Analysis of Characteristic
of Zagreb Stock Exchange Sectors
by Means of Fundamental Estimators

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Abstract. In the paper characteristics of ZSE stocks pertaining to the same sectors are analyzed by means of their basic fundamental estimators (such as P/E and P/Bv ratios). The most volatile sectors of banking, transportation, construction etc., will be analyzed and compared by means of statistical methods: principal components analysis and analysis of variance. Our aim is to analyze movements on the stock market in the period before the recent economic crises in order to identify certain regularities in stocks price evaluation as well as indicators of the forthcoming crises. The hypothesis is that evaluations of the stocks pertaining to specific sectors were asymmetrical in terms of fundamental indicators and related future projections.

Keywords. Zagreb stock exchange (ZSE), fundamental analysis, stock sectors, stock prices, principal components analysis, analysis of variance

1 Introduction

Our research can roughly be described as a kind of fundamental analysis (FA) in the domain of stock market research with choice of course that is often called the 'bottom-up' approach to the fundamental analysis. This approach is directed mainly at estimating the value of a stock and comparing it to its current market price. Usually, the goal is to establish if a stock is significantly underestimated or overestimated according in relation to the values of companies' relevant financial indicators. We have used several basic fundamental estimators to make evaluations of stocks pertaining to specific industries or sectors. Our hypothesis is that certain asymmetries the fundamental indicators. The reasons for that are acceptable from the point view of different structures of diverse industries operations, but we believe that investors' sentiments were encouraged and shaped by

some specific traits of the trends in the Croatian economy.

2 Indicators of Fundamental Analysis

Valuations of companies' stocks are often based on their earnings. Because of this common approach, the ratio between a stock's price and its earnings per share (P/E ratio) is a useful indicator of whether certain stock has attributes to be overestimated or underestimated. Certain researches in the fundamental analysis (such as Basu 1977, 1983) show that portfolios of low P/E have higher returns then high P/E portfolios [1]. Then, why investors sometimes choose a stock with higher P/E? The reason for that lies mainly in the domain of risk management. If a company's business contains many risk elements then it is expected that this stocks will sell at a lower price (P/E ratio). Also, the P/E ratio includes accounting earnings, and this circumstance suggests that there could be included arbitrary rules. On real markets the P/E ratio varies with the passage of time and, besides, it has different values in diverse industries.

Another market price ratio is the market price of a share of the company's stock divided by book value per share (P/Bv or P/B). In view of the possibility of selling company's assets for their book values it is commonly believed that market price should exceed the book value. A higher value of company's P/B indicates that investors' believe their companies have high potential of returning the investment. However, analysts claim that a stock with lower P/Bv ratio is safer in the portfolio. It is important to note that asset values on a company's balance sheet do not represent the current market value of its assets. Oil companies, for example, often underestimate the value of land on their balance sheets [2]. Interestingly, the intellectual capital (intangible assets) is not stated on balance

sheet [3], and this fact explains why in some instances the P/B ratio is expected to be higher than the average value.

Price to cash flow ratio (P/CF) is calculated by taking the current share price and dividing the total cash flow from the operations presented on the cash flow statement, it is stock's capitalization divided by its cash flow for the last fiscal year. The sources of cash can be put in categories such as: CF from operating activities, CF from investing activities, CF from financing activities [4].The P/CF ratio varies in dependence on industries. The companies that are engaged in capital-intensive activities and have to invest much money in research, facilities and fixed assets, usually have lower values of P/CF indicator. Several financial indicators based on CF can be classified in four groups [5]: assessment of solvency and liquidity, quality of income, capital expenditures, cash flow returns. A common method for determining a fair stocks' value is the so-called *discounted cash flow* (DCF). This (fundamental) analysis is based on calculating the present value of an investment's future cash flows with an aim to get a current fair value estimate for the investment.

The price-sales ratio (P/S) is the ratio between the market value of equity and a company's revenues for the last fiscal year. It represents market valuation of a company's revenues. This ratio allows us to compare companys that generate losses and it is also usable when P/E indicator is not acceptable. Some analysts claim that P/S ratio is useful when comparing companies within the same industry only. An important characteristic of the P/S ratio is the impact of the profit-margin changes on this indicator in a way that the decline in profit margins causes reducing of P/S value. As an alternative approach, this ratio is less affected by accounting choices.

Market capitalization refers to the measurement of corporate or economic size equal to the share price multiplied by the number of shares. Since owning stocks means owning the company, including all of its equity, the capitalization is likely to reflect the public perception of the company's net worth and be the determining factor for the stock valuation [6]. According to the most common classification, companies can be classified as large, medium and small sized. In 2007 the Croatian Financial Services Supervisory Agency (HANFA, CFSSA) proclaimed in 2007 a regulation about the criteria of investment of Croatian Retirement Funds. This regulation sets limitations to the Funds on investments in a way that market capitalization for companies out of the first listing should amount to at least 750M kunas.

Given that many analysts believe that a common investment with simultaneously small ratios of P/E and P/Bv is a good decision, we designed the indicator that is a product of these two ratios. A considerable number of investment related decisions can certainly be explained by the fact that the product of P/E*P/Bv has small values.

We decided not to include some other known models or indicators of the fundamental analysis, such as Dividend discount models, mainly for the reason of absence of data or events.

If we accept these indicators of the fundamental analysis in a way that their values explain current and future market stock prices, then we have created preconditions and laid foundations for the research of the differences between stock performances in different industries, establishing at the same time connection between those achievements and the levels of the fundamental indicators. The question is whether or not the values of, for example, P/E and P/B ratios ensure consistent evaluation of stock values for companies of different industries.

3 Industry Analyses and Croatian Stock Market

The differences among the performance of industries and the dynamic behavior of their respective stocks are well known to both investors and analysts. The stock market, like many aspects of business and the economy, has long been subject to a host of cyclical influences. While destabilizing events, such as earthquakes, assassinations, terrorist attacks, occasionally disturb regularities, there appears to be some consistency in the dynamics of share prices [7].Characteristically, the patterns of stocks prices in different industries, on the basis of fundamental indicators, represent a challenge for understanding and explanation.

In Germany, for example, the prices of stocks listed on the *Neuer Markt*, where many "new economy" companies are listed, have risen almost threefold between November 1999 and March 2000, while the market as a whole (including the *Neuer Markt*) gained 50% [8]. This phenomenon motivated analysts to do a research into new formulas and models with an ambition to explain differences and find out how the market appreciates the new economy companies.

It is interesting that the dispersion of industry performance in, for example, the expected earning (US Comments, May 1993, Institutional Brokers Estimate System) is lesser than the dispersion of the returns at the stock exchange obtained from that particular industry[4].

Until five years ago, Zagreb Stock Exchange (ZSE) was an underdeveloped institution that emerged from the Communist economy, with no experience or business culture in the stock market investment. On the other hand, as much as 30% of all market shares in Germany have been held by individuals and households over the past decade [9]. However, the ZSE has experienced a very high growth rates over the past several years that is well

illustrated in Fig. 1. There was no real connection between the ZSE and other stock markets worldwide in the way that we did not follow world trends. While in the U.S.A. everything was stagnating or dropping, the ZSE saw growth. The downfall at ZSE was also impressive; it was caused by overestimation and by the financial crisis that has stricken the whole world.

Figure 1. Comparison of CROBEX and Dow Jones (DJ Euro Stoxx 50) ^STOXX50E [10]

The years of 2008 and 2009 have seen a significant correlation between the changes in CROBEX indices and the leading US (for example S&P500) and European market indices. The changes at the Croatian stock market follow the changes in the values on the world markets on a daily, even hourly basis.

Over the past several years, the Croatian economy has gone through specific development phases, and certain characteristics that influenced stock market should be pointed out:

> High level of government infrastructure investment (specially for roads construction)
> Inheritance of the ship transport sector
> Re-animation of tourism sector
> Process of privatization

Because of major job orders and contracts between construction companies and government, investors developed great confidence and positive sentiment toward the stocks of these companies from ZSE. Accordingly, it is assumed, for the reason of lower risks, that the values of ratios P/E and P/Bv of the construction companies in Croatia were higher than the average value of the companies from our economy. Likewise, the economic development in Germany in the late 1980's, for example, required investments into new capacities, factories, warehouses that provide the construction industry with most benefit [11].

We believe that, as a result of the recovery of tourism and its great results, after the war crisis, and in expectation of the EU accession, the rise in the prices of land and real estates, stocks of tourist agencies could also have potentially asymmetrical treatment in terms of fundamental indicators.

The Croatian shipping is largely affected by the world trade movements and the increased demand for transport capacities due to intensification of the economies of China and India. The trade between these countries and Europe as well as the U.S.A. has resulted in the highest values ever of the freight rates (for example, the Baltic Exchange Dry Index). Our companies engaged in this industry have had a specific position in comparison with the predominantly regionally oriented companies in other sectors.

4 Research Conducted in the Zagreb Stock Exchange

4.1 Data Set and Statistical Methods

Our research was conducted on a sample of 30 companies in the ZSE with great liquidity, and data pertaining to 42 weeks in the year 2007 (FIMA web site [12]). Analyses were made on the basis of weekly changes (we had at our disposal 31 weekly reports relating to the observed time period). The reports relating to the first 16 weeks were made on the basis of estimations, whereas those pertaining to the later period of the observed time period were made on the basis of exact values. The observed companies are from six sectors: Industry, Food Processing, Construction, Tourism, Transport and Banks. It needs to be mentioned that due to the relatively small Croatian economy, we were unable to employ the U.S. classification of companies, such as: Financial Services & Real Estate, Technology, Media & Telecommunications, Healthcare, Consumer Goods & Retail, Energy, Industrials, Materials & Utilities [13].

Dionica	Tjedan	Tekuća cijena	MkCap	P/E	P/CF	P/S	P/Bv	PP/Ebv	
	1	3471,0	4843,0	21,4	13,3	3,5	4,6	98,4	
Atlanska plovidba	2	3358,0	4686,0	20,7	12,9	3,4	4,5	93,2	
	3	1975,0	4152,0	18,3	11,4	3,0	4,0	73,2	
Sektor	4	2770,0	2865,0	17,0	10,6	2,8	3,7	62,9	
TRANSPORT	5	2860,0	3991,0	17,6	10,9	2,9	3,8	66,9	
	6	2522,0	3520,0	15,5	9,7	2,6	3,4	52,7	
	7	2594,0	3620,0	16,0	9,9	2,6	3,5	56,0	
	8	2697,0	3764,0	16,6	10,3	2,7	3,6	59,8	
	10	2657,0	3708,0	16,4	10,2	2,7	3,5	57,4	
	11	2363,0	3298,0	14,5	9,0	2,4	3,2	46,4	
	12	2111,0	2945,0	13,0	8,1	2,2	2,8	36,4	

Table 1. Example of the structure of analysed data

In our research we will use statistical methods of principal components and analysis of variance [14, 15]. The principal components analysis provides insight into the most relevant factors around which variables are grouped. It allows expressing large proportion of total variance of data with smaller number of variables in directions of maximum variation of data. The first principal component is the linear combination of original variables with maximum variance; the second principal component is

the linear combination with maximum variance orthogonal to the first component and so on.

Analysis of variance (ANOVA) is a set of procedures in which variance of random variable is divided according to the sources of variability. The aim of ANOVA is to test if there is a significant difference between groups or levels of observed factors. The significant difference exists if the variation of data within groups or levels is much smaller then the variation between groups or levels.

4.2 Results of Research

Tables 2-7 contain basic descriptive statistics (mean, number of cases and standard deviation) for the observed estimators.

Descriptive statistics: MkCap			
Sektor	MkCap Means	MkCap N	MkCap Std.Dev.
Industry	6110,177	186	8942,000
Food proces.	1085,561	310	815,628
Construction	1304,809	155	769,040
Tourism	1860,594	124	552,244
Transport	1900,287	217	1135,589
Banks	9074,136	217	11683,879
All Grps	3546,258	1209	6829,384

Table 2. Descriptive statistics for estimator of market capitalization

Descriptive statistics: P/E			
Sektor	P/E Means	P/E N	P/E Std.Dev.
Industry	38,332	186	59,150
Food proces.	35,566	310	30,654
Construction	48,382	155	43,172
Tourizam	172,517	124	360,058
Transport	63,698	217	96,489
Banks	19,324	217	6,770
All Grps	53,815	1209	133,007

Table 3. Descriptive statistics for variable P/E

Descriptive statistics: P/CF			
Sektor	P/CF Means	P/CF N	P/CF Std.Dev.
Industry	8,141	186	2,995
Food proces.	12,683	310	7,514
Construction	15,192	155	9,671
Tourism	15,847	124	6,587
Transport	26,570	217	40,713
All Grps	15,656	992	20,975

Table 4. Descriptive statistics for variable P/CF

Descriptive statistics: P/S			
Sektor	P/S Means	P/S N	P/S Std.Dev.
Industry	1,042	186	0,569
Food proces.	1,404	310	0,859
Construction	1,165	155	0,829
Tourizam	4,187	124	1,221
Transport	4,702	217	2,998
Banks	4,696	217	37,120
All Grps	2,786	1209	15,852

Table 5. Descriptive statistics for variable P/S

Descriptive statistics: P/Bv			
Sektor	P/Bv Means	P/Bv N	P/Bv Std.Dev.
Industry	1,968	186	1,203
Food proces.	1,842	310	1,447
Construction	3,936	155	1,920
Tourizam	1,916	124	0,742
Transport	5,570	217	8,587
Banks	3,550	217	1,570
All Grps	3,113	1209	4,108

Table 6. Descriptive statistics for variable P/Bv

Descriptive statistics: PP/EBv			
Sektor	PP/EBv Means	PP/EBv N	PP/EBv Std.Dev.
Industry	74,589	186	127,381
Food proces.	55,145	310	48,908
Construction	219,862	155	255,148
Tourizam	290,150	124	561,224
Transport	1127,098	217	3079,683
Banks	42,046	217	26,861
All Grps	293,408	1209	1377,799

Table 7. Descriptive statistics for variable PP/Ebv

The primary goal of our research was to see how fundamental estimators are grouped into principal components. We had some doubts whether to include

data from all observed periods of time, or to use just the data from the period after the 16th week which rely on exact data. Table 8 shows loans of variables in the first three principal components, which account for 72,66% of data variation (here are included data from the whole time period). In the first principal component the loans for variables P/E, P/CF, P/Bv and PP/EBv exceed 0,5 in absolute value. These variables belong to the first component which alone accounts for 42,10% of data variation. In the second component the loans of variables MkCap and P/S exceed 0,5 in absolute value and these variables pertain to the second component. The variable of Price change pertains to the third component where it has a high loan of 0,99. It can be seen that variables are sharply organized into principle components. The number of factors is selected on the basis of the criterion that the respective *eigenvalue* is higher than 1.

Variable	Factor coordinates of the variables		
	Factor 1	Factor 2	Factor 3
Price change	-0,003251	-0,083351	**0,985263**
MkCap	0,031162	**-0,791269**	-0,149551
P/E	**-0,500303**	0,197208	0,040301
P/CF	**-0,945660**	0,060349	0,008459
P/S	-0,100092	**0,664294**	0,074352
P/Bv	**-0,921431**	-0,143216	-0,034549
PP/EBv	**-0,970731**	0,018886	-0,011984

Table 8. Loans of variables in the first three principal components

Table 9 shows loans of variables in the first three principle components for selected subset of data (data from the 17th week onwards for every stock).

Variable	Factor coordinates of the variables Include condition: Week>16		
	Factor 1	Factor 2	Factor 3
Price change	-0,052944	-0,205975	**-0,972040**
MkCap	0,053854	**-0,776302**	0,198047
P/E	**-0,891814**	0,080420	-0,027710
P/CF	**-0,949145**	0,063685	-0,015864
P/S	-0,048026	**-0,738067**	0,046533
P/Bv	**-0,912117**	-0,140896	0,063379
PP/EBv	**-0,959160**	0,000930	0,043638

Table 9. Loans of variables in the first three principal components for data from 17th week onwards

It can be seen that variables are organized as components in the same manner as in the first case, but the loans of variables in the respective components are higher. So, variables are, in this case, more sharply organized into three selected components.

This conclusion can also be confirmed if figures 2 and 3 are compared. Three principal components in the latter case account for 80,99% of data variation. Consequently, our hypothesis is that by selecting the data from 17th week onwards we can refine our analysis and obtain more reliable results.
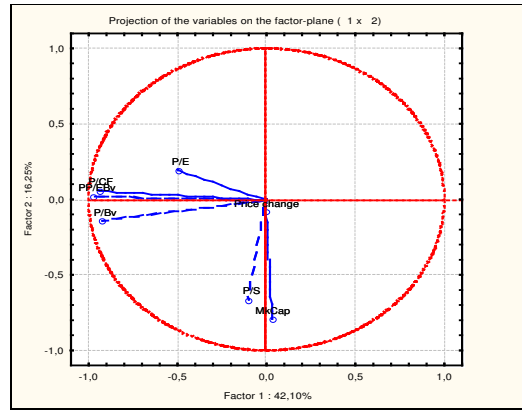

Figure 2. Projection of variables onto first two principal components (all data included)
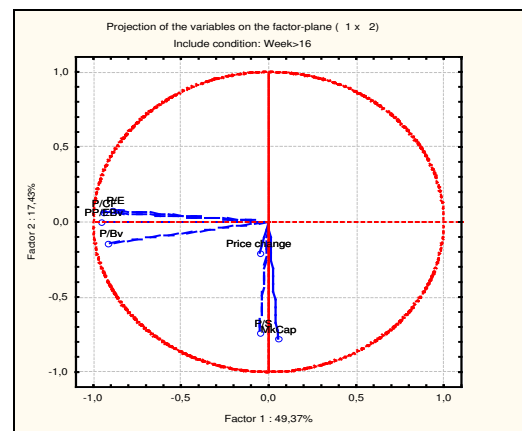

Figure 3. Projection of variables onto the first two principal components for data from the 17th week onwards

As for variables MkCap, P/E, P/CF, P/S, P/Bv and PP/Ebv a two-way analysis of variance (ANOVA) will be made, including sector and week (time) as factors. In fact, our interest is predominantly focused on the question whether the parameters represented by the mentioned variables significantly differ in different sectors. The factor of time is required because here we deal with a dependent sample (depending on time). For the purpose of this analysis certain companies with the extreme performances were excluded from processing.
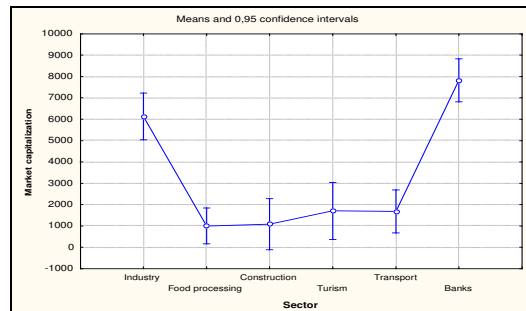
Figure 4. Means and 0,95 confidence intervals of variable MkCap (market capitalization)

Variable MkCap (market capitalization) differs significantly for levels of variable Sector (p<<0,05, see Figure 4). According to the post hoc test of Bonnferoni there is a significant difference between sectors Banks and Industry and all other sectors. There is no significant difference between sectors of Banks and Industry. The variable of MkCap is a good predictor for discrimination of sectors Banks and Industry.
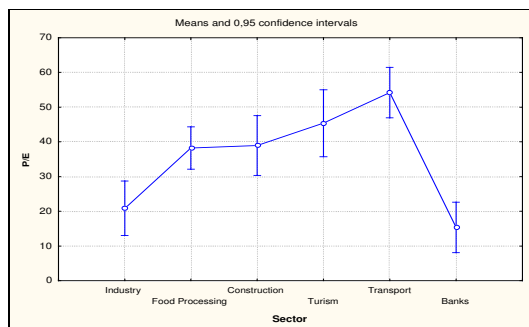

Figure 5. Means and 0,95 confidence intervals for variable P/E

Variable P/E (Price/Earning) has similar effects on the discrimination of sectors as variable MkCap. It differs significantly for levels of variable Sector (p<<0,05, see Figure 5). According to the Bonfferoni test, significant differences exist between sectors Banks and Industry and all other sectors. Between the sectors of Banks and Industry there are no significant differences, and sector Transport differs significantly from the Food Processing sector.
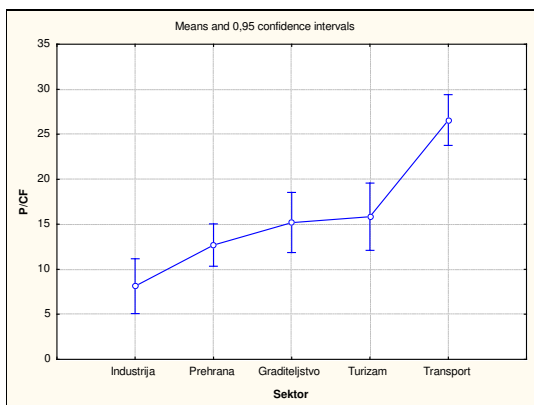

Figure 6. Means and 0,95 confidence intervals for variable P/CF

Variable P/Cf (Price/Current Flow) differs significantly among the sectors (Figure 6). The highest values are achieved for sector Transport. According to the Bonfferoni test sector Transport differs significantly from all other sectors. Also, sector Industry differs significantly from sectors

Construction and Tourism. Hence, generally, the variable of P/Cf is a good predictor for the discrimination of sectors Transport and Industry.
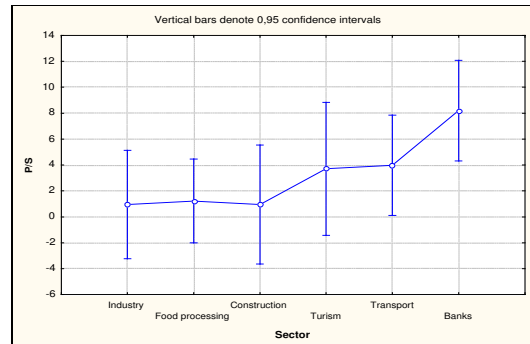

Figure 7. Means and 0,95 confidence intervals for variable P/S

Variable P/S (Price/Sales) does not differ significantly among different sectors (Figure 7). That is why this variable is not a good predictor for the discrimination of sectors.
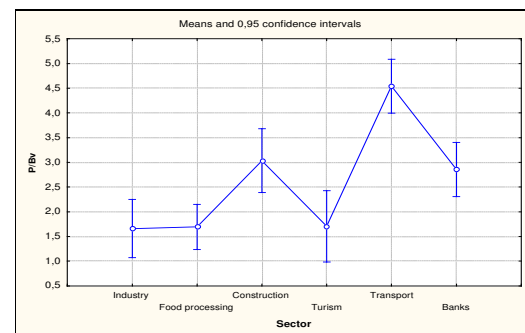

Figure 8. Means and confidence intervals for variable P/Bv

Variable P/Bv (Price/Book value) is a good predictor for the discrimination of sectors (Figure 8) because there is a significant difference between sectors in terms of the analysis of variance. According to the post hoc test of Bonfferoni, sector Transport (which has the highest values) differs from all other sectors. Sector Construction also differs from sectors Industry and Food Processing, and sector Banks differs from the Food Processing sector.
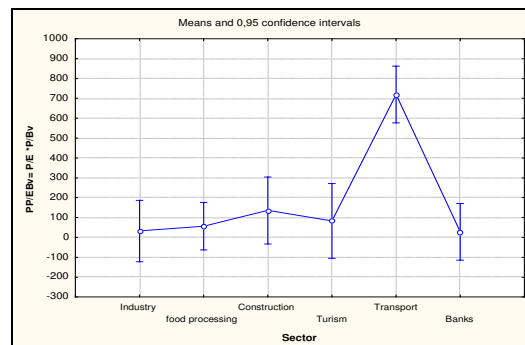
Figure 9. Means and confidence intervals for variable PP/EBv

As regards the derivate variable of PP/EBv, there is a significant difference between sector Transport and all other sectors (Figure 9). Hence, this variable has the discrimination power for sector Transport, but such discrimination can be obtained by using former variables.

5 Conclusions

The research performed on a sample of stocks from different industries, listed on ZSE, indicates that fundamental estimators are grouped into principal components very strictly. Three principal components account for 80,99% of data variation. Two orthogonal factors *f1* and *f2* are composed as **f1**(P/E, P/CF, P/Bv and PP/Ebv) and **f2** (Price change, P/S, MkCap). As for factor *f2*, it can be said that it is composed with an emphasis on the size (of company and revenues), and also with respect to the perspective of stability in a long run. On the other side, the composition of factor *f1* is oriented towards the attributes of profitability. Factor *f1* is more exposed to possible influence of the accounting "policy" that makes investments more risky.

As regards the distinction between different industry sectors, and in view of the variables of the fundamental analysis that are considered as "predictors", below are significant conclusions that are derivated in Chapter 4.2:

- Variable MkCap (market capitalization) is a good predictor for the discrimination of sectors Banks and Industry.
- As for variable P/E, there are significant differences between sectors Banks and Industry and all other sectors. Sector Transport differs significantly from the sector of Food Processing.
- Variable P/CF is a good predictor for the discrimination of sectors Banks and Transport.
- Variable P/B relative to sector Transport (which has the highest values) differs from all other sectors. Sector Construction differs also from sectors Industry and Food Processing, and sector Banks differs from the Food Processing sector.
- As for the derivate variable of PP/EBv, there are significant differences between sector Transport and all other sectors.

The hypothesis that evaluations of stocks pertaining to specific sectors are asymmetrical in terms of the fundamental indicators is mainly correct, thanks to the characteristics of the fundamental indicators described in Chapters 2 and 3, and to the dynamics in the macroeconomic environment.

In view of the above conclusions, and taking into consideration the results of the descriptive statistics, we suggested a short interpretation for popular ZSE industry sectors. Some industries have "credits" with investors and they keep high levels of ratios between P/E and P/B. Investors have confidence in the sector of Tourism because of the values of companies' (hidden) assets and a perception of the future growth. This makes possible relatively high mean value of the P/E ratio for Tourism. We believe that small banks within the sample of the Bank sector were under the influence of the investors' perception of CFSSA regulation regarding the bottom MkCap levels for the Funds investments. The risks of financial crisis can also be included in the evaluation of the financial sector stocks that explain the reasons for small P/E. As for the sector of Transport, estimator P/E has high values presumably owing to the expected future development and financial credits to the Croatian seaports (Ploče and Rijeka), as well as to indications of investment in oil transport infrastructure to increase their capacities. Indicator P/Bv is higher for sector Transport than the average values that indicate evaluation of this sector's high potential for the return of investment. Sector Industry has relatively small indicator P/CF at ZSE, which is in agreement with our conclusion that greater investment into facilities and operations in some sectors may result with lower values of this indicator. Industry of Construction has relatively high P/Bv mean value, which suggests investors' positive sentiment regarding the potential of earning, thanks to the existing and future government projects in infrastructures. Given that expectations for the Food industry are not so high, this sector is marked by a low P/Bv mean value.

Certain other differences between the industries in terms of the stocks evaluation can be explained in larger part by global trends and macroeconomics related to the risks of investment, belief in industries' growth perspectives, fiscal policies, and so on.

References

[1] Z. Bodie, A. Kane, A.J. Marcus: **Essentials of investments**, McGraw-Hill Companies, Inc., 1995.

[2] B., O'Neill Wyss: **Fundamentals of the Stock Markets**, Copyright © 2001 by The McGraw-Hill Companies Inc. , pp. 132

[3] K., Standfield: Intangible Finance Standards-Advances in Fundamental Analysis& Technical Analysis, Copyright© 2005, Elsevier Inc.

[4] R.C. Higgins: **Analysis for Financial Management**, 4th ed., Richard D. Irwin Inc., 1995.

[5] K. Žager, L. Žager: **Analiza financijskih izvještaja**, Masmedia, Zagreb, 1999.

[6] **Web site SG Private Banking- Market Capitalization**,

http://www.sgprivatebanking.com/outils/glossary.html; Accessed: 12.05.2009.

[7] Michael J., Panzner: **The New Laws of the Stock Market Jungle- An Insider's Guide to Successful Investing in a Changing World**, FT Prentiize Hall 2005 , pp.141.

[8] B. Ayrer, C. Upper, T. Werner: **Stock Market Valuation of Old and New Economy Firms**, Paper prepared for the Working Group on The Financing of the New Economy of the Committee on the Global Financial System, Deutsche Bundesbank, Frankfurt, www.bis.org/publ/cgfs19bbk2.pdf , Accessed: 09.05.2009.

[9] Ž., Mrkušić, A.,Petrić Mrkušić: **Dionice- što s njima**, Vita graf d.o.o., Rijeka 1993., pp. 50.

[10] **Web site to/one**, http://appsrv1.to-one.com/pls/b21web/taexe.graf1?p_first=NO&p_tip=&p_ticker=CROBEX&p_cmpticker=%5ESTOXX50E&p_period=1095&p_datum=-Zavrsni+datum-&p_datum_od=-Pocetni+datum-&p_style=LINE&p_matype=SMA&p_ma_interval=7&p_matype2=SMA&p_ma_interval2=14&p_gind1=&p_ind1=&p_ind2, Accessed: 13.05.2009.

[11] Bestenbostel, von P. et al.: **Dionice i burze-savjeti za dioničko i burzovno poslovanje**, prijevod s njemačkog, Informator, Zagreb, 1992.

[12] FIMA, http://www.fima-vrijednosnice.hr/default.aspx?id=89&arhiva=1 , Accessed: 16.04.2009.

[13**] Reuters - finance**, http://www.reuters.com/finance/industries/allstries , Accessed: 10.05.2009.

[14] P. Newbold, W. L. Carlson, B. Thorne, **Statistics for Business and Economics**, fifth edition, Pearson Education, Inc. Upper Saddle River, New Jersey, 2003.

[15] A.C. Rencher, **Methods of Multivariate Analysis**, second edition, Wiley-Interscience, 2002.