VOLATILITY AND RETURNS IN THE PHILIPPINE STOCK MARKET

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Excessive volatility creates so much noise that it makes market informational efficiency difficult to attain. An informationally inefficient market then makes Pareto or allocative efficiency a hit or miss proposition. Using two measures of the cost of volatility, this paper concludes that stock return volatility is much too high relative to the equity risk premium in the local stock market. Thus, controlling this volatility may be desirable to the extent that market trading is not constrained. Most of stock returns volatility appears to be price-driven as against event- or error-driven. Thus, any measure to dampen volatility must address this particular source.

I. INTRODUCTION

Stock price volatility creates the market liquidity that makes trading possible. On the other hand, excessive volatility creates so much noise that it makes market informational efficiency difficult to attain. Black (1986) defined noise simply as that which makes our observations imperfect. He noted further that "noise makes financial markets possible, but also makes them imperfect." Market informational efficiency is a desirable property that makes Pareto or allocative efficiency of the stock market possible. If the stock market is allocatively efficient, then stock prices properly reflect their fundamental values and the derived equity cost of capital is accurately measured. Investment decisions can then be made on the basis of rational rules implemented by tools like the net present value (NPV) or internal rate of return (IRR) methods using a threshold implied by the firm's average cost of capital. By contrast, in an inefficient capital market where information is limited or unreliable, difficult to process, and only gradually revealed to market players, investors find it hard to make sound investment decisions. At the very least, stock market signals will be ignored by firm managers in making investment decisions, making the stock market just a sideshow to real economic decision-making.

Given the considerations just mentioned, is there an acceptable level of volatility? As a first step in answering this, the cost of volatility[1] must be computed, or at least estimated. This paper is an attempt at a first approximation of the cost of stock market volatility. The capital asset pricing model (CAPM) as well as the celebrated Black-Scholes option pricing formula

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[1] This term is used loosely and for want of a better one. It must be contrasted with the term "the price of risk" which has a precise meaning in the CAPM (capital asset pricing model) literature. Under the CAPM, the price of risk is the ratio of the excess return of an asset (or portfolio) over the risk-free rate to the standard deviation of returns (volatility).

introduced in their 1973 paper will be used to estimate this cost. If the cost of volatility is too high, then it must be brought under control. Controlling volatility requires that their sources must first be identified. This paper will also discuss this issue. In particular, volatility due to pricing behavior in the stock market (see Haugen, 1999) will be examined.

II. AN APPROXIMATION USING CAPM

In a reasonably informationally efficient market, the basic capital asset pricing model or CAPM can provide an answer. The cost or price of volatility is the equity risk premium or the excess return over the risk-free rate. In the U.S., this is 6% for the period 1890-1979, which is the source of the famous equity premium puzzle.[2] The volatility (defined usually as the standard deviation of annualized log returns) in the U.S. stock market is 15.8% (Campbell, 1996) while that in the Philippines using quarterly data is 86.9% for 1987-2000. If markets are efficient and the basic CAPM holds, this implies that the Philippine equity premium should be equal to the ratio of the variance of Philippine stock returns to that of U.S. stock returns.[3] This is about 30 times that of the U.S.! This, however, results in a very unreasonable figure.

Under an intertemporal version of the CAPM, the consumption CAPM (CCAPM) with investors having constant coefficient of relative risk aversion (CRRA), the 6% equity risk premium implies a CRRA of 25 which is considered very high. Friend and Blume (1975) estimated a CRRA of 2 for the same period (1890-1979). Mehra and Prescott (1985) considered a CRRA less than ten to be reasonable. Using a Taylor approximation of the CAPM, Romer (2001) provides the following relationship between the expected equity risk premium on a stock or portfolio of stocks and the covariance between the return to the stock or stock portfolio r_i and the growth rate in consumption g_c:

$$\mathrm{E}[r_i] - r = \theta \mathrm{Cov}(r_i, g_c)$$

where r is the risk-free rate and θ is the CRRA. Letting the stock portfolio be the stock market portfolio and given an estimated covariance between the return to the market portfolio and consumption growth of 0.0024, a more reasonable estimate of the U.S. equity risk premium for a CRRA ranging from 2-10 is about 0.48–2.40%. This means that the Philippine equity premium for comparable CRRA should be about 14.4–72.0 %. In reality, the Philippine equity risk premium is only about 2.8% on an annualized basis for the period 1987-2000 using the composite index of the Philippine Stock Exchange (PSE). This implies that investors in the local market have an unusual degree of risk tolerance. Either the equity risk premium is too low, given the risk, or the stock market

[2] Mehra and Prescott (1985). This is the origin of the much studied equity premium puzzle in the U.S.

[3] Under the CAPM, the risk premium on the market portfolio, e.g., the Phisix, should be proportional to the variance of market returns (see Cuthberston, 1996). The ratio of the variance of stock returns of the Philippine stock market to that of the U.S. stock market is 30.25. As a technical matter, an implied assumption is that the price of risk (see footnote 1) is the same for both markets.

is too volatile, or both. However, there is ample evidence that the local market is not efficient (see, for example, Cayanan, 1995 and Estalilla, 1995). In inefficient markets where there is also excessive volatility, the cost of volatility is difficult to define, much less estimate. In the succeeding section, another attempt is made to estimate the cost of excessive volatility.

Normally, the cost of volatility can be equated to a differential obtained by decomposing stock returns into those that can be attributed to fundamentals and those that can only be attributed to other factors, including the compensation to investors for taking on additional risks due to excessive volatility. This volatility cannot be attributed alone to variability in consumption or in economic fundamentals. Thus, we cannot rule out exogenous factors like "animal spirits," brokers' self-dealings,[4] "noise traders," and the occasional stock manipulation episodes. The present value model or dividend discount model which equates stock price to the discounted value of all expected dividends is the only model of fundamental value of asset price that we have. It is used in U. S. studies that attempt to decompose price movements into those that can or cannot be attributed to fundamentals (see for example Shiller, 1981). This model, however, is not practicable in the Philippine context because Philippine firms pay little or no dividends. Thus, other approaches should be tried.

III. OPTION PRICING

Option pricing theory suggests a way of segregating the price of a stock attributable to volatility. The residual is then attributed to fundamentals. The Black-Scholes option pricing formula is used for this purpose. Assume a hypothetical options market where European put and call options are freely traded.[5] The formula gives the price of a European put option, p, and a call option, c, as

$$p = Xe^{-rT}\mathrm{N}(-d_2) - S\mathrm{N}(-d_1) \tag{1}$$

$$c = S\mathrm{N}(d_1) - Xe^{-rT}\mathrm{N}(d_2) \tag{2}$$

where X is the strike price, S is the stock price at the start of the option period, r is the risk-free interest rate, T is the length (in years) of the option period up to maturity, and

$$d_1 = \frac{\ln(S/X) + (r + \sigma^2/2)T}{\sigma\sqrt{T}}$$

and

$$d_2 = \frac{\ln(S/X) + (r - \sigma^2/2)T}{\sigma\sqrt{T}}$$

[4] Reyes (2001) estimates that before the passage of the Securities Regulation Code of 2000, brokers' self-dealings represented more than half of the exchange's daily turnover. These consist mainly of day trades wherein the brokerage's dealers would buy or short-sell in the morning and close the position before the trading day is over.

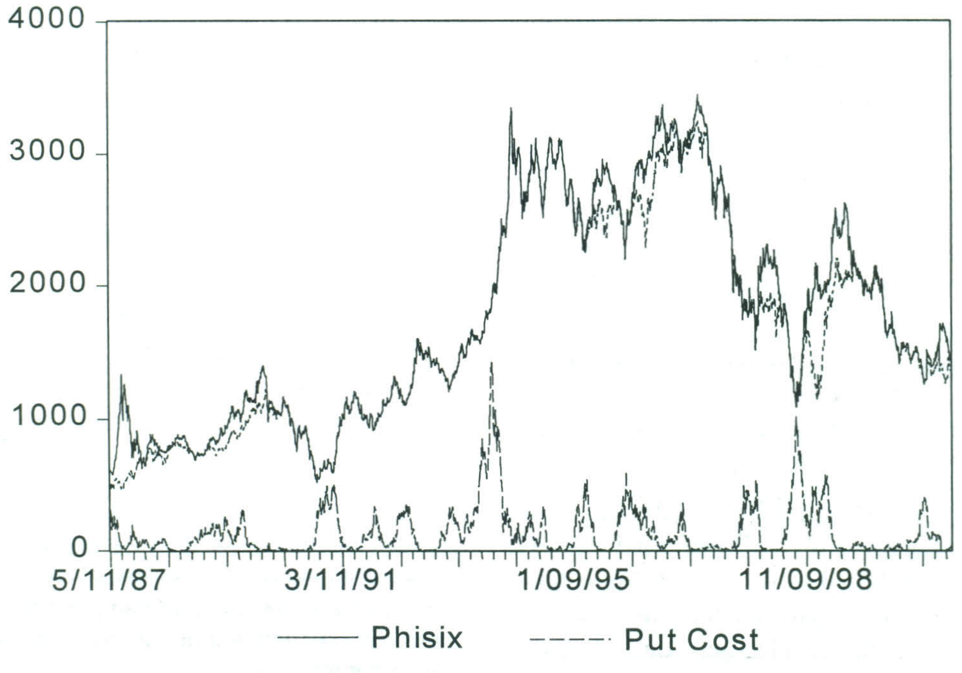
[5] A put option on stocks gives the holder the right to sell a share of stock he owns at a preset strike price at the expiry of the option period. A call option, on the other hand, is the right to purchase the share of stock at the agreed strike price. A European option allows the holder to exercise the option only at maturity. By contrast, an American option can be exercised any time during the life of the option.

The standard deviation σ on an annualized basis is also called the volatility of the stock price. N(x) is the cumulative value of the standard normal distribution evaluated at x.

Assuming all the variables in equations (1) and (2) are known, an investor holding a share of stock can get an assured price X for his stock at the end of a certain period by buying a European put option set to expire at the end of the same period at a price p. The net price to the seller is then $X - pe^{rT}$. We conjecture that this risk-free sale proceed is the fundamental value of the stock. A similar argument can be developed in the case of a call option but the computations will be more involved.

Applying this approach to a portfolio equivalent to the PSE composite index, the Phisix, let S (the current value of the portfolio) be equated to the current level of the Phisix, and X (the strike price) to the level of the Phisix T time periods from now. Volatility is estimated from actual movements of the index. For specific stocks, Hull (1997) recommends using closing prices from daily data of the most recent 90 to 180 days and annualizing the result by multiplying it by the number of trading days (e.g., 250 days). For this exercise, a European put option with 90 trading days maturity is assumed. Chart 1 shows the results covering the period May 1987 to March 2001, with the top line representing the actual value of the index and the bottom line representing the cost of the option in index points after interest cost at maturity. As expected, the graph shows that the cost of the option increases with volatility. The average cost of the option for the period is computed to be 55.2% of initial stock price on an annualized basis. This is well within the range of the first approximation of 14.4% to 72% above.

Chart 1
Phisix and Cost of Put Option



IV. SOURCES OF VOLATILITY

The computations in previous discussions are necessarily still rough approximations. Nevertheless, they point out the fact that the stock market is just too volatile for the equity risk premium that it provides stock investors. Putting it another way, the equity risk premium is much too low given the volatility of stock returns. The equity investor is simply not getting the appropriate reward for the risk he is taking in putting his money in the stock market. While this is just one more support to the proposition of stock market inefficiency, it also means that either the equity premium has to be raised or volatility has to be dampened in order to make the stock market relevant to the real economy. Otherwise, the investor base will remain limited as more conservative investors looking for safer long-term gains continue to shy away from the market.

As mentioned in the introduction, controlling excessive volatility requires first identifying its sources. Haugen (1999) identified three types of volatility by source. The first is event-driven volatility such as those that result from political and economic developments like the Aquino assassination, the debt crisis, the three EDSAs, and the Asian financial crisis. Obviously, there is very little that can be done about these events. Bautista (2001) provides a recent discussion of the effects of event-driven volatility in the Philippine stock market. Event-driven volatility also includes those arising from dividend announcements and other industry or firm-specific events. The second type is error-driven volatility. This refers to overreactions and underreactions to events. Hopefully, this can be mollified by more accurate and timely information. The third is what Haugen calls price-driven volatility. Simplistically speaking, these are equivalent to Black's noise created by the mere act of trading.

Fitting a first order autoregressive model, AR (1), to the daily log return data, the first order autoregressive coefficient of 0.177 obtained indicates that past prices, in this case the previous day's prices, have an effect on current prices.[6] An autoregressive process with positive first order autocorrelation will also have a higher unconditional variance than a white noise process. These are indications of price-driven volatility. However, it is still necessary to decompose observed volatility into what is due to price movements and what is not.

French and Roll (1986) estimated the difference in volatility in stock returns in the U.S. between periods where there is trading and periods when there is none. Since global market, political and economic events occur 24 hours a day, seven days a week and, with 24-hour television, reported continuously, their hypothesis is that if volatility is caused only by these factors and the traders' under- or overreaction to them, then there should be no significant difference in estimated volatility during trading hours and non-trading hours. In this case where there is no price-driven volatility, the fact that price information are only available during trading hours should not lead to material differences in overall volatility. The same methodology is used here for daily data from January 1987 to March 2001. The sample variance of log returns

[6] A higher order autoregressive model may be more appropriate but an AR (1) will suffice for our purpose.

s_{SM}^2 is computed for the three days starting at close of trading on Fridays up to close of trading the following Monday (weekends). Monday is included in the weekend days to capture price changes that should also reflect the events that occur during the preceding weekend non-trading days. Then, the sample variance of daily log returns s_{TF}^2 is computed for the remaining four-day periods (weekdays). From these, it is found that the ratio of the three-day variance of Saturday through Monday's returns to the one-day variance of daily returns during Tuesday to Friday is 1.44.[7] If there is no price-driven volatility, the ratio $\sigma_{SM}^2 / \sigma_{TF}^2$ should be equal to 3 (three days variance as against one day variance) since price changes would be driven only by events that are equally likely to occur in weekdays and weekends. Under the null hypothesis that this is true and using the sample variance ratio of 1.44, the following statistic is computed (see Winkler and Hays, 1975):

$$F = \frac{s_{TF}^2 / \sigma_{TF}^2}{s_{SM}^2 / \sigma_{SM}^2} = 2.08 \qquad (3)$$

Given the sample size of 2,972 and 742 for s_{TF}^2 and s_{SM}^2, respectively, the p-value for a one-tailed test is 0.0000. Thus, the null hypothesis of no price-driven volatility is rejected.

Given 24 hours in a day and a 9:30 a.m. to 12:00 p.m. or 2.5 hours trading schedule at the Philippine Stock Exchange, the following formula (see Haugen, 1999) is used to estimate the difference in volatility:

$$\frac{69.5 \times \sigma_C^2 + 2.5 \times \sigma_O^2}{21.5 \times \sigma_C^2 + 2.5 \times \sigma_O^2} = 1.44 \qquad (4)$$

where the numerator represents the variance of log returns for the three-day weekends and the denominator represents the one-day variance during weekdays. σ_C^2 and σ_O^2 are the true but unobserved variances when the market is closed and open, respectively. From equation (4), the ratio σ_O^2 / σ_C^2 can be calculated as 35.36. The square root of this, 5.95, is the ratio of volatility when the market is open to when it is closed. This result suggests that a large part of stock return volatility is price-driven, certainly much more than what can be expected just from political and economic developments and traders' reactions to them.

V. CONCLUSION

Excessive volatility creates so much noise that it makes market informational efficiency difficult to attain.

An informationally inefficient market then makes Pareto or allocative efficiency a hit or miss proposition. Using two measures of the cost of volatility, this paper concludes that stock return volatility is much too high relative to the equity risk premium in the local stock market. Thus, controlling this volatility may be desirable to the extent that market trading is not severely constrained. Most of stock returns volatility appears to be price-

[7] French and Roll (1986) computed this to be 1.11 for the U.S. data. The p-value for the first order autoregressive coefficient is 0.0000. The Box-Pierce Q-statistic has a p-value of 0.0000. Thus, the first order autoregressive coefficient is statistically different from zero.

driven as against event- or error-driven. Thus, any measure to dampen volatility must address this particular source. For instance, high price-driven volatility implies that expected capital gains as a component of stock returns is much more volatile than expected cash dividends. This is confirmed, for example, in the U.S. by Campbell (1991). In the Philippines, Aquino (2001) found that the returns of stocks that pay regular cash dividends are less volatile than stocks that do not. Therefore, if volatility is to be controlled, the differential tax treatment that favors capital gains at the expense of cash dividends, especially for listed stocks, bears looking into. High price-driven volatility could also be because trading in the local stock market is concentrated in a limited number of stocks. As a consequence, the low equity premium could also reflect a market that is supply-constrained in terms of quality issues desired by investors. Thus, increasing the number of quality stocks traded in the market, both in terms of number of issues as well as proportion of total shares held, can help dampen excessive volatility as trading is spread over more stocks.

It should also be interesting to study if overall volatility declined after the implementation of the Securities Act of 2000. Correspondingly, stock returns volatility before and after the change in trading hours in early 2002 is worth looking into. Provided that other factors can be statistically controlled for, the results can either support or disprove the hypothesis advanced in this study. One way or the other, it will bring us one step further in understanding stock price dynamics in the Philippines.

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