Stock Selection Based on Discriminant Analysis: Case of Capital Market of Bosnia and Herzegovina

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Abstract: *The main goal of this paper is to scientifically examine and propose new approach of stock selection and analysis based on multivariate technique, i.e. discriminant analysis, in order to help investors, individual and institutional, in their decision making process, especially in case of underdeveloped capital markets. Therefore, in this paper we investigate the cross—sectional relation between the independent variables of the model, comprised of beta coefficient and some fundamental variables as well as the average stock returns on the underdeveloped capital market of Bosnia and Herzegovina. We concluded that discriminant analysis is a useful quantitative tool that can help investors in shaping their investment strategies. We also found that the beta coefficient, market capitalization and realized historical return have discriminatory capabilities in case of the capital market of Bosnia and Herzegovina. The real implications of this research can be seen in the shaping of investment strategies of potential investors looking to diversify their portfolios. The main limitations of this study are to be found in the shorter available financial time series in newly formed capitalistic economy, missing data due to the lack of collective records on levels of securities offerings issues.*

Keywords: *discriminant analysis, stock selection, stock return, capital market of Bosnia and Herzegovina*

JEL Classification: *G11, C38*

Article History
Submitted: 06 June 2013
Resubmitted: 17 October 2013
Accepted: 11 December 2013

http://dx.doi.org/10.14706/JECOSS11421

Introduction

The stock selection is one of the most important decisions an equity investor has to make. The use of quantitative models and methods of stock selection has many advantages in the portfolio construction. For underdeveloped capital markets, however, quantitative stock selection models are still rarely used. Therefore, and based on theoretical inferences and empirical evidence on stock selection process, the main goal of this paper is to scientifically examine and propose new approach of stock selection and analysis based on multivariate technique, i.e. discriminant analysis, in order to help investors, individual and institutional, in their decision making process, especially in case of underdeveloped capital markets. These markets are generally characterized by low market capitalization, poor liquidity and turnover, weak legal protection for minority shareholders, low correlation with developed and emerging capital markets, etc. All of this directly determines investment decision making process on one hand and on the other may have crucial impact on portfolio performance as well. Therefore, in this paper we investigate the cross – sectional relation between the independent variables of the model, comprised of beta coefficient and some fundamental variables as well as the average stock returns on the capital market of Bosnia and Herzegovina. Since the goal defines objectives of any research, the main objective of this paper is stock selection process based on discriminant analysis. Having in mind the above said, the central research hypothesis shall be as follows: *Discriminant analysis is a useful quantitative tool that can help investors in shaping their investment strategies.* The paper is organized as follows. After introduction, the first section gives a short overview of the recent literature that is relevant to the main objective of the paper. The second section brings description of our research methodology. In the third section we explain the data and finally the fourth section, that is the centre of the paper, contains analysis of the result of the stock selection process based on discriminant analysis. In the end, we give some final remarks and conclusions.

Literature Review

So far, a significant number of scientific researches have been conducted on the use of quantitative models and methods of stock selection. Siqueira, Otuki and Da Costa (2012) used discriminant analysis in order to analyze nexus between stock return and some selected fundamental variables. They examined stocks traded on Sao Paulo Stock Exchange and found out that the beta coefficient has discriminatory capabilities.

Şenol, Dinçer and Timor (2012) proposed stock selection model based on fundamental and technical analysis by using artificial neural networks and support vector machines. Schadler and Eakins (2001) examined a stock selection model using Morningstar's style box. Basing on the Gordon model perspective and applying multiple criteria decision making (MCDM), Lee, Tzeng, Guan, Chien and Huang (2009) explore the influential factors and relative weight of dividend, discount rate, and dividend growth rate. Among the eight evaluation criteria, market *beta* was the most important factor influencing investment decisions, followed by dividend growth rate and risk-free rate.

In their research, Shiuh-Nan, Chin-Tsai and Wang-Ching (2007) chose relative operating performance and stock price evaluation as stock classification criteria, and applied them to divide the sample stocks into four types, i.e.: value, monitor, speculative and avoidance. Kuang Yu and Chuen-Jiuan (2009) combined the moving average autoregressive exogenous (ARX) prediction model with grey systems theory and rough set (RS) theory to create an automatic stock market forecasting and portfolio selection mechanism.

Chunhachinda, Dandapani, Hamid and Prakash (1997) investigated portfolio selection and skewness. The empirical findings suggested that the incorporation of skewness into an investor's portfolio decision causes a major change in the construction of the optimal portfolio. Sorensen, Miller and Ooi (2000) introduced an alternative approach to traditional methods of stock screening based on a statistical technique known as classification and regression tree (CART). In their paper, Achour, Harvey, Hopkins and Lang (1998) examined stock selection in emerging markets of Malaysia, Mexico and South Africa, where they presented a comprehensive, market – by – market analysis of the information in firm attributes for portfolio strategies. Van der Hart, Slagter and Van Dijk (2002) concluded that within emerging markets, value, momentum and earnings revisions strategies are successful in selecting well performing stocks. The excess returns of these strategies are strongly significant. Combining the factors into one model enhances the performance.

Theoretical Background

According to Huberty and Olejnik (2006) some of the ideas associated with discriminant analysis (DA) go back to around 1920 when the English statistician Karl Pearson (1857–1936) proposed what was called the coefficient of racial likeness (CRL), a type of intergroup distance index. The idea of multivariable intergroup distance was translated to that of a linear composite of variables derived for the purpose of two – group classification by R. A. Fisher (1890–1962) in the 1930s. The distance and variable composite ideas appeared in print prior to Fisher's seminal discriminant analysis article in 1936.

Discriminant Analysis: A Methodological Overview

Basically, discriminant analysis is a multivariate statistical method designed to set up a model to predict group memberships. The model consists of discriminant functions that appear based on a linear combination of predictive variables that provide the best discrimination between groups.

This analysis is the appropriate statistical technique when the dependent variable is categorical and the independent variables are metric. Brown and Wicker (2000, p. 209) claim that discriminant analysis is a powerful descriptive and classificatory technique developed to: (1) describe characteristics that are specific to distinct groups; and (2) classify cases (i.e., individuals, subjects, participants) into pre-existing groups based on similarities between that case and the other cases belonging to the groups.

Discriminant analysis results with the *discriminant function* (or variate), i.e. linear combination of the independent variables that are capable to discriminate between a priori defined groups. Discrimination is achieved by setting the variate's weights for each variable to maximize the between – group variance relative to the within - group variance (Hair, Anderson, Tatham and Black, 1998, p. 244). Each discriminant function has the general form (Brown and Wicker, 2000, p. 219):

$$D = a + b_1 x_1 + b_2 x_2 + \ldots + b_p x_p \, , \tag{1}$$

where *D* is the discriminant score, *a* is the *y* - intercept of the regression line, *b* is the discriminant function coefficient, *x* is the discriminator variable raw score, and *p* is the number of discriminator variables. Discriminant analysis multiplies each independent variable by its weight and adds these products together. As a result, *discriminant score* for each independent variable in the analysis is calculated. By averaging these scores for all the independent variables within a particular group, we get the group mean. This mean is referred to as *centroid* that indicate the most typical location of any independent variable from a particular group, and comparison of the group centroids shows how far apart groups are along the dimension being tested (Hair, Anderson, Tatham and Black, 1998, p. 245).

Data

The capital market of Bosnia and Herzegovina is characterized by territorial division, the incompatibility of entity institutions and of legal regulations; which negatively affect the investment climate and the liquidity of securities.

According to the MSCI Global Market Accessibility Review (2012), capital market of Bosnia and Herzegovina is included in the so called *standalone markets*. These markets include all country markets covered by MSCI but not included in the MSCI International Indices. This category includes potential candidates for the MSCI Frontier Markets Indices that currently do not meet the minimum liquidity requirements as well as markets that are currently partially or fully closed to foreign investor. Furthermore, stocks lending and short selling are activities that are either not developed or completely prohibited in all standalone market countries and the summary does not highlight these issues on a country-by-country basis.

Basically, the MSCI Global Market Accessibility Review (2012) provides an evaluation of the four market accessibility criteria, which are: (1) openness to foreign ownership; (2) ease of capital inflows/outflows; (3) efficiency of the operational framework and (4) stability of the institutional framework. In case of capital market of Bosnia and Herzegovina, the evaluation of the above mentioned criteria is given in Table 1.

Table 1. Assessment results for the capital market of Bosnia and Herzegovina

Criteria	Evaluation
Openness to foreign ownership	
Investor qualification requirement	++
Foreign ownership limit (FOL) level	++
Foreign room level	++
Equal rights to foreign investors	++
Ease of capital inflows / outflows	
Capital flow restriction level	++
Foreign exchange market liberalization level (there is no offshore currency market)	+
Efficiency of the operational framework	
Market entry	
Investor registration and account set up	++
Market organization	
Market regulations (not all regulations can be found in English)	+
Competitive landscape	
Information flow[i]	-/?
Market infrastructure	
Clearing and Settlement (there is an absence of a real DVP system and the prefunding of trades is required in Republic of Srpska)	-/?
Custody[ii]	++
Registry / Depository (there are two central depositories, each of them acting as central registry)	++
Trading (there is a very limited level of competition among brokers which can lead to high trading costs)	-/?
Transferability (in-kind transfers and off-exchange transactions are prohibited)	-/?
Stock lending	+
Short selling	-/?
Stability of institutional framework	+

Source: The MSCI Global Market Accessibility Review (2012), p. 45

Note: ++: no issues; +: no major issues, improvements possible; -/?: improvements needed / extent to be assessed

The capital market of Bosnia and Herzegovina consists of two independent regions that have separate stock exchanges, i.e. *The Sarajevo Stock Exchange* or SASE which operates in Federation of Bosnia and Herzegovina and *The Banja Luka Stock Exchange* or BLSE which operates in Republic of Srpska. Each of the above mentioned stock exchanges has its own regulation and indices calculated on daily basis. SASE, for example, has three indices, i.e.: (1) Bosnian Investment Fund Index - BIFX which is the first index published by the SASE. It consists of the stocks of the 11 investment funds registered in the Federation of Bosnia and Herzegovina (formerly Privatization Investment Funds - PIFs). By its purpose, it is considered a benchmark index, whose main goal is to provide investors a general view and evaluation of the current market trends in the segment of investment funds listed at the SASE.[iii] (2) The Sarajevo Stock Exchange Index 10 – SASX-10 is the main index on the SASE. It depicts the price movement of the top 10 issuers on the SASE (excluding investment funds) ranked by market capitalization and frequency of trading.[iv] (3) The Sarajevo Stock Exchange Index 30 – SASX-30 is the index of the Primary Free Market of the SASE. It depicts the price movement of the issuers on the Primary Free market, which is reserved for the most liquid issuers from the free market. Its main goal is to serve as a general benchmark index.[v]

On the other hand, BLSE has six indices, but only three are active. These indices are: (1) The Investment Funds Index of the Republic of Srpska – FIRS which consists of the stocks of investment funds that fulfill selection criteria[vi]. (2) The Stock Exchange Index of the Republic of Srpska – BIRS which consists of the socks of from 5 to 30 issuers. Number of issuers whose stocks may be included in the BIRS depends on the number of the issuers listed on the BLSE Official Market and the number of stocks that fulfill criteria for the BIRS composition.[vii] (3) The Index of Electric Energy Sector of the Republic of Srpska – ERS10 which consists of the stocks of the 10 companies from the power utility sector which are listed on the BLSE.[viii]

The only index that represents stocks traded both at SASE and BLSE is the Bosnian Traded Index or BATX[ix]. It is a capitalization-weighted price index[x] which is made up of the most actively traded and highest capitalized stocks traded at the SASE and BLSE. The index is calculated and disseminated on a real-time basis in EUR, USD and BAM. BATX is designed as a tradable index to be used as an underlying instrument for structured products and for standardized derivatives (futures and options).[xi]

Sample

Given the large number of available, but not actively traded securities, in this paper we will use subset of the most actively and highest capitalized stocks traded on SASE and BLSE. Since BATX incorporates the most liquid securities from the capital market of Bosnia and Herzegovina (BH Telecom – BHTSR, Bosnalijek - BSNLR, Fabrika duhana Sarajevo - FDSSR, JP Elektroprivreda BiH - JPESR, Nova banka ad Banja Luka - NOVB-R-E, Telekom Srpske - TLKM-R-A)[xii], we will use them as a sample[xiii] in the further process of stock selection as well as some of the top 10 issuers

in 2012 (Tvornica cementa Kakanj d.d. Kakanj - TCMKR, Elektro grupa d.d. Jajce - ELGJR, ZIF BIG Investiciona grupa d.d. Sarajevo - BIGFRK3, ZIF Bosfin d.d. Sarajevo - BSNFRK2, ZIF MI Group d.d. Sarajevo - MIGFRK2, IK Banka d.d. Zenica - IKBZRK2, ZIF Zepter fond ad Banja Luka - ZPTP-R-A, ZIF Jahorina Koin ad Pale – JHKP-R-A).

Our observed period of time is December 2009 - December 2012. Top 10 issuers by turnover both on BLSE and SASE in 2012 are presented in Table 2.

Table 2. Top 10 issuers by turnover in 2012

Rank	Issuer (SASE)	Turnover (in BAM)	Issuer (BLSE)	Turnover (in BAM)
1.	Bosnalijek d.d. Sarajevo	35.762.756,14	Republika Srpska T - bills	14.841.884
2.	BH Telecom d.d. Sarajevo	4.716.269,56	Republika Srpska - izmirenje ratne štete	14.175.515
3.	Tvornica cementa Kakanj d.d. Kakanj	4.531.367,17	Telekom Srpske ad Banja Luka	12.979.869
4.	Fabrika duhana Sarajevo d.d. Sarajevo	4.256.016,17	Republika Srpska - stara devizna štednja	7.616.466
5.	Elektro grupa d.d. Jajce	4.149.400,00	Kaldera Company d.o.o. Laktaši	6.624.484
6.	ZIF BIG Investiciona grupa d.d. Sarajevo	2.430.672,12	Republika Srpska - izmirenje ratne štete	4.525.190
7.	ZIF Bosfin d.d. Sarajevo	2.269.729,58	Republika Srpska - izmirenje ratne štete	4.191.977
8.	ZIF MI Group d.d. Sarajevo	2.185.090,45	ZIF Zepter fond ad Banja Luka	4.161.346
9.	Dobrinja d.d. Ilidža	2.070.613,85	Republika Srpska - izmirenje ratne štete	2.781.926
10.	IK Banka d.d. Zenica	1.889.629,11	ZIF Jahorina Koin ad Pale	2.564.735

Source: Annual Report 12 (2012), p. 21 and Annual Statistical Report (2012), p. 2

Dependent and independent variables

Since, index BATX is made up of the most actively traded and highest capitalized stocks traded at the SASE and BLSE we coded all issuers that, at the moment when this research was done, were included in the index mentioned, with number 1 (*Highest liquidity*). And those issuers from our sample that, at the time this research was conducted, were not included in BATX we coded with the number 2 (*Lowest liquidity*).

In this context, liquidity may be defined as possibility to convert stocks into cash and vice versa without affecting the price or with minimal impact on it. If we denote successive stock price[xiv] made at time t and $t+1$ as P_t and P_{t+1}, respectively, then continuous compounding transforms a stock price series $\{P_t\}$ into a return series

$\{r_t\}$ as:

$$r_t = ln \frac{P_t}{P_{t-1}} . \qquad (2)$$

The independent variables of the model were comprised of following variables: beta coefficient, market capitalization, turnover and return. The beta coefficient was estimated as:

$$\beta = \frac{cov(r_i, r_m)}{\sigma^2(r_m)} , \qquad (3)$$

where $cov(r_i, r_m)$ is the covariance between the asset returns and the returns on the selected indices, and $\sigma^2(r_m)$ is the variance of returns on the selected indices.

Special attention was given to the variables “market capitalization” and “turnover” which are a gross value, and therefore represented in rather high monetary terms.

Thus, to standardize it according to the other variables and make the analysis more meaningful its logarithm was calculated.

Empirical Results and Discussion

Empirical results[xv] will be present in the following order. First, we will give short overview of descriptive statistics and correlation analysis. After that, estimation of the beta coefficient will be presented and at the end results of estimated discriminant function will be discussed.

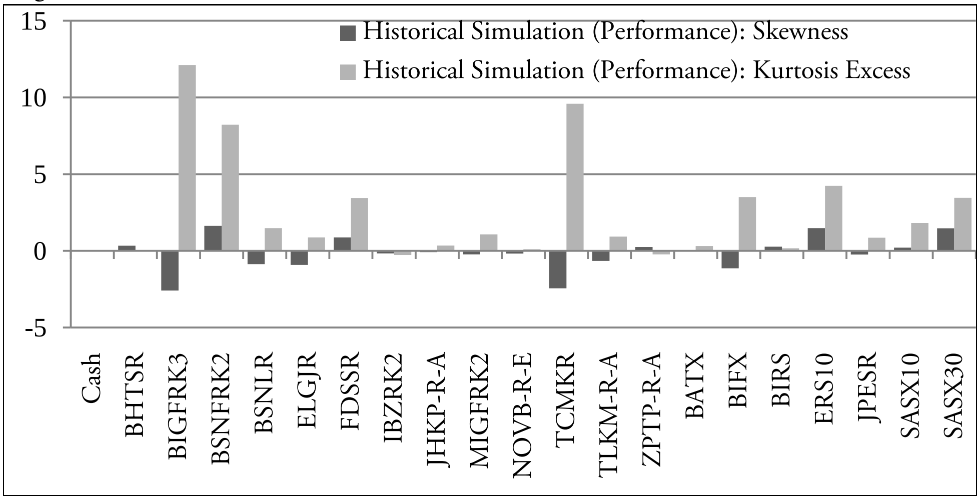
Descriptive Statistics and Correlation Analysis

By using scientific method, and in order to create a better insight into a specificity of observed financial time series, we will analyse some basic parameters of descriptive statistics for the observed period of time.

Based on the Jarque-Bera test we reject the null hypothesis (H_0*: the data are from a normal distribution*) at the 5% significance level for the following variables: BIGFRK3, BSNFRK2, FDSSR, TCMKR, ERS10 and SASX30. Only BSNFRK2, JHKP-R-A, ZPTP-R-A and TLKM-R-A had positive average return (Table 3). The same conclusion is for ERS10 and FIRS (Table 4). Based on the analysis of results given in Table 3, it can be concluded that BHTSR, BSNFRK2, ELGJR, FDSSR, JHKP-R-A, JPESR, MIGFRK2, NOVB-R-E and ZPTP-R-A had positive skewness. In the case of selected indices, positive skewness has been detected with BATX, BIRS, ERS10, FIRS, SASX10 and SASX30.

Skewness and excess kurtosis, based on historical simulation, are given in Figure 1.

Figure 1. Skewness and kurtosis excess



Why is this so important to analyze? Well, the skewness of a symmetric distribution, such as the normal distribution, is zero. Positive skewness means that the distribution has a long right tail and negative skewness implies that the distribution has a long left tail.

In other words, negative skewness means there is a substantial probability of a big negative return. Positive skewness means that there is a greater-than-normal probability of a big positive return. Furthermore, kurtosis points out leptokurtosis for all selected variables, except for IKBZRK2, NOVB-R-E and ZPTP-R-A.

Table 3. Descriptive statistics - issuers

Variables: / Parameters:	BHTSR	BIGFRK3	BSNFRK2	BSNLR	ELGJR	FDSSR	IKBZRK2	JHKP-R-A	JPESR	MIGFRK2	NOVB-R-E	ZPTP-R-A	TLKM-R-A	TCMKR
Mean	-0.001852	-0.006771	0.008400	-0.004344	-0.020388	-0.015503	-0.010584	0.004514	-0.008554	-0.001089	-0.018033	0.007638	0.003334	-0.004022
Median	-0.004523	-0.006185	-0.005902	-0.000611	0.000000	-0.017015	-0.000770	-0.004640	-0.012735	0.000000	-0.014536	-0.001969	0.003413	0.000000
Maximum	0.152630	0.295117	0.914309	0.184340	0.497922	0.309673	0.113516	0.251314	0.193816	0.258574	0.169603	0.188324	0.108733	0.133531
Minimum	-0.091216	-0.470358	-0.308615	-0.211553	-0.497922	-0.189757	-0.160657	-0.223144	-0.214070	-0.211309	-0.202524	-0.136203	-0.121361	-0.318208
Std. Dev.	0.054109	0.118211	0.187597	0.083051	0.254728	0.086779	0.066792	0.104454	0.080365	0.096131	0.089948	0.082181	0.046859	0.078867
Skewness	0.464632	-1.249478	3.059631	-0.518837	0.010894	1.364898	-0.012285	0.238849	0.065970	0.179005	0.083453	0.428155	-0.470501	-1.753493
Kurtosis	3.124869	8.586634	16.47644	3.756509	3.473340	7.218904	2.507085	3.049095	3.360884	4.005455	2.883006	2.730604	3.476562	8.535399
Jarque-Bera	1.318688	56.18290	328.5897	2.473606	0.336788	37.87641	0.365353	0.345909	0.221468	1.708668	0.062318	1.208760	1.668897	64.40940
Probability	0.517191	0.000000	0.000000	0.290311	0.845021	0.000000	0.833038	0.841176	0.895177	0.425567	0.969322	0.546413	0.434114	0.000000

Table 4. Descriptive statistics - indices

Variables: / Parameters:	BATX	BIFX	BIRS	ERS10	FIRS	SASX10	SASX30
Mean	-0.004267	-0.003875	-0.005721	0.000244	0.000330	-0.009035	-0.004603
Median	-0.002465	-0.000760	-0.007594	-0.007388	-0.011953	-0.004061	-0.009721
Maximum	0.097816	0.079885	0.095962	0.280094	0.175007	0.146682	0.096895
Minimum	-0.086516	-0.148956	-0.080724	-0.125555	-0.106946	-0.120636	-0.047559
Std. Dev.	0.042950	0.042600	0.038246	0.073986	0.062848	0.048972	0.028226
Skewness	0.162552	-0.856056	0.364747	1.782538	1.062165	0.445566	1.521780
Kurtosis	3.201353	5.147046	3.094798	7.671008	4.146038	4.796183	6.242264
Jarque-Bera	0.219352	11.31171	0.811722	51.79214	8.739272	6.030584	29.66329
Probability	0.896124	0.003497	0.666403	0.000000	0.012656	0.049032	0.000000

Table 5. Correlation matrix

		BIFX	BIRS	ERS10	FIRS	SASX10	SASX30	BATX	BHTSR	BIGFRK3	BSNFRK2	BSNLR	ELGJR	FDSSR	IBZRK2	JPESR	JHKP-R-A	MIGFRK2	NOVB-R-E	TCMKR	TLKM-R-A	ZPTP-R-A
BIFX	Pearson Correlation	1	.557**	.469**	.613**	.581**	.546**	.572**	.290	.813**	-.027	.380*	.000	.518**	.275	.454**	.401*	-.185	.113	.168	.238	.543**
	Sig. (2-tailed)		.000	.004	.000	.000	.001	.000	.086	.000	.874	.022	.999	.001	.105	.005	.015	.281	.512	.328	.161	.001
BIRS	Pearson Correlation		1	.825**	.755**	.321	.367*	.314	.014	.444**	.172	.142	.073	.206	.240	.228	.547**	.164	.241	.303	.405*	.642**
	Sig. (2-tailed)			.000	.000	.056	.028	.063	.936	.007	.317	.410	.670	.229	.159	.180	.001	.341	.157	.072	.014	.000
ERS10	Pearson Correlation			1	.762**	.241	.360*	.169	.047	.330*	.001	.039	-.067	.073	.270	.275	.515**	.214	-.012	.182	.124	.637**
	Sig. (2-tailed)				.000	.156	.031	.324	.787	.049	.996	.823	.696	.672	.111	.104	.001	.211	.945	.287	.472	.000
FIRS	Pearson Correlation				1	.325	.509**	.226	.054	.503**	.269	.100	.129	.078	.350*	.346*	.761**	.068	.060	.222	.276	.868**
	Sig. (2-tailed)					.053	.002	.185	.753	.002	.113	.561	.453	.652	.036	.039	.000	.693	.729	.194	.103	.000
SASX10	Pearson Correlation					1	.788**	.802**	.679**	.513**	.094	.527**	.002	.588**	.351*	.784**	.165	-.324	.011	.268	.098	.264
	Sig. (2-tailed)						.000	.000	.000	.001	.587	.001	.990	.000	.036	.000	.336	.054	.949	.114	.569	.120
SASX30	Pearson Correlation						1	.638**	.527**	.522**	-.034	.332*	.103	.446**	.348*	.621**	.342*	-.146	-.149	.089	.246	.458**
	Sig. (2-tailed)							.000	.001	.001	.845	.048	.548	.006	.037	.000	.041	.397	.386	.604	.148	.005
BATX	Pearson Correlation							1	.717**	.516**	-.020	.710**	-.169	.801**	.352*	.689**	.071	-.203	.253	.136	.343*	.167
	Sig. (2-tailed)								.000	.001	.906	.000	.324	.000	.035	.000	.681	.234	.137	.428	.040	.331
BHTSR	Pearson Correlation								1	.334*	-.072	.396*	-.137	.515**	.249	.463**	.068	-.327	.039	-.094	-.065	-.042
	Sig. (2-tailed)									.046	.677	.017	.427	.001	.143	.004	.693	.052	.820	.587	.706	.810
BIGFRK3	Pearson Correlation									1	-.077	.418*	.056	.314	.297	.255	.341*	-.145	.173	.155	.323	.522**
	Sig. (2-tailed)										.654	.011	.745	.062	.078	.133	.042	.399	.313	.367	.055	.001
BSNFRK2	Pearson Correlation										1	.029	.052	.075	-.020	.182	.246	.192	.220	.376*	-.015	.279
	Sig. (2-tailed)											.867	.765	.665	.906	.288	.149	.263	.197	.024	.930	.100
BSNLR	Pearson Correlation											1	-.306	.485**	.185	.403*	-.106	-.300	.296	.203	.085	.184
	Sig. (2-tailed)												.069	.003	.279	.015	.540	.075	.080	.235	.623	.283
ELGJR	Pearson Correlation												1	-.091	.055	-.094	-.021	.028	-.105	.227	.057	.025
	Sig. (2-tailed)													.597	.749	.587	.902	.872	.541	.183	.740	.885
FDSSR	Pearson Correlation													1	.136	.589**	-.027	-.101	.173	-.034	.175	.098
	Sig. (2-tailed)														.428	.000	.877	.557	.314	.846	.306	.570
IBZRK2	Pearson Correlation														1	.348*	.150	-.034	.061	.067	.280	.188
	Sig. (2-tailed)															.038	.381	.842	.724	.697	.098	.272

JPESR	Pearson Correlation															1	.110	-.139	-.093	.315	-.027	.240
	Sig. (2-tailed)																.523	.417	.591	.061	.877	.159
JHKP-R-A	Pearson Correlation																1	.053	.020	-.019	.295	.696**
	Sig. (2-tailed)																	.758	.909	.910	.081	.000
MIGFRK2	Pearson Correlation																	1	-.242	.035	.176	.165
	Sig. (2-tailed)																		.155	.838	.304	.335
NOVB-R-E	Pearson Correlation																		1	.138	.466**	.047
	Sig. (2-tailed)																			.423	.004	.786
TCMKR	Pearson Correlation																			1	.029	.214
	Sig. (2-tailed)																				.867	.209
TLKM-R-A	Pearson Correlation																				1	.262
	Sig. (2-tailed)																					.122
ZPTP-R-A	Pearson Correlation																					1
	Sig. (2-tailed)																					

**. Correlation is significant at the 0.01 level (2-tailed)

*. Correlation is significant at the 0.05 level (2-tailed)

Correlation matrix was presented in Table 5. Correlation between two variables indicates the level to which those variables move together. The sample correlation coefficient r is an estimate of the population correlation coefficient ρ. We also tested statistical significance of correlation coefficients where the following hypotheses were being tested (Doane, Seward, 2009, p. 501):

$H_0: \rho = 0$,
$H_1: \rho \neq 0$.

Shaded values in Table 5 show that the correlation coefficient is significant at the 0.01 or 0.05 level. After examining basic parameters of descriptive statistics and correlation analysis, in the next part of the paper, we give results of the beta coefficients estimation.

The Beta Coefficients Estimation

In the case of prime linear regression, it is significantly important to test the hypothesis if the slope coefficient (β) equals zero. This is an important question because if $\beta = 0$, than independent variable does not influence dependent variable. In that case, the following hypotheses are tested (Doane, Seward, 2009, p. 520)

$H_0: \beta = 0$,
$H_1: \beta \neq 0$.

Results of the beta coefficient estimation for selected dependent and independent variables are presented in the following table.

Table 6. Beta coefficients estimation

Dependent variable		Independent variables							Adj. R^2
		BATX	BIFX	BIRS	ERS10	FIRS	SASX10	SASX30	
BHTSR	Beta coefficient	0.629	-0.162	-0.476	0.307	0.029	0.344	-0.008	0.553
	p-value	0.005	0.365	0.047	0.175	0.898	0.164	0.972	
BIGFRK3	Beta coefficient	0.043	0.760	0.092	-0.176	0.039	-0.087	0.158	0.601
	p-value	0.828	0.000	0.673	0.406	0.854	0.704	0.434	
BSNFRK2	Beta coefficient	-0.133	-0.466	0.349	-0.720	0.943	0.687	-0.585	0.265
	p-value	0.618	0.049	0.245	0.017	0.003	0.034	0.038	
BSNLR	Beta coefficient	0.841	0.009	-0.142	-0.016	0.143	0.071	-0.280	0.423
	p-value	0.001	0.964	0.590	0.950	0.577	0.797	0.250	
ELGJR	Beta coefficient	-0.590	-0.020	0.527	-0.691	0.187	0.181	0.308	0.052
	p-value	0.058	0.939	0.126	0.040	0.570	0.610	0.323	
FDSSR	Beta coefficient	0.808	0.283	0.036	0.016	-0.281	-0.184	0.045	0.615
	p-value	0.000	0.094	0.868	0.936	0.186	0.417	0.819	
IBZRK2	Beta coefficient	0.337	-0.150	-0.254	0.160	0.428	0.119	-0.060	0.038
	p-value	0.272	0.566	0.457	0.625	0.202	0.740	0.846	
JPESR	Beta coefficient	0.342	-0.140	-0.471	0.311	0.339	0.704	-0.187	0.629
	p-value	0.078	0.388	0.032	0.133	0.107	0.003	0.338	
JHKP-R-A	Beta coefficient	-0.108	-0.047	0.122	-0.223	0.876	-0.033	0.053	0.505
	p-value	0.620	0.802	0.618	0.345	0.001	0.899	0.812	
MIGFRK2	Beta coefficient	0.202	-0.239	0.208	0.270	-0.107	-0.627	0.232	0.072
	p-value	0.501	0.354	0.534	0.403	0.741	0.081	0.450	
NOVB-R-E	Beta coefficient	0.619	-0.099	0.579	-0.513	0.250	-0.166	-0.514	0.226
	p-value	0.030	0.673	0.065	0.088	0.403	0.604	0.073	
TCMKR	Beta coefficient	-0.234	-0.133	0.409	-0.231	0.210	0.742	-0.447	0.041
	p-value	0.443	0.610	0.233	0.479	0.527	0.045	0.157	
TLKM-R-A	Beta coefficient	0.598	-0.092	0.835	-0.684	0.135	-0.808	0.422	0.374
	p-value	0.020	0.662	0.005	0.014	0.613	0.008	0.100	
ZPTP-R-A	Beta coefficient	-0.075	0.063	0.040	-0.075	0.840	-0.067	0.110	0.701
	p-value	0.660	0.667	0.834	0.680	0.000	0.737	0.529	

Shaded values in the previous table show that, with 5% risk, can be concluded that variable x (selected indices) influences variable y (selected issuers), and that the estimation of parameter β is statistically important, i.e. in this case we reject null hypothesis. [xvi]

Discriminant Function Analysis

The first objective of discriminant analysis is to identify a set of variables that "best" discriminates between the two groups. In our case, we had two groups, i.e. the most liquid (group 1) and the least liquid (group 2) stocks from the capital market of Bosnia and Herzegovina. As we explained earlier, the independent variables of the model were comprised of the following variables: beta coefficient, market capitalization, turnover and return. Since we have, depending on index selected, seven beta coefficients for every issuer, general form of the discriminant function can be noted as follows:

$$D = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + b_7x_7 + b_8x_8 + b_9x_9 + b_{10}x_{10}, \qquad (4)$$

where x_1, x_2, x_3, x_4, x_5, x_6 and x_7 represent estimated beta coefficient in accordance with indices BATX, BIFX, BIRS, ERS10, FIRS, SASX10 and SASX30, respectively; x_8 represents (logarithmic) market capitalization, x_9 is used as representation of (logarithmic) turnover and x_{10} as a representative of return. We used stepwise method that basically removes independent variables that are not significant. A variable with very low tolerance contributes little information to a model and therefore may be removed from it. In our case, out of initial ten independent variables, we are left with only five of them: x_1 – BATXBETA, x_4 – ERS10BETA, x_6 – SASX10BETA, x_8 – LOGMCAP and x_{10} – RETURN. Summary of the most relevant results is presented in the following tables.

Table 7. Eigenvalue

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
(1)	210.391	100.0	100.0	0.998

The larger the eigenvalue, the more of the variance in the dependent variable is explained by that function. Also, the canonical correlation is the measure of association between the discriminant function and the dependent variable. The square of canonical correlation coefficient is the percentage of variance explained in the dependent variable. In our case, that means that 99.60% (0.998 x 0.998) of variance in the dependent variable is explained by the model.

Furthermore, results of the Wilk's Lambda test are presented in Table 8.

Table 8. Wilks' Lambda

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
(1)	0.005	24.092	5	0.000

Wilks's lambda, is an inverse measure of the importance of the functions. Values close to 1 indicate that almost all of the variability in the discriminator variables is due to within-group differences (differences between cases in each group); values close to 0 indicate that almost all of the variability in the discriminator variables is due to group differences (Brown and Wicker, 2000, p. 223). Basically, Wilks' lambda is a measure of how well each function separates cases into groups. Smaller values of Wilks' lambda indicate greater discriminatory ability of the function.

The interpretation of the discriminant coefficients (or weights) is like that in multiple regression. Table 9 provides an index of the importance of each predictor like the standardized regression coefficients did in multiple regression. The sign indicates the direction of the relationship.

Table 9. Standardized canonical discriminant function coefficients

Function	x_1	x_4	x_6	x_8	x_{10}
(1)	8.078	-6.110	-3.274	7.045	-4.643

Summa summarum, our estimated model can be written as follows:

$$D = 8.078 BATXBETA - 6.110 ERS10BETA - 3.274 SASX10BETA + 7.045 LOGMCAP - 4.643 RETURN$$

Basically, the standardized discriminant function coefficients indicate the relative importance of the independent variables in predicting the dependent. In our case, BATXBETA score (variable x_1) was the strongest predictor while LOGMCAP score (variable x_8) was next in importance as a predictor. These two variables with large coefficients stand out as those that strongly predict allocation to the most liquid or the least liquid group. In general, if we rank these other coefficients by their absolute values, next to LOGMACP, as the best predictor comes ERS10BETA (variable x_4), RETURN (variable x_{10}) and finally SASX10BETA (variable x_6). Let us now examine the practical implications of these results.

BATXBETA, or the beta coefficient as a measure of sensitivity of a stock price to movement in BATX, is very important tool when making an investment decision on capital market in Bosnia and Herzegovina. Why? Well, since the BATX is made up of the most liquid stocks traded on SASE and BLSE, every investor should first examine the sensitivity of the selected stock to the mentioned index.

Beta coefficient has proved itself as a very useful instrument which investors can use in the process of defining an investment decision on the capital market. For example, if we look at Table 6, we see that the estimation of parameter BATXBETA was statistically important in case of the following issuers: BHTRS, BSNLR, FDSSR, NOVB-R-E and TLKM-R-A. Furthermore, when knowing the beta coefficient, an investor may classify any selected stock in one of the three possible groups, i.e.: (1) an average stock ($\beta = 1$); (2) an aggressive stock $\beta > 1$, and (3) a defensive stock ($\beta < 1$). An average stock, according to the definition, will have beta 1 value, which means that its return will proportionally follow return on the selected stock exchange index. A beta coefficient higher than 1 implies that returns for the stock move more than the market. These stocks are known as aggressive. On the other hand a beta of less than 1 means that the stock will be less volatile than the market. These stocks are known as defensive. According to the results presented in Table 6 all of the selected stocks may be classified as defensive.

As second best predictor in our analysis, LOGMCAP, or the number of stocks multiplied by their current price on the stock market, is in general, very important tool in investment decision making. Since market capitalization may be used as a measure of liquidity (Von Wyss, 2008) this indicator is especially important when investing in underdeveloped capital markets.

Furthermore, the modern portfolio theory predicts that if the general assumptions of the capital asset pricing model (CAPM) hold, and the markets are efficient, systematic risk is the only priced in factor. However, there is a stream of literature that spills doubt over CAPM and provide evidence that the systematic risk factor is not the only priced factor, adding firm-specific parameters such as company size (which can be seen as a proxy for marketability, large bid-ask spreads, non-transparent information, etc.) and earnings yield affect returns to the discussions. Measuring the size of a company by its market capitalization value, studies utilizing data from different stock exchanges, often find that smaller companies carry a so called "small-firm" premium and earn higher returns than their larger counterparts in a buy and hold strategy. Since 1926, the nominal returns on large cap stocks have averaged about 10% per annum, whereas small-cap stocks brought about 12% and corporate bonds about 6% gross of inflation rate and taxation (Keating, 2013). Developed markets have acknowledged this, and decision makers have placed large incentives in form of commissions and trading spreads to support small-caps with equity analysis, market makers and the like. As concerns for investor protection rise in the recent years the rule making has reversed a bit.

When allocating funds to peripheral and emerging markets, investors particularly look into parameters such as market capitalization and liquidity, as well as market depth (the sensitivity of bid-ask spreads on the local stock exchange to the placement of trading volumes within a certain period of time). This liquidity risk is defined as the risk of a security not being able to trade quickly enough in the market such to prevent losses. In the modern times of high frequency trading, sophisticated systems and cash abundant investors in search of yields, liquidity provides investors with an option to exit, and induces them to take risk, growing capital formation, which in turn funds innovation and leads to constantly improving standard of living. If liquidity is eliminated or reduced, this process is reversed meaning that smaller markets will be more and more excluded in investment decisions based on these parameters and seen as unattractive for any sort of capitalization, which in turn diminishes future economic growth. The impact of liquidity can be reduced, if firms have a firm financial management in place and diversify across several liquidity providers in the region.

Investing in small-cap companies is one of the most widely used passive growth strategy where discipline and diversification gains on importance. A conviction bet in a less liquid market can bring higher returns; as such markets are more volatile, rewarding their participants for the risks being taken. Understanding this relationship between company size, return potential and risk is crucial before adding any equity position to the investor portfolio.

Conclusion

In this paper we investigated the possibilities of stock selection and analysis on the underdeveloped capital market of Bosnia and Herzegovina. Due to its many specificities (such as low market capitalization, poor liquidity and turnover, weak legal protection for minority shareholders, low correlation with developed and emerging capital markets, etc.), any kind of scientific research on this market can help investors in shaping their investment strategies. Therefore, the main goal of this paper was to scientifically examine and propose new approach of stock selection and analysis based on multivariate technique, i.e. discriminant analysis, in order to help investors, individual and institutional, in their decision making process, especially in case of underdeveloped capital markets. The main limitations of this study are to be found in the shorter available financial time series in newly formed capitalistic economy, missing data due to the lack of collective records on levels of securities offerings issues. However, the main advantage of this research is that we concluded that discriminant analysis is a useful quantitative tool that can help investors in shaping their investment strategies in case of capital market of Bosnia and Herzegovina. We also found that the beta coefficient, market capitalization and realized historical return have discriminatory capabilities in case of the capital market of Bosnia and Herzegovina. The real implications of this research can be seen in the shaping of investment strategies of potential investors looking to diversify their portfolios as well as financial managers of smaller listed companies looking for ways to make their financial structure more attractive to investors. To summarize, previously formulated scientific hypotheses can be confirmed and further research suggests a need for more in depth analysis of effects investment strategies based on the new approach of stock selection and analysis proposed in this paper.

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[i] Stock market information, including dividend information, is often not complete and is not always disclosed in English. There is no central source for this type of information.
[ii] According to additional information, it has been learned that there are several active custodians available for foreign investors.
[iii] Bosnian Investment Fund Index – BIFX, The Sarajevo Stock Exchange, Retrieved 18 April 2013, from http://195.222.43.81/sase-final/language/en-US/Market/Index/Index_BIFX.aspx
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[ix] For more information see: The Bosnian Traded Index (BATX), The Wiener Börse AG, Retrieved 30 December 2012, from http://en.indices.cc/indices/cee/profiles/batx.html

[x] Real historical values for BATX are available at: BOSNIAN TX BAM (BXL.VI), Yahoo! Finance, Retrieved 14 December 2012, from http://finance.yahoo.com/q/hp?s=BXL.VI+Historical+Prices

[xi] Bosnian Traded Index (BATX), The Wiener Börse AG, Retrieved 20 April 2013, from http://en.indices.cc/static/cms/sites/indices/media/en/pdf/download/profiles/en_BATX.pdf

[xii] For more information on composition of BATX see: Bosnian Traded Index in BAM - BATX BAM, The Wiener Börse AG, Retrieved 7 July 2012, from http://en.indices.cc/indices/details/bxl/composition/

[xiii] Dobrinja d.d. Ilidža was not used because at the time this research was done, quotes weren't available on the official web site of the SASE.

[xiv] For this, in this paper the stock closing prices for the first and last trading day of each month were collected.

[xv] All results in this research were generated by: *SPSS® Student Version 11.0 for Windows®*, ©SPSS Inc. 2002, Quantitative Micro Software *EViews 7.1* Enterprise Edition 2010 and *STATISTICA 7.0* Copyright© StataSoft, Inc. 1984-2004.

[xvi] Null hypothesis is confirmed in this case, if p – values are higher than selected significance level.