An Empirical Study on the Weak-Form Efficiency of the Philippine Stock Market

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This paper determines the weak-form efficiency of the Philippine stock market. Three-year daily returns (1990 - 1992) of six stocks which account for about 60 percent of the index as of December 31, 1992 were used in the study applying cointegration tests. These stocks are ANSCOR A, ALI B, First Philippine Holdings A, PLDT "Common," PNB, and SMC A. The results show that the market is not efficient in the weak-form which suggests that technical analysis can be useful in analyzing the Philippine stock market.

1. Introduction

Investment is one of the critical factors that determine the growth of an economy. For a country to sustain economic development, its level of investments must continuously grow. An increase in investments is anchored on an investor-friendly environment that requires political as well as economic stability. Capital markets provide long-term financing and its role in economic growth and development cannot be overemphasized. Moreover, the efficient allocation of scarce resources is greatly influenced by the degree of capital markets development.

Two of the most common sources of long-term capital are term loans from financial institutions and the issuance of stocks to the public. The development of the latter is reflected in the growth of the stock market, which is the focus of this study.

The Philippine stock market was founded on August 8, 1927 with the establishment of the Manila Stock Exchange. A second bourse, the Makati Stock Exchange, was established in 1963. Indeed, the Philippine stock market is one of the oldest in the Far East, but has ironically remained small over the years. With a market capitalization of $56.5 billion as of December 31, 1994, the Philippine stock market is the second smallest in the *ASEAN* region, next to Indonesia (see Table 1).

Many Filipinos are unaware of the mechanics of investing in the stock market. Hence, they do not view it as a prime investment opportunity. This lack of sufficient knowledge about the operations of the stock market encourages investments which are biased in favor of short-term government securities. This situation may have a stifling effect on the full development of the capital market.

The success of initial public offerings (*IPOs*) of a number of Philippine companies in 1993, however, indicates renewed interest of investors in the country's capital market. While 1994 was not as successful as 1993 as far as *IPOs* are concerned, still a number of newly-listed companies

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such as Megaworld, Negros Navigation, *PS* Bank, and Petron outperformed the market. The amount of capital raised by issuers in 1994 was also much higher compared to that of 1993.

Of the thousands of corporations registered at the Securities and Exchange Commission (*SEC*), only 189 companies are listed at the stock exchanges as of December 31, 1994. In addition, only about 80 - 90 of the 189 listed companies are actively traded in any given day. Only 30 stocks comprise the current stock price index (*Phisix*).[1] These statistics suggest that the Philippine stock market remains relatively thin.

Table 1
Stock Market Capitalization of ASEAN Countries
December 31, 1994
(in Million US Dollars)

Country	Amount
Indonesia	50,000
Malaysia	193,000
Philippines	56,533
Singapore	137,000
Thailand	131,000

Given renewed confidence in the Philippine economy and a favorable investment climate, there is a need to sustain efforts geared towards the full development of the Philippine stock market. Having a better understanding and appreciation of stock market behavior will contribute to the realization of this goal.

Stock markets are principally driven by information. A market that fully integrates information in the stock prices is efficient. The informational efficiency of the market is a major concern, not only of the issuers, but also of investors, financial analysts, and government regulators.

For the issuers, an efficient stock market implies that the cost of obtaining capital is commensurate to the prospects for each firm. Companies that provide more attractive investment opportunities can realize higher prices in their stocks compared to others. Investors, on the other hand, design their investment strategies based on premises about informational efficiency. These investors provide signals to corporate issuers with respect to their investment plans and their perceptions of the companies. In an efficient market, investors provide the right signals to corporate investments.

Appropriate security analysis is dependent on the degree of market efficiency. An efficient market will render technical analyses and theories related thereto irrelevant. If the market is not efficient, there will be a use for technical analyses. The importance of fundamental analyses will be limited depending on the market's level of efficiency.

[1] Last revised in October 1994.

Government agencies such as *SEC* are concerned about the abuse of privileged information. Thus, a set of rules have been formulated to guard against insider trading.

Eugene Fama[2] defined three levels of informational efficiency in his 1970 study of the stocks traded at the New York Stock Exchange. The market is weak-form efficient when stock prices reflect all information inherent in historical prices. It is semi-strong form efficient when all publicly available information, such as dividend announcements, annual report issuances, and announcement of corporate plans are instantaneously reflected in stock prices. Finally, the market is strong-form efficient when prices assimilate all relevant information, both public and private.

There have also been studies in the Philippines which show that the Philippine stock market is not efficient in the semi-strong form. These studies include the study on the effect of stock dividend declaration, an example of publicly available information, by Salita. He concluded that prices do not adjust perfectly to stock dividends on ex-date and that trading gains are possible. Saldana and Victoria, on the other hand, demonstrated a significant relationship between reported earnings and stock prices.[3]

This study attempts to determine the behavior of some actively traded stocks in the Philippines, and to assess whether the Philippine stock market is at least weak-form efficient. Specifically, it intends to find out whether or not the returns from the pre-selected stocks follow a trend.

2. Conceptual Framework

The theory which best illustrates the efficient market hypothesis is the fair game model. It states that expected returns will be equal to actual returns given an information set θ_t. Notationally, this can be described as follows:[4]

$$z_{i,t+1} = r_{i,t+1} - E\left(r_{i,t+1} | \theta_t\right)$$

and

$$E\left(z_{i,t+1} | \theta_t\right) = 0$$

where $z_{i,t+1}$ = return at $t + 1$ for security i in excess of the expected equilibrium return projected at time t.

$r_{i,t+1}$ = actual return at $t + 1$ for security 1

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[2] Eugene Fama, "Efficient Capital Markets: A Review of Theory and Empirical Work," *The Journal of Finance*, 25 (May 1970): 388.

[3] For those who are interested in the review of literature, refer to "An Empirical Study on the Efficiency of the Philippine Stock Market and the Determinants of Market Returns," master's thesis by Cayanan.

[4] Fama, "Efficient Capital Markets," pp. 383 - 387.

$E(r_{i,t+1}|\theta_t)$ is the expected return projected at time t given an information set θ_t for security i.

Since this study intends to test the weak-form efficiency, information set θ_t will refer to the historical returns of the stocks considered in the study. To test this form of market efficiency, an examination of the serial correlation properties of the error terms of the models for individual stocks will be made.

Consider the following model for estimating the expected returns of individual stocks:

$$E(r_t|\theta_{t-1}) = \alpha_0 + \sum_{j=1}^{t} \alpha_{jt} r_{t-j} + u_t \qquad (1)$$

where

$E(r_t)$ = expected return of a security at time t
j = time lags
u_t = error term at time t

Actual returns for individual securities are computed as follows:

$$r_t = \frac{P_t - P_{t-1}}{P_{t-1}} \qquad (2)$$

where P_t is the price of security at time t; P_{t-1} is price of security in the previous period.

Cash dividends were not included as part of the returns because the companies covered in the study seldom declare cash dividends or even if they do, the amounts are insignificant. This is a major characteristic of most listed stocks in the Philippines. Investors, on the other hand, invest in a particular stock, not for the cash dividends, but for the potential capital gains.

Prices prior to ex-dates are adjusted to account for the effects of stock dividends , stock splits, and stock rights offerings, if there are any.

3. Methodology

A. Description of Data Set

In order to test the model, six stocks were selected based on their contribution to the total market capitalization and volume of trading. These stocks are: San Miguel Corporation A (*SMC*), Philippine Long Distance Telephone Company "Common" (*PLDT*), Andres Soriano Corporation A (*ANSCOR*), First Philippine Holdings Corporation A (*FPHC*), Ayala Land, Incorporated B (*ALI*), and Philippine National Bank (*PNB*).

Out of the 30 stocks included in the computation of the Makati Stock Exchange Composite Index (*CPI*) as of December 31, 1992, four stocks accounted for about 80 percent of the index's market

capitalization. These are Ayala Corporation , *MERALCO*, *SMC*, and *PLDT*. Of these, two are included in the present study, namely *SMC* and *PLDT*, which accounted for about 50 percent of the index.

Table 2
Most Actively Traded Stocks
For the year ended December 31, 1992

Name of Stock	Value Traded
PNB	6,273,320,948
MERALCO B	5,400,195,775
PLDT Common	3,902,916,043
MERALCO A	1,951,103,176
ALI B	1,934,201,289
SMC B	1,838,092,112
ICTS	1,481,606,456
FPHC B	1,377,139,224
PLDT PREF. A	1,278,438,000
SMC A	1,252,075,317
ABS CBN	1,053,479,578
FPHC A	895,881,203
Basic Petroleum A	873,312,736
Robinsons Land Corp.	785,336,386
Ayala Corp. B	710,140,360
Oriental Petroleum A	687,256,605
Basic Petroleum B	666,106,947
EEI	638,774,638
Petrofields A	534,438,010
Unionbank	448,548,087
Ayala Corp. A	430,832,740
Philodrill A	405,386,571
FEBTC	379,568,470
Petrofields B	371,972,840
Easycall	358,454,900
Alcorn A	331,349,200
Kuok A	328,780,027
ANSCOR A	309,133,748
Unioil A	308,851,300
Philodrill B	287,090,552

Together, the stocks included in the present study account for about 60 percent of the *CPI* and 30 percent of the total market capitalization of listed stocks as of December 31, 1992. All of these six

stocks were actively traded in 1992, four of which landed in the top 10 performing stocks. The other two stocks, *FPHC* and *ANSCOR*, ranked 12 and 28, respectively (see Table 2).

Three-year daily returns (1990 - 1992) are used to test the hypothesis, except for ALI which was only listed in July 1991. The country was politically stable during this period.

B. Statistical Tests

In determining the appropriate time series models, cointegration tests are performed.

Cointegration Tests

The theory of cointegration developed by Engel and Granger (1987) is used in determining equilibrium long-run relationships between two or more variables. This equilibrium is interpreted differently from most definitions of equilibrium in economics. In the cointegration literature, equilibrium simply refers to the observed relationship which, on the average, has been kept by a set of variables over a long period of time.[5]

A concept that is essential to the understanding of cointegration is the concept of stationarity. A time series (x_t) is defined to be weakly stationary if its mean, $E(x_t)$, is independent of time t and its variance, $E[x_t - E(x_t)]^2$, is finite, and therefore, does not vary systematically with time.[6] On the contrary, a non-stationary series has first and second moments which vary over time.

Strictly speaking, regression analysis cannot be used when variables have different orders of integration. The test for stationarity allows the researcher to determine the order of integration of a single variable.

If a series is differenced d times to become stationary, then the series is integrated of order d, denoted by $I(d)$. Thus, a series x_t is integrated of order one if $\Delta x_t = x_t - x_{t-1}$ is integrated of order zero, $I(0)$ which is stationary.

In determining the order of integration, and therefore the stationarity of the series, unit root tests are made. Common unit root tests are the Dickey-Fuller tests which test the null hypothesis that $\alpha = 1$ in the following model:[7]

$$x_t = \beta_0 + \beta_1 t + u_t \qquad (1)$$

$$u_t = \alpha u_{t-1} + \varepsilon_t \qquad (2)$$

where ε_t is white noise process. Using equations (1) and (2), we get:

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5 Keith Cuthberson et. al. *Applied Econometric Techniques* (London: Harvester Wheatsheaf, 1992) p. 132.

6 Ibid.

7 G.S. Maddala, *Introduction to Econometrics* (New York: McMillan Publishing Company, 1992), p. 583.

$$x_t = \gamma + \delta t + \alpha x_{t-1} + \varepsilon_t$$

where $\gamma = \beta_0(1-\alpha) + \beta_1\alpha$ and $\delta = \beta_1(1-\alpha)$

The equation is said to have a unit root if $\alpha = 1$.

The distribution of $\hat{\alpha}$, the least squares estimator of the autoregressive parameter α has a nonstandard distribution because of the non-stationarity of the original series. Therefore, the critical values in the standard "t" table cannot be used in testing the significance of α. To address this problem, Fuller (1976) and Dickey (1976)[8] computed appropriate limit distributions for the test statistic which were later expanded by MacKinnon (1988).[9]

Two series, $y_t \sim I(1)$ and $x_t \sim I(1)$, are said to be cointegrated, denoted by $CI(1, 1)$, if there exists a β such that $y_t - \beta x_t$ is $I(0)$.[10] Generally, two or more variables must be integrated of the same order before a cointegrating regression is established. Otherwise, the variance of the residual arising from the regression would be explosive, that is, it will become infinitely large over time.[11]

Similar to the unit root tests, drawing inferences on parameter values arising from the cointegrating regressions will not be carried out in the usual way. This is because the standard errors from ordinary least squares when performing cointegrating regressions are biased. Cuthberson (1992) identified two reasons why the standard errors are biased: (1) a static regression will generally be subject to serial correlation in the error process which leads to inconsistent estimates of the standard errors of the parameters; and (2) the non-stationarity in the data leads to "nuisance" parameters in the asymptotic distribution of the parameter estimates.[12] This means that the distribution of the parameter estimates is not normal. Therefore, for significance tests, tables of critical values were computed by Dickey and Fuller using Monte Carlo methods. The table was later expanded by MacKinnon.

The following procedures were performed in testing the variables:

a. Determining the stationary of the time series data

Unit root tests which follow an augmented Dickey-Fuller (*ADF*) tests for single series are performed. The null hypothesis is that the error term (u_t) has a unit root and therefore, the time-series is non-stationary.

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8 Cuthberson et. al. *Applied Econometric Techniques*, p. 137.

9 Ibid., p. 138.

10 Maddala. *Introduction to Econometrics*, p. 583.

11 Cuthberson et. al. *Applied Econometric Techniques*, p. 132.

12 Ibid., p. 138.

McKinnon critical values at a specified significance level, say 10 percent, five percent or one percent, are determined which are then compared with the computed Dickey-Fuller *t*-statistic (*DF t*-statistic). The following decision criterion is observed: Reject the null hypothesis if the *DF t*-statistic is greater than the McKinnon critical value.

b. Regressing stock returns against lagged returns

After determining the stationarity of the series, co-integrating regressions of stock returns against their lags are run. For each regression run, a comparison of the *DF t*-statistic with critical McKinnon values is made to determine if the disturbance term has a unit root, that is, if the error term is white noise.

4. Results

Using cointegration and applying the procedures previously described, the following estimation models were fitted for each stock:

ALI B: $r_t = 0.168675\ r_{t-1} + 0.120626\ r_{t-7} + 2.06\text{E-}06\ trend + u_t$

ANSCOR: $r_t = 0.176276\ r_{t-1} + 5.50\text{E-}06\ trend + u_t$

FPHC: $r_t = 0.071689\ r_{t-1} + 0.085384\ r_{t-7} + 6.45\text{E-}06\ trend + u_t$

PLDT: $r_t = 0.164753\ r_{t-1} + 2.82\text{E-}06\ trend + u_t$

PNB: $r_t = 0.225227\ r_{t-1} - 0.114459\ r_{t-15} + 2.16\text{E-}06\ trend + u_t$

SMC: $r_t = 0.174385\ r_{t-1} + 4.31\text{E-}06\ trend + u_t$

Disturbance terms of the fitted model are stationary as indicated by the computed *DF t*-statistic for the six co-integrating models made which in absolute amounts are all higher than the McKinnon critical values at 10 percent, five percent, and one percent significance levels (see Table 3). These results show that present stock returns are cointegrated to past returns.

5. Concluding Comments

Based on the above mentioned results, it can be concluded that the Philippine stock market is not weak-form efficient. Applying cointegration tests, all the six individual stocks considered in the study provided a pattern that can be used in predicting returns and eventually, prices.

The results of the study reinforce the usefulness of technical analysis in analyzing the stock market. Caution and prudence, however, must still be observed in the application of this tool. It must be noted that the computed autocorrelation coefficients, while statistically significant, may not be economically significant, especially when transaction costs are considered. This situation tends to support the generally accepted principle that variables other than historical prices influence current and future prices. Therefore, the application of fundamental analysis likely remains an essential complement to technical analysis.

Fundamental analysis involves the evaluation of the intrinsic value of individual stocks. This includes looking into the management of the company, conducting financial ratio analysis,

evaluating the prospects of the company, and determining the effects of macroeconomic variables such as changes in exchange rates on the overall profitability of the company.

The rapid advancement in information technology must not be overlooked, more particularly by technical analysts who benefit most from it. Recent innovations in high-powered, fast-paced computers have been put in place by top investment houses and brokerage firms abroad that make prediction of security prices more reliable and accurate.

Table 3
Engle-Granger Cointegration Test

	Co-integrating Vector			Mackinnon Critical Values		
Stock	Variable	Coefficients	DF t-stat	1%	5%	10%
Ali B	*Ali B* Returns	1.000000	-14.3404	-4.7058	-4.1494	-3.8588
	Lag1	(0.168675)				
	Lag 7	(0.120263)				
	Trend	2.06E - 06				
ANSCOR	*ANSCOR* Returns	1.000000	-18.3725	-4.3489	-3.7942	-3.5058
	Lag 1	(0.176276)				
	Trend	-5.50E - 06				
FPHC	*FPHC* Returns	1.000000	-19.0454	-4.6959	-4.1365	-3.8472
	Lag 1	(0.072669)				
	Lag 7	(0.084939)				
	Trend	6.69E - 06				
PLDT	*PLDT* Returns	1.000000	-18.6801	-4.3489	-3.7942	-3.5058
	Lag 1	(0.164753)				
	trend	-2.82E - 06				
PNB	*PNB* Returns	1.000000	-19.5768	-4.7047	-4.1389	-3.8482
	Lag 1	(0.225227)				
	Lag 15	0.114459				
	Trend	2.16E - 06				
SMC	*SMC* Returns	1.000000	-20.3235	-4.3489	-3.7942	-3.5058
	Lag 1	(0.174385)				
	Trend	-4.31E - 06				

What is interesting about these firms is that they apply different approaches, making them as heterogeneous as human traders. The advancement in computer technology is coupled with the

development and rediscovery of theories which can detect patterns from a seemingly random process. Among these are the fractal theories and the Elliott Wave Theory. The latter is being practiced by a handful of investors in the Philippines who claim modest success with the technique.

The foregoing implies that inefficiencies exist in the market which drive investors, both institutional and individual, to look for information well ahead of the others. These arbitrage opportunities explain the massive amount of the funds invested in computers and manpower resources, specially mathematicians and physicists.

The question that remains to be addressed is the time frame of these arbitrage opportunities. Advances in computer and communication technology will likely shorten the time span of such opportunities, but that is dependent to a large extent on the willingness and ability of analysts to utilize these facilities. Otherwise, only the privileged few will be able to consistently beat the market, at least in the short-run, until a more superior technique is discovered.

Institutional investors have a significant stake in the search for better techniques. Hence, they tend to be the leading investors in technological innovation. Ironically, such competition is expected to result in the faster elimination of opportunities for arbitrage. In a sense, this is fortunate for corporate issuers, as signals can be relayed in a timely manner to corporate issuers about investors' perceptions of corporate plans and strategies.

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