FORECASTING STOCK PRICES USING REPORTED EARNINGS AND PAST PRICES

By *Cesar G. Saldaña and Jose S. Victoria**

This study explores the use of corporate income and past prices as bases for predicting stock prices, leading to well-informed investment decisions. The regression model is used to show a significant relationship between reported earnings and the stock price (using San Miguel Corporation as example). This result provides support for the use of Price-Earnings multiples by practitioners in the Philippine stock market in estimating the long-term or intrinsic value of a security.

Likewise, the use of time series modelling as a prediction tool for SMC stock price is analyzed. The study intends to find out whether the price of San Miguel shares would have a long term influence on its present price. Upon examination of a few autoregressive models fitted on weekly SMC price data, only the autoregressive model of order one is found to be a valid predictor. This means that only the most immediate past value of share price is useful in predicting the present share price.

There goes a sage and simple rule on how to make money in stock market trading: *Buy low and sell high.*

Implementing this rule, however, is far more difficult. The problem lies in knowing when prices are "high" and when they are "low". It requires a seasoned investor to accurately forecast stock prices. There are no set guidelines for the investor on how to make accurate forecasts and certainly none guaranteed to work all the time.

In this paper, two alternative approaches to forecasting stock prices are presented. The first is called *regression analysis*, based on the financial and operating performance of the company. The second, *time-series analysis,* uses historical prices of the stock itself in the hope that patterns can be derived from past data to help predict future prices. In the process, the following questions are addressed:

1) Do reported earnings and past stock prices serve as valid basis for predicting future stock prices?

2) What are the implications of these findings on investor advisory services and stock market regulations?

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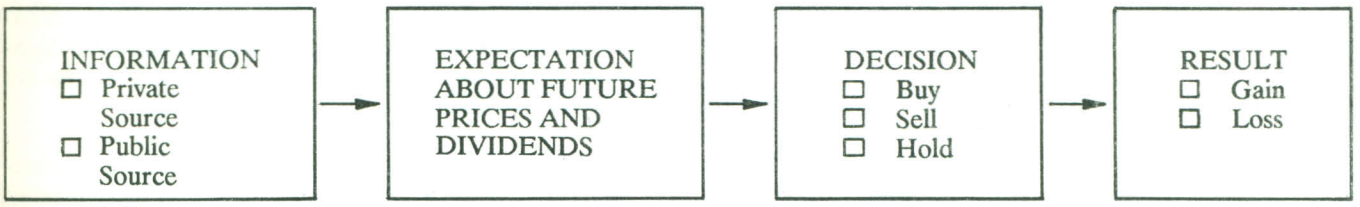
INFORMATION FOR INVESTORS

In July 1988, a Capital Market Development Symposium was conducted under the auspices of various professional organizations with the Securities and Exchange Commission (SEC) as lead institution. During the proceedings, discussants expressed their concern about the underdeveloped state of the capital market. One factor identified as a current constraint is the lack of information regularly available to the public. Without such information, investors find it difficult to develop data-based projections of future prices. Two consequences are: reluctance to invest in equity securities and poor decisions on actual trade. Both conditions are detrimental to investors' interest and eventually to the development of a well-functioning capital market.

One can view the stock investment decision *(buy, sell or hold)* as based on a process of gathering information from private and public sources on the company and forecasting the future price and dividends performance of that company's stock as shown in the figure next page.



Private sources of information for investors on corporate prospects include the listed company's officers, third party expert opinion and primary data from surveys. Public sources include financial statements, published industry reports, public announcements by regulatory agencies, e.g., the Bureau of Energy Development on oil drilling results, and volume and price data on commodities and the listed stocks.

Information from private sources are not readily available to the ordinary investor and may be expensive to obtain. The essence of capital market development lies in ensuring that privately available information are immediately made public to enable investors to obtain a proper basis for investment decisions. The SEC regulation prohibiting *insider trading* activities rests on the principle that officers of listed companies and officials of government agencies have the special fiduciary responsibility to report what they know to the investing public. Hence this issue is essentially a regulatory one, involving mainly the SEC, the Stock Exchanges and the listed companies.

Of the various publicly available data, financial statements and historical stock prices are probably comprehensive in the sense that they reflect and summarize detailed information about the company's financial performance. There are probably two best readily available types of information upon which a reasonable basis for investment decision can be made. Reported earnings reflect the company's investment performance and the competitiveness of its products in the marketplace. Historical stock prices incorporate the investors' perception of the company's prospects as well as its current performance. With these detailed information, an investor can form an acceptable forecast about the future price of a stock which can serve as a basis for his investment decision.

This paper describes two forecasting methods: one based on earnings reported in the audited financial statements and another based on past stock prices. Both approaches shall use statistical techniques. The price forecast based on accounting earnings uses a technique called regression analysis while that based on historical stock prices uses the time-series statistical model. The application of both techniques uses San Miguel Corporation as the sample case.

FORECASTS USING REPORTED EARNINGS

The SEC requires all companies listed in the stock exchanges to submit financial statements audited by independent external auditors. These audited financial statements can provide investors with a reliable estimate of the company's earnings and its potential for future dividends and capital appreciation. Stockbrokers and analysts routinely assess stock prices based on multiples of earnings, e.g., the *price to earnings* or P/E ratio or multiple. These P/E multiples are set based on the company's industry, its historical price performance, and its unique characteristics. The prevailing market conditions also influence the P/E multiple.

To illustrate, the current market has a range of P/E multiples based on 1989 earnings shown below.

Commercial and Industrial Sector	P/E
Highest	29.8 [Philippine Realty (B)]
Median	9.9 (Anscor)
Lowest	5.1 (PNB)
Number of Traded Shares	28
Mining Sector	
Highest	11.8 (Surigao)
Median	7.0 (Dizon)
Lowest	2.6 [Atlas (A)]
Number of Traded Shares	13
Oil Sector	
Highest	24.0 [Oriental (B)]
Median	12.9 [Philodrill (B)]
Lowest	5.4 [Balabac (A)]
Number of Traded Shares	11

Examples of selected other companies' multiples are likewise shown:

Commercial and Industrial Sector	*P / E*
SMC (A)	14.4
PLDT	8.7
Keppel (A)	8.7
Jardine Davies	10.7
Globe-Mackay	13.3
Ramie Textile	12.1
Mining Sector	
Benguet (A)	7.8
Philex Mining (A)	7.2
Lepanto (A)	7.8
Oil Sector	
Trans Asia	13.3
Basic Petroleum (A)	6.8
Unioil	13.0

Source: Pryce Securities, Inc. Weekly Newsletter (30 June 1989). Forecasts of Earnings from Pryce Securities, Inc.

The decision rule is based on the following steps. First, a "P/E standard" for the company is selected by the investor. This should take into consideration all factors identified previously. Comparison of the above P/E multiples with historical levels for each stock would show that PLDT and Benguet Corporation have consistently traded at lower P/E multiples than the industry average. However, the recent market experience has pushed stocks like PLDT, Benguet and noticeably, SMC, beyond their historical levels. Secondly, the earnings per share is forecasted by the company. Based on this forecast earnings and the "standard" multiple, a forecast or "target" price is determined which in turn is compared to the current market price. An assessment of a stock's value is developed as follows:

The stock is "overvalued" if the current price is higher than forecast price while the stock is "undervalued" if the current price is lower than forecast price.

On this basis, the rule of "buy low and sell high" is implemented. "Overvalued" stocks are considered as "high-priced" and should be sold. "Undervalued" stocks are considered as bargains and are purchased.

Obviously, the procedure presumes a valid relationship between stock prices and earnings of the company. This relationship can be explored through a technique called *statistical regression analysis*. The technique derives an average line relationship between stock price and earnings per share based on an algebraic (rather than visual) curve-fitting approach. The regression provides an estimate of the constants m and a in an equation of the form:

$$P = a + m \times EPS$$

where:

P	=	stock price
m	=	the slope of the regression line
ESP	=	earnings per share
a	=	a constant

In words, the stock price is a multiple of the earnings per share plus (or minus) a constant. In the above equation, the estimate of m corresponds roughly to the "P/E multiple" of earnings with the added advantage that it is "objectively derived" using regression methods on historical stock price to earnings data for the company. However the analogy to P/E multiple is different in two important aspects, namely:

1) There is a constant a used to adjust the price estimate after multiplying the EPS by the "P/E multiple", m. This suggests that there is a component of the stock price that does not depend on earnings.

2) The multiple, m, is a derived relationship using historical earnings and price data. To the extent that historical experience is not representative of future conditions, the validity of the estimate may be suspect. For example, the political changes due to the EDSA Revolution of 1986 may imply that the results from Table 1 may not hold. On the other hand, it is not clear that the country's (and SMC's) economic structure has likewise changed.

Table 1 shows the historical earnings per share and price data for San Miguel Corporation. All earnings and price per share data were adjusted for stock dividends and splits.

Table 1. **AVERAGE ANNUAL STOCK PRICE AND EARNINGS**

Per Share of San Miguel Corporation (1969-87)

Year	Price (Peso)	Earnings per Share (Peso)	P/E Ratio (Times)
1969	56.79	4.51	12.59
1970	38.52	4.65	8.28
1971	34.44	5.13	6.71
1972	30.41	4.82	6.31
1973	31.60	5.94	5.32
1974	42.20	6.42	6.57
1975	38.19	6.57	5.81
1976	39.70	6.04	6.57
1977	40.31	6.83	5.90
1978	45.15	4.58	9.86
1979	34.32	4.41	7.78
1980	27.16	3.79	7.17
1981	21.18	2.68	7.90
1982	15.57	2.94	5.30
1983	20.40	3.82	5.34
1984	15.60	3.99	3.91
1985	10.96	4.24	2.58
1986	40.21	9.14	4.40
1987	105.00	14.45	7.27

Source: SMC Annual Reports

The resulting regression equation, and estimates of coefficients, indicate a statistically valid relationship:

Stock Price = 6.5 x Earnings Per share - P 0.28
Statistics: R-squared : 0.85
Significance level : 0.00001

The graph is shown in Figure 1.

In mathematical terms, every peso of additional SMC earnings per share is related to an average increase in stock price by P6.50 based on SMC's experience from 1969-1987. Subject to an "adjustment factor" of P0.28 this coefficient of 6.5 is the statistically derived P/E multiple for SMC. Instead of making a subjective assessment of the P/E multiple, past data on stock prices and earnings were used to derive the implied average P/E multiple. Further statistical analysis revealed that the "adjustment factor" is not significantly different from zero and can be ignored.

This analysis provides a justification for the use of P/E multipliers by stockbrokers in their analysis of the fundamentals, or earnings of stocks. However, there are some limitations in the application of the foregoing findings. For example, the June 30, 1989 P/E multiple of SMC is about 14.4, equivalent to a price of P243 on forecasted 1989 earnings of about P16.93 per share. This P/E exceeds (or more than doubles) the regression estimate of 6.5 because the latter is an average over the 17-year period 1969-1987. An analyst who thinks that the 1989 stock market is not representative of the market of the 70's and 80's would need to make a further subjective adjustment of this estimated P/E.

One can now sum up and apply the investment decision process previously described to the case of SMC.

The EPS estimate for SMC in 1989 has been made at P16.93 per share. From the regression, the "P/E multiple" is 6.5. Since the adjustment factor can be ignored, the estimate of SMC's "correct value" based on 6.5 times earnings is P110.05. Allowing for one standard error, the high end of the regression estimate is P127. Comparing these estimates with the June 30 price of P243, SMC appears "overvalued". The indicated advice: sell SMC shares.

One obvious weakness of this regression approach is in its use of the "abnormal period" of the political crisis years (1984-1986) in deriving the estimates. Eliminating

this period results in a revised P/E multiple of 6.82 and price forecast of P115.5. This is higher than the first estimate but still less than the current price. The analyst can readily note that the statistical estimate of the P/E multiple will always be less than the maximum historical average P/E of 12.6. The strongest statement one can probably make in this exercise is that *if historical experience can be relied upon* (probably a big "if"), SMC should "correct" to a range of P/E multiple of about 6.8 to 12.6, compared to the 14.4 as of June 30, 1989. Regression analysis, because of its use of price-EPS history, provides for an estimate of the correction range for a stock.

An alternative approach is to ignore earnings, and forecast prices based on the past price data. The suggested technique is called *time-series analysis*. This is developed next.

FORECASTS USING HISTORICAL PRICES

Time series models as applied to stock prices are well-established methods. Its range of applicability in stock price forecasting is even more enhanced by the availability of software and low-cost computing. The time series model is constructed for the stock price performance of SMC. The model can provide rational guidelines for prospective stock investors over and above any *a priori* information they may have on stock values of corporations, e.g., earnings.

Stock prices of SMC on a weekly closing basis represent an example of time series data. Several models are used to describe the typical time series. The most popular is the classical model which attempts to explain the pattern observed, in an actual time series by the presence of four components: trend, cyclical, seasonal and random components. A particular form of this classical model as used in this paper is the additive time-series model. Hence, the series of stock prices (Y) is viewed as consisting of the four elements of trend (T), cyclical (C), seasonal (S) and random (I) as indexed by time (t):

$$Y = T_t + C_t + S_t + I_t$$

where more specifically:

1) The trend component (T) is a reflection of the long range gradual change (e.g., linear, quadratic) due to factors like population size or consumer preferences.

2) The cyclical component (C) is characterized by wide swings of the variable of interest around the trend. In business terms, this refers to the business cycle of boom and bust.

3) The seasonal component (S) is characterized by the arrow up and down swings of the variable of interest predictably repeating each other within periods of one year or less.

4) The random component (I) is the irregular variation or movements of the three trends mentioned above. The movements are completely unpredictable and probably nonrecurring changes or events.

The time series model is constructed for the San Miguel weekly stock price data for the period January 1, 1986 through July 31, 1988. The graph is shown in Figure 2. Such a model derives one forecast function for each assumed lead time of one, two or more weeks ahead (e.g., an autoregressive model of order one, assumes a lead time of one week ahead). The objective is to obtain a forecast function which is such that the mean square of the deviations between the actual and forecast prices for SMC is as small as possible for each forecasting lead time. In short, the error rate of the forecast is minimized for each assumed lag time.

Using an appropriate computer software, i.e., PEST (see Brockwell and Davies), the time series for SMC stock price are shown in Table 2.

Of the above three models, the model chosen is the one which has the largest t-value corresponding to the highest significance level (i.e., lowest forecast error). This time series model is the auto-regressive model with one parameter of the form:

$$Z_t = Z_{t-1} + a_t$$

where

Z_t = the current week's price of SMC (A) stock
Z_{t-1} = the previous week's price
a_t = the forecast error calculated as follows:

Let $\hat{a}_t$ be the estimate of a_t. The form of this estimate is

$$\hat{a}_t = \hat{Z}_t - \hat{Z}_{t-1}$$

Where $\hat{Z}_t$ and $\hat{Z}_{t-1}$ are the forecast values at time t and time t-1.

a_t is a sequence of what is called "white noise" by engineers. The idea is that the time series in which successive values are highly dependent can be usually regarded as generated from a series of "independent" shocks a_t. In short the sequence a_t can be regarded as the mechanism which drives the process.

FIGURE 1. Regression Equation for SMC:
Price to EPS

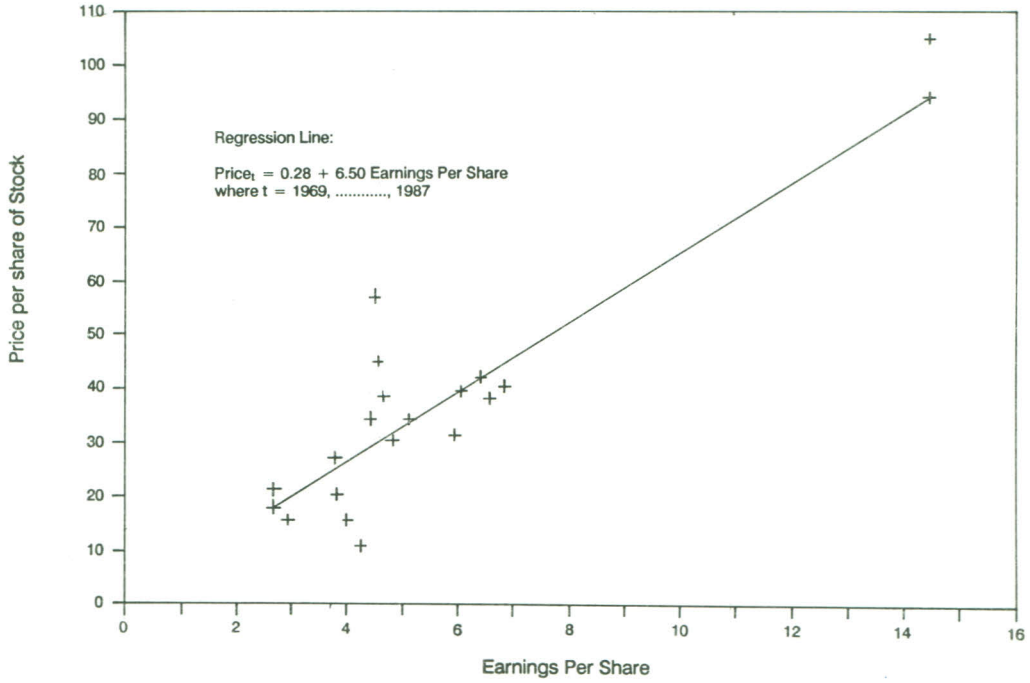


FIGURE 2. SMC (A) Stock Price
January 1986 – July 1988

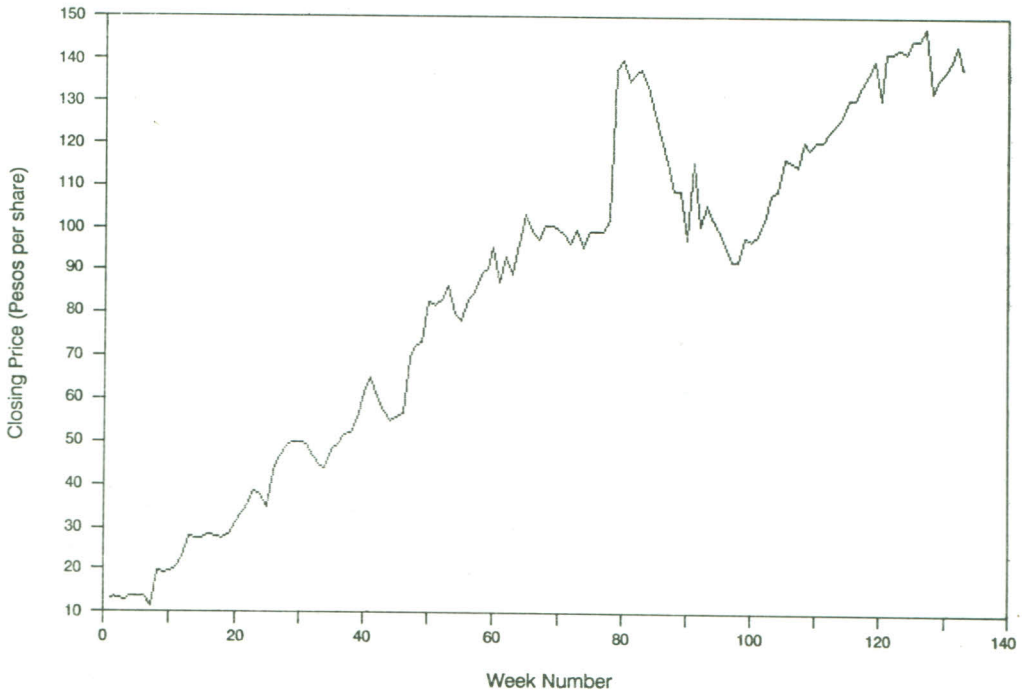


Table 2. **TIME SERIES MODELS FOR SMC WEEKLY STOCK PRICE**
January 1, 1986 to July 31, 1988

	Model	t-Value	(Std. Error)
Order 1	Auto Regressive	42.09	1.00
			(0.02384)
Order 1	Moving Average	-9.76	-0.76
			(0.07813)
Order 2	Auto Regressive	38.82	1.00
			(0.02580)
Order 2	Moving Average	-0.2	0.04
			(0.12755)

This model thus derived is the most efficient time series model for forecasting the SMC stock price and needs only one piece of information: the prior week's price.

To see how the model works, a forecast of the SMC (A) stock prices is made for the 20 weeks following the end of the sample period of 3rd week of May 1988. The results, shown in Table 3, indicated a mean error rate of P0.30 with standard error of P0.678. A 95 percent confidence interval corresponds to a confidence band of Pesos (-1.07, 1.634) around the forecast price.

One implication of the preceding results concerns stock analysts who forecast prices on the basis of previous price data. A number of brokers offer this service to their clients. Most, if not all, use the moving average model of various lead times (e.g., 200-day moving average). The result shown here demonstrates that only the prior period's price data is needed to forecast the present stock price, not prices of many prior periods. Another implication of the recommended time series model is that forecast can only be made for the next period. Unlike the previous regression models, the derived time series model for SMC (A) stock price cannot be used for a "long-term" forecast.

This result is consistent with well-known results in more developed stock markets that stock prices follow a "random walk," i.e., that the best predictor of the next period's stock price is the current price. How can this be reconciled with the previous section's result that earnings are somehow predictive of prices? The time series model should be used for short-term prediction by the active stock trader. In fact, only for very short-term forecasts since the best model based on the study for SMC is the one-week forecast model using only the previous week's closing price. In contrast, regression analysis is better for longer-range forecast or for estimates of "intrinsic values" or trends. Earnings can be a useful predictor of stock prices under appropriate conditions identified in this paper.

SUMMARY AND CONCLUSIONS

This paper illustrated two statistical methods of forecasting stock prices, namely regression and time series methods. While these two methods aim to achieve the same goal - prediction, the user is cautioned on the need to consider some underlying assumptions if meaningful and reliable results are to be derived. More often than not, some assumptions are not intuitive and this is all the more reason why the user should examine the results of his prediction in the light of some auxiliary information. Knowledge about the company in question and business intuition come into play in key phases of the analysis.

The methods discussed in this paper are not the only methods that can be used for forecasting. The methods were chosen because they are justifiable on the basis of

Table 3. **SMC (A) STOCK PRICE (PESOS PER SHARE)**

Forecast Versus Actual

Month	Week	Actual Price	Forecast Price	Error (Forecast Less Actual)
July 1988	4	142	148	-6
August	1	149	140	9
	2	149	152	-3
	3	148	149	-1
	4	140	132	2
September	1	139	132	7
	2	139	138	1
	3	140	139	1
	4	139	141	-2
October	1	139	138	1
	2	138	139	-1
	3	138	137	1
	4	140	137	3
November	1	141	142	1
	2	141	142	-1
	3	143	141	2
	4	141	145	-4
December	1	141	139	-2
	2	142	141	1
	3	144	143	1
	4	146	146	0
January 1989	1	146	146	0
	2	145	148	-3

Mean Error: 0.30
Standard Deviation: 0.678

a rigorous mathematical foundation. Thus, a manager who makes appropriate use of these tools can be assured of a reasonable degree of confidence. Confidence in the face of uncertainty as in stock market price forecasting can lead to an improved decision making process.

The key conclusions of these techniques address the two questions raised earlier. Reported earnings, used in the context of regression analysis, can serve as valid basis for predicting the "normal" price of a stock. In this sense, accountants (and auditors) are doing a service to investors in providing such information to the public. Past stock prices do also serve as predictors of future prices, but only in the very short-term. The implications of these findings for investor advisory services and regulators are straightforward. Investors are well-advised to take long-term positions in stocks on the basis of intrinsic values derived by, say, regression analysis of prices against historical earnings.

However, for short-term trading decisions, regression analysis is not of much help. However, neither are moving average models which use past prices. The best time series model is one which uses only the current price and which projects only one period ahead. Per this paper, the investor's task is to predict the jump in only this period's price. He cannot (efficiently) predict beyond. Finally, regulators should continue to enhance the immediate availability of quality and timely financial statements and other information to the public. Earnings are related to long-term stock price performance, while current news determine the day-to-day changes in stock prices.

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