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# The capital asset pricing model and arbitrage pricing theory on the Johannesburg Stock Exchange

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implications of the information on the value of the security. There should be no need for a subsequent correction, for example, of an overreaction to a piece of information".

The question that springs to mind is: "Do markets really behave like this?". Some academics have argued that it may not. Their arguments are based on the following concepts:

- noise; and,
- the structure of information.

Noise was first discussed by Black (1986). He argues that but for noise there would be no trading on the market. This phenomena that facilitates trading makes the market inefficient. The point about markets and information is that if everyone has the same information and everyone is agreed to the effect it will have on prices, no one will be prepared to trade individual securities[5]. Noise trading overcomes this problem. Differences in beliefs and opinions about the prospects of a share will ensure that people trade in the market. This Black (1986) refers to as "noise trading". If there are people trading on noise, (even if they think the noise to be information) then there will exist incentives for those investors with information to trade. The effect of information-traders trading with noise-traders will be to introduce noise into share prices. The price of shares will now include both information and noise.

Black (1986:531) states that as prices get more and more noise in them so it will be more profitable to trade on information. Thus we will see more information traders taking positions in the market. This does not imply that share prices will become more efficient. Share prices will tend to move away

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[5] Trading can and will occur even if investors have the same expectations regarding the future. If investors wish to alter their consumption patterns they may restructure their portfolios, giving rise to trading. LeRoy (1989: 1584) points out that under certain restrictions, differences in holding securities ie. trading can be traced back to differential information.

from their "true value" as more noise trading occurs. Countering this phenomena will be the fact that more information-traders will enter the market and take larger positions in the mis-priced share. Thus there will be a tendency for the share price to return to its "true value" over time. Black (1986: 532) argues that this process will be slow. This particular argument should be seen in the light of Merton's (1971) argument that short run prices need not be efficient but that long run prices are efficient[6]. While prices do tend to return to their "true value", Black (1986:533) submits that because all estimates of value are noisy, it is impossible to tell the magnitude of the difference between price and value.

Summers (1986:598) makes a further point about noise: even if inefficiencies in share prices are noticed by speculators, the risk-averse speculator will be unwilling to take a position in the share because increased noise makes such a position highly risky. The profit that can be earned is likely to be "small and uncertain" and the speculator will only take a limited position in the mis-priced share. Valuation errors will only be corrected if they are widely noticed. While Summers (1986) makes an interesting point, it is unlikely that speculators should be as risk-averse as the ordinary investor. Keane (1991:32) provides an economic rational for the fact that valuation errors may persist. He identifies two considerations that are "critical" in determining whether or not valuation errors are exploitable:

- in order to undertake an arbitrage position the investor may have to abandon a position that he holds in a diversified portfolio, the valuation error will have to compensate the investor for a number of costs, including the loss of risk reducing diversification and the marginal effort needed to undertake arbitrage; and,
- the return that is "promised" by a particular position is unlikely to equal the

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[6] Similarly, Blowers (1984: 47) said that, "the market is efficient *only* over extended periods of time. Unless there are some remaining inefficiencies at some points in time, no one is ever going to make any more money than the market on average."

expected return for various reasons, viz.:- the degree of confidence in the model used to price shares may be low;

- transaction costs;
- the investor may lack the necessary skill; and,
- the valuation error may be corrected before the investor has a chance to act.

Miller (1987) presents a similar argument to Black (1986) although the terms used are different and Miller makes no mention of Black in the article or his bibliography. Miller (1987) sets out to demonstrate a generalisation of the EMH. He argues that the EMH assumes a perfect market and homogeneous expectations. He shows how in a market where there is no perfect knowledge or homogeneous expectations inefficiency will occur even if investors are well-informed and rational.

While Black (1986) differentiates between information-traders and noise-traders, Miller (1987:4) refers to informed and uninformed investors. Informed investors will buy shares that they expect will rise in price (undervalued) and sell those shares that they expect to fall in price (overvalued). In terms of conventional EMH theory if a share is overvalued its price will fall when informed-investors try to sell it. In terms of Miller's (1987) argument this need not happen, if there are sufficient uninformed investors the informed investors will simply sell to the uninformed. If the stock is overvalued and the informed investors have sold all their shares to the uninformed the share price will be determined by the uninformed trading among themselves.

The question arises: "Where does this leave the EMH?". Black (1986:533) writes that: "we might define an efficient market as one in which price is within a factor of 2 of value, ie., the price is more than half of value and less than twice of value." He admits that the value of two is arbitrary but submits that given the circumstance it is reasonable. He further states that he thinks given

this modified definition of efficient markets that "almost all[7] markets are efficient almost all the time".

Similarly to Black's (1986) argument Miller (1987) argues that the range of share prices will be "bounded" by the behaviour of economic actors. While prices may be determined by uninformed actors trading among themselves, should the price diverge too far from the price anticipated by informed actors these investors will begin to sell the shares short. Thus the share price is bounded at the lower limit by informed investors buying the share and at the upper limit by informed investor selling the share short[8]. These arguments lend support to Summers (1986:599) when he states that "[t]here are no grounds for assuming either that irrational traders will be eliminated, or that they will be unable to move market prices".

Damodaran (1987:53-54) argues that information structure will affect share returns. He states that we must differentiate between natural events and information events. A natural event is an event that will cause the true value of a share to change, while an information event is an event that causes the observed price to change, ie. the market value. In the EMH information structures are perfect; in reality information structures vary in three important respects:

- the *frequency* with which information is collected and disseminated varies across firms;
- information releases contain *noise* and this noise may introduce estimation errors into the market; and,
- information releases may contain *bias*, ie. good news is released promptly while bad news is suppressed.

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[7] By "almost all", Black (1986: 533) means at least ninety percent.

[8] Miller (1987: 6) does acknowledge that there are restrictions on selling shares short. He argues that despite these restrictions the theory could still remain valid for individuals.

Given these differences in information structures, it is unlikely that true value and market value will always be equal. Information-rich firms will tend to have true value equal to market value, but not so information-poor firms. In information-poor firms the price of the firm should be inactive for relatively long periods of time, with intermittent price jumps of large magnitude. This approach seems to ignore the fact that markets often anticipate news events and that often what may be considered to be news has already been incorporated into price.

While Damodaran's (1987) argument is intuitively pleasing, much of it is covered by the EMH in that there are no financial illusions. With respect to the concept of trusting market prices, given the arguments set out above, one might say that when market prices equal true prices it is a miracle. However, none of the counter-EMH theories that have been reviewed here provide any empirical analysis. Indeed, Black (1986:530) writes: "...I recognise that most researchers...will regard many of my conclusions as wrong, or untestable, or unsupported by existing evidence. I have not been able to think of any conventional empirical tests that would distinguish between my views and the views of others. In the end, my response to the scepticism of others is to make a prediction: someday, these conclusions will be widely accepted...".

While these theories may appear to challenge the status quo, they may in fact be supporting that status quo. The status quo according to Brealey and Myers (1991:301) is that "[o]n the *average* the value [of the firm] will be correct" (emphasis added). It can be argued that the status quo is no different from the arguments set out above. These views could merely pass for an expanded exposition of the accepted theory.

### 2.4.3 THERE ARE NO FINANCIAL ILLUSIONS

Brealey and Myers (1991:302) argue that in an efficient market "[i]nvestors are unromantically concerned with the firm's cash flows and the portion of those

cash flows to which they are entitled". This indicates that investors are not overly concerned about accounting figures but are concerned about cash that can be attributed to them. It is the earnings of a firm that determines its share price (Lorie, Dodd and Kimpton 1985:97). The earnings that we refer to is *the economic earnings not accounting earnings*. The manner in which this theory may be tested is by determining the effects of changes that increase or decrease the cash position and cash flows of the firm, eg. accounting changes[9] and share splits. The classic study in the field was done in 1969 by Fama, Fisher, Jensen and Roll.

In this study Fama et al. (1969) used the market model to investigate the informational effects of share splits. This is the first published article that purports to test the EMH in the semi-strong form. Their study attempted to determine whether or not there was any "unusual" activity[10] in the period surrounding a share split and secondly whether there was any economic rationale for this "unusual" activity. They found that there was "unusual" activity around the period of a share split and concluded that the share split conveyed information to the market about expected future dividends (ie. a share split contains information about future cash flows). When a firm announces a share split, investors re-evaluate the cash flow of that firm and as they expected greater earnings and dividends the share price of the firm increases. Fama et al. (1969) concluded that markets are "efficient" in that prices quickly adjust to the new information.

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[9] A potential contradiction arises. We have just argued that economic earnings are important, not accounting earnings, yet the tests refer to accounting changes. The key to resolving this contradiction is to recognise that accounting changes may signal changes in economic earnings.

[10] Fama et al. (1969: 4) used a variant of the market model to determine "unusual" behaviour, viz.

$\log_e R_{jt} = a_j + B_j \log_e I_t + u_{jt}$

where $R_{jt}$ = return on share j for the month t
aj and $B_j$ = parameters of the regression
$I_t$ = share index
$u_{jt}$ = error term.

This particular study was conducted on the New York Stock Exchange (NYSE) over the period January 1927 - December 1959. What is of interest is whether the JSE follows a similar pattern. Studies of whether or not there are no financial illusions have centred on accounting changes, specifically the debate concerning stock (inventory) evaluation.

When valuing stock there are two approaches that can be followed, viz. the so-called LIFO (last in first out) system and the FIFO (first in first out) system. A change to the LIFO approach (under inflationary conditions) has the following effects:

- it reduces the accounting earnings of the firm;
- reported book value of the firm is reduced as stock is reported at older prices;
- the equity of the firm is reduced and the firm may appear to more highly geared; and,
- it reduces the tax liability of the firm (Knight and Affleck-Graves 1983:21).

For income tax purposes firms are required to use the LIFO valuation method.

Tax is levied on net profit. Under the FIFO method more tax is paid than under the LIFO method; thus the cash flow to investors is reduced by the amount of the additional tax. The effect of a change from FIFO to the LIFO method is two-fold:

- it has a negative effect on accounting earnings; and,
- it has a positive effect on economic earnings as tax liability is reduced, thereby creating a positive cash flow benefit (Knight and Affleck-Graves 1983: 21).

A financial economist would predict (generally) that the value of the firm would rise when changing from FIFO to LIFO. An accountant on the other hand would argue that the value of the firm should fall as investors would be "fooled" by the accounting earnings.

Knight and Affleck-Graves (1983)[11] investigated those firms on the JSE that have changed their stock evaluation methods from FIFO to LIFO (1969-1980, twenty-one firms) to determine the effect of this change. Using a methodology similar to Fama et al. (1969) they found that the market reacts to the accounting effect and not to the economic effect of the announcement. From this they concluded that the JSE was inefficient with respect to information concerning stock changes for two reasons:

- the market was "deceived" by the accounting changes; and,
- this negative effect took a long time to impound into share prices (there was a cumulative negative effect of 8,4% after seven weeks).

They further concluded that if an investor had sold these shares short, he would have earned an abnormal profit of four percent based on public information.

In order to show that the conclusions of their study were not as a result of model specification they replicated the study correcting for the following variables:

- high and low beta shares;
- high and low earnings shares;
- short and long term betas; and,
- pre- and post-1979 announcements.

In all the above replications they found similar effects: the market is inefficient. What is encouraging is that in the pre and post-1979 replication was the finding that for post-1979 announcements the market seemed to be less inefficient; the magnitude of the negative impact of the announcement had decreased and the information impacted into price more quickly.

Although *prima facie* evidence of market inefficiency is the major conclusion of the paper, Knight and Affleck-Graves (1983:31) provide a potential alternative explanation; there is a self-selection bias in the data (there may be

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[11] Mike Page has indicated in private discussion that this study is potentially biased due to a thin trading problem.

a particular type of firm that switches to LIFO in order to avert a cash crisis). They compensate for this problem by using a control group and do not expect that this problem would negate the major finding of inefficiency. It is difficult to determine how this control group functions if a cash crisis results from managerial problems. The cash crisis would then be independent of the control group.

The argument that the sample size was low (twenty-one firms) was also rejected as a possible explanation for the findings:

- these firms constitute the universe of firms that changed their accounting policies;
- as there are no barriers to trading in these shares the existence of overvalued shares for a period of seven weeks cannot be reconciled with the EMH; and,
- as an efficient market would incorporate all information into share prices quickly and unbiasedly, no shares should be undervalued or overvalued for a given information set.

Thus Knight and Affleck-Graves (1983) conclude that the JSE is informationally inefficient with respect to accounting policy change announcements.

Knight, Affleck-Graves and Hamman (1985) introduced some new evidence to the debate. The new methodology arose out of conditions that allowed a new control group to be formulated. This occurred because of the practice known as "flip-flopping". Flip-flops were conglomerates that held subsidiaries who used the LIFO method to value stock, while the parent firm used FIFO to value stock. In the consolidated company report the accounting earnings were high and because of the subsidiary using LIFO the parent benefitted from an increased cash flow. The study consisted of the nineteen flip-flop firms (twenty firms less one new listing) listed on the JSE for the period November 1980 - April 1983. The results of the study showed that there was very little reaction to announcements of stock valuation changes for flip-flop firms. They conclude, however that their results confirm those of Knight and Affleck-

Graves (1983). The reason share prices do not change is because on consolidation the accounting earnings are unchanged for flip-flop firms even while they benefit from greater cash flows. This explanation alieviates the self selection bias that was present in the 1983 study. If the change to LIFO is interpreted as a "scramble" for cash, why not for flip-flop firms? Knight, Affleck-Graves and Hamman (1985:47) gave three alternative explanations for their findings:

(1) the market is inefficient;

(2) self selection bias is still present; and,

(3) the market is efficient, the reason for the "anomaly" is perfectly rational, but unknown.

It is premature to conclude that the JSE is inefficient with respect to accounting changes. In keeping with Knight, Affleck-Graves and Hamman (1985:47) it is still possible that the market is efficient and the reason for the "anomaly" is rational.

### 2.4.4 DO-IT-YOURSELF ALTERNATIVE

Brealey and Myers (1991:307) state that in an efficient market, investors will not be prepared to pay others to do what they can do equally well themselves. Thus there is no reason for a firm to diversify itself because the investor is able to diversify his portfolio and achieve the same effect. Similarly, any investor is able to lever up and thus it is unnecessary for the firm to lever itself up. Brealey and Myers (1991) end this particular section by arguing that the "problem" of the financial manager is to determine when the firm can arrange its affairs so as to maximise the investors wealth in a way that is cheaper for the firm to do so.

Coase (1937) argues that there are costs associated with using the price mechanism: it is these costs that make the existence of firms viable. In a world of no transactions costs the do-it- yourself alternative would be exactly as Brealey and Myers (1991) state. However, in a world with positive transaction

costs and other market imperfections (eg exchange control) it may be beneficial for firms to diversify or lever up on the shareholders' behalf.

### 2.4.5 SEEN ONE STOCK SEEN THEM ALL

Investors buy shares for the cash return that they offer: as long as the share has the prospect of a "fair return" for its risk, Brealey and Myers (1991:307) argue that shares are perfect substitutes for each other. Similarly, Shleifer (1986:579) has stated that, "[t]o the extent that stocks have close substitutes, [the] underlying value is not significantly dependent on supply". This would imply that shares have perfectly elastic demand functions.

This assumption, that price elasticities for shares are infinite, has not gone unchallenged. Loderer, Cooney and Van Drunen (1991:623-624) offer two reasons why price elasticities for individual stocks may be finite:

- investors may value liquidity; and,
- heterogeneous information may lead to investors having different reservation prices for the same stock.

Loderer, Cooney and Van Drunen (1991) attempt to determine the reason for the price discount exacted by the market when a listed firm announces a new issue. This discount could be as a result of expectations of a decline in future cash flow. Loderer, Cooney and Van Drunen (1991) adjust for this possibility and still find evidence of finite price elasticities. While they argue the point tentatively, it would appear that we should be complacent in believing that stocks are perfect substitutes for each other.

Finite elasticities for stocks are inconsistent with the EMH. The 'seen one stock seen them all' maxim is a tautology. In an efficient market, this is true by definition. If the stock is accurately priced, then it must, on a risk adjusted basis, be equivalent to all other stocks. If stocks do have finite elasticities, then it would appear that stocks are not necessarily correctly priced.

### 2.4.6 READING THE ENTRAILS

If markets discount all available information into share prices, we should then have a weighted average of investor opinion of the future. Brealey and Myers (1991:309) write that "if only we can learn to read the entrails, security prices can tell us a lot about the future".

The JSE used to be considered a leading indicator of general economic conditions (the JSE could reliably predict upswings and downswings nine months in advance, Kilalea 1990:53). However, in recent years, the JSE has failed to perform as a leading indicator. It is not alone. *Business Week* states that based on recent experience the NYSE is not a good forecaster (Pennar 1989:17). Paul Samuelson has been quoted as saying that the stock exchange has predicted "nine[12] of the last five recessions" (Pennar 1989:17). This change in the forecasting ability of the JSE has lead many people to doubt the value of the market (the JSE has been referred to as a "casino" (Kilalea 1990:56)).

It may be argued that the type of forecasting that the market does has changed. The market reacts to changes (specifically unexpected changes) in the economy and may buffer the real economy from the effects of a downturn.

> "In the real economy, for example, shaky [firms] would be driven into bankruptcy, forcing widespread lay-offs and possibly sparking a recession. But the stock market, by dealing investors ... a sobering blow in just one afternoon, may have fended off such travails much more quickly and at lower cost to the overall economy." (Pennar 1989:18)

The "scope and impact" of the market has changed from being one of a forecaster to being one of buffer. This, however, does not preclude the fact that a lot of information is contained in share prices. This information will be a

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[12] Brealey and Myers (1991: 309) have this as "seven of the last five recessions" and Kilalea (1990: 53) has it as "none of the last five recessions".

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