Improving Decision Making In Common Stock Selection : A DSS APPROACH

Dr. Dina Rateb

This study introduces a new approach to support investorís stock selection decision making process. Using historical financial data, a regression model is arrived at and then used in predicting buying and selling prices of common stocks.

In this research, and for the first time in the literature, a regression model is developed using previous fifteen years of financial historical data along with a proposed melange of independent variables. Once the regression equation is arrived at, the buying and selling prices of the common stocks are projected using estimates from financial information providers (e.g. Dun and Bradstreet, Merrill Lynch, Moodyís, Standard & Poorís, and Value Line Investment Survey). It is suggested, in this study, to use more than one estimate from different financial providers along with the proposed regression model. A simple "what-if" analysis should then be conducted to compare the results of all those projections. The outcome would then be the projected lowest and highest prices of common stock for the following year (i.e. price at which one should buy and sell respectively).

INDEX WORDS :- Common stock, regression model, company price performance, decision support system (DSS), price high, price low, forecasting, management information systems (MIS), Merrill Lynch, simulation, Value Line.

I. INTRODUCTION:-

Having conducted the fundamental financial analysis on a company and having decided that it represents a relatively sound investment, the investor is still faced with the decision of when and at what price one should buy or sell the stock and how much the stock is expected to appreciate or depreciate in the near future. Price forecasting, however, is not an end in itself (Hadik, 1998) and knowing exactly where the market is heading is utopian and quite hard to achieve. Rather one should focus on applying some proven rules or heuristics to help support the decision making process.

In this study a regression model is developed for a particular stock, and then that model is used to project the price high and price low for that same stock. This model uses independent variables combined for the first time. Additionally, the idea of using more than one source of estimate for those variables and conducting extensive 'what-if' is also proposed for the first time. Since the decision maker is using more than one source of estimate for the independent variables, he/she will end up with more than one price high and price low. It is then up to the decision maker to decide on which price to use or to simply average what is arrived at.

II. LITERATURE REVIEW:-

Previous studies always recommended that when one buys a stock one should establish a price at which one will then be willing to sell at; and actually sell it when it reaches that preset price (S.S., 1995). One study uses technical analysis based on price and volume changes rather than financial data (Hadik, 1998). Warnings such as ìÖone must not buy a stock simply because it is rising in priceî, (Morgenson, 1997) are always attempted to be followed. But the important question is how.

The application of quantitative analysis using statistical models has been rapidly spreading in recent years. A new type of investor, called momentum investor, uses such models to get significant results on the price of stocks. The high moves in Ascendís stock since 1989, showed that the momentum crowd has moved in (Serwer, 1997). Consequently, the informational value of the thousands of annuals produced by government agencies, nonprofit and other private groups, is increasing greatly (Hutchins, 1994). This study uses such information to help investors in their decision making process.

A lot of research has been conducted on the use of multivariate financial performance forecasting models including regression, discriminate and factor analysis (Fosback,1993). Regression analysis has also been used successfully in forecasting market share, market demand, advertising effect, allocation of variable overheads, and demographic trends. One of the reasons multivariate

regression was chosen over univariate regression is the advice of accountants who warn against using a single net income figure or "earnings per share" for a particular year (AICPA, 1947). A very interesting analysis and discussion has been carried out by Altman to demonstrate how an independent variable was insignificant on a univariate basis and how that same variable became significant on a multivariate basis (1968).As Marascuilo and Serlin (1988) put it, the multiple predictor approach allows for more detailed information about individuals or sampling units, thus permitting more precision in the prediction of performance as opposed to ìonly one piece of informationî.

It should be warned, however, that it is not always possible to quantify qualitative issues such as these and consequently such decision will never be 100% accurate. Macroeconomic conditions like low interest rates affect stock prices, wars also have a sudden unpredictable impact, and the introduction of new products cannot be predicted for years ahead. Ever since the ending of the Gulf War in 1991 and the stock market has been moving up more than 1,200 points; a gain of nearly 50% as measured by Dow Jones Industrial Average. (Rubenstein, 1994). Similarly, when Warner-Lambert introduced the new cholesterol reducer in February 97, stock rose 5, to 881/2 only two weeks later (Holland, 1997).

Once a regression model is arrived at, the investor needs to simulate using estimates from different sources to finally arrive at the price high and low to support the selection decision. This type of decision is not exactly structured and needs to be supported by

simulating and using more than one source rather than relying totally on one source only. This type of ìwhat-iffingî is referred to as decision support systems (DSS) and was first coined by Gorry and Scott Morton (1971) as being the information system that supports semi-structured decisions. DSS tend to be used in analyzing alternatives, trial and error search for solutions, and "what-if" analysis. Usually emphasis is on small, simple models that can be easily understood and implemented (Davis and Olson, 1985). This study uses the regression equation arrived at along with the estimates provided by Merrill Lynch and Value Line to come up with a simple "what-if" analysis to project the price of common stock. To use the regression model with one source only was avoided; since those estimates tend to be overly optimistic at times (Abelson, 1994).

The model used in this study is presented in the following section along with further discussion of previous relevant research.

III. THE MODEL:-

This study is based on the assumption that the buying and selling price of stock is related to more than one financial variable. The independent variables used in this model are cash flow per share, earnings per share, and book value per share. It is very easy to get hold of any data regarding those variables since they are the most commonly used by analysts and are made readily available by providers of financial information (Dun and Bradstreet, Merrill Lynch, Moody's, Standard & Poor's, and Value Line Investment Survey) in addition to the annual reports of the companies. Other variables, such as net worth, total sales, and average annual P/E ratio could be derived from the chosen variables and therefore were eliminated from the model (see Exhibit 1).

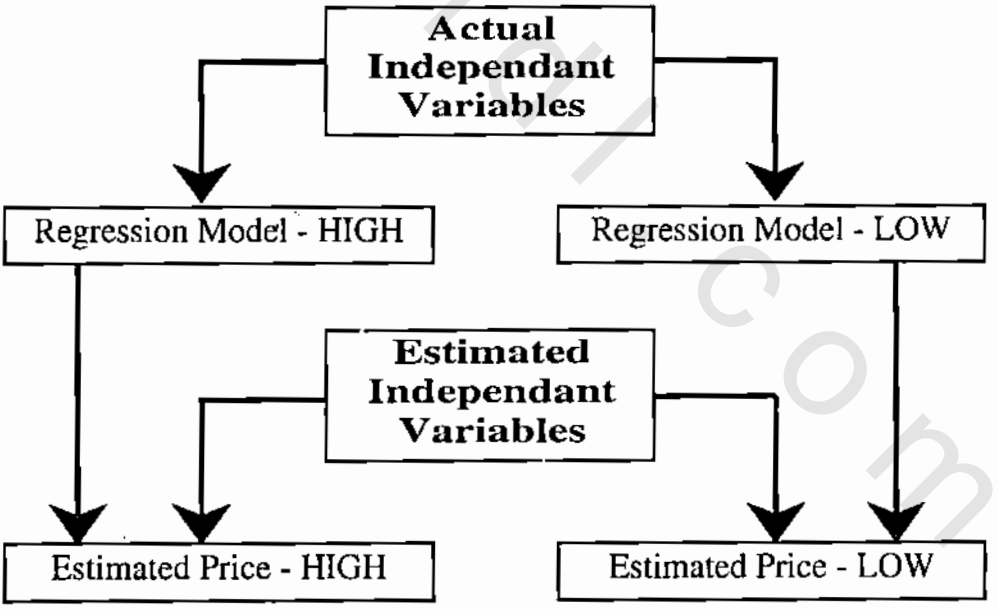

EXHIBIT 1: THE MODEL

Both earnings per share and cash flow measures serve different important purposes. The cash flow measure is useful for valuation of a firm and the earnings measure is useful for evaluating management's performance (Bierman, 1994). Cash flow per share is the net profit plus non-cash charges (depreciation, depletion, and amortization), minus any preferred dividends, divided by common shares outstanding at yearend (Value Line Investment Survey, 1993). It is a useful measure of a company's general ability to pay dividends and convert "book earnings" to cash (Cottle et al., 1988). Book value per share, another important independent variable, is the net worth minus preferred stock divided by common shares outstanding (Value Line Investment Survey, 1993). It is the relationship between common stock prices and the net worth of the company; it is a theoretical measure of what the company is worth (Fosback, 1993). These financial variables were selected because it is believed that they have a significant influence on the price of the stock. Financial ratios e.g. profitability, liquidity, and activity ratios were not included because they are less indicative of the market price of stock.

IV. THE RESEARCH METHOD:-

All historical data used in this study were obtained from The Value Line Investment Survey (1998, 1997, 1996, 1995), which is considered to be a reputable source of information, providing financial and economic information to investors and academicians

for more than 25 years. Although, generally speaking when using regression models, the greater the number of observations the more accurate, this study uses the past maximum of fifteen years; prior to that, data would reflect economic and financial conditions that no longer influence the companies being studied. Moreover, focus is on ten companies only, picked at random from among various industries such as food processing, household products, drugs, semiconductors, computers and peripherals. The companies chosen were considered major corporations in their respective industry.

For each company, the historical values for the independent variables are used to come up with the regression model. When price high is used as the dependent variable, the outcome is the regression model to project price high. Similarly, when price low is used as the dependent variable, the outcome is the regression model to project price low. Both models use the same independent variables of cash flow per share, earnings per share, and book value per share.

Regression equation for price high:

$$YPrice\ High = H0 + H1XH1 + H2XH2 + H3XH3$$

Note that H0, H1, H2 and H3 are all arrived at when running the actual historical data and using the price high as the dependent variable. These variables represent the constant, the cash flow coefficient, the earnings coefficient, and the book value coefficient respectively.

Once the price high regression equation is arrived at for a

particular company, we use it to project the price high of that company. Projection is based on the estimated values of our independent variables as provided by Merrill Lynch1 and Value Line.

Similarly, the regression equation for price low is as follows:

YPrice Low = L0 + L1XL1 + L2XL2 + L3XL3

Note that L0, L1, L2 and L3 are all arrived at when running the historical data and using the price low as the dependent variable. These variables again represent the constant, the cash flow coefficient, the earnings coefficient, and the book value coefficient respectively.

Once the price low regression equation is arrived at for a particular company, we use it to project the price low of that company. Projection is based on the estimates of our independent variables proveded by the different providers of financial data.

V. ANALYSIS AND RESULTS:-

The following two Exhibits represent the regression equations arrived at for price high and price low respectively. The regression analysis was performed using statistical software SYSTAT. The input retrieved was the eleven years of historical data for the independent variables of interest (cash flow per share, earnings per share, book value per share) along with the price high and low for each year. When the price high was used as the dependent variable, we got the regression equations displayed in

Exhibit 2.

COMPANY	REGRESSIONEQUATIONS							
Abbott	–	10.164	–	45.720XH1	+	66.139XH2	+	4.77XH3
Motorola	–	3.384	+	20.900XH1	–	0.911XH2	–	2.79XH3
Proctor&Gamble	–	13.688	+	14.890XH1	–	0.289XH2	+	0.726XH3
Schering-Plough	–	11.404	+	38.511XH1	–	27.471XH2	+	2.280XH3
Archer Daniels	–	3.265	–	20.930XH1	+	26.135XH2	+	3.328XH3

EXHIBIT 2:

REGRESSION EQUATION FOR PRICE HIGH

The output from the price high regression equations is displayed in Exhibit 3. By looking at the ìP valueî we find that all results are statistically significant at ?=0.01.

Company	SD High	P value	Adjusted Mult. R2
Hewlett-Packard	5.259	0.007	0.727
Motorola	6.438	0.001	0.862
Proctor&Gamble	4.257	0.000	0.944
Schering-Plough	3.605	0.000	0.911
Archer Daniels	1.790	0.000	0.907

EXHIBIT 3: REGRESSION EQUATION OUTPUT-PRICE HIGH

(Year of Estimate 1995)

Similarily, when the price low was used as the dependent variable, we got the regression equations

displayed in Exhibit 4.

Company	SD LOW	P value	Adjusted Mult. R2
Hewlett-Packard	4.118	0.009	0.698
Motorola	2.788	0.000	0.929
Proctor&Gamble	3.211	0.000	0.953
Schering-Plough	1.927	0.000	0.952
Archer Daniels	0.38	0.000	0.991

EXHIBIT 4: REGRESSION EQUATION FOR PRICE LOW

COMPANY	REGRESSIONEQUATIONS							
Hewlett-Packard	+	7.118	−	6.182XL1	+	6.134XL2	−	1.103XL3
Motorola	−	11.208	−	18.964XL1	+	18.175XL2	+	1.141XL3
Proctor&Gamble	−	20.527	+	2.038XL1	−	14.915XL2	+	1.584XL3
Schering-Plough	−	6.084	+	4.928XL1	+	6.240XL2	+	1.667XL3
Archer Daniels	−	2.814	−	21.874XL1	+	23.750XL2	−	13.047XL3

The output from the regression equations is displayed in Exhibit 5. Again all results are significant at ?=0.01 (see the ìP value in Exhibit 5).

EXHIBIT 5:

REGRESSION EQUATION OUTPUT-PRICE LOW

(Year of Estimate 1995)

These equations were then used to project price high and price low using different estimates (this was done using the spreadsheet EXCEL). For example when using Value Line's estimate of cash flow per share, earnings per share, and book value per share (our independent variables), we got the price high and low displayed in Exhibit 6 and 7 respectively.

Using Value Line's estimate for the independent variables, a comparison was made between the price high projection arrived at using our regression equation and the actual results (see Exhibit 6). The projected price was evaluated using the focus technique where by the projected value is divided by the actual value (Chase and Acquilano, 1995). If the result of the division is equal to "1", then the projected value is equal to the actual value. Looking at the focus results for the price high (Exhibit 6), we see that HP's projected price high is 15.41% higher than the actual price and while Archer Daniels is 33.56% higher than the actual price. On the other hand, Motorola is 3.83%, P&G is 14.11% and Schering-Plough is 18.74% lower than the actual.

Company	PRICE High Est	PRICE High Act	Focus %
Hewlett-Packard	111.51	96.625	+ 15.41 %
Motorola	79.34	82.5	_ 3.83 %
Proctor&Gamble	76.87	89.5	_ 14.11 %
Schering-Plough	49.37	60.75	_ 18.74 %
Archer Daniels	26.71	20	+ 33.56 %

Obviously 33.56% off is not considered satisfactory but looking at Exhibit 3, we see that the results were statistically significant (p=0.000) and that the regression equation is supposed to be very efficient (adjusted multiple R squared=0.907). To find an answer to this dilemma, the same regression equation was re-run but this time using the actual cash flow, earnings, and book value and not the estimate. The focus results showed an amazing difference: Archer Daniels became off by only 1.64% versus the previous 33.56%2.

Similarily Archer Danielsí projected price low was found to be 26.80% higher than what the actual price low turned out to be (see Exhibit 7). However, Exhibit 5 shows very significant results (p=0.000) and a very efficient regression equation (adjusted multiple R squared=0.991). Again the regression equation was re-run with the actual data just to test the accuracy of that equation and it was found to be off by only 6.89%.

Company	PRICE Low Est	PRICE Low Act	Focus %
Hewlett-Packard	47.68	49.0	_ 2.69 %
Motorola	45.98	51.5	_ 10.73 %
Proctor&Gamble	66.35	60.5	+ 9.66 %
Schering-Plough	35.40	35.5	_ 0.28 %
Archer Daniels	18.07	42.9	+ 26.80 %

EXHIBIT 7:

PRICE LOW ACTUAL & ESTIMATE USING VALUE LINE

(Year of Estimate 1995)

This analysis supports the argument that the price high and price low projections obtained using the regression equation presented in this paper greatly depends on the accuracy of the estimate of the independent variables supplied by different providers of financial data such as Merrill Lynch and Value Line. Consequently, as an investor, it is strongly recommended not to rely on one source only. One should make use of the different estimates from several providers of financial information and to conduct a simple "what-if" analysis to arrive at different projections of price high and price low. However, being in an unstructured situation, the investor will still have to make a decision as to which price high or low to follow so as to sell or buy the stock at hand.

The following Exhibit shows the projected price high and low for the year 1996, using both Merrill Lynch's and Value Line's projections.

Company	1996 HIGH		1996 LOW	
	VL	ML	VL	ML
Hewlett-Packard	134.2208	112.1545	58.1558	57.4076
Motorola	95.3522	81.6877	59.7488	49.4268
Proctor&Gamble	907.286	99.5995	80.7740	70.8022
Schering-Plough	57.2071	42.5221	41.0575	38.3734
Archer Daniels	27.7132	18.2342	19.2843	12.3500

EXHIBIT 8:

PRICE HIGH & PRICE LOW ESTIMATES FOR 1996

Note that although Merrill Lynch's price high, for example, is quite different from Value Line's price high, both use the same regression equation presented in this paper due to the difference in the estimates of the independent variables. Consequently, the accuracy of our projections heavily depends on the accuracy of those estimates and that is why it is strongly recommended to use more than one source and to carry out a "what-if" analysis to improve decision making on when to buy and sell your stocks.

VII. CONCLUSIONS:-

Never rely on one decision variable or one source of information only. Standard & Poor's earnings estimate, for example, was sometimes found to be overly optimistic (Abelson, 1994). A ìwhat-ifî analysis approach using a regression model that takes into consideration the estimates of different providers of financial data is strongly recommended. This regression model combined the cash flow, earnings and book value for the first time in the literature and got highly statistically significant results.

Regression analysis determines a relationship between past events and past conditions. On the basis of this relationship, future events are forecasted by using current estimates of future conditions. An intrinsic weakness in regression analysis, in general, is that it cannot accurately predict events resulting from new conditions. Future economic recessions or a change in the top management of a company may significantly affect the market price of that company and such events cannot be projected into the future by using regression analysis. For example, on the September day when Jerome York, the IBM CFO, left to join Chrysler, IBM dropped by more than a billion dollars in market value and on that same day the carmaker rose by the same amount (Fortune,1995). Similarly in 1996 when Dunlap decided to run the Sunbeam Corp., the companyís market value increased by $1 billion and was later referred to as the ìDunlap Effectî (Schifrin, 1997).

However, the results imply that regression analysis can be applied to some companies with reasonable accuracy to project the

price high and price low of those companies. The investor can then use such a model in making buy or sell decisions as long as a certain minimum error is accepted. The degree of error tolerated would vary from investor to investor and it is important to apply this model using different estimates and conduct "what-if" analysis to improve the decision making process.

VIII. SUGGESTIONS FOR FUTURE RESEARCH:-

Any investor can apply this simple model provided the historical data is available in addition to estimates from different sources of financial data. However, this research could be used to build upon it and replicate it using the following suggestions:-

1. Although the companies in this study are selected at random to include different industries, a replication with more than five companies would be interesting.

2. A replicate of this study with more than just two sources would; in fact, be highly recommended. A DSS approach could be applied with more projections from more sources and the outcome would be more than just two projections of price high and low.

3. This model is based on a one year forecast and did not attempt to test forecasts for more than one year although this would provide useful information to long term investors.

4. This study selected the three independent variables in accordance with the logic and good reasons previously discussed. It would be interesting, however, to test other variables and see if they significantly affect the market price of the stock.

5. Stepwise regression could be used to decide on the independent variables instead of using the same variables for all the companies. This would result in an even more accurate model that could later be used by providers of financial information. However, this would require the use of statistical packages as well as a different regression equation for each company and consequently, investors might find it difficult to use.

ENDNOTES

1. This data was provided by Merrill Lynch in an interview.

2. To test the accuracy of those projections, focus was used for the independent variables in the equation. Value Line's book value estimate for Archer Daniels was 48.29% higher than the actual book value in the year 95; and that explains the big difference when the model was re-run with the actual data.

REFERENCES

* Abelson, A., "Up and Down Wall Street: Mucho Macho," Barron's, Vol 74, Iss 37, September 12, 1994.

* AICPA, Accounting Research Bulletin No. 32, December 1947.

* Altman, E.I., "Financial Ratios, Discriminat Analysis and The Prediction of Corporate Bankruptcy," The Journal of Finance, Vol. XXIII. No. 4, September 1968.

* Bierman, H., "Accounting for Valuation and Evaluation," Journal of Portfolio Management, Spring 1994.

* Chase, R.B., and Aquilano, N.J., Production and Operations Management, Irwin, 7th edition, 1995.

* Cottle, S., Murray, R.E., and Block, F.E., Graham and Dodd's Security Analysis, McGraw-Hill Book Company, 5th edition, 1988.

* Davis, G.B., and Olson, M.H., Management Information Systems, Conceptual Foundations, McGraw-Hill Series, 2nd edition, 1985.

* Ezzat, H., "The Application of Multiple Regression Analysis Forecasting," Unpublished Manuscript, 1995.

* Fosback, N.G., Stock Market Logic to a Sophisticated Approach to Profits on Wall Street, Dearborn Financial Publishing, 1993.

* Gorry , G., and Scott Morton, "A Framework for Management Information Systems," Sloan Management Review, Fall 1971.

* Hadik, Eric S., ìLess is More,î Futures: News, Analysis & Strategies for Futures, Options & Derivatives Traders, January 98, Vol. 27, Issue 1, p40.

* Holland, Kelley, ìDrug High,î Business Week (Industrial Edition), Issue 3519, 3/24/1997.

* Hutchins, H. R., "Annual Reports (...who reads them?)," Communication World, October 1994.

* Marascuilo, Leonard A., and Serlin, Ronald C., Statistical Methods For The Social And Behavioral Sciences, W.H. Freeman

and Company, New York, 1988.

* Morganson, Gretchen, ìThe Great Skewering,î Forbes, Vol. 159, Issue 10, 05/19/1997.

* Rubenstein, Ed, ìStock Market High,î National Review, Vol. 46, Issue 2, 2/7/94.

* S.S., ìIt May Be Time For You to Take Some Profits,î Money, Vol. 24, Issue 8, August 1995.

* Schifrin, Matthew, ìThe Dunlap Effect,î Forbes, Vol. 159, Issue 6, 03/24/97.

* Serwer, Andrew, ìThe Scariest Tech Stock Ever,î Fortune, Vol. 136, Issue 9, 11/10/97.

* Tully, S., "Super CFOs: They Can't Jump...But Some Earn More Than Deion Sanders," Fortune, Vol. 132, No. 10, Nov 13, 1995.

* Value Line How to Invest in Common Stocks: A guide to Using The Value Line Investment Survey, Value Line Print Publications, 1993.

* Value Line The Value Line Investment Survey, 1995.

* Value Line The Value Line Investment Survey, 1996.

* Value Line The Value Line Investment Survey, 1997.

* Value Line The Value Line Investment Survey, 1998.