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Predictability of High-value Stocks on Australian and Shanghai Stock Exchange

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In this paper we examine the role of financial ratios in predicting high-value stocks. The motivation is that in the uncertain climate that followed the Global Financial Crisis, investors have become cautious and they need to distinguish between speculation and investment, by selecting stocks that are of high-value. Using discriminant techniques to analyse companies listed on the Australian Stock Exchange, this paper shows that the four most significant predictors of high-value stocks are earnings per share, return on asset, book value, and debt/equity ratio. In addition to these four predictors, this paper's analysis of companies listed on Shanghai Stock Exchange confirms that market capitalization and price/earnings ratio also empirically discriminate between those stocks of high-value and those not. The implications of this study are that high-value companies listed on these two stock exchanges can be identified by examining these financial ratios.

1. Introduction

The last few decades have witnessed stock market booms and busts, and cycles of economic prosperity and downturn. Among all these, the global financial crisis of 2008 was possibly the most devastating to investors' wealth, and their confidence. It wiped out billions of dollars in the stock market value, created the conditions for the worst bear markets since 1929 Stock Market Crash, and its ramifications are still felt in 2012 in the form of the debt crisis of the Europe.

In response to the call for guidance in uncertain economic times, financial analysts and researchers have offered their insights in stock selections to ensure their portfolio investments are of high value and financially sound.

Graham and Dodd (2009) in 'Security Analysis' introduced the concept of intrinsic value; and in Graham's classic book 'The Intelligent Investor', value investing is defined as the strategy of selecting stocks that trade for less than their intrinsic values (Graham, 2005). With this philosophy, value investors distinguish between speculation and investment (Williams, 1938) and seek stocks of companies that are underpriced compared to the intrinsic value indicated by the company's fundamentals, stocks with lower-than-average price-to-book or price-to-earnings ratios and stocks with higher-than-average yields.

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However, the main problem for value investing, as noted in Investopedia, an online investing education site, lies in the estimation of intrinsic value, as there is no 'correct' intrinsic value.

Investopedia also points out that the very definition of value investing is quite subjective, such that with the same information, two investors can place different values on the same company. Some investors would only look at present assets/earnings; others would base their strategies on future growth and cash flows. The key question is which financial indicators are most important in identifying high-value stock potential, and the key tool used in this paper is discriminant analysis.

Thus the purpose of this paper is to determine whether stocks can be quantitatively identified as "high-value" by their financial ratios. The discriminant model is developed, where samples of 100 Australian Stock Exchange and 700 Shanghai Stock Exchange companies are analyzed to establish a function that best discriminates between companies in three mutually exclusive groups: low, medium and high-value stocks. The reliability of the discriminant model reflects the accuracy of the group predictions based on the financial ratio data. The implications of the findings will be discussed more fully in the conclusion.

The rest of this paper provides a review of existing academic literature on the subject, followed by a description of data source and the development of the analytical model used. The paper then presents the empirical results of the study and concludes by discussing its findings, limitations and possible further research.

2. Literature Review

The prediction of stock returns has been well researched in academic publications (Keim and Stambaugh 1986, Breen, Glosten, and Jagannathan 1990, Pesaran and Timmermann 1995, Ferson and Harvey 1993, Qi 1999, Lewellen 2004, Campbell and Thompson 2008, Wachter and Warusawitharana 2009, Malkiel 2004). There have been numerous studies using various methodologies such as a neural network approach, financial and economic variables, predictive regressions or simple technical trading rules (Yoon and Swales 1991, Lewellen 2004, Gencay 1998, Avramov and Chordia 2006, Campbell and Yogo 2006, Nath and Galagedera 2011, Zhu 2011).

In contrast, financial applications of discriminant analysis have been predominantly used to predict corporate bankruptcy or forecasting company failure (Deakin 1972 and 1977, Taffler 1982, Altman 1968). Yoon, Swales and Margavio (1993) compared discriminant analysis with artificial neural networks to predict stock price performance, but using only four financial ratios: current ratio, return on equity, price to earnings, and price to sales. In the finance research literature, the prediction of value stocks using discriminant analysis has been limited, both in developed and in emerging economies.

In using data from the Australian Stock Exchange and the Shanghai Stock Exchange, this paper also brings in an element of comparison, framed within the question of

financial ratios as predictors of value stocks. As Chen et.al. have pointed out in their study of USA and China data, stock return predictability varies across jurisprudence but firm-specific variables can be significant predictors of stock returns in both countries (Chen et.al, 2010). Studying a narrower range of variables and a small sample of Malaysian companies, Kheradyar et.al. tests and confirms the predictive powers of the 3 financial ratios (book-to-market value, dividend yield and earning yield) known to be predictor of stock returns in the USA (Kheradyar et.al. 2011). Using data from Pakistan, a similar study found that 'financial ratios have significant power of predictability for forecasting returns of stocks' (Khan et.al. 2012). Following the same general thrust of forecasting stock returns using financial ratios, Aono and Iwaisako empirically establish that for the Japanese tocks, compared with the USA, price-earnings ratio is a weaker predictor (Aono and Iwaisako, 2009, 2010).

This paper extends and complements this body of work by analysing companies listed on the Australian Stock Exchange and those on the Shanghai Stock Exchange. With China's growing middle class, and given the current volatility of the stock market, people are seeking for 'more efficient and stable investment methods to maintain the value of their assets' (China Daily September 2012). This implies that investors prefer value investment portfolios that outperform the market while reducing risk. In addition, the economies of Australia and China are becoming more closely intertwined, as evidenced in the recent currency agreement of April 2013, This paper should be of use to those who seek to identify financial high-value stocks listed on these two exchanges, using discriminant analysis of publicly available financial data.

3. Data Sources and Development of the Model

Data on ASX companies are obtained from the *COMSEC* website which is the share trading division of the Commonwealth Bank of Australia Board (2010). The selection of the ASX companies is made on the basis of available data, as it is necessary to have significant stock measures to obtain a reasonably whole set of determinant variables. A list of thirteen potentially useful variables (financial ratios) is compiled for analysis. Data on SHSE companies are provided by Central University of Finance and Economics (CUFE) in Beijing.

Theoretically, discriminant analysis involves deriving a variate which is the linear combination of independent variables that will discriminate best between the objects (companies) in the groups defined as priori (Hair et. al. 2009, Johnson and Wichern 2002). That is the company profiles of the ASX are divided into three groups: High-Value, Medium-Value and Low-Value based on their Return on Equity (ROE).

Discrimination is achieved by calculating the variate's weights for each independent variable to maximize the difference between the company groups (i.e. the between-group variance relative to the within-group variance). The variate for a discriminant analysis, also known as the discriminant function, is derived from an equation similar to multiple regression and the general formula of the discriminant function is expressed as follows:

$$D = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots + \beta_i X_i$$

Where:

D = the discriminant z score
β_0 = a constant/intercept
β_i = the discriminant coefficient for X_i or discriminant weight for independent variable i
X_i = independent variable i

Discriminant analysis is applied to predict which companies are of greatest investment return for investors in the future. For discriminant analysis, a categorical dependent variable is needed; in this case the investment returns by company categorized into three groups: High (ROE>20), Medium (10<ROE<20 and Low (ROE<10) returns. These groupings are an arbitrary selection and more groups or only two could be used. The question of group categorisation is a practical one and three groups provide a reasonable categorization.

It is necessary to determine the characteristics of company profile that are useful in discriminating between these three groups. The twelve predictor variables used in this study are: Company Market Capitalisation, Dividend per Share, Dividend Yield, P/E, P/B, P/E Growth, Beta, Earnings per Share, Debt/Equity Ratio, Cash Flow, Book Value and ROA. This list is not exhaustive of all possible measures, but does represent a list that is commonly collected. As such it represents a reasonable set of variables to test the capacity of the method applied.

As this is an exploratory study where a large number of independent variables are involved, the objective is to identify which of these variables can produce a parsimonious equation to predict Return on Equity (ROE) group value. Therefore, Stepwise Multiple Linear Regression is used here, as the goal is to identify the smallest set of independent variables, which will correctly classify the largest number of cases on the ROE. It is noted that the stepwise approach involves entering the independent variables into the discriminant function one at a time on the basis of their discriminating power. And by sequentially selecting the next best discriminating variable at each step, variables that are not useful in discriminating between the groups are eliminated, thus a reduced set of variables is revealed. Note that the reduced set is almost as good as the complete set as long as the ratio of sample size to independent variable is below 20:1.

Once the Discrimiant analysis identifies the variables that display significant difference between the three value groups, performance of a test statistics determines the overall discriminating power of the model. This test statistics, which is the ratio of the sum-of-squares between-groups to the sum-of-squares within-groups, follows the equation:

$$Wilks' Lambda$$

$$\lambda = \frac{\sum_{g=1}^{G} N_g [\bar{y}_g - \bar{y}]^2}{\sum_{g=1}^{G} \sum_{j=1}^{Ng} [y_{jg} - y_g]^2}$$

Where,

G = total number of groups
g = Group g, g=1 to G
N_g = Number of companies in group g
Y_{jg} = Company j in group g, j=1 to N_g
$\bar{Y}_g$ = Group mean (centroid)
$\bar{Y}$ = Overall sample mean

Also, when Wilks' Lambda is maximized the group means or centroids of the three groups are effectively spreading apart, at the same time reducing dispersion of the individual points about their respective group means. In other words, these centroids are created in the reduced space, which is created by the discriminant function reduced from the initial predictor variables.

4. Empirical Results

Table 1 Discriminant Analyses on significant Variables

	Australian Stock Exchange (ASX)					
Predictors	Mean	Standard Deviation	Exact F Statistic	df1	df2	Sig.
ROA	13.887	11.848	36.649	2	63	.000
Earnings per Share	69.464	67.905	19.549	4	124	.000
Book Value	5.197	4.689	17.971	6	122	.000
Debt/Equity	52.086	40.302	15.335	8	120	.000

	Shanghai Stock Exchange (SHSE)					
Predictors	Mean	Standard Deviation	Exact F Statistic	df1	df2	Sig.
ROA	4.86	6.243	156.058	6	1330	.000
Earnings per Share	.40	.477	235.629	2	667	.000
Book Value	3.40	2.048	202.918	4	1332	.000
Debt/Equity	2.07	2.820	123.146	8	1328	.000
Capital	24158.61	114937.62	99.782	10	1326	.000
Price/Earnings	110.99	319.954	84.212	12	1324	.000

As mentioned previously, twelve financial variables commonly used by investors and financial analysts are performance measures. An F test is performed here to test the

discriminating power of each of the four variables: Return on Assets, Earnings per Share, Book Value and Debt/Equity. The China market shows two additional significant predictors are Market Capitalisation and Price/Earnings ratio.

All mentioned variables are found to be significant at .05 levels, indicating significant differences in these variables between the three groups. The statistical information of the four significant variables is shown in Table 1. In the Correlation Coefficients table the correlations between pairs of variables are not exceptionally high, i.e. no multicollinearity.

Table 2 Eigenvalues

Function	Eigenvalue		% of Variance		Cumulative %		Canonical Correlation	
	ASX	SHSE	ASX	SHSE	ASX	SHSE	ASX	SHSE
1	2.907	2.029	98.4	98.7	98.4	98.7	.863	.818
2	.047	.027	1.6	1.3	100.0	100.0	.211	.161

Wilks' Lambda

Test of Function(s)	Wilks' Lambda		Chi-square		df		Sig.	
1	.245	.322	86.625	753.756	8	12	.000	.000
2	.955	.974	2.811	17.435	3	5	.422	.400

The Eigenvalues provide information regarding the two discriminant functions produced by the analysis. Table 2 shows the first function of the ASX has a canonical correlation of .863, thus the first model explains 74.48% of the variation in the dependent variable Stock Groups, i.e. the discriminant function accounts for 74.48% of the between-group variability. The second function of ASX has a lower canonical correlation (.211) and explains only 4.45% of the variation in the dependent variable. Similar findings also found in the China market in which has a canonical of .818 and explains 66.91% of the variation in the dependent variable.

It is noted that the disciminant function 1 is significant (p-value=.000) at the .05 level. That means the function performs better than could be explained by chance. However, discriminant function 2 is not significant (p-value=.422). Hence, function 1 will be used to predict the dependent variable - ROE. It is noted that Wilks' Lambda is used to test whether the differences between the groups are significant.

Table 3 Relative Contributions oF The Variables: Canonical Discriminant Function Coefficients

	Standardized		Unstandardized	
	ASX	SHSE	ASX	SHSE
Debt/Equity	0.458	.288	0.011	.103
Earnings per Share	1.062	1.284	0.017	3.513
Book Value	- 0.664	-.953	- 0.143	-.469
ROA	0.902	.522	0.110	.105
Capital		-.082		.000*
P/E		-.065		.000*
(Constant)			- 2.558	-.483

* Round to 3 decimal places

The Standardized Canonical Discriminant Function Coefficients provide an index of the relative importance of the predictor variables (Table 3) in the same way that standardized regression coefficients are interpreted. The larger the absolute value the more important. The sign indicates direction of the relationship. Here, the ASX function shows Earnings per Share and ROA as the most important variables with 1.062 and .902 standardized coefficients respectively. Thus, the most highly valued stocks are expressed as stocks with high earnings, high ROA, under-priced and have a low Debt/Equity ratio. Note also by comparing this book value to the company's market value, the book value can indicate whether a stock is under- or over-priced. Note that a negative sign for book value (-.664) indicates the stock is underpriced. Similar findings are also found with China's stock market, except Book Value is considered as more important predictor than the ROA.

Unstandardized canonical coefficients provide the final discriminant function:

For ASX, $D = -2.558 + .011\ X_1 + .017\ X_2 - .143\ X_3 + .110\ X_4$

For SHSE, $D = -.483 + .103\ X_1 + 3.513\ X_2 - .469\ X_3 + .105\ X_4 + .000\ X_5 + .000\ X_6$

Where, X_1 = Debt/Equity
X_2 = Earnings per Share
X_3 = Book Value
X_4 = Return On Assets
X_5 = Market Capitalisation
X_6 = Price/Earnings Ratio
D = Discriminant Score

Note that the Debt /Equity ratio indicates what proportion of equity and debt the company is using to finance its assets. A high debt/equity ratio generally means that a company has been aggressive in financing its growth with debt. Of the three risk ratios

studied (Beta, Earning Stability and Debt/Equity), this one proved to be the most valuable but the least important predictor variables compared to Earnings Stability, Book Value and Return on Assets.The discriminant coefficients of the function for Debt/Equity, Earnings per Share, and Return on Assets show positive signs except for the Book Value. As mentioned before, a negative coefficient sign for book value indicates the company stock is underpriced. In overall, the higher a company's value, the higher its discriminant score.

Table 4 Predicted Group Memberships

			Low		Medium		High		Total	
Original			ASX	SHSE	ASX	SHSE	ASX	SHSE	ASX	SHSE
	%	Low	63.0	95.4	32.6	4.6	4.3	.0	100	100
		Medium	8.1	.5	86.5	93.6	5.4	5.9	100	100
		High	.0	.0	10.0	13.6	90.0	86.4	100	100

Note: 76.7% (93.6%) of original grouped cases correctly classified.

Table 4 presents the number and associated percentage of cases correctly and incorrectly classified based on the independent variables. With the use of original grouped cases, 76.7% and 93.6% overall are correctly classified for ASX and SHSE respectively. It is noted that this percentage is analogous to the coefficient of determination, R^2, in the regression model, which measures the percent of the variation of the dependent variable (ROE) explained by the significant predictor variables (ROA, Earnings per Share, Book Value, Debt/Equity ratio, Market Capitalisation and Price/Earnings ratio). Of the High-Value Group 90% (86.4%) are correctly identified with 10% (13.4%) misclassified as belonging to the Medium value group. 86.5% (93.6%) of the Medium-Value Group and 63.0% (95.4%) Low-Value Group are correctly classified.

5. Summary and Conclusions

Our results for the ASX market indicate that, out of twelve predictor variables, four variables display significant differences between groups: Earnings per Share, ROA, Book Value and Debt/Equity ratio; with both Earnings and ROA the most important variables in discriminating between high-value, medium-value and low-value groups.

The identification of these four variables as the most relevant to a company's value makes qualitative sense in the real world of finance. Earnings per Share and Return on Assets are indicators showing how profitably and efficiently a company is run. Book Value and Debt/Equity ratio give the investors an idea of the underlying financial strength of a company. The China market confirms these above four variables and

identifies two further significant predictors - Market Capitalisation and Price/Earnings ratio in predicting high-value stocks.

In this study, our discriminant analysis model could predict ASX value stocks correctly 76.7 per cent overall compared to 93.6 per cent of the China market. While the prediction power is not absolute, the implications may be useful for investors in two ways: in reviewing the performance of existing stocks in their portfolio, and in selecting stocks to add to it. First, investors who already own stocks, which seem to underperform can now use discriminant analysis model as an additional tool to review his or her portfolio and act accordingly. Second, for investors who are looking to acquire new stocks, in addition to the investor's other criteria for stock selection, the model can be use as a refinement tool in their selection of an efficient portfolio. The contribution that this paper makes is that it offers the investment community an additional quantitative method that can be applied on data that is readily available.

Finally, given the explorative nature of this study, some limitations exist, and further investigation is required on this very important topic. First, further comparative study between this model and another analytical method may ascertain which is the more superior approach to achieve the classification of value groups. Second, the data used cover a wide range of sectors, and an intra-sectoral analysis using the same technique may produce an even more exacting result.

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