THE RELATIVE EFFICIENCY OF STOCK MARKET TRADING RULES BASED ON STOCK PRICE CHARTS

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The Philippine stock market has long suffered from an "image problem" - that it is a speculator's market, and not even a "fair game" one at that. This paper investigates whether the market corresponds to a "fair game" or efficient market. Under a fair market, competition among investors based on readily available information ensures that prices move only because of new information ("news"). This implies that prices do not follow a pattern, as in cyclical and "manipulated" prices. The experiment described in the paper tests whether or not a chart-based trading approach like moving average can outperform or beat the market. The results suggest that stock prices in the Stock Exchanges do not follow a pattern (at least of the type analyzed) and it is not profitable to use the moving average method to beat the market. One implication of the study is that the investors should ignore suggestions by technical analysts based on price charts. On the average, an investor could not do better than make a forecast of economic industry conditions, buy stocks on that basis and hold them over his planned investment period.

THE STOCK MARKET: A "FAIR" GAME?

Shares of stocks of Philippine corporations represent the ownership of a major share of the country's commercial and industrial wealth. The prices of these stocks represent an indirect valuation of such wealth, the direct way being the valuation of the physical assets of these corporate organizations. There is a certain mystery in this indirect valuation via the pricing of shares of stocks. For one, it includes a subjective evaluation of the *future* earnings of the assets, not just the value of the assets. This makes stock price a more conceptually valid measure of wealth since the stock is a holder's legal claim against present as well as future corporate assets (e.g. from future earnings). For another, it appears to be affected by external economic and political conditions, practically on a day-to-day basis. However, this condition only follows from the subjective nature of the valuation process itself.

To illustrate the valuation phenomenon, the Philippine National Bank (PNB) was partially privatized with 30 percent of its shares offered to the public. By that act, the PNB invited the public to "estimate" the value of its shares. The subscription or offer price set by PNB was P170 per share, initially calculated as a certain "premium" over the prevailing book value of P157 per share.[1] Of course once the offer was made to the public, the market took over and assigned its own value which was different from P170. If the market collectively believed that the value of PNB was less than P170 per share, there would have been no takers. Otherwise, the issue would be oversubscribed. On the stock market listing of June 21, or one month after the public issue, PNB traded and closed at P255 per share. The next day, this quickly went up to P307. What did the market know on June 22 that was not known on June 21? Then the price went down by 17 percent, to P255 per share by July 4. Again, the same question can be asked. In addition, since the price went down, one might ask whether it was "fair" for buyers of PNB shares at P307 to lose 17 percent of their money in twelve days.

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[1] "Insider trading in PNB shares?", Business World, June 28, 1989.

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Capital market theory has an answer: the valuation process in a stock market is "fair" if investors in that market compete freely with one another in estimating the value of stocks on the basis of equally available information. In the PNB case, it was a "fair" game if the buyers of the PNB shares at P305 had as much opportunity (as the sellers) to assess the factors affecting PNB's value and prospects before making their decision to buy shares. Such a market is considered "efficient" because available information is processed by investors, who then "submit" their evaluation of this information by their buying or selling decisions in the market place. In short, there is no guarantee for investors against losses even in an efficient stock market. It is enough that conditions allow these investors an assurance of their being in a position to know what they are doing. In short the rule of *caveat emptor* holds in an efficient market.

But how might one begin to investigate whether the conditions prevailing in the Philippine stock market correspond to one of a "fair game" or efficient market? This is certainly a question of interest to regulators (e.g., the Securities and Exchange Commission), the Exchange, stock brokers and especially investors.

INVESTIGATING THE PHILIPPINE STOCK MARKET

There are two general approaches to evaluating whether conditions tend toward market efficiency.

The first is to look directly into the flow of information in such a market, including the institutions and mechanisms of information transfer. All investors should have access to information services, brokers, corporate reports and business news that concern the corporate stocks in question. As previously stated, inefficiency in this regard can be unfair to some investors not endowed with the same set of information. One can investigate whether or not there are evidences, among others, of: (a) individual's private access to corporate information; (b) dissemination of corporate reports to the public; (c) activity of a professional analyst community which interprets corporate reports for investors; and (d) enforcement and compliance with government regulations on corporate reporting. A special instance of an "unfair" market occurs when a few individuals are allowed to trade based on their private access to information, a practice known as "insider trading". In the other enumerated cases, an inefficient market may be primarily due to the underdeveloped infrastructure for information dissemination to the public, i.e., inadequacies attributable to the analyst community, government and corporations.

The approach of direct investigation of market conditions has several weaknesses: (a) it is difficult to determine whether conditions are adequate or inadequate, since information distribution can always stand some improvement and (b) the absence of some information mechanism need not imply that investors are not informed since individuals can use various alternative private sources in making their trading decisions.

The second and indirect approach to evaluating stock market efficiency is by studying stock prices. Since stock prices are the results of the investors' collective evaluation of information, can one infer the informational efficiency of the entire market by looking only at stock prices? Since each piece of information is new (by definition), then prices must adjust every time such information is known by the public. The prediction of capital market theory is then for prices to move in a *random* fashion, simply to reflect the random character of investment-related information in the marketplace. In technical terms, prices are then predicted to follow a *random walk* over time. There are appropriate statistical techniques that can test whether or not the time pattern of prices indeed follows a random walk, e.g., whether or not the best predictor of the next period's price is only the current price. These investigation techniques include time series forecasting models and time correlation methods.

Obviously the preceding approach invites mostly the statistician investigator types. Is there another that appeals more to the investor's intuition rather than to brute statistics? Fortunately, the answer is an affirmative. Suppose for a moment that prices are *not* random. Then that is the same as saying that prices move along some pattern over time. Watching stock price charts would then be a fruitful exercise to guide trading decisions. However, if the capital market were efficient, then charting prices would have been done by many investors. By their competition in their own trading activities, they shall then eliminate any potential gain through the use of this method. Hence, capital market theory once more states that precisely because investors can look out for such patterns, only random price movements will remain - the random walk prediction. In this case, the nature of the verification work is relatively simple: fixing the time period, an investor who uses price charts in making his trade is matched against another who buys the same shares and holds them for the entire period. The latter investment policy would simply reflect the market's performance. If prices follow a random walk, investment decisions based on price charts would not generate superior earnings compared to the buy-and-hold approach. The notion of an efficient market is consistent with the demonstrated inability of chart-based investment rules to "beat the market" (as measured by its average performance).

This paper reports the results of an experiment to

Table 1. ILLUSTRATION OF TRADING RULE BASED ON 3-DAY MOVING AVERAGE				
Day	Price	3-day Moving Average (MA)	Price Less Than (Greater) MA?	Recommendation
1	P22	-	-	-
2	21	-	-	-
3	17	P20	Less	Do nothing
4	16	18	Less	Do nothing
5	18	17	Greater	Buy
6	23	19	Greater	Do nothing
7	22	21	Greater	Do nothing
8	21	22	Less	Sell
9	17	20	Less	Do nothing

determine whether or not a chart-based approach - the use of moving average, so routinely calculated by stock-brokers and technical analysts - can perform better than the market. Can this chart- based decision rule beat the market?

MOVING AVERAGE TRADING RULE VERSUS BUY-AND-HOLD: AN EXAMPLE

Trading rules using historical price analysis are part of a practice called "technical analysis". The techniques in technical analysis can be roughly classified into either subjective methods (e.g., "chart formation" analysis) or methods which yield statistical decision rules (e.g., moving average analysis). The first set of approaches requires subjective interpretations by "chartists" and could not be readily evaluated in a head-to-head comparison with the market.[2] On the other hand, statistical decision rules are mechanical and allow for the conduct of verifiable testing procedures used in the present study.

The class of trading rules tested in the study is the n-day moving average technique.[3] The rule says: "*purchase a stock whenever its price exceeds the n-day moving average price and conversely, sell whenever the price drops below the n-day moving average price*". The rule is illustrated in Table 1.

The rationale for the moving average trading rule is that since the moving average is a "smoothed" version of a trend, the "crossing" of the stock price and the moving average supposedly indicates the end of the current trend and the start of a new one. In the illustration in Table 1, the investor was advised to buy at a price of P18 and eventually, to sell at P21, or a gain of 16.7 percent[4] (if there are no transaction costs). How efficient is this investment rule? One should compare it not with complete foreknowledge of prices but simply with a buy-and-hold-rule. In contrast, under the buy-and-hold, buying at Day 3 and holding through Day 9 gives no gain nor loss to the investor. In this illustration, the trading rule based on the moving average method is superior to buy-and-hold. The example is graphically shown in Figure 1.

It should be instructive to note why the trading rule "worked" in this illustrative example. It is obvious from Figure 1 that prices actually followed a clear cyclical pattern, indicating that a statistical method which reflects trends should provide "correct" trade signals. However, suppose that in the example, Day 6 price was not P23 but P16, a "reversion" to the declining price pattern of the first four days. Then the "Buy" signal of Day 5 would be an "incorrect" signal since (as it turned out) an increasing pattern was not to be the new trend. This phenomenon is called by analysts as a "whipsaw" or "trend reversal". Errors of this type will negatively affect the trading rule-based portfolio because of price losses and transaction costs.

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[2] One obvious approach is to allow a "chartist" to manage a portfolio and see whether he can beat the market. But it would be difficult to control such an experiment as the "chartist" may not be able to explain his decisions as consistently arising from the use of price charts alone, rather than other information. Another difficulty with this approach is that the ability of the chartist would be difficult to determine since the outcome of the experiment would measure the effectiveness of the chartist as well as the charting method itself.

[3] The n-day moving average is simply the average of all daily prices beginning n-days from the present date, to the present.

[4] Compared to perfect foreknowledge of prices: buy at P16 and sell at P23 or a gain of 43.75 percent. The MA trading rule does not achieve this return because the moving average can be thought of as "verifying" the trend (and is thus delayed), before recommending a buy or sell.

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Figure 1 :

**Example of Three - Day
Moving Average Trading Rule**
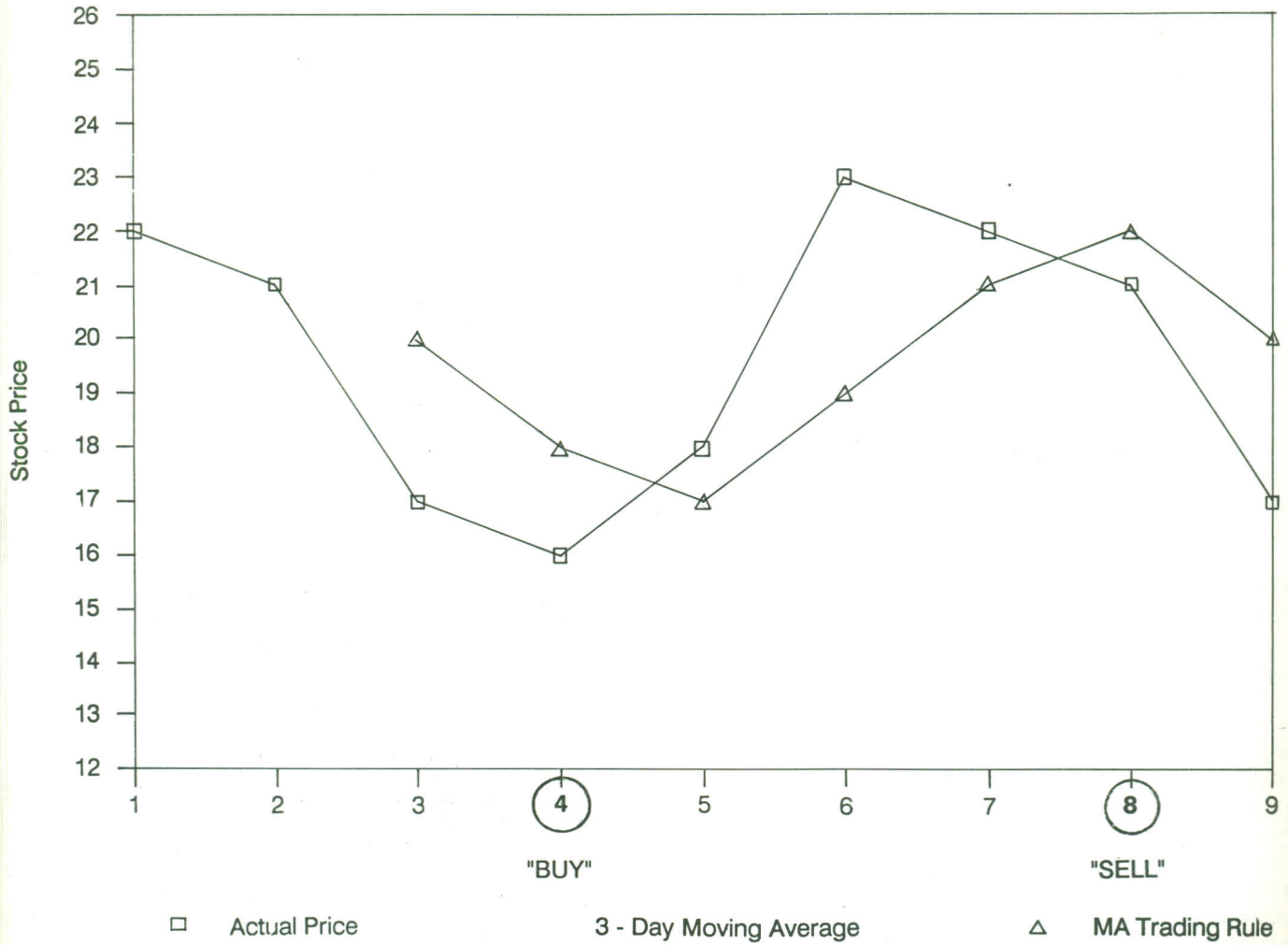
A related issue concerns the threshold level for buy or sell recommendation. One may require that buy/sell signals be indicated only if the difference between actual and moving average price exceeds a certain threshold level, e.g., 10 percent. If so, the "buy" signal only happens on Day 6 and the "sell" on Day 3. The threshold level serves as a "buffer" against the possible "whiplash" effect cited earlier in the sense that trade orders are only made if the trend is "established" (in the degree specified by the threshold level).

Lastly, the trading rule can yield more returns for the portfolio if short selling is allowed. If trends are predictable, one can obviously sell the stock short (as well as buy on account) on buy signal on Day 5 (at P18) and then buy back[5] the stock when price goes down on Day 9 (at P17). This practice can increase returns if the trading rule works but can also result in losses otherwise. Short selling is not allowed in the Philippine stock exchanges.

SAMPLE DATA

The statistical trading rule was tested on six selected stocks traded on the Manila Stock Exchange. Two of the most heavily-traded stocks from each of the three sectors [Commercial-Industrial (CI), Mining, and Oil] were chosen for this study. The decision to select the most heavily-traded stocks was based on the premise that large trading volumes generally imply a large number of buyers and sellers, a desirable characteristic for market efficiency. The six issues chosen were the Class A shares of San Miguel Corporation and Philippine Long Distance Telephone Company (PLDT) from the Commercial-Industrial sector, Philex and Benguet from the Mining sector, and Philodrill and Oriental Petroleum from the Oil sector.

The period covered by the test was from the first trading day of May 1987 to the last trading day of April 1988 (a total period of one year). The middle of the year was chosen as the starting and ending period in order to prevent, or at least negate, any "January effects" which might be present.[6]

Unadjusted daily closing prices were gathered for the six stocks for the period covered and adjustments were made for stock dividends or splits declared during this period. Cash dividends for each of the six stocks were also recorded and used in calculating returns. All computations of stock returns were based on daily closing prices as adjusted in this manner.

EXPERIMENT METHOD

In testing the results of the statistical trading rule, the 30-day simple moving average was used as a means of defining the trend. The moving average period of 30 days appears to be a good compromise between shorter periods (e.g. 10 days) which generate earlier signals and longer periods (e.g. 60 days) which generate more delayed signals. The 30-day moving average is also commonly used by technical analysts of stockbrokers for short-term trading. The threshold level was set at zero percent. Therefore, any amount of intersection of the moving average by the price of the stock indicated a signal. Adjusted daily closing prices were used in all of the computations since it was assumed that the execution of trading orders was still possible during the remaining minutes after the announcement of the closing prices.

Since the study intended to approximate the Philippine capital market situation, no short-sales were performed in the test. Although a limited amount of short-selling may actually be performed by a few traders, it was assumed that existing laws prevent most players from short-selling. By disallowing short-sales in the experiment, idle funds would be generated between buy and sell signals under the trading rule. A rational investor desiring to maximize his profits would place such idle funds in a short-term investment account until the trading rule once again indicated a "buy" signal. It was assumed that this investment account earned four percent, the equivalent to the savings account yield after 20 percent final tax.

Cash dividends which were received under either the moving average trading or the buy-and-hold portfolio were placed in the short-term investment account to earn four percent.

It was assumed arbitrarily that P100,000 be allotted for investment in each of the six stocks of the sample, or a total of P600,000. In the case of the moving average trading rule portfolio, since trading signals can occur at any time, all net proceeds from the sale of each stock were allocated only for the future purchase of that stock. In short, each of the six stocks was segregated with its own P100,000 initial fund and short-term investment account. Under this scheme, it would be feasible to determine the performance of the trading rule for each stock.

A similar portfolio of P600,000 allocated among the six stocks was set up as the buy-and-hold portfolio. Since the moving average can only be calculated after 30 days, it was assumed that all purchases for the buy-and-hold

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[5] Or do "short covering" in the jargon of stock brokers.

[6] Studies in the US stock market found that there was a systematic undervaluation of stocks in the market in January and it may be possible to generate excess returns on this basis.

portfolio were made on the thirtieth trading day of the experiment period. There were no further transactions for this portfolio except for cash dividends received. The results were assessed by comparing closing prices at the end of the sample period and accumulated cash dividends with the initial transaction prices.

Transaction costs would be an important consideration in this experiment. In order for the moving average trading rule to come out as a superior approach, a portfolio adopting that method should generate returns which cover transaction costs and still perform better than the buy-and-hold portfolio. In the Manila Stock Exchange, a one-and-a-half percent broker's commission is set only as a ceiling but even preferred clients (outside of block trades) are normally charged at least one-half percent in broker's fees.

Calculations of returns under both the trading rule and the buy-and-hold strategies were performed in two stages: the first disregarded transaction costs (broker's commissions and the transaction tax) while the second stage included prevailing standard transaction costs (broker's commissions of 1.5 percent at purchase and at sale, plus 0.25 percent transaction tax).

In all computations it was assumed that available funds for each stock would be used to purchase the necessary shares of stocks, even at fractional or odd-lot purchases at the current price.

RESULTS

The results of the experiment are summarized in Tables 2 and 3.

For the overall portfolio, the moving average trading portfolio did not perform better than the buy-and-hold portfolio with or without transaction cost. Specifically, profits of the moving average rule portfolio were lower by 43 percent on 'without transaction costs' basis and lower by 58 percent on 'with transaction costs' basis.

The effect of transaction costs is very evident from the results. However, the magnitude of the effect varied substantially between the two methods. Under the buy-and-hold approach, the transactions costs reduced portfolio profits by 4.5 percent. However, under the trading rule, the loss increased from one percent to 19 percent when transaction costs were factored in. The numerous transactions in the trading portfolio substantially affected profits, especially since during the experiment a number of signals produced "whipsaws" (false signals from price changes which "reversed" after a few trading days).

When interpreted on a specific stock basis, the results of the experiment become somewhat ambiguous. Most interesting is that *ignoring transaction costs*, the trading rule worked for PLDT, San Miguel and Benguet stocks. In other words, the overall portfolio result in favor of buy-and-hold was largely due to the very poor performance of the trading rule on the remaining three stocks, particularly the oil stocks. Table 2 shows that for the CI sectors, the trading rule (before transaction costs) gained 15.3 percent, outperforming the buy-and-hold method which lost 3.1 percent.

It is when transaction costs are considered that the trading rule fails to outperform the buy-and-hold approach. For the CI stocks, the two portfolios are about equal in performance but the buy-and-hold rule was clearly superior for all stocks except for PLDT. As previously pointed out, the crucial question is whether the trading rule should be recommended to investors, thus requiring such rule to perform better under a full-transaction-costs assumption. On this basis, the moving average trading rule is not a demonstrated success in this experiment. It cannot be recommended for use by investors.

Two limitations of the experiment results should be noted at this stage. One is the use of a zero threshold level. A higher threshold level would alleviate the trading rule's tendency to give incorrect signals when "trend reversals" happen. The trading rule would perform better under that condition, especially in the oil stocks. The second is the very limited number of stocks being studied. While it is not clear that the small sample favors one of the two methods, a larger portfolio of stocks would probably lead to more generalizable results.

CONCLUSION

The results of the study discussed in this paper are more consistent with the claim that the Manila stock market shows appropriate efficiency characteristics. This may be somewhat surprising in the light of evidence [e.g., Tan(1985)] that the stock market remains small and underdeveloped, with the government and securities industry still considered inadequate in coping with the information requirements of a growing investor market.

The evidence from the experiment indicates that prices do not follow a trend or pattern, at least one discernible by the popular moving average statistical technique. If no trend is evident, it must then be the case that prices change largely on the basis of news arriving in the marketplace. Since each piece of news can have either a positive or negative effect on current price, the history of past prices (used in moving averages) shall have very little relevance in determining the future price of the stock.

Table 2. COMPARATIVE PORTFOLIO PERFORMANCE

(No Transaction Costs)

Gain (Loss) Relative to Initial Investment of P100,000 per Stock

Stock	M.A. Trading Rule		Buy and Hold		Trading Rule Less Buy and Hold	
	Amount	Percent	Amount	Percent	Amount	Percent
PLDT	(P 896)	0.9	(P 21,064)	(21.1)	P 20,168	20.2
San Miguel	31,520	31.5	17,915	17.9	13,605	13.6
Total	P30,624	15.3	(P 3,149)	(3.1)	P 33,773	16.9
Benguet	(P14,477)	(14.5)	(P 17,773)	(17.8)	P 3,296	3.3
Philex	(5,730)	(5.7)	5,326	5.3	(11,056)	(11.1)
Total	(P20,207)	(10.1)	(P 12,447)	(6.2)	(P 7,760)	(3.9)
Oriental	(P 992)	1.0	P 17,610	171.6	(P172,602)	(17.3)
Philodrill	(15,432)	(15.4)	97,550	97.5	(112,982)	(11.3)
Total	(P16,424)	(8.2)	P269,160	138.5	(P285,584)	(14.2)
All Stocks	(P 6,007)	(-1.0)	P253,564	25.4	(P259,571)	(26.4)

note: Positive amount means Trading Rule profits exceed Buy-and-Hold and negative amount otherwise.

But such is the description of prices moving on a *random walk*, with the direction of the "walk" triggered by the (random) news or event affecting the stock. An analyst forecasting such price changes using a calculator and a library of old stock prices could not be very effective.

Results similar to this have long been established in the much larger U.S. stock market. The use of a wider variety of moving average signals for larger portfolio was done by Cootner (1962) and by Van Horne and Parker (1967) with results similar to the present study in terms of the overall dominance of the buy and hold approach over trading rules. Other trading rules based only on historical price changes, called "filter" techniques could not demonstrate superior results as shown in Alexander (1961) and in the Philippine case, in Azurin (1979).

One implication of the study for the investor is that one should not pay much heed to "bullish or bearish tendencies" often predicted by technical analysts based on price charts. It would be better for the average investor to make a general forecast of the economy and industries (to ascertain whether good news will predominate over bad ones in the future), buy stocks in those industries and then hold the shares over his planned investment period. Another implication for the stock market analyst is that the best predictor of next period's price would be just the previous price. Another study [Saldaña and Victoria (1989)] using statistical prediction techniques is consistent with this assertion.

Table 3. COMPARATIVE PORTFOLIO PERFORMANCE
(With Transaction Costs)

Gain (Loss) Relative to Initial Investment of P100,000 per Stock

Stock	M.A. Trading Rule		Buy and Hold		Trading Rule Less Buy and Hold	
	Amount	Percent	Amount	Percent	Amount	Percent
PLDT	(P 18,685)	(18.7)	(P 23,566)	(23.6)	P 4,881	4.9
San Miguel	10,037	10.0	14,184	14.2	(4,147)	(4.1)
Total	(P 8,648)	(4.3)	P 9,382	4.7	P 734	(0.4)
Benguet	(P 31,426)	(31.4)	(P 20,386)	(20.4)	(P 11,040)	(11.0)
Philex	(24,564)	(24.6)	2,045	2.0	(26,609)	(26.6)
Total	(P 55,990)	(27.9)	(P 18,341)	(18.6)	(P 37,649)	(18.8)
Oriental	(P 22,793)	(22.8)	P163,063	16.3	(P185,856)	(18.6)
Philodrill	(32,370)	(32.4)	91,368	9.1	(123,738)	(12.4)
Total	(P 55,163)	(27.6)	P254,431	12.7	(P309,594)	(15.5)
All Stocks	(P119,801)	(20.0)	P226,708	37.8	(P346,509)	(57.8)

note: Positive amount means Trading Rule profits exceed Buy-and-Hold and negative amount otherwise.

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