to determine whether to take position in the company or not. If manager is about to take position in company, the availability of information will affect the size of the position that should be taken. In addition, the market price at which the company's shares could be sold and the uncertainty of transaction effect on buyer's price have to be taken into accounts. The aim is to hedge positions.

The main risk of merger arbitrage is related to merger and acquisition process incompleteness. Should the acquisition deal not be completed, the target's stock price will fall and merger arbitrage hedge fund could incur significant loss. Nevertheless the level of risk undertaken varies among the merger arbitrage hedge funds. Some hedge funds" managers will invest in announced mergers and acquisition only, while others will invest before the merger or acquisition is officially announced.

2.5. Characteristics of private issue/regulation D

Private Issue/Regulation D strategies which employ an investment process primarily focused on opportunities in equity and equity related instruments of companies which are primarily private and illiquid in nature. These most frequently involve realizing an investment premium for holding private obligations or securities for which a reasonably liquid market does not readily exist until such time as a catalyst such as new security issuance or emergence from bankruptcy proceedings occurs. Managers employ fundamental valuation processes focused on asset coverage of securities of issuer firms, and would expect over a given market cycle to maintain greater than 50% of the portfolio in private securities, including Regulation D or PIPE transactions.

2.6. Characteristics of special situations

Special situations represent a strategy that is related to all events other than mergers and acquisitions or bankruptcies. In other words, this strategy is referred to situations, such as companies with depressed values of their shares, unannounced mergers and acquisitions, recapitalization, refinancing, reorganization, public offering, leveraged buy-out, government privatization etc. The position taken in these situations can be combined with the positions that are already taken in distressed securities or in mergers. This substrategy is focused on opportunities in equity and equity-linked securities of companies that are involved in different corporate situations. In other words, strategy include both announced and non-announcement events. The managers are oriented to corporate investing in a numerous forms (e.g. distressed securities, issuance of bankruptcy securities, asset sales etc.) that are identified by fundamental analysis. Strategies do not employ leverage, but returns on investments made exhibit greater volatility than other event-driven hedge funds.

2.7. Characteristics of multi strategy

Multi strategy represents a hedge fund strategy that combines two to five investment strategies in order to offer a diversified product. That means that the company may offer individual funds, multi strategy fund or a diversified portfolio only. Each strategy is typically managed independently. In order to limit exposure to manager and to reduce the risk of strategy implementation, the capital is allocated among various managers. The strategy collapse may be stable over time or can be actively managed. When the strategy is managed in-house, the breakdown between strategies will tend to be stable or to evolve within bands. When external teams are used, the lead manager of the global portfolio usually retains the right to change the capital allocation over time. In this case rebalancing will usually be carried out monthly, quarterly or semi-annually (Capocci (2007) and Capocci and Hubner (2004)).

Multi strategy is characterized by a number of advantages. Multi strategy offers a diversified exposure to hedge funds. The provided liquidity is usually similar to liquidity of underlying strategies or can be even better. The strategy enables the hedge funds to diversify the risk of individual strategy. Multi strategy does not require a due diligence on underlying manager which influence the cost reduction. Finally, this strategy enables monthly (or quarterly) or consistently rebalancing. On the other hand, the multi strategy has its limitations. The main drawback of multi strategy hedge funds is the lack of freedom in making decision regarding the underlying manager. Hedge funds tend to stick to the same manager even if performance is poor. In addition, multi strategy hedge funds" managers can have a different level of transparency and invisibility to potential investors.

3. PERFORMANCE OF EVENT-DRIVEN STRATEGIES OF HEDGE FUNDS

Hedge funds performance evaluation is enabled by creation of hedge funds indices. Although these indices are still suffering from lack of continuous and complete data, they are capable of indicating the recent hedge funds" performances with a small error and can help investors determine expectations of their own hedge funds. Even though no universal hedge fund index can adequately represent the hedge fund industry as a whole and although existing indices differ in composition and performance, hedge fund indices are enough good indicators of hedge funds" performances. There are different providers of hedge fund indices, but despite this the indices are usually divided according to investment strategy of a hedge fund. Most firms publishing indices have an index for each hedge fund strategy and commonly subindices within the particular strategy. So, the investors can track with reasonable confidence the performance of hedge funds that pursues a specified investment strategy. In addition, the today"s development of hedge funds indices is supported by the inception of investable indices, i.e. the indices that mimic the aggregate performance of individual hedge fund strategies (e.g. Morgan Stanley Capital International Inc. and Standard&Poor"s). Having this in mind, the investors should carefully choose a hedge fund index because of its representativeness of industry performance as well as the imperfect hedge fund databases.

Performance of hedge funds strategies is usually evaluated based on detailed analysis of daily, monthly or quarterly returns and their standard deviations, correlations among different hedge funds strategies and among hedge funds indices and equity and/or bond indices. The frequently used performance measure is Sharpe ratio. Sharpe ratio was introduced by William Sharpe (Sharpe (1966)) as a measure of mutual funds performance. Sharpe proposed a term reward-to-variability ratio (Sharpe (1975)) that indicates the expected differential return per unit of risk associated with the differential return (ex ante ratio) or the historic average differential return per unit of historic variability of the differential return (ex post ratio). Specifically, measures the return adjusted for each level of risk undertaken. It represents a ratio between the difference in average return on investment and risk-free rate and standard deviation of the returns. This ratio can be applied to different hedge funds regarding return and volatility relationship. The higher the value of Sharpe ratio, the higher return investors can expect to receive for additional risk accepted by investing in riskier assets. Several authors pointed out to drawbacks of Sharpe ratio and other traditional performance measures. Among them, the most attention deserve Cappoci, Duquenne and Hubner (2007) who developed an extended risk measure that integrates the specific features of alternative strategies. Besides, some authors proposed and examined the use of Sortino ratio (van Dyk, van Vuuren and Heymans (2014) and Omega ratio (Botha (2007)). Despite a number of shortages, the most consistent and widely used measure of hedge funds' performances is Sharpe ratio and this is the performance analysis of event-driven hedge funds is based on this ratio.

Capocci (2009) and Cappoci and Hubner (2004), Agarwal (2001), Agarwal and Naik (2000), Bertelli (2007), Fung and Hsieh (2002b) and Gregoriou et al. (2006) had analyzed the general or partial performance of hedge funds. Nevertheless, there is analysis focused on event-driven strategy. That's why the paper tries to analyze this specific and important group of strategies. Availability and consistency in data represent a relatively great weakness, but we tried to overcome this problem by the use of publicly available date of event-driven hedge funds' index and subindices of HFR (HFRX Indices (August 2015)).

According to HFR hedge fund strategies classification, the event-driven strategy has substrategies, and their performance is could be traced by values of strategy's index and subindices (event-driven index, activist index, credit arbitrage index, distressed/restructuring index, merger arbitrage index, special situations index and multi strategy index). Performance of private issue/regulation D could not be analyzed because for this hedge fund strategy no subindex exists.

The performance of event-driven strategies is analyzed on the basis of data provided by Hedge Fund Research of HFRX Global Hedge Fund Index (HFRXGL), HFRX Event-driven index (HFRXED), MSCI US\$ World Index (MSCI (2016) and S&P 500 w/dividends over the 1998-2014. In order to analyze the performance of event-driven hedge funds, we firstly compare the data that may indicate the performance of the event-driven hedge fund index with the performance of Global hedge fund index (the observed period was the same). The HFRX Global Hedge Fund Index (HFRXGL) is designed to be representative of the overall composition of the hedge fund universe. Over the period of concern (1998-2014) HFRXGL had geometric average monthly return of 0.39%, which was higher than the returns both on 3-month LIBOR and MSCI World Index (0.21% and 0.27% respectively). Standard deviation of monthly returns was 1.8, i.e. the volatility was greater than for 3-month LIBOR (0.19) but significantly lower than for MSCI World Index (4.56). Annualized return of HFRXGL was 4.82% and was higher than both 3-month LIBOR and MSCI World Index (2.59% and 3.24% respectively). The annualized standard deviation of returns was 6.24 and that was higher than 3-month LIBOR (0.65) and significantly lower than for MSCI World Index (15.80). The risk-free rate over the analyzed period was 2.11%. Correlation between HFRXGL and 3-month USD LIBOR was low positive (0.17), while was significantly positive between HFRXGL and MSCI World Index (0.63). Finally, Sharpe ratio as a measure of global hedge fund performance was 0.45 or better than ratio for MSCI World Index (0.15) but weaker than for 3-month LIBOR (0.69). The HFRX Event-driven Index (HFRXED) is designed to be representative for all hedge funds pursuing event-driven strategies. Over the period of concern (1998-2014) HFRXED had geometric average monthly return of 0.37%, substantially higher than the returns on MSCI index (0.27%) and slightly lower the returns on both S&P 500 w/dividends and HFRXGL (0.49% and 0.39% respectively). Standard deviation of HFRXED returns was 1.93, which was slightly greater than the standard deviation of HFRXGL (1.8) and substantially lower than the standard deviations of both MSCI and S&P 500 indices (4.55 and 4.46 respectively). Annualized return on HFRXED was 4.52% which were lower than the return on S&P 500 (6.04%) and higher than the returns on both MSCI index and HFRXGL (3.24% and 4.82% respectively). Annualized standard deviation of HFRXED returns was 6.68 and it was slightly greater than for HFRXGL (6.24) but substantially lower than the standard deviations of both MSCI and S&P 500 indices (15.80 and 15.45 respectively). This can be partly explained by financial crisis influence on hedge fund industry and especially on hedge funds that followed some event-driven substrategies. Correlation between the HFRXED and MSCI World index was 0.70 which was greater than the correlation coefficient for HFRXGL (0.63). Finally, Sharpe ratio as a performance measure was 0.38 for HFRXED, which was higher than ratios values for both MSCI and S&P 500 indices (0.15 and 0.32 respectively), but lower than ratio of HFRXGL (0.45). This may suggest that because of specific characteristics of event-driven strategies, the hedge fund industry performed slightly better. In general, it seemed that hedge funds as a whole performed better than

event-driven hedge funds. Hence, it would be difficult to give the final conclusion regarding event-driven hedge funds' performance. In other words, more detailed analysis should be done.

Event-driven hedge funds attempt to enable investors to diversify their investments. In general, the rationale for diversification would depend on correlation between the assets within the investment portfolio. The correlation is measured by correlation coefficient that may take values from -1 to + 1. Ideally, the best diversification and risk reduction would be obtained if coefficient had value of -1 (negative correlation). On the other hand, diversification wouldn't reduce the risk exposure if coefficient is +1. In general, as long as acceptable positive correlation exists between assets, it would've been worth of adding asset in the given portfolio. Having this in mind, the table 1 is created with a goal to give the information regarding the historical correlations between event-driven hedge funds and classical indices.

Results presented in table 1 are in accordance to what could've been expected from event-driven substrategies. All event-driven substrategies are positively correlated to both MSCI World index and S&P 500 w/dividends, except for activist hedge funds, which can be explained by the specific active role they commonly undertake in companies of interest. Apart from this, we tried to determine the correlation between event-driven strategies over the whole period, but the inconsistency in data and the lack of data for some years, not allowed us to do so. However, we managed to determine the correlation between only two event-driven substrategies (distressed/restructuring and merger arbitrage). In this regard, correlation coefficients were 0.57 which could be considered attractive to further portfolio diversification. With further development of event-driven hedge fund data collection and creation of wider range of subindices, the correlation would be possible to examine and to make useful conclusion about how to combine event-driven substrategies in order to enhance the hedge funds' return.

Table 1:Correlation between event-driven substrategies and market indices (1998-2014)

	Correlation with MSCI World index	S&P 500 w/div
Activist index	- 0.60	0.65
Credit arbitrage index	0.67	0.62
Distressed restructuring index	0.49	0.61
Merger arbitrage index	0.44	0.41
Special situations index	0.75	0.69
Multi strategy index	0.66	0.59

Source: HFRX Indices, Hedge Fund Research Inc., August 2015; MSCI World Index-annual performance- 1998-2014, MSCI Inc., 2016.

Table 2: Performance of event driven strategy and event-driven substrategies 1998-2014

	Event-driven index	Activist index	Credit arbitrage index	Distressed /restructuring index	Merger arbitrage index	Special situations index	Multi strategy index
GAMR* (%)							
Subindex	0.37	0.57	0.60	0.24	0.44	0.15	0.52
MSCI index	0.27	0.27	0.27	0.27	0.25	0.27	0.27
&P500w/div.	0.49	0.56	0.56	0.07	0.49	0.56	0.56
SDMR*							
Subindex	1.93	3.98	1.12	2.02	0.99	2.21	2.61
MSCI index	4.56	4.55	4.55	4.56	4.21	4.55	4.55
S&P500w/div	4.46	4.19	4.19	2.19	4.46	4.19	4.19
Annualized return (%)							
Subindex	4.52	7.00	7.50	2.91	5.36	1.81	6.41
MSCI index	3.24	3.25	3.25	3.24	2.99	3.25	3.25
&P500w/div.	6.04	6.88	6.88	0.82	6.04	6.88	6.88
SDAR*							
Subindex	6.68	13.80	3.89	7.00	3.43	7.64	9.03
MSCI index	15.80	15.78	15.78	15.80	14.60	15.78	15.78
&P500w/div.	15.45	14.51	14.51	7.60	15.45	14.51	14.51
Sharpe ratio							
Subindex	0.38	0.46	1.54	0.14	0.93	0.10	0.59
MSCI index	0.15	0.20	0.20	0.15	0.13	0.20	0.20
S&P500w/div.	0.32	0.44	0.44	(0.13)	0.32	0.44	0.44

Data source: HFRX Indices, Hedge Fund Research Inc., August 2015; MSCI World Index-annual performance: 1998-2015, MSCI Inc., 2016.

*GAMR - Geometric average monthly return; SDMR - Standard deviation of monthly returns; Standard deviation of annualized returns.

Finally, on the basis of data used, the performance of event-driven substrategies was analyzed by comparison of returns (monthly and annually), standard deviations (monthly and annually) and Sharpe ratio. The aim was to research in more details the performance of event-driven hedge fund substrategies because this issue has been insufficiently explored. Table 2 shows the results that indicate the performance and potential of particular event-driven substrategies. In summary, table 2 suggests that best performing strategies are credit arbitrage and merger arbitrage which is in line with the market conditions deterioration after the financial crisis emergence in 2007 and strategies' orientations. Activist and multi strategy were "medium-performed" ones, while the weakest performing were distressed/restructuring and special situations strategies. The results should be analyzed in broader context, especially because of the fact that distressed/restructuring and special situations strategies are commonly low correlated to traditional investments (e.g. shares and bonds) and frequently related to low liquid assets.

4. CONCLUSION

Hedge funds are the fastest growing group within the alternative investment over the last fifteen years because of unique characteristics and the return potential with medium or low volatility and commonly medium or low risk exposure. The hedge funds are usually defined by the investment strategy they implement. Hedge funds loosely regulation and commonly lack of transparency led to wide range of hedge funds' strategies which are formulated to suite the investors need. Over time investors required more and more information about their investments returns and performance. As a result specialized companies emerged and started to provide data of hedge funds' operations and shortly after this, created hedge fund indices. This encouraged more investors to invest in hedge funds. There is variety of different hedge funds' investment strategies. Having in mind, the consistency and use of different hedge funds' classification, the paper was based on HFR classification of hedge funds because it enables to examine one special group of hedge funds, i.e. event-driven hedge funds. These funds represent probably the most challenging and promising hedge funds due to their specific character that enables the performance enhancement when and if specified event occurs. The performance of event-driven hedge funds can be measured, not only in terms of returns (daily and month) and standard deviation of returns, but also by using Sharpe ratio as widely used measure of hedge funds' performance. The analysis of event-driven hedge funds' performance showed relatively good performance though slightly weaker than the performance of hedge funds industry as a whole. Compared to widely used market indices (such as MSCI World Index and S&P 500), performance of event-driven strategies was better. Best performing strategies were credit arbitrage and merger arbitrage which is in line with the market conditions deterioration after the financial crisis in 2007 and strategies' orientations. Activist and multi strategy were "medium-performed" ones, while the weakest performing were distressed/restructuring and special situations strategies.

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USING FINANCIAL STATEMENT DATA TO EXPLAIN STOCK PRICE MOVEMENTS - BELGRADE STOCK EXCHANGE CASE

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Abstract: *This study uses regression as a tool to create regression models that are able to explain stock price movements based on selected financial statement data and financial ratios. For the purpose of this study, we build both univariate and multivariate linear regression models. The proposed models are used to explain stock price movements for Prime Listing companies in Belgrade Stock Exchange. To explain stock price movements, we use in total nine financial statement items and five ratios as independent variables in our regression models. The results shows that the best method to explain and predict future price movements is to analyze raw financial statement data. Good results are also achieved using DuPont decomposition ratios.*

Keywords: *stock price, regression, financial ratios, financial statements, forecasting*

1. INTRODUCTION

In the analysis of rational investment behavior it is necessary to observe two key things: possible profit and risks. Often the investment motives are tested by investing in equities that are the most extensively traded and most valuable in stock markets. Stock prices are the basic and most important indicator to observe successfulness of the company. More precisely, positive movements in share prices indicates success and higher valuation. Therefore, using stock prices we can learn a lot about companies' operating quality, efficiency and effectiveness of governance for the future of the company. It is important to understand stock price movements and their dependence on various factors.

Research aim or research questions need to be fairly well defined. This is an important point. We always need to have a clear focus on what we want to find out. Without a clear research question, it becomes much harder to understand both which data sources to look for and which techniques to employ. In applied research, we use a range of statistical techniques. We tend to distinguish between univariate (summaries and inferences about a *single* [uni-] variable), bivariate (summaries and inferences about the relationships between *two* [bi-] variables) and multivariate (summaries and inferences about the relationships between *three* or more [multiple] variables) statistics.

In this study, we focused on bivariate and multivariate statistics. The idea was to use statistics as a model of real world problems. In other words, we used mathematical models in order to understand and explain events regarding the study theme. We used regression to explain influence of the data from financial reports and ratios calculated based on this data on stock price movements, namely correlation between these two. Linear regression is used for experiments where only one factor that influences stock price is observed, in our case the influence of one valuation ratio on stock price. On the other side, we used multiple regression when more factors have to be taken into account (influence of several ratios on stock price). We divided input data in two sections: financial statement data (net profit, interest expenses, short term liabilities, etc) and ratio data derived from financial statement data (return on assets, return on equity, profit margin, asset turnover, financial leverage).

The rest of the paper is organized as follows. In the next section we give a brief background about this subject, and mention some of the most important work. Detailed explanation of methodology and our model is provided in Section 3. Section 4 gives brief explanation of data sample and presents results of our experiment with the corresponding discussion. Section 5 concludes our paper and give some thoughts for further work.

2. BACKGROUND

Analyzing correlation between current earnings, income and financial statement data in general, and stock prices is very important topic in finance. Understanding this relationship is crucial, especially for those who are participating stock markets. Beaver (1998) says that one link, theoretically speaking, between earnings and stock prices is that current earnings and other data from financial reports provide information to predict

future stock prices and thus future earnings. Based on this statement, researchers have looked for current financial report information to predict future movements in stock price and earnings, pointing out that this should be one of the main goal of fundamental analysis (Penman, 1992; Lee, 1999).

Sloan (1996) decomposed earnings into accruals and cash flows and found that companies with higher operating accrual tend to have lower future earnings and returns. Lewellen (2004) studied whether financial ratios like dividend yield can predict aggregate stock returns. He showed that dividend yield can predict market returns in a whole sample, while book-to-market and price-per-earnings ratios have predictive power in the shorter sample. Soliman (2004) investigated in his study whether the industry-adjusted DuPont analysis is a useful tool in predicting future changes in return-on-net-operating-assets and obtained positive results.

3. METHODOLOGY

In this study, the problem we are focusing on is whether there is a direct dependency between changes in financial statements data (and therefore also changes in financial ratios) and stock price movements. In order to find out the answer on this question we will employ different regression models. The first part of this section will provide a brief overview of regression method. Further, we will present our univariate and multivariate regression models. Finally, at the end of this section, valuation method is provided.

3.1. Regression

Regression is a dependency model. Its' idea is to explain the variation in a certain variable (income, profit, expenditure etc), as a function of explanatory variable(s). In other words, regression tries to figure out to what extent does the variation in explanatory variables explain the variation in the dependent variable?

The basic linear regression model can be set up in the following way:

$$Y = \beta_0 + \beta_1 X + \varepsilon , \quad (1)$$

where β_0 is Y-intercept, β_1 is a slope coefficients and ε is a random error term. In this univariate model, changes in Y are assumed to be caused by changes in X .

If the one independent variable is not enough to explain behavior of dependent variable, we can set a multiple regression model with k independent variables:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_k X_k + \varepsilon , \quad (2)$$

where $\beta_0, \beta_1, \dots, \beta_k$ are regression coefficients and ε is a random error term.

3.2. The proposed model

In our study we perform several experiments. First, we studied stock price movements based on the changes of single variable (return-on-assets, return-on-equity), and second, we studied those movements based on the changes of multiple variables (multiple financial statement data, multiple ratios). Therefore, we used both univariate and multivariate regression models.

Our first model type is the following:

$$P = \beta_0 + \beta_1 R + \varepsilon , \quad (3)$$

where P represents stock price, while R stands for return-on-equity (ROE) or return-on-assets (ROA) ratio.

Our second model type is the following:

$$P = \beta_0 + \beta_1 PM + \beta_2 AT + \beta_3 FL + \varepsilon , \quad (4)$$

where PM represents profit-margin ratio, AT stands for asset-turnover and FL is financial-leverage ratio. These three ratios represent DuPont decomposition ratios of ROE ratio. We believe that these components of ROE, when put in regression model, have greater explanatory power than the ROE.

Our final model studies influence of financial statement components on stock price movements. Using several items from financial report we build the following regression model:

$$P = \beta_0 + \beta_1 A + \beta_2 C + \beta_3 STL + \beta_4 DTL + \beta_5 LTL + \beta_6 I + \beta_7 EBIT + \beta_8 IE + \beta_9 NP + \varepsilon , \quad (5)$$

where A represents total assets, C is capital, STL means short-term liabilities, DTL is differed tax liabilities, LTL stands for long-term liabilities, I is total income, $EBIT$ is earnings-before-interest-and-taxes, IE are interest expenses, while NP is a net profit.

3.3. Method valuation

To determine influencing factors and method success we observed T-statistic, P-Value and R Squared.

R Squared (R^2)

R Squared is a coefficient of determination and represents the portion of the total variation in the dependent variable that is explained by variation in the independent variable.

Table 1: Examples of approximate R^2 value

$R^2 = 1$	R^2 between 0 and 1	$R^2 = 0$
100% of the variation in Y is explained by variation in X	Some but not all of the variation in Y is explained by variation in X	The value of Y does not depend on X (None of the variation in Y is explained by variation in X)

T-test for a population slope

We are trying to understand a linear relationship between X and Y. We have null and alternative hypotheses

$$\begin{aligned} H_0 : \beta_1 &= 0 \text{ (no linear relationship)} \\ H_1 : \beta_1 &\neq 0 \text{ (linear relationship does exist) } \end{aligned} \quad (6)$$

Test statistic is

$$t = \frac{b_1 - \beta_1}{sb_1} , \quad (7)$$

where b_1 is a regression slope coefficient, β_1 is a hypothesized slope, sb_1 is a standard error of the slope. Confidence level is by default 0,95 so $\alpha = 0,05$.

In Table 2 we present an example of analysis of influence of ROE on stock price which is the part of our analysis.

Table 2: t-test example

	Coefficients	Standard Error	t Stat
Intercept	98,24833	58,03348	0,12892
ROE	0,10977	0,03297	3,32938

Regression slope coefficient is $b_1 = 0,10977$, $sb_1 = 0,03297$, while $t = 3,32938$.

Further, we look at the T distribution critical value table, and decide whether the t -value for ROE falls into the specific interval (which is determined by the critical value table). Since the value for t does not fall into critical area, the decision is to reject H_0 .

P-Value Method

In this method we starts with the same hypotheses. The following Table 3 presents an example from our analysis.

Table 3: p-value example

	Coefficients	Standard Error	t Stat	P-value
Intercept	98,24833	58,03348	0,12892	0,12892
ROE	0,10977	0,03297	3,32938	0,01039

This is a two-tail test, so the p -value is $P(t > 3,329) + P(t < -3,329) = 0,01039$ (for 8 d.f.). If the p -value is smaller than $\alpha = 0,05$, we reject H_0 . The bigger the t -value is, the smaller the p -value, and consequently the stronger is the evidence against the H_0 hypotheses. In this example from our study, there is sufficient evidences that ROE affect the stock price.

4. EXPERIMENTAL RESULTS

In the first part of this section we will present data sample used in this study. In the next part we will structure results and provide appropriate comments.

4.1. Data

We used data from the financial reports of Prime Listing companies listed on Belgrade Stock Exchange (BELEX), given the fact that these companies are obliged to inform public quarterly on their results. BELEX Prime Listing is consisted of four companies: Energoprojekt holding (ENHL), Naftna Industrija Srbije (NIIS), Sojaprotein (SJPT) and Aerodrom Nikola Tesla (AERO). Data are taken from the official financial reports of these companies, and can be found on www.belex.rs. Data ranges from the first quarter of 2006 to the last quarter of 2015.

We organized data from the reports, and calculated relevant financial ratios: return-on-equity (ROE), return-on-assets (ROA). In order to analyze relationship between stock price and these ratios more efficiently, we also did DuPont decomposition (Soliman, 2008) of ROA into profit margin (PM) and asset turnover (AT), and ROE into PM, AT and financial leverage (FL).

Table 4: Financial ratio and stock price data

Company	Stock price	ROA	ROE	PM	AT	FL
ENHL	3232	0,039	0,043	0,972	0,040	1,096
	2901	0,034	0,041	0,852	0,040	1,213
	2101	0,034	0,047	0,134	0,254	1,380
	1600	0,079	0,111	0,299	0,265	1,404

NIIS	506	0,129	0,849	0,151	0,850	6,603
	481	0,177	0,488	0,197	0,902	2,752
	580	0,225	0,692	0,268	0,842	3,071
	624	0,066	0,197	0,074	0,888	2,977

SJPT	2970	0,047	0,094	0,040	1,179	1,996
	2490	0,079	0,156	0,082	0,960	1,983
	1042	0,092	0,251	0,114	0,806	2,718
	840	-0,009	-0,027	-0,009	1,016	2,985

AERO	526	0,051	0,056	0,263	0,194	1,092
	484	0,068	0,075	0,300	0,228	1,092
	515	0,088	0,098	0,363	0,243	1,115
	460	0,064	0,070	0,271	0,238	1,092

4.2. Summary results

Using Excel and its Data analysis tools we tried to determine the dependence between stock price and all factors previously mentioned. Through testing of each individual factor and its impact on the price as well as their combinations, we came to the following results shown in Figure 1.

Company	ROA	ROE	DuPont decomposition ratios*	Financial statement items**
ENHL	✗	✗	✗	✓
NIIS	✗	✗	✓	✓
SJPT	✗	✗	✓	✓
AERO	✓	✓	✓	✓

Figure 1: Summary results

*We use ROE decomposition which include Profit margin, Asset turnover and Financial leverage.

**All items from financial reports are Total assets, Capital, Current liabilities, Deferred tax liabilities, Long-term liabilities, Income, EBIT, Interest expenses, Net profit.

Our summary results shows interesting conclusions. ROA and ROE factors are able to explain stock price movements only in one case – AERO. Further, DuPont decomposition of these ratios into PM, AT and FL gives more explanatory power for stock price prediction. It successfully explained price movements for three stocks: AERO, ENHL and NIIS. It is important to note here, that SJPT experienced several stock splits and also suffered huge losses during the selected time period, which could be a reason why it was difficult to explain its price movements. Finally, using raw financial statement data we obtained the best results in explaining stock market movements. All four stock price movements were explained successfully.

4.2.1. ROE results

The following regression Table 5 presents detailed results for our ROE model.

Table 5: Regression statistics for ROE

Company	R Square	t Stat	P-value
AERO	0,59599	4,02830	0,00199
ENHL	0,01644	0,60640	0,55046
NIIS	0,07712	1,04230	0,31627
SJPT	0,03812	0,95483	0,34962

From the regression table, which examines relationship between ROE and stock price movement, we can see that there is a relative strong influence of ROE on AERO price changes. However, other three companies do not show statistical significance for ROE influence, which means that ROE cannot be used to explain neither predict price movement of these stocks. It is interesting to mention, that analysis of price movements of these stocks showed, that AERO is the only company among these four with relatively steady price trend through time observed.

4.2.2. ROA results

The following regression Table 6 presents detailed results for our ROA model.

Table 6: Regression statistics for ROA

Company	R Square	t Stat	P-value
AERO	0.60199	4.07894	0.00182
ENHL	0.00001	0.01897	0.98503
NIIS	0.00000	0.00334	0.99738
SJPT	0.03021	0.84644	0.40603

ROA, as well as ROE has strong influence on stock price movement in the example of AERO. And again, as in the previous example, this influence is not significant for other three companies.

5. CONCLUSION

In this paper linear regression is used to establish the relationship between data from financial statements and financial ratios, and stock price movements. Experiment was conducted for Prime Listing companies on Belgrade Stock Exchange including Aerodrom Nikola Tesla, Energoprojekt holding, Naftna Industrija Srbije, Sojaprotein.

Our results have shown that the biggest influence on stock price movements have the raw financial statement data. In a way, this was expected result since it is only logical that deep analysis of financial statement items can give us detailed insights in companies performances. The second results were obtained using DuPont decomposition ratios for ROE and ROA profitability measures. Finally, using only ROA and ROE factors seems not to be very helpful for those who wants to understand stock price movements. Our final conclusion is that in financial analysis one should never underestimate a detail inspection of financial statements and other internal factors that influence companies' performances in order to obtain good insight in investment perspective of the stock.

As for the future research, we plan to include more factors in our analysis and to use other statistical and machine learning methods in order to explain stock price movements.

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APPLYING A NEURO FUZZY SYSTEM FOR CREDIT RISK EVALUATION

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Abstract: *One of the most relevant issues in financial analysis is credit score calculation. In order to solve this problem, numerous methods have been proposed in the literature for credit risk evaluation. In this paper, to create the prediction model for creditworthiness, Neuro-Fuzzy approach has been used, more specifically, an adaptive neuro-fuzzy inference system (ANFIS). In order to reduce the dimensionality problem Principal Component Analysis (PCA) was employed. The system was trained and tested with different number of inputs.*

Keywords: *fuzzy logic, neuro-fuzzy system, ANFIS, Principal Component Analysis, credit risk*

1. INTRODUCTION

In the past years, financial analysis has developed significantly on account of bigger complexity of business systems. Thus, the need for advanced calculations and used techniques has also increased. Conventionally, creditworthiness and other types of assessments have been done using various statistical methods and, in general, creditworthiness assessment has been a statistical category.

One of the most relevant issues in financial analysis is credit score calculation. A credit score is primarily based on a credit report information. Lenders, such as banks, use credit scores to evaluate the potential risk posed by lending money to companies. Lenders use credit scores to determine who qualifies for a loan, at what interest rate, and what credit limits.

To predict the model for credit score, there are number of techniques like: Statistical techniques, Neural Network, Genetic Algorithm, Fuzzy Logic and hybrid approaches, such as Neuro-Fuzzy. As it is fact that each technique has their own pros and cons.

In this paper, to create the prediction model for creditworthiness, Neuro-Fuzzy approach has been used, more specifically, an adaptive neuro-fuzzy inference system (ANFIS). Neuro-Fuzzy approach is applied because the combination of Neural Network and Fuzzy Logic results in such hybrid intelligent system that is having learning ability to optimize its parameters with the use of neural network and to represent the knowledge in an interpretable manner, with the use of Fuzzy System. Created system does not require an expert in finance.

Model in this paper is based on financial information, represented by 23 financial ratios, regarding 150 companies located in Serbia for the period 2011-2013. In order to optimize the given data set and reduce number of ratios, Principal Component Analysis is used.

The paper is structured as follows: Sections 2, 3, 4, 5 provide the basic concepts of Fuzzy Logic, Neural Networks, Neuro-Fuzzy Systems and ANFIS. Related work is given in Section 6. In Section 7 the concept of Principal Component Analysis is introduced. Section 8 is devoted to the experimental results and their analysis and finally, Section 9 concludes the paper and discusses future work.

2. FUZZY LOGIC

The theory of fuzzy sets was initiated by Lofti Zadeh in 1965. In his influential paper named Fuzzy Sets he pointed out that such imprecisely defined sets or classes “play an important role in human thinking, particularly in the domains of pattern recognition, communication of information, and abstraction” (Zadeh, 1965.).

Fuzzy set, as the name says, is a set without a crisp boundary. That is, the conversion from “belonging to a set” to “not belonging to a set” moves gradually, and this fine gradation is defined by membership functions that give

fuzzy sets adaptability in modeling, a concept similar to commonly used linguistic expressions, such as “the man is tall” or “he is driving quite fast”.

Definition of fuzzy sets and membership functions is:

If it is assumed that X is a collection of objects expressed generically by X, then a fuzzy set A in X is described as a set of ordered pairs:

$$A = \{(x, \mu_A(x)) | \forall x \in X\} \quad (2)$$

$\mu_A(x)$ is called the membership function (MF for short) of x in A. The MF maps each element of X to a continuous membership value (or membership grade) between 0 and 1 (Jang & Sun, 1995.).

2.1. Fuzzy rules and fuzzy models

The process of drawing conclusions based on fuzzy rules is called fuzzy inference and the system made of it is called Fuzzy inferencing system – FIS. A fuzzy if-then rule (fuzzy rule, fuzzy implication or fuzzy conditional statement) presumes the form

$$\text{if } x \text{ is } A \text{ then } y \text{ is } B \quad (3)$$

where A and B are linguistic values described by fuzzy sets on universes of discourse X and Y, respectively (Jang & Sun, 1995.).

Two kinds of Fuzzy logic systems (FLS), the Mamdani and the Takagi-Sugeno-Kang (TSK) FLSs are widely used and they are currently adopted by the scientific community. Mamdani FLS is an intuitive and numerical system that maps crisp (deterministic) inputs to a crisp output (Mamdani & Assilian, 1975). Takagi-Sugeno-Kang FLS is very similar to Mamdani FLS. It is a special FLS which is also characterized by *if-then* rules, but its consequent is a polynomial. Its output is a crisp value obtained from computing the polynomial output, so it does not need a defuzzification process (Sugeno & Kang, 1988.; Takagi & Sugeno, 1985.).

3. NEURAL NETWORK

Artificial neural networks generalize the mathematical models of the human cognition and neural biology. Artificial neural networks show the ability to learn from the environment in an interactive fashion and show remarkable abilities of learning, recall, generalization and adaptation in the wake of changing operating environments (Azam, 2000.). The simplest neural network model is called a perceptron which can be trained to discriminate between linearly separable classes. For more complex tasks of classification or regression, models with multiple layers of neurons are necessary. This artificial neural network model is generally referred to as a multi-layer perceptron (MLP). This architecture consists mainly of three types of neuron layers, namely input layer, hidden layer(s) and an output layer. The nodes in an input layer encode the data presented to the network for processing. These nodes do not process the information, but simply distribute the information to other nodes in the next layer. The nodes in the middle layers are called hidden nodes. These neurons provide the nonlinearities for the network and compute an internal representation of the data. The nodes in the output layer are referred to as output neurons: they encode possible desired values assigned to the input data. A typical multilayer perceptron neural network model is shown in Figure 1.

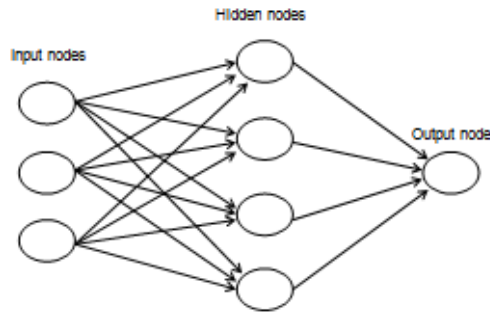


Figure 1: Artificial neural network

3.1. Neural network learning

Neural networks enable the intelligent processing without previously defined model or algorithm, but based on information about particular system behaviour. Neural networks learn from experience. The process of learning is called training and it can be divided into three phases: calculating the output, comparing the obtained value with the desired value, adjusting the weight coefficients and going back to the first step. Learning algorithm that is mostly used is backpropagation algorithm. Neural network adjusts the weight coefficients according to error values assigned to each node. The calculating is done backwards, starting from the output layer to hidden layers and the process ends on the input layer. After the modification of parameters is completed, the process of training continues until the network is able to give outputs with a satisfying accuracy.

4. NEURO-FUZZY SYSTEMS

From the point when fuzzy systems started to be applied in industrial purposes, it has been clear that the progress of a fuzzy system that gives good results is not a simple task. The difficulties of defining membership functions and suitable rules is usually an exhausting process of tries and mistakes. Eventually the idea of combining learning algorithms with the fuzzy systems had been created. The neural networks, that have efficient learning algorithms, had been given as a solution to automate or to help the improvement of tuning fuzzy systems.

The combination of neural networks and fuzzy systems in order to join their good sides and to fix their separate flaws. Neural networks bring up their computational characteristics of learning in the fuzzy systems and take in from them the interpretation and the precision of systems representation. Thus, the parameters of the fuzzy systems can be fixed by the neural networks' competences. These concepts complement each other, which validates its use as a combination.

5. ANFIS

Adaptive neuro-fuzzy inference system (ANFIS) represents a multilayered adaptive network that uses fuzzy inference system with its membership functions. Adaptive neuro-fuzzy inference system's structure consists of network's directly connected nodes. Each node is defined by a function with adaptive or fixed parameters. Functions included in ANFIS build a fuzzy inference system using given input and output parameters. The ANFIS model uses Sugeno fuzzy inference system, and fuzzy if-then rules for describing complex system behaviour (Jang, 1992).

5.1. ANFIS architecture

ANFIS (Jang, 1993) has an architecture that consists of five layers as shown in Figure 2. The first hidden layer is used for fuzzification of the input variables and T-norm operators are used in the second hidden layer to calculate the rule of the prior part. The function of the third hidden layer is to normalize the strengths of the rules. Next hidden layer is the place where the consequent parameters of the rule are concluded. Output layer estimates the total input as the incoming signals complete sum. ANFIS applies backpropagation learning algorithm in order to set parameters of the premise (to learn the parameters associated with membership functions) and least mean square estimation to determine the consequent parameters.

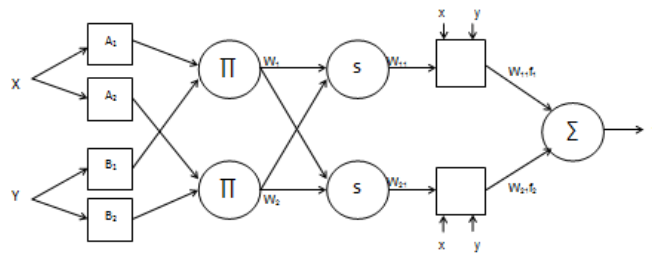


Figure 2: ANFIS architecture

6. PRINCIPAL COMPONENT ANALYSIS

The univariate statistical analysis, generally used to treat a large amount of data, could cause misunderstanding and error in the interpretation. In this paper, Principal Component Analysis (PCA) was used, in order to reduce the dimensionality problem. Highly dimensional data set is reduced by explaining the correlation amongst a large number of variables in terms of a smaller number of underlying factors (principal components or PCs) without losing much information (Beatriz et al, 2000).

In fact, PCA creates linear combinations of variables. The first linear combination of variables is adequate for the most of the variation in the sample; the second combination is used for the second largest amount of variance in a dimension and there is no dependence between the first and the second combination; and so on (Petroni & Braglia, 2000). One of the advantages of the PCA methodology is to be quite simple to exploit. The analysis that is illustrated in the following has been carried out by using the SPSS computer package.

7. RELATED WORK

ANFIS has been very popular in solving many problems of financial nature, especially the ones dealing with some kind of prediction. (Trinkle, 2005) successfully anticipates stock prices at U.S. Stock Exchange Trade and (Chang et al, 2011) use ANFIS for anticipating stock prices trends and (Schott & Kalita, 2011) apply time series trends to Tehran stock exchange by combining ANFIS with three neural networks. (Ansari et al, 2010) use ANFIS for prediction of patterns and for trading support in financial markets. Combining ANFIS with KERNEL algorithm (Efendigil et al, 2009) predict emergency orders to pre-adjust the available capacity and production plan. Using ANFIS, satisfactory results were obtained in prediction of annual profits. (Abraham et al, 2001) (Efendigil & Önut, 2012) used ANFIS for credit analysis.

(Bagheri et al, 2014) investigate the possibilities of particle swarm optimization (PSO) technique for determining the value of subtractive clustering parameters and ANFIS models for forecasting business failures based on five financial ratios. A new hybrid model that uses technical indicators as factors affecting the prediction and the use of three new methods (correlation matrix, subtractive clustering method and ANFIS) is proposed. (Melin et al, 2012).

8. MODEL DESCRIPTION

A credit score is a statistically derived numeric expression of a person's creditworthiness that is used by lenders to access the likelihood that a person will repay his or her debts. It is usually calculated using different complex statistical methods which require expert knowledge of financial concepts and elements that affect company's credit score. Knowing the disadvantages of the previously described approach, the idea of creating an ANFIS model for credit score calculation emerged as a logical response. In order to build the wanted system, the only necessary thing is an adequate database, while the system itself creates the neuro-fuzzy system that determines the credit score values. The experiment described in this paper is based on information regarding 150 companies settled in Serbia. All the information was obtained from Cube Risk Management Solution, a company that provides business information and credit risk services. The used database contains values of 23 financial ratios for each individual company for the period 2011-2013 and their credit score values in the same period.

Financial ratios represent relationships derived from a company's financial information and used for comparison purposes. In general, financial ratios can be divided into four main categories: profitability or return on investment, liquidity, leverage, and operating or efficiency, with several specific ratio calculations prescribed within each.

The main database provides information about following ratios: EBITDA margin, profit margin, net margin, return on assets, the operating cash flow ratio, quick ratio, return on equity, debt-to-equity ratio, fixed assets to equity ratio, long-term debt to total assets ratio, fixed assets to long-term liabilities ratio, amortization period for a loan, days sales outstanding, days payable outstanding, days inventory outstanding, cash conversion cycle, total assets turnover ratio, fixed assets turnover ratio, working capital turnover ratio, trend in income, EBITDA trend, working capital trend and short-term liability trend.

In order to reduce the dimensionality of the given data set and retain the most relevant information, the method of principal component analysis was applied.

8.1. Correlation between variables

PCA is based on the diagonalization of the correlation matrix. The observation of that matrix is useful because it can point out associations between variables that can show the global coherence of the data set (Beatriz et al, 2000). Table 1 shows the correlation matrix of the variables. Usually, significant correlations (at a P =0.05 level) are searched for. We can observe highest and positive correlations between credit score and six following ratios: net margin, profit margin, EBITDA margin, return on assets, the operating cash flow ratio and the quick ratio. Given correlation matrix shows that credit score is most correlated with EBITDA margin where the value of correlation coefficient is 0.529. In general, computed correlation indicates that the connection between credit score and presented financial ratios is not very strong.

Table 1: Correlation matrix

Ratio	1	2	3	4	5	6	7	8
1	1.000	0.913	0.732	0.578	0.336	0.382	0.423	0.529
2	0.913	1.000	0.846	0.620	0.386	0.394	0.436	0.497
3	0.732	0.846	1.000	0.683	0.410	0.474	0.518	0.490
4	0.578	0.620	0.683	1.000	0.761	0.223	0.229	0.465
5	0.336	0.386	0.410	0.761	1.000	0.049	0.068	0.183
6	0.382	0.394	0.474	0.223	0.049	1.000	0.909	0.222
7	0.423	0.436	0.518	0.229	0.068	0.909	1.000	0.201
8	0.529	0.497	0.490	0.465	0.183	0.222	0.201	1.000

1- EBITDA margin 2-Profit margin 3-Net margin 4- Return on assets 5- Return on equity 6- The quick ratio 7 -The operating cash flow ratio 8- Credit score

The main part of the PCA is creation of principal components. A rule-of-thumb for determining the number of components to extract is to consider the “eigenvalue greater than one” criterion (Petroni & Braglia, 2000).

In the present analysis, nine components are a workable solution (since the residual components have all eigenvalues less than 1). The first nine components account for approximately 75 percent of the total variance of the variables (Table 2).The percentage of variance explained by each component represents its relative importance.

Table 2: Total variance explained

Component	1	2	3	4	5	6	7	8	9
Initial Eigenvalues Total	4.702	2.788	2.286	2.078	1.773	1.289	1.131	1.051	1.016
% of Variance	19.591	11.618	9.526	8.658	7.388	5.371	4.712	4.380	4.232
Comulative %	19.591	31.208	40.735	49.393	56.781	62.152	66.864	71.244	75.476

Highest values of component loadings in each of the components, presented in the component matrix, belong to the following ratios respectively:

- **net margin** tells what percent of profit is made from sales (Griffin, 2009),
- **fixed assets to equity ratio** is computed by dividing the fixed assets by the company's equity,
- **the cash conversion cycle (CCC)** is a net time-interval between actual cash expenditures on purchase of productive resources and the ultimate recovery of cash receipts from product sales (Ortín-Ángel & Prior, 2004),
- **total assets turnover ratio** measures a firm's efficiency at using its assets in generating sales or revenue – the higher the number the better (Griffin, 2009),
- **the quick ratio** measures a company's ability to meet its short-term obligations with its most liquid assets by subtracting inventory from total current assets (Griffin, 2009),

- **days sales outstanding** (DSO) gives a measure of the number of days it takes for the company's inventory to turn over, i.e. to be converted to sales. (Marr, 2012)

trend in income, EBITDA trend, working capital trend.

The first six variables were kept as the result of the principal component analysis whose purpose was the optimal reduction of the data set.

After creating a new data set that contains companies' information expressed with seven financial ratios including the credit score, the created data set was used for preparing inputs for ANFIS.

8.2. Data

In order to perform the ANFIS analysis, Matlab R2011 software was used and its neuro-adaptive learning techniques incorporated in the `anfis` command provided by the Fuzzy Logic Toolbox. Fuzzy inference system is formed with the process of training, done on input data. As a result, a single output values is obtained which represents the value of company's data score based on given inputs. In the process of testing the new, unlabeled data, the final task is comparing whether the output corresponds to the output of given data set.

The training set included information from 2011 and 2012, which involved 300 records, and the testing was done for the period of 2013, which involved 150 records.

Considering the nature of the problem, fuzzy inference system parameters were set:

- For each input three membership functions were assigned
- Membership functions are generalized bell curve (`gbellmf`)
- Membership type of the output was selected to be a constant, which means we made zero-order Sugeno model.

One of the chosen parameters for training the network was the hybrid method of optimization, i.e. a combination of the backpropagation algorithm and the least squares method. The process of training is done into two phases. In the first phase, the least squares method is used for defining output membership functions which are positioned on the fourth layer of the ANFIS architecture model. In the second training phase, the backpropagation algorithm adjusts the parameters of input membership functions.

The data set was divided into two subsets, one for the training part and one for the testing part. This was done in order to enable neuro-fuzzy model testing. Training data set was used for network learning and adjusting weights in network, while testing data set was used to test if the network was properly formed, based on new, unlabeled data. Initial data set was split with the ratio 70:30.

8.3. The experiment and the results

The first set used for training in ANFIS contained six inputs (net margin, fixed assets to equity ratio, the cash conversion cycle, total assets turnover ratio, the quick ratio and days sales outstanding) and one output (credit score). Training the FIS required approximately 90 minutes to be done. After testing the FIS and plotting the results against training data, relative error, regarding measured and actual credit score values, was calculated. It is expressed in percents and its value is 6.13%.

The second set used for training contained five inputs (net margin, fixed assets to equity ratio, the cash conversion cycle, total assets turnover ratio and the quick ratio). Training of this FIS lasted approximately five minutes and the value of calculated relative error after testing the FIS was 6.73%.

Data set that included four inputs (net margin, fixed assets to equity ratio, the cash conversion cycle and total assets turnover ratio) was used for training that demanded approximately one minute to be finished. After testing the FIS using the data set with the same four inputs and their values for the different period (2013), the value of the relative error was 6.81%.

With the final reduction of the number of inputs, data set with three inputs (margin, fixed assets to equity ratio and the cash conversion cycle) was created and used for training the FIS. The process of training required less than a minute to be completed. The difference between measured and actual values of credit score values after testing the FIS, expressed by the relative error, was 7.14%.

Comparing the results represented by time needed for training and the relative error values after the process of testing, the conclusion is that values of the relative error increase by reducing the number of inputs in a data set. By increasing the number of inputs, number of corresponding fuzzy rules also increases, and consequently, the total amount of stored data grows larger which leads to more time required for training the system. The chosen combination and the most satisfying by means of time and error is the one regarding four inputs.

Considering that there are three membership functions for each input, regarding the chosen model with four inputs, that means that $4^4 = 256$ if-then rules are defined, and therefore 256 output membership function are defined, too. Inside the fifth layer, the output value is defined as a constant and it represents the value of credit score. The process of training was done after 20 epochs, and the built network included 193 nodes and 117 parameters.

Figure 3 shows the correspondance between the actual and the measured values of credit score through the epochs after the process of testing was done. The circular points in blue color represent the testing data output and the star points in red color represents the predicted outputs of the trained FIS.

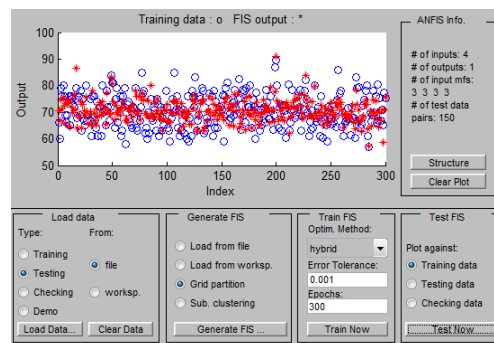


Figure 3: Testing error

The value of the relative error was not significantly increased in comparison to the error regarding the data set with five inputs. However, training required five times less time and that difference would be more evident for larger data sets. ANFIS model with three inputs completed its training process for significantly shorter period of time. However, the value of the relative error of the model is significantly higher, comparing to four-input model, for approximately 0.33% and that was the reason for not taking into consideration further input reduction.

9. CONCLUSION

Creditworthiness prediction is one of the most complex financial problems which commonly requires a thorough understanding of company's financial information and various statistical methods. Experts are always searching for simpler techniques that give satisfying results.

Neuro-fuzzy systems are used for exploiting the capacities of neural network learning in the best possible way in order to improve the fuzzy inference system performance. Additionally, fuzzy inference system represents the most important tool for modelling, based on the theory of fuzzy sets. The adaptive neuro-fuzzy inference system (ANFIS) is a good choice for modelling a system with already known inputs and outputs. Knowledge of the system and its processes is not necessary.

In this paper, authors formed an adaptive neuro-fuzzy inference system for determining credit score for 150 companies, based on values of financial ratios for a two-year period. The system was trained and tested. After doing a comparative analysis regarding system's performance by changing number of inputs i.e. ratios in the initial data set, it was concluded that data set with four inputs (net margin, fixed assets to equity ratio, the cash conversion cycle, total assets turnover ratio) gives the best results, by means of time needed, the amount of data and error in prediction. Hence, it can be concluded that ANFIS applied on the problem of creditworthiness assessment gives satisfying results in reasonable time.

In future work, it would be interesting to explore and apply other neuro-fuzzy models or different network learning algorithms in order to examine the possibility of obtaining more accurate results or less time for the process of training the network.

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OPTIMIZATION OF ATM CASH MANAGEMENT

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Abstract: *Having in mind recent financial crisis and liquidity shortages which banks have to face on regular basis, bank liquidity management has become one of the main concerns within this industry. Automated mathematical solutions accurately predict currency supply and demand and this may enable banks to reduce costs, especially costs of keeping significant exceptional sum of money in ATMs. In today's business environment which is characterized by tremendous competitiveness and globalization of business, cash management has become a critical success factor. Despite comprehensive literature reviews on similar topics, studies focused on cash management in ATMs in Serbia are still at the initial phase. This paper aims to decide on the optimal amount of money that will be placed in an ATM for minimizing opportunity costs as well as meeting clients' daily uncertain demands. The biggest challenge for this study is to calculate the amount of money that is sufficient to provide services to ATM customers and small enough to avoid any losses to the bank due to holding too much cash in the ATM. The study offers quality basis of information for banks and academics. The results we have obtained clearly show that the costs which arise when the ATM is filled to the optimal amounts of money are lower than those if the ATM is at full recommended value.*

Keywords: *Bank cash management, ATMs, optimization*

1. INTRODUCTION

Banks are nowadays willing to reduce liquidity tensions and optimize all functions having impact on liquidity management. Despite the fact that every model has its imperfections, banks put a lot effort to improve distribution channels in order to reduce liquidity tensions. In order to meet their customers' demand, banks have created extensive cash outlet networks, which consist of both bank branches and automatic teller machines (ATMs). ATM is a computerized telecommunication device that provides a financial institution's customers a method of financial transactions in public space without any human support needed (Simutis et al., 2015). Cash management in ATMs is certainly among activities that can make difference within tight competition in banking. Purpose of this paper is to decide on the optimal amount of money that will be placed in an ATM, which is placed within bank office, for minimizing opportunity costs as well as meeting clients' daily uncertain demand. The biggest challenge for this study is to calculate amount of money sufficient to provide service to ATM customers and small enough to avoid any losses to the bank due to the fact of holding too much cash in the ATM. This surplus could be used for generating money when invested in other bank products such as bills, certificates of deposits, commercial paper and any other money bank instruments.

Banks are now thinking from the customer's point of view and trying to bring most services door to door. Efficient bank cash management guarantees effective collection and payment technique, proper disbursements of free funds, and help for urgent cash requirement. The problem of cash management in automatic teller machines (ATMs) is similar to cash management in branches. These problems are characteristic for every bank and have to be analyzed according to future unknown probabilistic demand. In a very competitive bank market in Serbia, decision support systems for liquidity management activities in banking can make a significant difference within banks. In general, cash management in ATMs (and similarly in branches) is a well-known problem faced by any bank, hence worth researching.

This paper is structured as follows: in section 2, literature overview is presented; In section 3, cash management in ATMs is discussed; In section 4, methodology is defined; In section 5, some experimental results are presented and analyzed, followed by conclusions and future work.

2. LITERATURE OVERVIEW

Having in mind recent financial crisis and liquidity shortages which banks have to face on regular basis, bank liquidity management has become one of the main concerns within this industry. Numerous researchers have brought about significant improvements in cash management, which began by Baumol (1952) and

Tobin (1956), continued with Miller and Orr (1966) and more recently with Roman and Sargu (2014) who presented the research with the aim to evaluate the liquidity risk of banks operating in Bulgaria and Romania in the context of the EU affiliation process. The authors have investigated role and impact that a series of financial indicators for the capital adequacy, assets quality, management quality and profitability have on the liquidity risk of the banking institutions. Vuillemeys (2014) in his paper made a conclusion that the increase in banks' probabilities of default in most banking sectors in the Euro area during the latest financial crisis is mostly attributable to liquidity risk.

In addition, DeYoung and Jang (2015) have conducted research 'Do Banks Actively Manage their Liquidity?' Authors have been testing whether and how US commercial banks actively managed their liquidity positions between 1992 and 2012 and made conclusion that as banks increase in size, they set lower liquidity targets, but manage those targets more efficiently.

Ekinci et al. (2015) have been focused on one of the main banking goals: how to use fewer resources (e.g. cash kept in ATMs, trucks for loading cash, etc.) for meeting fluctuating customers' demands. Their article proposes grouping ATMs into nearby-location clusters and also optimizing aggregates of daily cash withdraws in order to minimize costs of replenishing cash, cash-interest charge and potential customer dissatisfaction. Venkatesh et al. (2014) have built a time series model for each ATM by analyzing prediction of cash demand for groups of ATMs with similar day-of-the week cash demand patterns. The main conclusion of their research is that the cluster wise cash demand forecast helps the bank's top management to design similar cash replenishment plans for all the ATMs in the same cluster. This means that banks can optimize operational costs geographical regions. Yan et al. (2015) have proposed a daily vehicle routing model for minimizing the total cost of replenishing inventory within a supply chain. Scholtz et al (2013) have done a case study for Orion in order to solve the cash management problems of ATMs with stochastic discrete-event simulation in retail banking. Their decision support system integrates four Operations Research methods: the vehicle routing problem, the continuous review policy for inventory management, the knapsack problem and stochastic, discrete-event simulation. The results have shown that the use of vehicle routing methods is especially useful when the bank has substantial control over transportation cost. According to Teddy and Ng (2011) conventional global learning computational intelligence models may not be efficient enough in order to record complex and time-varying characteristics of time series data. The authors have proposed a new model - cerebellar-inspired associative memory network, which can produce accurate forecasts of ATM cash demands.

On the basis of what we have described above, one may conclude that liquidity management is a very comprehensive topic, analysis of which may hugely contribute to health and quality of the overall banking sector. ATM cash management has been an integral part of bank management mechanism asking for a clearly defined steps aiming at enhancement. One approach to this problem solution will be elaborated on in the next part of this paper, nonetheless there are undoubtedly many research issues that would be worth analyzing in the future.

3. CASH MANAGEMENT IN ATMs

It is widely believed that advanced operational research methods can optimize demand forecasting and contribute to proactively currency management. Automated mathematical solutions accurately predict currency supply and demand and this may enable banks reduce costs, especially costs of keeping significant exceptional sum of money in ATMs.

Serving ATMs network takes employees' time to optimize the network and make decisions about cash management. Moreover, it involves high operating costs and needs proper currency management in order to avoid having cash in ATMs. In a very competitive market, banks are willing to provide the most efficient way for cash management. Transportation and servicing costs are of a great interest within banking industry. As previously said, banks can conduct work itself or they can hire companies specialized for money transportation and filling of ATMs. Either way banks need an effective tool that determines the lowest cost of distribution. These tools are based on accurate supply and demand forecasting and optimization procedures with the aim to lower operational expenses and enhance return on cash assets.

Historical demand by using data from actual cash-in transactions and cash-out transactions is a starting point for every research on cash management in ATMs. Only when precise currency demand is defined it is possible to create software for monitoring, management and optimization of the ATM network. It is very important to have in mind that demand depends on additional factors, such as paydays, holidays, and seasonal demand in a specific area. Analytical models should be developed according to experience of the bank's daily operations, as well as additional events that occur under certain conditions. Procedures to determine the optimal cash demand for each ATM is the same regardless of most known solutions for ATM

network cash management. Firstly, based on the daily cash demand, transport and money upload costs should be calculated. Usually cash drawings are subject to trends and generally follow weekly, monthly and annual cycles. It is noticed that people draw relatively large sums of cash at the beginning of each month as well as before Christmas. ATMs placed in shopping centers are mostly used on Fridays and Saturdays. During summer holidays drawing rates decline considerably.

4. METHODOLOGY

In this paper, we consider ATM Cash Management as a newsvendor problem i.e. single period stochastic inventory problem. The newsvendor problem is related to the situation in which a decision maker needs to order a quantity of some goods each day in the circumstances of uncertain demand (Phillips, 2005). Three main characteristics of the newsvendor problem are (Brandimarte & Zotteri, 2007): a) it observe single-product and single-period and single-echelon inventory problem; b) demand is uncertain and its distribution is known; c) the objective is to minimize expected overall costs consisting the excess costs and the shortage costs i.e. costs of purchasing too many and too few.

Considering the previous characteristics, replenishment of ATMs can be formulated as a newsvendor problem: decision makers need to determine an amount of single product - cash for ATM refilling each day; daily cash demand is uncertain; excess and shortage of cash in ATMs entail certain costs. In order to formulate ATM Cash Management as a newsvendor problem, the following notation will be used (Krcevinac et al, 2004; Shapiro & Dentcheva, 2014)):

- c_h - excess cost per units expressed through the opportunity costs;
- c_p - shortage cost per unit;
- x - daily cash demand;
- Q - amount of cash stocked in ATM.

Overall daily cost depending on daily demand and amount of cash in ATM can be expressed as:

$$C(Q, x) = c_h(Q - x)^+ + c_p(x - Q)^+ \quad (1)$$

where $(Q - x)^+ = \max\{(Q - x), 0\}$, $(x - Q)^+ = \max\{(x - Q), 0\}$.

Since cash demand is uncertain, the expected overall costs are:

$$c(Q) = E[C(Q, x)] = c_h \int_0^Q (Q - x)\varphi(x)dx + c_p \int_Q^\infty (x - Q)\varphi(x)dx \quad (2)$$

where $\varphi(x)$ is demand probability density function and $\Phi(x)$ is cumulative distribution on demand.

Optimal Q^* that minimize expected overall cost $C(Q)$ satisfies:

$$\Phi(Q^*) = \frac{c_p}{c_p + c_h} \quad (3)$$

Therefore, the goal is to find Q^* such that:

$$Q^* = \Phi^{-1}\left(\frac{c_p}{c_p + c_h}\right) \quad (4)$$

The main prerequisite for the application of the proposed approach is the existence of data about demand for cash in the previous period. If data is available, the methodology for optimal ATM Cash Management introduced in this paper can be conducted through the following steps:

1. Separation of demand by date and removing outliers from datasets. The assumption of the proposed methodology is that the cash demand is similar within the same date, notwithstanding the month. However, certain deviation can appear. For instance, demand might depend on additional factors, such as paydays, holidays, and seasonal demand in a specific area. Consequently, outliers should be removed from obtained datasets.
2. Grouping of data by average demand similarity.
3. Determination of the probability distribution of demand for each obtained data group.
4. Determination of the opportunity costs and shortage cost per unit.
5. Calculation of optimal using equation (4) the expected overall cost.

5. FINDINGS AND DISCUSSION

The model which is presented in this paper is tested against real data. The ATM, which was observed is located within the branch and current practice is that once per day the manager checks the status of the cash in the ATM. The manager devotes a part of their time to this activity and risks their own safety as well as the security of the money. As well, it was observed that there is a need for systematization, because there is the opportunity cost of holding excess cash. In addition, the bank has no record of the cost penalty in terms of the number of clients who were planning to withdraw money, but they could not due to lack of cash in the ATM. To always be on the safe side, banks deposit more cash than necessary in ATMs and thereby miss an opportunity to make a profit, in other words they have the opportunity costs of holding excess cash. To test the model we had data on demand from 1.1.2013 until 31.12.2015. The results are presented according to the steps described in the previous part of this paper.

5.1. Steps 1 – 3

After separating the demand by date and removing outliers, average demands by dates are obtained. The values shown in Figure 1 are expressed in thousands of RSD.

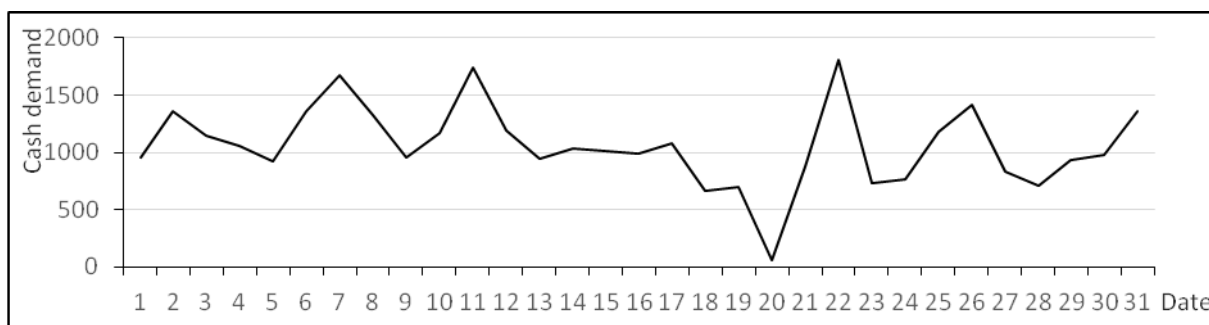


Figure 1: Average cash demands by dates

In an interview with bankers we came to the conclusion about the key dates for withdrawing money from ATMs 9 and 24, due to the pensions that were received on those days, as well as the salary received by the Serbian military on the 5th and 21st. In addition, the Serbian Ministry of Interior receives their salaries on the 10th and 25th of each month. The previous graph shows peaks in the average demand on those dates.

Based on the obtained average values and their similarities, six groups of dates are created. Dates that belong to each group as well as the average demands and demand probability density functions with corresponding parameters are listed in Table 1.

Table 1: Groups of dates and corresponding demand probability density functions

Group	Dates	Average	Probability distribution
1	7,11,22	1725.673	GenExtreme (0,02953; 493,26; 1426,1)
2	2,6,8,26,31	1392.737	Cauchy (295,47; 1361,7)
3	3,4,10,12,14,15,17,25	1102.875	Cauchy (644,6; 1155,6)
4	1,5,9,13,16,21,27,29,30	941.161	Cauchy (689,08; 946,34)
5	18,19,23,24,28	716.082	Frechet (0,27993; 0,82341; 0,49142)
6	20	57.386	Cauchy (0,0919; 0,77301)

5.2. Steps 4 and 5

Excess cost per units is expressed through the opportunity costs. Depending on the strategy of the bank, the most profitable form of investment of surplus cash is chosen. Some banks invest in over-night deposits, others lend cash to other banks, while some invest in government securities. After talking with experts from the bank we came to the conclusion that it would be optimal to use the value of the repo rate of the National Bank of Serbia as an opportunity cost, given that it is usually the rate used in pricing of deposits and loans.

The analysis of the average repo rate during the past year, the value for the parameter is estimated to be 0.0329. Since the shortage cost per unit could not be precisely determined, we examined two scenarios: the first one involves the same importance of excess and shortage of cash in ATMs while the second one considers the shortage more significantly than excess of cash. Scenarios characteristics are as follows:

- Scenario 1: $c_p = c_h = 0.0329$. By applying equation (3) it follows that $\Phi(Q^*) = 0.5$.
- Scenario 2: $c_p = 2 \cdot c_h = 0.0658$ and $\Phi(Q^*) = 0.6667$.

The optimal amounts of cash that should be stocked in an ATM are shown, each group of dates are calculated using equation (4) and based on corresponding probability function from Table 1. Summarized results are shown in Table 2 (expressed in thousands of RSD).

Table 2: Optimal amounts of cash for an ATM

Group	Q*	
	cp=ch	cp=2ch
1	1607.9	1877.5
2	1361.7	1532.3
3	1155.6	1527.8
4	946.34	1344.3
5	3.541	21.209
6	0.77301	0.82609

As expected, the obtained optimal amounts of cash are higher in the second scenario because higher shortage cost leads to higher probability of optimal amount and, consequently, higher optimal amount of cash for an ATM. Comparing these values with the average values from Table 1, it may be noted that the optimal values in the first scenario are mostly lower than average while those in the second scenario are higher than average.

In order to evaluate the proposed methodology, we have compared overall expected costs based on the optimal solution with overall costs caused by the application of the bank's replenishment policy. It is recommended for bankers to fill ATMs with 1.7 million RSD on weekdays and 2.5 million RSD on weekends. Since those amounts were determined based on historical data and insufficient analysis, we saw the space to create a model that would be able to more reliably predict the optimum quantity for refilling ATMs. Also, in order to compare the results in this paper we have used the recommended amount of 1.7 million RSD because the days of the weekend were excluded from the analysis. The ATM that we observed is distinctive because it is part of the branch that does not work on Sundays and Mondays.

Table 3 shows the overall expected costs for scenarios 1 and 2. Rows 1(opt) and 1(1700) are related to the Scenario 1 and give costs per group of dates and total costs if amounts of cash that should be stocked in an ATM were optimal and 1700, respectively. Rows 2(opt) and 2(1700) contain the same data for Scenario 2. Costs are calculated for each day of the entire period using the equation (1) and summarized by corresponding groups of dates.

Table 3: Overall expected costs

scenario	group						total
	1	2	3	4	5	6	
1 (opt)	857.606	1810.741	4871.345	5007.249	2661.637	33.611	15242.190
1 (1700)	867.934	2153.240	5852.324	6389.690	4519.970	972.756	20755.913
2 (opt)	1333.011	2622.292	6799.877	6638.002	5305.919	67.170	22766.272
2 (1700)	1325.129	2744.631	6980.933	7200.299	4950.999	972.756	24174.746

The same results are graphically presented in Figure 2.

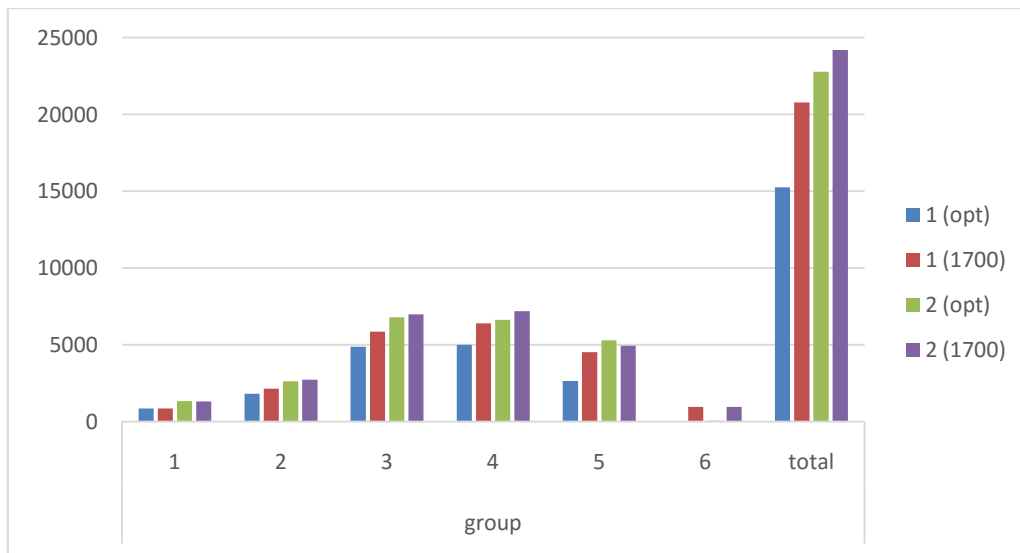


Figure 2: Overall expected costs comparison

In both variants it shows amount of cash that should be stocked in an ATM (optimal and 1700), the overall costs in Scenario 2 are higher than those in Scenario 1 due to the higher shortage costs. In addition, the optimal amounts of cash are higher. However, in both scenarios, the overall costs with optimal amounts are lower than corresponding costs with bank replenishment policy, separately per groups and in total. Furthermore, optimal costs in Scenario 2 – 2(opt) are not significantly higher than the bank policy cost in Scenario 1 – 1(1700) although they have higher shortage cost. The results show that it is better to stock the ATM with the amount of cash corresponding to the expected demand for that date than the same amount every day. The selection of scenarios that will be applied depends on the attitude of decision makers to the excess and shortage of cash in the ATM.

6. CONCLUSION

On the basis of what we have described above, one may conclude that liquidity management is a very comprehensive topic, analysis of which may hugely contribute to health and quality of the overall banking sector. ATM cash management has been an integral part of the bank management mechanism asking for clearly defined steps aiming at enhancement.

The purpose of this paper is to decide on the optimal amount of money that will be placed in an ATM for minimizing opportunity costs as well as meeting clients' daily uncertain demands. The biggest challenge for this study is to calculate the amount of money that is sufficient to provide services to ATM customers and small enough to avoid any losses to the bank due to the fact of holding too much cash in the ATM. The study offers quality basis of information for banks and academics. The results we obtained clearly show that the costs which arise when the cash dispenser is filled to optimal amounts of money is less than the costs that arise if the ATM is at full recommended value of 1.7 million RSD. The selection of scenarios that will be applied depends on the attitude of decision makers to the excess and shortage of cash in the ATM. The conclusion of the investigations show that improving systems and procedures in the bank should be worked on.

The study incorporates both quantitative and qualitative data on cash management for ATMs, the basic limitations are related to the assumptions that we have made in terms of opportunity cost and shortage cost of cash in the ATM. In addition, the test model used is one particular bank ATM. However, the limitation of the analysis provide interesting research directions to further investigate models for improving cash management in ATMs. The models for cash management in ATMs can be extended in several ways to fit the particular banking reality. For example, the model could be applied to different ATMs in order to observe the group results and the results of each ATM. Moreover, more attention can be devoted to the cost structure, which was analyzed in terms of representation of the various opportunity costs and shortage costs that arise if there is insufficient cash in an ATM.

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DRIVERS OF HOTEL PROFIT MARGINS: A STUDY OF THE BELGRADE HOTEL SECTOR

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Abstract: *Tourism and hospitality have received an immense attention from scholars, policy holders, decision makers and other important stakeholders in Belgrade, a main tourist destination of Serbia. The aim of this paper is to analyze different drivers of profitability, such as size, market concentration, market share and customer perception, that affect the profitability of hotels in Belgrade. The results indicate that customer perception is a paramount factor driving the financial performance of hotels.*

Keywords: *profit margin, hotels, customer perception, Belgrade*

1. INTRODUCTION

Tourism and hospitality industry has been highly on the agenda of policy holders and decision makers in Serbia (Milosavljević, Milanović & Benković, 2015), particularly in Belgrade as it accounts for the majority of arrivals and nights of tourists in Serbia. The rationale for this is the high impact of tourism to the economic development of the Belgrade region and the economy as a whole. Academic publications almost equally intensively elaborate on the importance of tourism, the sources of development, the features of processes in the industry and its economic effects (Dimitrovski, Todorović & Valjarević, 2012; Mulec & Wise, 2013). However, there is a paucity of scholarly contribution to the origins of financial performance of the Belgrade's hotel sector, and the main drivers of its profitability.

This research gap sets a scene for the main aim of this paper. The aim is to analyze different drivers of profitability, such as size, market concentration, market share and customer perception, that affect the profitability of hotels in Belgrade. In particular, the study aims to test the influence of 10 different factors to determine their correlation to the hotels' financial performance, and

The studies of this kind are a hot topic in academic and practitioners' publications. For instance, Ben Aissa & Goaid (2016) empirically tested the main determinants of 27 Tunisian hotels. Lado-Sestayo et al. (2016) conducted a study encompassing nearly 9000 hotels in Spain to test the impact of location on profitability in the Spanish hotel sector. However, the originality of this study is based on two important pillars. Firstly, to the best of authors' knowledge, the study is unique in this geographical region. Some aspects of the Belgrade hotel sector, such as the change in offer have been discussed in the extant literature (Šimičević & Štetić, 2015), but non of the papers dealt with the profitability of the sector. Secondly, the study is unique in the developed set of indicators selected as the main drivers of profitability

The remainder of the paper is organized as follows. Section 2 deals with theoretical background. Particular emphasis is given to the business case for hotel industry in Belgrade. Section 3 elaborates on the methodology used in the study. Section 4 depicts the results and discusses the main findings. Section 5 provides concluding remarks, dealing with the resume of key findings, managerial and other implications, limitations and further recommendations.

2. THEORETICAL BACKGROUND

2.1. Profitability drivers in hotel industry

Profitability drivers are frequently elaborated in the extant literature. Ever since the pioneering attempts of Kotas (1982), Sheldon (1983) and Croston (1995) researches have been examining various determinants of profitability striving to find the best methodology for analysis of financial operations and appropriate business strategy. Currently, several streams of publications regarding the set of variables selected as the main determinants of profitability are specifically important.

The first stream are scholarly publications emphasizing the importance of market power, location and concentration. Singh & Dev (2015) have analyzed hotels as winners and losers in the aftermath of the recession, suggesting that marketing expenses play an important role in financial success. Lado-Sestayo et al. (2015) explored the influence of location, market power and other factors to the profitability of the Spanish hotel sector. They find that profitability depends largely on the market structure and the level of demand of the tourist destination.

The second stream are the papers dealing with operational and financial efficiency. Zeglat (2008) finds that profitability is positively influenced by sales growth, as a consequence of customer retention, and negatively influenced by premium price by analyzing the UK hotel sector. Chiu and Huang (2011) analyzed the effects of occupancy rate and operational efficiency on profitability of Taiwanese hotels and found that occupancy rate and increase in sales are not the best way to increase financial performance. This is not in line with the main findings of O'Neill & Ma. Instead, they suggested optimal occupancy rate and focus on operational efficiency. Another study from the same country deals with the effects of service quality, and indicates that, for instance, food and beverage quality has non-linear relationship with profitability (Chen & Lin, 2012). In the example of Croatian hotel industry, Škuflić & Mlinarić (2015) find that size, concentration, liquidity, solvency and productivity significantly affect hotel profitability.

The third stream are studies examining the role of online hotel presence and the effects of social media on hotel performances. The results are to some extent adverse. For instance, Neirotti, Raguseo, & Paolucci (2016) find that the increasing importance of user-generated reviews in online communities for tourists is “shifting hotel competition from unit profit margin to volumes and to higher room occupancy rates, with online retailers capturing most of the value created in online transactions through social media features and with a limited effect brought on net profitability”. Using a more sophisticated approach of neural networks, Phillips et al. (2015) the interactive effects of online reviews on the determinants of Swiss hotel performance, finding a positive effect of four nodes to a hotel performance.

Some studies do not fit into this three-stream pattern. Certain studies address macroeconomic features and their influence over the profitability (Pan, 2005). On the other side, a broad body of evidence takes into consideration the human factor as an important pillar of the profitability. For instance, Morey & Ditman (1995) examined the effects of general managers efficiency to the hotel profitability. Finally, profitability is examined through the prism of long term yields generated from the adequate customer profitability analysis (Noone & Griffin, 1999).

2.2. A short business case for hotel sector in Belgrade

Belgrade accounts for more than a third of all tourist capacities of Serbia, which puts a spotlight to the importance of this industry to the total economic output of the country. Belgrade is the most important tourist destination in Serbia. The following figures illustrate the portion of total arrivals and nights of tourist in Serbia and in Belgrade in specific (RZS, 2015).

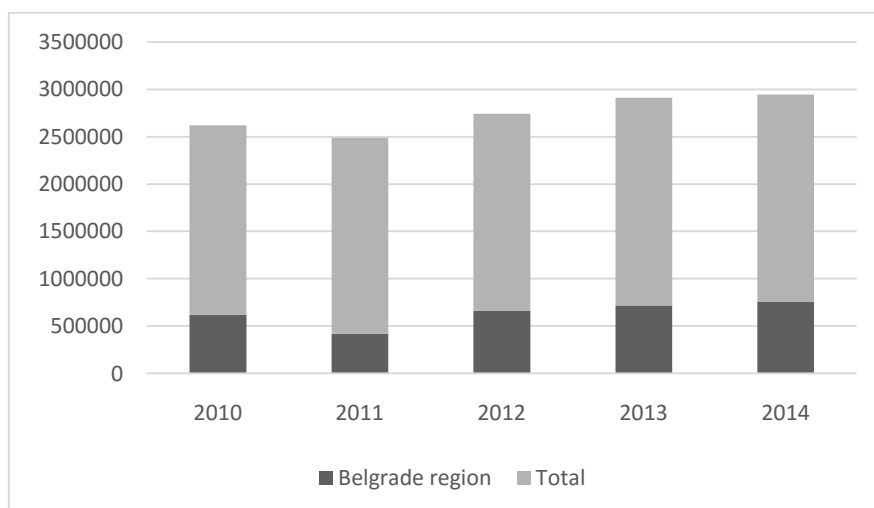


Figure 1: Total arrivals of tourists in Serbia and in Belgrade

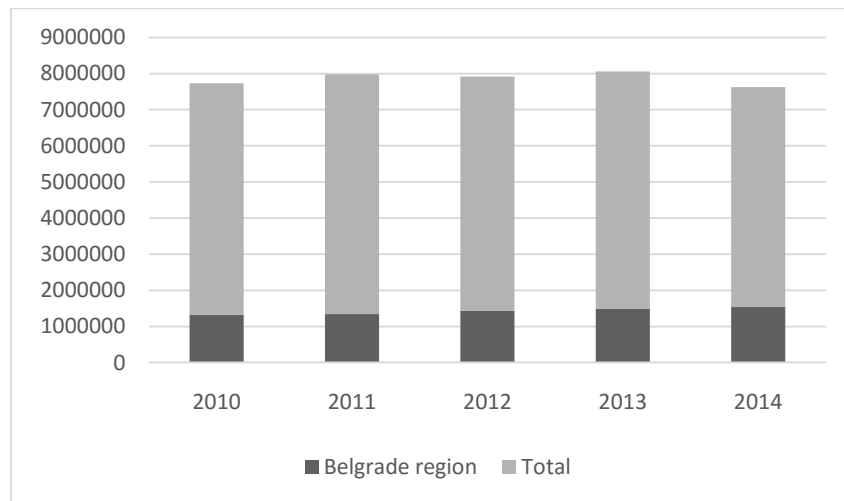


Figure 2: Total nights of tourists in Serbia and in Belgrade

According to Horwath (2015), internationalization of the demand profile is evident, followed by permanent increase in the relative share of foreign hotel overnights in total overnights. This study points out the international demand as a primary source of demand for Belgrade hotels, with annual growth rate of 10% (2009-2014).

3. METHODOLOGY

3.1. Variables

The study used one dependent and 10 independent variables. They are summarized in the table below:

Table 1: Variables, variable type, indicators, calculations and hypothesized influence over dependent variable

Variable	Type	Indicator	Calculation	Hypothesized influence (+/-)
Hotel profitability	Dependent	Profit margin	EBIT/Revenue	n/a
Location	Independent	Distance from three focal points – city center, central bus station and airport	$(D_{cen} + D_{bus} + D_{air})/3$	+
Market power	Independent	Market share (revenue based)	Net revenue for a hotel/Total revenue for industry	+
Economy of scales	Independent	Size	Natural logarithm of hotel assets	+
Financial structure	Independent	Financial leverage	Liabilities/Equity	-
Social reach	Independent	Social media reach	No of Facebook page likes	+
Customer satisfaction	Independent	Aggregate hotel ranking	Booking.com ranking	+
Word-of-mouth	Independent	Net promoter score	Highest to lowest ranks of customers	+
Margins	Independent	Net margin	Net income/Revenue	+
Capacity	Independent	Total accommodation share	No of beds of a hotel/No of beds of all hotels	+
Hotel rating	Independent	Category of a hotel	No of stars	+

3.2. Sampling and data collection

The study examined 42 hotels located in the city area of Belgrade. The sample was randomly generated from the total of 530 hotels.

The study is based on secondary data collected from different reliable sources. Financial data (assets, operating revenues, operating income, net income, liabilities, equity, average number of employees, foundation date) were retrieved from the Serbian Agency for Business Registers. These data refer to the year 2014. The data on the location and the distance from three aforementioned focal points were generated from Google Maps. The data on customer satisfaction were retrieved from the *booking.com* online service for hotel bookings and rankings, where the scores from 1 to 10 assigned by hotel customers were used as an input. Social media reach as an important variable for this study was analyzed through the usage of Facebook. The data on number of hotel Facebook page likes and scores from 1 to 5 awarded by page visitors were collected. The data on number of available beds and rooms were retrieved from hotels official websites and Tourist organization of Belgrade. Hotel ranking, reputation and luxury were measured by number of stars retrieved from Tourist organization of Belgrade. Foundation dates were collected on hotel official websites.

3.3 Data analysis

After filtering the collected data, the lack of data on booking.com scores for several hotels was noticed. The software Orange Canvas was used to replace the missing values with the average value of the booking.com scores available for other hotels. Furthermore, Orange algorithm recognized few outliers and excluded them from database before proceeding with analysis. Due to perceived anomalies, the data on hotels Constantine The Great and Zepter were also excluded. Finally, statistical analysis of refined data was conducted through SPSS software.

4. RESULTS AND DISCUSSION

4.1. Descriptive statistics

The following table displays the descriptive statistics: means and standard deviation for 37 observed hotels.

Table 2: Descriptive statistics

	Mean	Std. Deviation
Profit margin (%)	1.02711	31.693632
Average distance (km)	8.67805	3.206473
Market share (%)	2.30195	2.296098
LN(assets) (#)	19.77232	1.521281
Financial leverage (#)	8.144443	92.881617
No of Facebook likes (#)	3812.19	6449.961
Average score on Booking (#)	8.308	.8855
Net Promoter Score (%)	55.23511	28.186677
Net margin (%)	-11.57597	48.096229
Accommodation capacity (%)	2.00535	1.499629
Number of stars (#)	3.68	.626

4.2. Hypotheses testing

In order to test the hypotheses the study employed correlation analysis (Pearson moment two-tailed correlation) and multiple regression. Correlation analysis is performed as a preliminary analysis in order to assess the strength of relationships among the variables in the study. The results of correlation analysis are displayed in the following table. The correlation coefficients reflected low to medium values and therefore did not indicate a potential multicollinearity among variables.

Table 3: Correlation matrix

	Profit margin (%)	Average distance (km)	Market share (%)	LN(assets) (#)	Financial leverage (#)	No of Facebook likes (#)	Avg. scr. on booking.com (#)	Net Promoter Score (%)	Net margin (%)	Accommodation capacity (%)	Number of stars (#)
Profit margin (%)	1.000	.040	.212	-.013**	.006**	.102	.788	.367	.634	.082	.438
Average distance (km)	.040*	1.000	.008**	-.271**	-.080**	-.236**	.037*	.284	.024*	-.152**	-.151**
Market share (%)	.212	.008	1.000	.556	.023	.389	.277	.011*	.107	.338	.400
LN(assets) (#)	-.013**	-.271**	.556	1.000	-.260**	.307	.138	-.217**	.073	.410	.445
Financial leverage (#)	.006**	-.080**	.023*	-.260**	1.000	.225	.051	.014*	.201	.001**	-.194**
No of Facebook likes (#)	.102	-.236**	.389	.307	.225	1.000	.281	-.304**	.143	.300	.320
Avg.scr. on Booking (#)	.788	.037*	.277	.138	.051	.281	1.000	.204	.535	.009**	.561
Net Promoter Score (%)	.367	.284	.014*	-.217**	.014*	-.304**	.204	1.000	.501	-.116**	-.036**
Net margin (%)	.634	.024*	.107	-.073**	.201	.143	.535	.501	1.000	.149	.126
Accomm. capacity (%)	.082	-.152**	.338	.410	.001**	.300	.009**	-.116**	.149	1.000	.169
Number of stars (#)	.438	-.151**	.400	.445	-.194**	.320	.561	.036*	.126	.0169*	1.000

The correlation matrix shows the highest correlation of average score on Booking to profit margin. The results of employed t-test underlines this variable as the only statistically significant variable for profit margin. The next variable according to the value of correlation coefficient is net margin, followed by number of stars, implying that hotels with higher ranking, reputation and luxury generates higher profit margin. The analysis of correlation between independent variables shows that the most correlated variables are number of stars and average score on Booking, with the value of correlation coefficient 0.634. The correlation of LN(assets) to market share (0.556) confirms that hotels that achieve economies of scale take greater market share.

Table 4: Regression model and ANOVA

Regression model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error			
1	Constant	-112.747	70.341		-1.603	.121
	Average distance (km)	-.729	1.128	-.074	-.646	.524
	Market share (%)	1.490	1.900	.108	.784	.440
	LN(assets) (#)	-4.739	3.094	-.227	-1.531	.138
	Financial leverage (#)	-.032	.040	-.095	-.814	.423
	No of Facebook likes (#)	-0.001	.001	-.126	-.964	.344
	Avg. scr. on booking.com (#)	22.364	5.538	.625	4.038	.000
	Net Promoter Score (%)	.074	.153	.066	.484	.632
	Net margin (%)	.163	.099	.247	1.639	.113
	Accommodation capacity (%)	2.382	2.508	.113	.950	.351
	Number of stars (#)	5.496	7.284	.109	.754	.457
Dependent Variable: Profit margin (%)						
ANOVA		Sum of Squares	df	Mean Square	F	Sig.
Regression		26723.265	10	2672.326	7.362	.000 ^p
Residual		9438.243	26	363.009		
Total		36161.507	36			
Dependent Variable: Profit margin (%)						
Predictors (Constant), Number of stars (#), Net Promoter Score (%), Financial leverage (#), Accommodation capacity (%), Average distance (km), Market share (%), Net margin (%), No of Facebook likes (#), LN(assets) (#), Avg.scr. on booking.com (#)						

Regression model is validated through F-test. Null hypothesis implies that linear regression model is not statistically significant, and alternative hypothesis implies that this model is statistically significant. The result

of F-test $F = 7,362$ and $p < 0,001$ indicates that null hypothesis is accepted, meaning that overall linear regression model is statistically significant.

Average distance. The initial hypothesis: There is a negative relationship between average distance and profit margin. Average distance variable should influence the decision of tourist/customer to choose particular hotel according to the amount of time needed to get to the city's most important focal points (city center, central bus station and airport). Hotels with smaller average distance have higher occupancy rates, which could lead to higher profit margin. The result of t-test $t = -0,646$ and $Sig = 0,524$ indicates that this variable is not statistically significant for profit margin.

Market share. The initial hypothesis: There is a positive relationship between market share and profit margin. The assumption is that hotels with higher market share are more recognizable by the tourists, which could increase their profit margins. However, the result of t-test $t = 0,784$ and $Sig = 0,440$ indicates that market share is not statistically significant for profit margin.

LN (assets). The initial hypothesis: There is a positive relationship between hotel size and profit margin. Hotels with higher value of LN(assets) achieve economies of scale and reduce expenses, which increases their profit margins. The result of t-test $t = -1,531$ uz $Sig = 0,138$ indicates that this variable is not statistically significant for profit margin.

Financial Leverage. The initial hypothesis: There is a negative relationship between financial leverage and profit margin. It is assumed that hotels with lower financial leverage are more efficient, which could lead to higher profit margins. The result of t-test $t = -0,814$ and $Sig = 0,423$ indicates that this variable is not statistically significant for profit margin.

Social media reach. The initial hypothesis: There is a positive relationship between number of Facebook likes and profit margin. The number of likes on social networks indicates how particular hotel is popular among customers. Higher number of likes and followers increases the potential of a hotel to be chosen by tourists as a place to stay. Consequently, this could lead to higher profit margins. The result of t-test uz $Sig = 0,524$ shows that this variable is not statistically significant for profit margin.

Aggregate hotel ranking. The initial hypothesis: There is a positive relationship between average score on booking.com and profit margin. Higher average score shows higher popularity among tourists and higher customer satisfaction and potentially attract more hotel guests, which can consequently increase profit margins. However, the result of t-test $t = 4,038$ uz $Sig = 0,000$ indicates that this variable is statistically significant for profit margin.

Net Promoter Score: The initial hypothesis: There is a positive relationship between Net Promoting Score and profit margin. Net Promoting Score is marketing metrics that indirectly shows word-of-mouth effect achieved by certain hotel. Higher score indicates significant difference between respondents who recommend certain hotel and those who would not recommend it. This could lead to higher profit margins, but the result of t-test $t = 0,484$ and $Sig = 0,632$ shows that Net Promoting Score is not statistically significant for profit margin.

Net margin. The initial hypothesis: There is a positive relationship between net margin and profit margin. According to the result of t-test $t = 1,639$ and $Sig = 0,113$, this variable is not statistically significant for profit margin.

Accommodation capacity: The initial hypothesis: There is a positive relationship between accommodation capacity and profit margin. Hotels with high accommodation capacity could take advantages of economies of scale and consequently increase profit margin. The result of t-test $t = 0,950$ uz $Sig = 0,351$ indicates that accommodation capacity is not statistically significant for profit margin.

Category of hotel. The initial hypothesis: There is a positive relationship between category of hotel and profit margin. Number of stars reflects hotel's ranking, reputation and luxury. Hotels with high ranking should attract more tourists and consequently increase profit margin. According to the result of t-test $t = 0,754$ and $p > 0,05$, this variable is not statistically significant for profit margin.

5. CONCLUSIONS

This paper aimed to determine the main drivers of profit margins of the Belgrade hotel sector. As the results indicate the main profit margin driver is the previous customer satisfaction with hotel services As for the

contribution to the theory and practice of hotel management, this study has twofold implications. Firstly, the study contributes to the practice of hotel management as it empirically confirms that consumers and their opinions is the utter factor that adds financial value to a hotel sector. Accordingly, the efforts of decision makers in hotels should be placed to the online reputation creation. As the results of statistical analysis indicate, the only variable that is statistically significant for profit margin is average score on booking.com, so it is recommended to make the effort to increase the rankings on booking.com. The average score on booking.com is composed by the following elements: cleanliness, location, staff, free wi-fi, comfort, additional facilities, and price-quality relation. Hotels should strive to set higher hygiene standards, improve wireless network performance, and to employ HR training and development programs in the field of customer relationship management. Significant attention should be paid to tracking and in-depth analysis of customers comments on websites booking.com and tripadvisor.com, and official Facebook pages. This analysis provides the information on the level of customer satisfaction and necessity of additional facilities and services provision. Timely identification of negative customer feedback enables hotels to fix their internal processes in order to prevent negative impact on their image and reputation. This is why these comments should be carefully tracked and responded to by a professional, regardless whether they have a positive or negative connotation.

Secondly, the paper has implications to other researchers in the field. Although the study did not cover all possible drivers of profit margins, it is important to path the way for further research in the area of hospitality industry. The study has some major limitations, both fundamental and technical. Fundamental limitations are linked to the set of variables used in the study. Accordingly, a recommendation for further research is to encompass a wider set of variables and statistically tested and refined indicators. Technical limitations are based on the sample size, timeframe, and the techniques used for the analysis. The sample size is rather small, and this study should be viewed as an ongoing project. This study is cross-sectional and based on the data from 2014. Further studies should apply time series and capture the evolutionary features of the hotel profitability in Belgrade. Finally, as all the other quantitative studies, this study has some technical flaws. Further studies should conceptualize on qualitative aspects of the topic covered and include a mixed-method approach in the analysis. Accordingly, the success on this intensively competitive market in digital era should not and can not be based solely on improvements of offline aspects of hotel industry. Hotels must focus their efforts on improving online appearance and digital reputation management.

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PROTECTION OF INTELLECTUAL PROPERTY RIGHTS - WHAT DO FINANCIAL REPORTS SAY?

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Abstract: *Given the increasing importance of non-material assets, or intangibles, and the limitations which make their recognition difficult, traditional financial statements often fail to capture the value drivers that determine the market value of the companies. Although patents, trademarks, industrial designs and other intellectual property rights belong to the intangible assets in financial reports, the reports often do not separate these rights and, therefore, they are not adequately valued as a part of the companies' market value. We suggest that the change in the number of filed intellectual property rights application by companies should reflect the alteration of the share of intangible assets in the financial reports of the same companies. The methodology included quantitative and qualitative research method based on a survey, while the data has been statistically analyzed with the use of analysis of variance and chi-square tests. The findings suggest that the increased filing of intellectual property rights does not significantly affect reporting on intangible assets in financial reports of companies from technology-intensive industries in Serbia.*

Keywords: *intellectual property, intangible assets, intellectual capital, patents, trademarks*

1. INTRODUCTION

Financial reporting of intangible assets of companies is under increased focus in the last decades. Intangible assets are considered to be among the key factors of success for any company, both at present and in future (Álvarez Villanueva, 2011). It is generally understood that the biggest share of the modern company's market value lies in its non-material property, or intangible assets. Hulten and Hao (2008) state that intangible assets stand as one of the possible contributors to the disparity between market and book values of companies, and that market capitalization should reflect the value of intangible assets. Therefore, any decision on merger or acquisition, or on any big transaction between companies, require serious and detailed analysis of the intangible side of the companies in stake. Also, the relatively recent growth of the service sector and of information technology-related businesses, along with the dramatic increase in the number and size of international mergers and acquisitions, has made accounting for intangible assets highly significant (Lev, 2001; Saudagaran, 2001). An intangible asset is a claim to future benefits that does not have a physical (e.g., building or equipment) or financial (e.g., stock or bond) embodiment (Lev, 2001). For example, patents, brand names, and unique organizational infrastructures that generate cost savings for companies can be defined as intangibles (Kang and Gray, 2011). Currently, there are few comprehensive guidelines for corporations in either International Financial Reporting Standards (IFRS) or in U.S. GAAP on how to report IA, other than for purchased goodwill and development costs, in company financial statements. In other words, while the importance and the necessity of intangible assets in creating and maintaining corporate value have been widely accepted, traditional financial reporting frameworks unfortunately do not capture many of these value drivers (Jenkins and Upton, 2001; Upton, 2001; Lev and Zarowin, 1999). The reasons for that are "non-physical" nature of intangible assets and the uncertainties associated with their future benefits. However, it is clear that intangible assets in financial reports should include all intellectual property types which company possesses (as stipulated in the *International Accounting Standard 38 - Intangible Assets*). In this paper, we analyze how the applications for patents, trademarks and industrial designs, which are among the most commonly used intellectual property rights for achieving market competitiveness, are related to the reported intangible assets section of companies' financial reports.

A patent protects an invention which is new, involves an inventive step and is susceptible of industrial application. Patent applications have been frequently used as an innovation indicator on both micro and macro level. On the micro level, patenting is not carried out only for the reason of profiting from a patented

innovation through either its commercialization or licensing, but also for strategic reasons, one of which is the increase in negotiation power through increasing the value of intangible assets (Cohen et al., 2000). Evidence shows that patents very often play a critical role in creating competitive advantage of companies (Kollmer and Dowling, 2004; Giuri et al., 2005). Therefore, patents are considered to positively affect how owners and a stock market value the potential of companies through intangible assets (Fukugawa, 2012).

Trademark is the right that protects a mark used in the course of trade to distinguish goods and/or services of one natural or legal person from identical or similar goods and/or services of another natural or legal person. Regarding trademarks, Block et al., (2015) suggests that seeking trademark protection is of significant importance to small and medium-sized enterprises (SMEs) with orientation towards innovation, especially due to scarce resources which are usually a burden for smaller companies. Trademark registration is characterized as inexpensive and less complexed than patenting and, as such, serves as an important appropriation function for SMEs which are interested in using intellectual property rights (Block et al., 2015). Furthermore, trademarks are seen as supplementary tools in negotiations for licensing and other means of product or service commercialization. They can strengthen the negotiating position of companies and they also have the ability to provide assurances on quality (Srinivasan et al., 2008; Block et al., 2014). The literature also suggests that trademarks are complementary to patents and that the two are used in conjunction with each other to offer more complete protection of IP assets (Blind et al., 2006; Thomä and Bizer, 2013). Trademarks may also play an important role in the appropriation of innovation rents by SMEs (e.g., Helmers and Rogers, 2010; Flikkema et al., 2014). The effects of trademarks on firms' market values have been analyzed by Sandner and Block (2011), who observed that trademarks have a positive effect on firm market value. Similar results are reported by Fosfuri and Giarratana (2009). Greenhalgh and Rogers (2012) studied the relationship between trademarks and market values of service and manufacturing firms and concluded that trademarks have a greater effect on the market values of the former than of the latter.

Finally, industrial designs are the third most common industrial property right, which provide their holders with the 25-year long monopoly (in most countries) for commercialization and prevention of use by third parties. Industrial designs are also considered an indicator of innovativeness, as they have to fulfill the requirement of global novelty as the most important requirement. Also, in some sectors, such as lighting, industrial designs are more frequently used as the IPR protection strategy than, for example, patents, due to their aesthetic characteristics. Therefore, industrial design applications are also considered as the driver of the value of intangible assets of companies.

Based on these findings, we suggest that increased orientation to patent, trademark and industrial design protection should lead to higher shares of intangible assets in companies' financial statements. We used indicators of patent applications, trademark applications and industrial design applications as variables in the analysis.

2. METHODOLOGY

In order to analyze the relationship between the filing of intellectual property rights and the reporting of intangible assets as the share of the value of total assets of companies, we have selected 29 companies from technology-intensive industries in Serbia. The selected companies are operating in the pharmaceutical industry, chemical industry, civil engineering, IT and telecommunications, and electrical equipment manufacturing. The value of reported intangible assets of companies within their total assets value reported has been taken from the mandatory financial reports open to the public and given in the database of enterprises by the Serbian Business Registers Agency (available at www.apr.gov.rs).

For the purpose of the analysis, the data had to be normalized. In this regard, companies where the share of intangible assets was below 5% of the total assets value, the intangible assets level attributed to these companies was 0. Where this share was between 6 and 15%, the given mark was 1, while for the range between 16 and 25%, the mark was 2. The threshold for the maximum mark of 3 was at least 25%. Normalization of application for intellectual property rights has been done in a similar way. The companies who applied for only one patent/trademark/industrial design, received the mark of 1 for that intellectual property right. Where the number of applications was between 2 and 5, the mark was 2, while the maximum mark of 3 was given to companies where the number of applications for a particular intellectual property right was at least 6. Where there were no intellectual property rights filings, the company received 0 mark for that intellectual property right. The reason behind this normalization of scores is that the company who filed more than 5 applications of a particular IP right can be identified as an entity which has elements of strategic IPR management in its business.

In the final step, the comparison of the level of filing of intellectual property rights with the indicator of intangible assets share of companies has been carried out, in order to determine if there a significant interdependence of the variables. The comparison was performed with the statistical test by using analysis of variance (ANOVA) and by cross tabulation with the Chi-Square tests statistical method by using the SPSS software. Such tests were carried out having in mind that the analysis of variance (ANOVA) is normally used to determine whether there are any significant differences between the means of independent groups, while crosstabulation generates information about bivariate relationships.

3. RESULTS

Based on the analysis regarding filing intellectual property rights, total of 27.59% of analyzed companies filed at least two types of intellectual property rights which are still under IPR protection, while slightly higher portion of 31% companies filed none. Only 13.79% of companies have all three types of intellectual property rights filed and valid. Concerning particular intellectual property rights, trademark applications are dominant with 62.07% of companies filing trademark applications, 27.59% of analyzed companies filed patent applications, and 20.69% filed industrial design applications. Regarding intangible assets value share, only 31% of companies had the portion of intangible assets within the total assets value higher than 5%.

The statistical analysis with the application of cross tabulation with the Chi-Square tests has been applied to the intangible assets value and the filing of all three types of intellectual property rights separately in order to describe the relationship between these variables. The following three tables provide results from the analysis.

Table 1: Chi-Square Tests – Trademark applications/Portion of IA in total assets

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	6,638a	6	,356
Likelihood Ratio	5,428	6	,490
Linear-by-Linear Association	3,268	1	,071
N of Valid Cases	29		

a. 10 cells (83,3%) have expected count less than 5. The minimum expected count is ,17.

Table 2: Chi-Square Tests – Industrial design applications/Portion of IA in total assets

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	15,671a	6	,016
Likelihood Ratio	7,788	6	,254
Linear-by-Linear Association	3,328	1	,068
N of Valid Cases	29		

a. 10 cells (83,3%) have expected count less than 5. The minimum expected count is ,07.

Table 3: Chi-Square Tests – Patent applications/Portion of IA in total assets

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3,420a	6	,755
Likelihood Ratio	3,816	6	,702
Linear-by-Linear Association	,040	1	,841
N of Valid Cases	29		

a. 10 cells (83,3%) have expected count less than 5. The minimum expected count is ,07.

Based on the likelihood ratio values of 0.490, 0.254 and 0.702 respectively, the analysis revealed that no significant interdependence has been found between the applications for intellectual property rights and the portion of intangible assets reported as the share of the total assets value by companies. Therefore, we assume that the increased filing of intellectual property rights does not significantly affects the increase in the reporting on intangible assets share in financial statements of companies in technology-intensive industries in Serbia.

The same evidence could be found from the ANOVA analysis, as shown in the following table.

Table 4: ANOVA – Filing of IP rights

		Sum of Squares	df	Mean Square	F	Sig.
Trademarks	Between Groups	4,424	2	2,212	1,813	,183
	Within Groups	31,714	26	1,220		
	Total	36,138	28			
Designs	Between Groups	3,034	2	1,517	1,972	,159
	Within Groups	20,000	26	,769		
	Total	23,034	28			
Patents	Between Groups	1,589	2	,795	,622	,545
	Within Groups	33,238	26	1,278		
	Total	34,828	28			

The results of the ANOVA analysis show that there is no statistically significant difference between the group means, with the significance level standing above the usual cut-off point of 0.05. Thus we do not have enough evidence of interdependence between the variable representing filing of trademarks, patents and industrial designs, and the variable representing the portion of intangible assets in the value of total assets of companies.

4. CONCLUSION

The research has been carried out for the purpose of determining whether filing of intellectual property rights application significantly affects intangible assets value which is reported in the mandatory financial statements of companies coming from technology-intensive industries in Serbia. Not only that it has been shown that there is no significant interdependence between filing of intellectual property rights application and the reported share of intangible assets, but the analysis revealed that firms coming from technology-intensive industries generally report significantly small shares of intangible assets in their financial statements. Having in mind the nature of technology-intensive industries, both results were surprising. In addition, the analysis has shown that a trademark protection is highly sought by these companies, making this industrial property right dominant in comparison to both patents and industrial designs. Almost three times higher portion of companies from technology-intensive industries applied for trademark applications compared to patent applications.

The main limitation of this research is that, although it is a result of a creative activity with intangible assets involved, filing of patent, trademark or industrial design application do not necessarily lead to the granted intellectual property right. Therefore, non-granted intellectual property right may not provide monopolistic incentives for the company and may not be financially reported in the intangible assets part of the company's value. In addition, lack of ability or willingness to report separate intangible assets forms, such as patents or trademarks, in the financial reports, represents serious obstacle for detailed analysis of the effect of company's IPR protection orientation on the valuation of non-material assets of the company.

The findings of this study could be important to organizations from technology-intensive industries, which are active in filing intellectual property rights. The analysis of the relationship between filing particular intellectual property right and intangible assets value share can provide insight into the effect of IPR strength of companies to their market potential in terms of book value indicators. The results of this research may contribute to management of companies coming from technology-intensive industries, having in mind that these industries heavily rely on intellectual property rights for their competitiveness.

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THE IMPORTANCE AND APPLICATION OF TRANSFER PRICING COMPLIANCE IN MODERN BUSINESS

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Abstract: *In the modern business world it is very important that managers of international companies, which have businesses with cross-border intercompany transactions, understand the concept of transfer pricing. A transfer price is the price at which divisions of a company transact with each other. Transactions may include the trade of supplies or labor between departments. Transfer prices are used when individual entities of a larger multi-entity firm are treated and measured as separately run entities. In this paper the following issues will be explained: the concept of transfer prices and their importance in tax regulations, both in Serbia, and intranationally; who are the related parties from the point of accounting and other non-tax legislations; what are the methods used for compliance of the transfer prices, what are the arm's-length transaction and how the company could avoid them. The results and data given in this paper represents the problems seen through our clients' business and their transactions with related parties. Also, the most important and frequently asked questions about this topic are explained, and the practical answers were given. It was also necessary to justify why and how certain situations were measured. We also find that changes in exchange rates have differential effects on arm's-length and related-party prices; an appreciation of the Euro reduces the difference between the prices.*

Keywords: *transfer pricing, taxpayers, related entities, arm's length principle, methods for verifying transfer prices, Corporate Income Tax Law*

1. INTRODUCTION

The study on transfer pricing is based on the "arm's length principle" formulated in the OECD publication, entitled "OECD Transfer Pricing Guidelines for Multinational Enterprises and Tax Administrations 2010", originally published in 1995, and modified in July 2010. Adopting the principle of arm's length ensures the equal tax treatment of all taxpayers, regardless of whether it is a person who is considered to be related or not. Serbia is not a member of the Organization for Economic Cooperation and Development (OECD), but the Serbian legislation generally follows the OECD methodology and documentary requirements. (*OECD Guidelines for the application of the rules on transfer pricing, 2010, p. 25*)

According to the "arm's length principle", internal (transfer) prices between related companies must be specified in the same way to do this unrelated parties in similar circumstances. OECD regulations require that the application of the "arm's length principle" mainly based on the comparison of the essential conditions of a controlled (related) transactions and uncontrolled conditions (between independent parties) transactions. According to the OECD Rules, transactions can be compared, if there is no difference in the conditions that may substantially affect the price, or if the differences can be removed by appropriate adjustments. To determine whether there are significant differences between the compared transactions and operations, the following five factors should be carefully considered:

- characteristics of goods or services
- functional analysis
- contractual terms
- market conditions
- business strategy

Controlled and uncontrolled transactions and entities are not comparable if there are significant differences in terms of the risk, which cannot make appropriate adjustments. If, after comparing these five factors, we conclude that the differences between the compared transactions or businesses substantially affect the price and that it cannot carry out any reasonable adjustments to eliminate these differences, transactions and operations, according to the OECD Code, cannot be considered comparable. However, the Regulation clearly states that it should not happen that useful information, that can be obtained from uncontrolled

transactions that are not identical controlled, are not taken into account because they do not meet the strict criteria of comparability. (Denčić Mihajlov, Trajčevski,, 2011, p. 397)

Permissible methods of establishing "arm's-length" price in Serbia in 2013 (Article 61 of the Corporate Tax Law," Official Gazette of RS", no. 25/2001 ... 108/2013) are:

- Comparable (uncontrolled) market price method
- Costs price plus usual earnings method (Costs plus gross margin method) - Cost-plus method
- Resale price method
- Transactional net margin method
- Profit split method

Denčić Mihajlov, and Trajčevski, (2011) explained that any other method by which it is possible to determine the price of a transaction on the "arm's-length" principle, providing that the application of the method previously mentioned in this paragraph is not possible, or that the second method is more applicable to circumstances than the methods previously mentioned in this paragraph (p.399).

2. TRADITIONAL METHODS

Traditional methods are based on transactional analysis using direct and indirect methods (e.g., gross profit) in examining the nature of arm's length transactions between related companies. Traditional methods include method comparable (uncontrolled) prices in the market, the method of cost price plus usual earnings (cost plus gross margin method) and the resale price method.

- Comparable (uncontrolled) market price method "shall compare prices that will be charged with trade in goods and services in a controlled transaction with prices that are applied in the trade of goods and services in a comparable uncontrolled transaction under comparable conditions".
- Cost plus method "is based on the cost of supplier goods (or services) in a controlled transaction, which refers to the transfer of goods or services to the customer, a related party. These costs are then added to the appropriate margin to be achieved adequate earnings, according to the functions performed and the market conditions. What is obtained by adding the margin can be considered arm's length price of the original controlled transaction."
- Resale price method "is based on the price at which the product was purchased from a related party and resold to an unrelated party. This price ("resale price") shall be reduced by an appropriate gross margin ("resale price margin") representing the amount of which is expected to cover the reseller sales and other operating costs, and that, according to the functions performed (taking into account assets used and risks assumed), achieve adequate profits. What is left after deducting the gross margin and corrections based on other costs incurred in the acquisition of the good (e.g. costs of customs), can be regarded as the arm's length price for the initial transfer of assets between related parties." (*OECD Guidelines for the application of the rules on transfer pricing*, 2010, p.29)

2.1. Transactional profit methods

Transactional profit methods examine the profits resulting from transactions between related parties. Two basic methods are the transactional net margin method and profit split method. Profits arising from controlled transactions may be a relevant indicator of whether the transaction was affected by conditions that differ from those that would be incurred by third-party companies or other comparable terms. (Oosterhoff, 2014).

- Transactional net margin method examines the net profit compared to the appropriate base (e.g. costs, turnover, and assets) that a taxpayer realizes the controlled transaction. Transactional net margin realized by the taxpayer in a transaction with related parties is compared with the transactional net margin realized by unrelated parties predominantly engaged in similar transactions, and it is done by applying a statistical method that net margins in transactions between unrelated parties are spilt into the quartiles. The basic principle of this method is that the party is being tested its activity can achieve similar net profit (compared on the basis of the resulting analysis) as an independent party, then consequently prices of transactions between related parties had to be just as arm's length prices..
- Profit split method attempts to eliminate the effect on profits of a controlled transaction which is appeared due to created or imposed conditions by determining the distribution of the profit that an unrelated party expected to realize from engaging in a transaction or transactions. This method first identifies the profit from the controlled transactions in which they are related parties engaged,

which should be distributed between the parties ("combined profit"). The same goes when the company realized losses instead of profits. Then, this method distributes the combined profits between related parties, the economic-based basis which approximates the distribution of profits that would have been expected and agreed to an arrangement that is in accordance with the principle of arm's length.

When determining the price of transactions on the principle of "arm's length" is used the method that best suits the circumstances of the case, where it is possible to use multiple methods when necessary. The choice of method is based on analysis of the facts on which it is necessary to consider:

1. The nature of transactions which are the subject of analysis
2. Availability and reliability of data for analysis
3. Degree of comparability between transactions carried out on transfer pricing with transactions carried out with or between unrelated parties, if these transactions are used to verify the compliance of taxpayers transfer prices with prices determined by the principle of "arm's length"
4. The appropriateness of using financial data of unrelated parties to analyze the compliance of transfer prices for certain types of transactions that the taxpayer perform with related parties
5. The nature and reliability of assumptions (*OECD Guidelines for the application of the rules on transfer pricing, 2010, p. 45*)

Table 1: Reasons for rejection / acceptance the transfer price method from the company

Method	Reasons for rejection / acceptance from the company
Comparable (uncontrolled) market price method	Intern comparable price is not applicable as the most of the given companies have only transaction with a related parties in Serbia -The application of Externally comparable prices is also not possible because there are no publicly available data for this type of transactions (external comparable price in the country as well as the prices of such transactions abroad are not available)
Cost plus method	- there is not a possibility of establishing an internal comparable margins -There Are no publicly available data for determining externally comparable margins
Resale price method	- In order to achieve comparability of transactions and obtaining valid results, according to the OECD methodology and the Ordinance on transfer pricing, this method is primarily recommended for distributors
Transactional net margin method	- At this method the companies are comparing the net profit margin realized by the taxpayer in transactions with related parties, with net profit margins achieved in similar transactions with unrelated parties. Transactional net margin in Serbia resale is 0.53% and is significantly lower than the average transactional net margin in theEuropean resale industry, which is between 6.41% and 16.28%.
Profit split method	- This is a more optimal method because the activities of related parties so united in a way that makes it difficult to separate analysis of individual transactions between them.

3. TRANSFER PRICING - CORRECTION OF REVENUE AND EXPENDITURE IN TAX BALANCE

Popović (2013), explained that Transfer Pricing, respectively Corporate Income Tax Law, and the Ordinance on transfer pricing require Companies which have transactions with related parties that in the Tax Balance express the effects of the correction of expenditure and revenue and to increase the taxable tax base if needed. To calculate the required data, it is necessary to apply some of the previously explained methods for determining whether transactions between related prices are in line with market prices. When submitting the Tax Balance, companies should also submit a study / report on transfer pricing to the tax authorities. (p. 285)

In the business analysis, if the company determines that the price based on transactions with individual related party differs from the established market price, applying the principle of "arm's length", the company is required to incorporate in the tax base:

- 1) the amount of the positive difference between the revenues arising from the transaction at a price determined by applying the principle of "arm's length" and income arising from the transactions with transfer price, or
- 2) the amount of the positive difference between expenditures arising from the transactions with the transfer price and expenses arising from the transactions at a price determined by applying the principle of "arm's length".

In the conclusion of the Study of transfer pricing, it is first necessary to determine the proper amount of correction of transfer prices for each transaction associated with the related parties or for each type of transaction with individual related parties (Popović, 2013, p. 290).

Adding the precise amount of the correction, the company determines the total amount of the adjustment of transfer prices based on transactions with individual related parties. In accordance with Article 60, paragraph 8 of the Corporate Income Tax Law, the Company is entitled to decrease the total amount from the adjustment of transfer prices on the basis of individual transactions with related parties for:

- 1) the amount of the negative difference between the revenues arising from transactions with the individual related party at a price determined by applying the principle of "arm's length" and income arising from the transactions after the transfer price, or
- 2) the amount of the negative difference between the expenditures on the basis of individual transactions with the related party after the transfer price and expenses arising from these transactions at a price determined by applying the principle of "arm's length".

There is the necessity if the Company is not able to do internally compare the cost of transactions with related and unrelated parties, to make a comparison externally and to determine the quartiles, regarding the range of realized margins of other companies within the same Industry on the market. If the established range:

- 1) considers that the transfer price of the transaction does not differ from the price based on the principle of "arm's length" if the value of transfer prices is within that range;
- 2) the price according to the "arm's length" is equal to the central value of the specified range when the transfer price is outside the specified range.

After reducing the amount of correction, based on transfer pricing as the transactions with related party, referred to the paragraph 3 of this Article, the taxpayer determines the final amount of the adjustment of transfer prices on the basis of individual transactions with a related party. (*Law on Tax Procedure and Tax Administration (2014), paragraph 85*)

Example 1:

The taxpayer "X" during the tax sold its goods to related party "Y" on the transfer price of 10 million dinars. The price that would be achieved on this basis on the market (price - "arm's length") is 12,000,000 dinars. So, there is a positive difference between the price based on the "arm's length" and transfer price. So the taxpayer corrects its revenue for the amount of 2,000,000 dinars.

With the same related party the tax payer "X" had the expenses for lease of immovable property in the amount of 2,500,000 dinars. The rent which would be paid by the taxpayer on the market (rents on the "arm's length") is 3,000,000 dinars. So, on the expenditure side, the taxpayer, "X" on the transaction with the same related party, achieved a negative difference (transfer price is lower than the price of "arm's length") of the amount of 500,000 dinars.

The taxpayer "X" in the conclusion of the transfer pricing documentation makes a final correction of transfer prices to related party "Y" by the amount determined by the correction (2,000,000 dinars) reduced by the amount of the negative difference that is achieved on the expenditure side (500,000 dinars), so that the final correction of transfer prices to the taxpayer will be 1,500,000 dinars. 2. (Čubrić and Negovanović, 2013, p. 12)

Example 2:

The taxpayer "X" in the tax period for which the tax balance was generated, had the revenue by selling products to the related party "Y" on the transfer price of 15 million dinars. The price which the taxpayer "X" could get on the market (price "arm's length") is 18,000,000 dinars. Therefore, the correction by the taxpayer "X" on this basis is 3,000,000 dinars (positive difference between the price of "arm's length" and transfer price).

The taxpayer "X" is within the same tax period generated revenue by selling real estate to related party "Z" on the transfer price of 20 million dinars. The price which the taxpayer X would make on that basis on the market (price "arm's length") is 18,000,000 dinars. Thus, on the basis of this transaction, the taxpayer "X" has made a negative difference between the price of the "arm's length" principle and the transfer price in the amount of 2,000,000 dinars.

However, the taxpayer "X" in this case cannot be offset correction that is found in the first mentioned transaction on the basis of the positive difference between the price of the "arm's length" principle and the transfer price with negative difference that is generated in the second transaction with other related party. So that the amount of the final correction based on transfer prices to the taxpayer Y remains 3,000,000 dinars. (Čubrić and Negovanović, 2013, p. 15)

- In determining the correction based on the transactions with related parties, the company need to go through the following process:
- With individual related party transaction for each individual, and for each type of transaction, determines the amount of correction of transfer prices;
- Identifies the total amount of the adjustment of transfer prices with individual related persons on the basis of all transactions with this related party;
- The total amount of the adjustment of transfer prices with individual related persons reduced by the amount of negative differences arising in transactions with these related party;
- Reduction of the total amount of correction of transfer prices with individual related party may not exceed the amount of correction associated with that person;
- Finally, adds the total amount of correction of transfer prices established by each related party, as described above. The sum of total correction of the taxpayer needs to be stated in the tax balance position under number 50, and this amount increases the tax base of income tax.

4. TRANSACTIONS WITH RELATED PARTIES – INTERCOMAPNY LOANS

4.1. Types of transactions- intercompany financing

In accordance with Article 61, paragraph 3 of the Law on Corporate Income Tax Law ("Off. Gazette of RS", no. 25/2001, 80/2002, 80/2002 - Law, 43/2003, 84/2004, 18 / 2010, 101/2011, 119/2012, 47/2013 and 108/2013), which provides for purposes of determining the interest that would be based on the "arm's length" calculated on loans, or loans between related persons, the Minister of Finance may prescribe interest rates that will be considered in accordance with the principle of "arm's length", written in the Ordinance of interest rates which is considered to be in accordance with the principle of "arm's length". This Ordinance was published in "Off. Gazette of RS", no. 023/2015 of 02.03.2015. years and shall enter into force on the day following its publication, ie 03.03.2015. year. (*Law on Income Tax,2013, paragraph 66*)

The Law on Personal Income Tax (2013)
The Law on Enterprises (2011)

This regulation defines the interest rates that are considered to be in accordance with the principle of "arm's length".

For 2014 the interest rates that are considered to be in accordance with the principle of "arm's length" were:

- 13.82% for short-term loans in RSD;
- 11.12% on long-term loans in RSD.

The above rates apply to loans.

The taxpayer has the right to substitute the amount of the interest rate prescribed by the Minister of Finance, for the purposes of determining the amount of interest that would be based on the "arm's length" calculated

on a loan or credit with related parties, the application of general rules on determining the value of transactions on a "beyond arm's length" from the art. 60 and 61, 1 and 2 of the Law on Corporate Income Tax. (*The Law on Personal Income Tax, 2013, paragraph 52*).

A taxpayer who decides to exercise this right, shall general rules on determining the transaction price based on the "arm's length" from the art. 60 and 61 st. 1 and 2 of the Law on Corporate Income Tax Law is applied to all loans or loans with related parties.

If the taxpayer decides to exercise this right, the Tax Administration, for the purposes of determining the amount of interest that would be based on the "arm's length" and then calculated on loans, or loans between that taxpayer and related persons, is not related to the amounts of interest rates prescribed by the Minister of Finance .

In the our example The Company did not to use the opportunity given to the prescribed regulations on transfer pricing, and that it does not have to prove the level of market interest rate which should be applied to those loans in the current circumstances, but to apply the rates proposed by the Ministry of Finance of the Republic of Serbia. (Milićević and Malinic., 2013, p. 522)

During 2014 a subsidiary of the Company Ltd. gave-connected society ABC, Serbia, interest-free loans. Below is a table with an overview of current borrowings and accrued interest.

Table 2: An overview of current borrowings and accrued interest from the inter companies loans

AMOUNT OF LOANS	The date of returning	The Duration of loan in days	The period for calculation	Applied rate	Accrued interest
1.704.580,96	31.5.2014.	451	151	0,03046%	78.401,52
1.200.000,00	31.5.2014.	451	151	0,03046%	55.193,52
20.000,00	31.5.2014.	450	151	0,03046%	919,89
230.000,00	31.5.2014.	446	151	0,03046%	10.578,75
109.783,08	31.5.2014.	426	151	0,03046%	5.049,43
205.195,96	31.5.2014.	424	151	0,03046%	9.437,91
154.804,04	13.6.2014.	437	164	0,03046%	7.733,14
100.000,00	13.6.2014.	436	164	0,03046%	4.995,44
450.000,00	13.6.2014.	434	164	0,03046%	22.479,48
370.000,00	13.6.2014.	382	164	0,03046%	18.483,13
1.000.000,00	13.6.2014	329	164	0,03786%	62.090,40
550.000,00	13.6.2014.	326	164	0,03786%	34.149,72
2.200.000,00	13.6.2014	311	164	0,03786%	136.598,88
400.000,00	13.6.2014	267	164	0,03786%	24.836,16
1.200.000,00	13.6.2014	256	164	0,03786%	74.508,48
600.000,00	13.6.2014	224	164	0,03786%	37.254,24
120.000,00	13.6.2014	193	164	0,03786%	7.450,85
2.250.000,00	13.6.2014	192	164	0,03786%	139.703,40
50.000,00	13.6.2014	185	164	0,03786%	3.104,52
50.000,00	13.6.2014	184	164	0,03786%	3.104,52
100.000,00	13.6.2014	183	164	0,03786%	6.209,40
300.000,00	13.6.2014	182	164	0,03786%	18.627,12
350.000,00	13.6.2014	178	164	0,03786%	21.731,64
220.000,00	13.6.2014	140	140	0,03786%	11.660,88
536.289,54	13.6.2014	133	133	0,03786%	27.004,21
1.000.000,00	13.6.2014	128	128	0,03786%	48.460,80
850.000,00	13.6.2014	127	127	0,03786%	40.869,87
700.000,00	13.6.2014	123	123	0,03786%	32.597,46
300.000,00	13.6.2014	122	122	0,03786%	13.856,76

300.000,00	13.6.2014	120	120	0,03786%	13.629,60
10.000,00	13.6.2014	86	86	0,03786%	325,59
50.000,00	13.6.2014	85	85	0,03786%	1.609,05
250.000,00	26.9.2014	9	9	0,03786%	851,85
					973.507,61

In the tax balance is necessary to make a correction at the company our company which is a lender, so the tax base will increase for the amount of 973,507.61 dinars.

In the company of the borrower ABC is not possible to reduce the tax base on this basis.

5. THE EXAMPLE OF TRANSACTIONAL NET MARGIN

Transaction net margin applied in this particular case has the form:

$$Net\ margin = \frac{Net\ profit}{Operating\ costs} \times 100\%$$

This form of net margin is recommended for transactions concerning the provision of services. In determining transactional net margin realized by the taxpayer in a transaction from which he emerged transfer price, as a rule, are taken into account only those operational revenues and expenses that are directly or indirectly related to the transaction, and to the extent that they contributed to achieving net profit in the transaction. (OECD Guidelines for the application of the rules on transfer pricing, paragraph 2.77)

Costs and revenues that are not related to a controlled transaction should be excluded because they significantly affect the comparison with uncontrolled transaction. (Garrison, R and Noreen, E, 2012, p. 61)

Non-business items such as interest income and expense and income taxes should be excluded from the determination of net profit indicators. (OECD Guidelines for the application of the rules on transfer pricing, paragraph 2.80). From the income statement of the company ABC it can be seen that the total financial expenses (negative exchange differences and interest expense) was 6,416,231.34 RSD and are not taken into the calculation when calculating the total operating costs. Although it appears in the numerator net income, it is in fact about a business operating profit (excluding financial, and other extraordinary expenses and revenues), which is placed in relation to operating expenses. This is stated in Article 25, paragraph 3 of the transfer pricing that in determining transactional net margin realized by the taxpayer in a transaction from which it is derived transfer price, as a rule, are taken into account only those operating revenues and operating expenses that are directly or indirectly related to the transaction, and to the extent that they contributed to achieving net profit in the transaction.

Table 3: the example of TNM calculations

Transaction of the internal trade	
The revenue of the GERMAN company in RSD	213.210.414,80
Relevant Expenses	212.335.751,77
EBIT	874.663,03
TNM	0,41%
TNM on the company level	
Total Business Revenues	217.927.397,10
Total Business Expenditures	212.876.484,01
EBIT	5.050.913,09
TNM	2,37%

5.1 External comparable data

Data which the independent company engaged in the same or most similar type of activity and the company has tested a range of margins between 6:41% and 16.98%. This applies only to the functions performed by an independent company and tested the company. To obtain the proper range margin the company had used publicly available database AMADEUS issued by the company Bureau van Dijk. Data obtained from studies of transfer pricing companies from similar activities.

By searching the data AMADEUS obtained a sample of several companies and for each of the selected companies account net margin for each year, then the average is calculated for the analyzed period 2009-2013. year. Based on the average values of gross margins were calculated minimum and maximum, as well as the first and third quartile and median. Since there was only one comparable company from Serbia, the company included in the analysis the European companies.

The choice of this method is based on analysis of the facts that were analyzed and according to the Regulations on transfer pricing:

- Nature of transactions that are the subject of analysis;
- the availability and reliability of data for analysis;
- the appropriateness of the use of financial information unrelated persons for the analysis of transfer pricing compliance by certain types of transactions that the taxpayer performs with related parties;
- The nature and reliability of assumptions.

Net margin is the most appropriate indicator of the rate of profit to evaluate the financial operations of selected comparable companies. Based on the average value of the indicator of profit, calculated the minimum and maximum value of the net margin, or the first / third quartile and median. In order to eliminate the influence of temporary or accidental factors on the financial results, we used the averaged data for the period from 2011 to 2013. This approach is in line with the OECD Guidelines, which confirm that the use of data from several years accepted approach, and in accordance with Art. 26, paragraph 3 of the Rules on transfer pricing.

Table 4: The comparison of the quartiles

Minimum	2,37%
The first quartile	6,41%
Median	8,86%
The third quartile	16,98%
Maximum	20,43%

According to these results when they reject the extremes (minimum values between the first quartile and third quartile and maximum) conclusion is that the usual net margin of companies engaged in this activity between 6:41% and 16.98%, a median of 8.86%.

Net margin of our company achieved by the financial reports for 2014 is 2:37%.

6. CONCLUSION

Transfer pricing represents a major international tax planning opportunity and risk for many Multinational Companies. With a global increase in the volume and complexity of transactions among related parties and with countries looking to increase in tax revenue, tax authorities around the world have increased their scrutiny of transfer prices. The OECD has stated that "In a global economy where MNEs play a prominent role; governments need to ensure that the MNEs are not artificially shifting taxable profits out of their jurisdiction; the taxable income reported by MNEs should reflects the economic activity undertaken in the countries in which they operate." Today, MNEs are encountering an increase in the number of transfer pricing related tax audits and tax adjustments. This has brought transfer pricing to the forefront of attention for MNEs.

MNEs can create sustainable tax efficient structures by layering transfer pricing and tax planning with their supply chain initiatives. As MNEs expand or streamline their supply chains, they can make tax smart decisions about where to locate the value drivers and the important functions within their supply chains. For instance, if it makes sense to create a regional headquarters or centralized services such as a strategic sourcing group, MNEs should consider the tax rates that their cash flows would be subjected to in the various jurisdictions. MNEs should keep in mind that there are significant differences in the tax rates levied by countries they are operating in. As they decide on locations of important supply chain functions, they should perform their cost benefit analyses on an after tax basis.

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