FILTER TESTS AND MARKET EFFICIENCY: SOME COMMENTS

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In a recent edition of this Journal, Nolan, Naphtali and Praetz[1] [7] reported the findings of an experiment which they conducted using Melbourne Stock Exchange share price data. The experiment, which was designed principally as a test of Australian capital market efficiency, is very similar to a number of earlier studies conducted in the U.S.A.[2] and entails an examination of the relative profitability of a simple trading rule, specifically, a filter rule.

The test methodology employed by the authors involves a comparison of the results which an investor could have attained by following a filter rule with those he could have attained by following a naive buy-and-hold strategy. The experiment was performed with ten well-known stocks[3] listed on the Melbourne Stock Exchange over the period 1958-1966. Twenty-nine filter sizes ranging from .5% to 50% were examined and the results obtained were reported both before and after transactions costs.

The findings of the tests closely paralleled those reported overseas. In general, the filters performed poorly, individually and collectively, both before and after transactions costs. They consistently produced returns below those obtained from a naive buy-and-hold strategy. The implication for investors is that it would be in their best interests to steer clear of filter rules in their endeavour to do well in the market. The authors conclude [7, p.22]:

> The evidence presented in this study is of a very broad kind, in that we cannot observe any general tendency for excess returns to be produced, i.e. as a first approximation to describing the market mechanism, **the efficient market model is not contradicted**[4].

The purpose of this paper is to argue that the authors' experiment is erroneously constructed, their conclusions on the efficient market model are ill-founded and that, in general, the results of their experiment are sterile, no really worthwhile conclusions being possible. Specifically this paper will argue that:

(a) the returns from filter rules and buy-and-hold strategies are non-comparable, each being attained under different risk conditions;

(b) transactions costs, whilst being relevant for calculating **some** investors' returns, are not universally relevant and, in particular, are not relevant to a test of market efficiency; and

(c) even if the experiment was without methodological faults, the authors misinterpret their results in terms of the efficient market model.

Since the experiment was conducted as a test of the efficiency of the Australian share market (or at least the Melbourne share market) before proceeding to the specific criticisms it seems appropriate to firstly consider the rationale behind the authors' tests.

Risk, Return and Market Efficiency

When investors purchase an asset (share) they do so in the expectation of earning a return from their investment. The magnitude of the return which they expect to earn directly depends upon the level of risk which they are prepared to bear. Specifically, the higher the level of risk borne by an investor, the higher his expected rate of return, and vice versa. A number of models have been developed which attempt to explain the real-world relationship between risk and expected return. The simplest and most successful of these posits a positive, linear risk-return tradeoff as shown in Figure 1.[5]

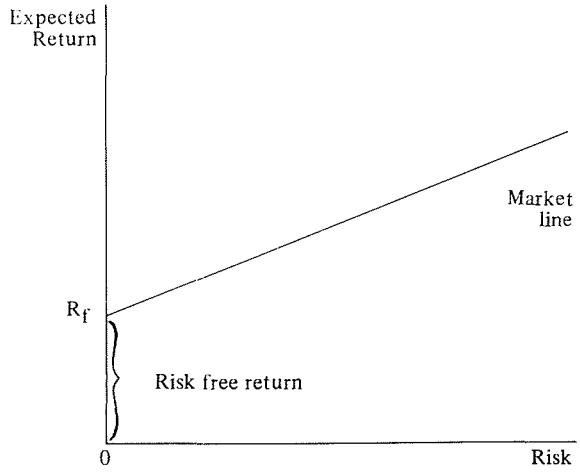

Figure 1
The Relationship Between Risk & Expected Return.

The model revealed by Figure 1 is known in the literature as the Capital Asset Pricing Model [CAPM]. Because the market line described in the model is linear, this implies that the premium per unit of risk (as indicated by the slope of the line) is constant, and thus the return which can be expected from any asset (share) depends upon the number of units of risk an investor is prepared to take. The more risk he runs, the higher his expected return, and vice versa. If he is totally risk averse, he still earns a positive return equal to the risk-free rate, R_f[6].

Empirical evidence both in the U.S.A. [6] and in Australia [2] confirms that the CAPM is a good description of real-world capital market behaviour. The evidence by Ball, Brown and Officer [3, p.74] produced from Melbourne Stock Exchange data confirms the model's usefulness in explaining risk-return relationships in this country. Results of their study are similar to those represented in Figure 2.

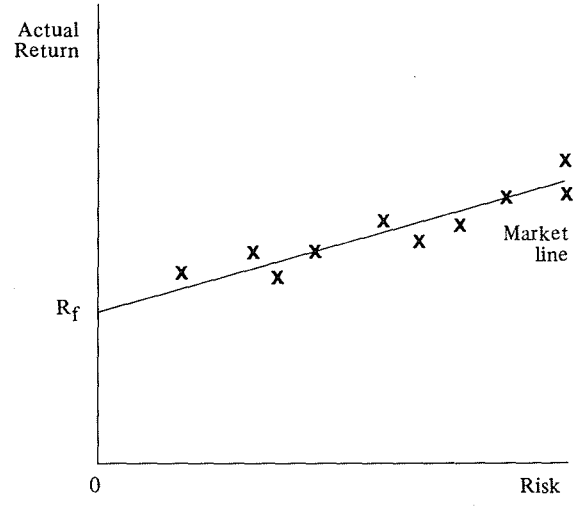

Figure 2
The Relationship Between Risk and Actual Return.

Notice that in Figure 2 real-world observations are designated by X's on the diagram and the market line is an ordinary least squares regression line of best fit of the observations. In terms of expectations, the CAPM asserts that all investments (as designated by the X's) would lie exactly on the line. However, empirically one would not expect this to be the case since expected returns can only be estimated or measured with error. Actual returns are used as a surrogate for expected returns and consequently it would not be expected that when plotted as in Figure 2, all the X's would form a perfect straight line. The deviation of the X's from the line can properly be construed as a measurement error rather than a model misspecification or a departure from the model's predictions. The tightness of the X's around the line indicates that the model seems to work well.

An efficient market is one in which security prices fully reflect all available information about individual securities in the market. If all known information about a particular security is reflected in its price, then price is an unbiased estimate of the value of that security. Available empirical evidence from overseas and Australia confirms that capital markets are semi-strongly efficient[7]; that is, security prices fully reflect all obviously publicly available information. Consequently, a model of such a market would deny the usefulness of a trading scheme which uses publicly available information, such as historical share prices. If such data has implications for security pricing then, in an efficient capital market, that information is already impounded in prices. To pursue a scheme or trading rule which employs publicly available information alone (for example, a filter rule), is doomed to failure as far as producing excess (or abnormal or monopoly) returns goes.

An investor earns an excess or monopoly return when he earns higher than the return expected in the market for the level of risk he runs. Consider Figure 3. If an investor acquires an asset B with x units of risk, his expected return in the market is R_1. If the market is efficient, it will price all securities having x units of risk so that they all fall at B on the market line and all yield returns of R_1. To earn an excess return, an investor who purchases an asset with x units of risk must somehow get to point A and thus earn a return of R_2. The difference between R_1 and R_2 is excess or monopoly return.

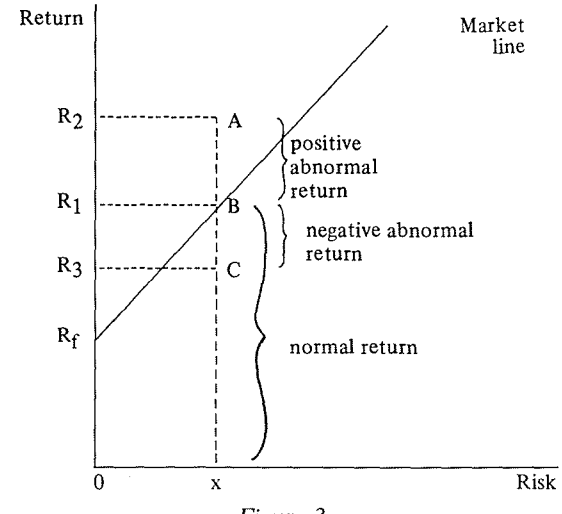

Figure 3
Abnormal Returns

An efficient capital market does not deny an investor access to point A. However, it does assert that point A will not be attained from the use of public information alone; for example, from using filter rules.[8] Consequently, one test of market efficiency is to examine trading rules such as filters

which solely utilize public information to see whether they produce returns consistent with points A, B or even C. Returns indicative of points A or C would provide evidence against the efficient market model, whilst returns at B would confirm the model. It is within this framework that NNP have attempted to construct their experiment. Some of the specifics of their methodology can now be analysed.

The Risk Control

Certainly the most damaging criticism which can be levelled at the experiment is the failure of the authors to adequately control for risk.[9] Their final analysis hinges upon a comparison of the returns obtained from filter strategies with returns obtained from a naive buy-and-hold [BH]. In terms of Figure 3, what NNP are attempting to do is to use the BH to measure R_1, against which specific filter returns can be compared. However, as the Figure clearly shows, the risk associated with the filter and the risk associated with the control or standard of comparison (in this case, the BH) **must** be identical. Unless the risk of the filter and the control are identical, returns can not be compared. The CAPM asserts, "different risks, different returns". It is far from obvious that the risk of a BH strategy and a filter are equal. A little reflection will reveal that they are not.

A BH strategy requires an investor to go long in a particular security for the duration of the test period. His return is the difference between the opening and closing prices of the stock adjusted for dividends received and any capital rearrangements (such as splits, bonus issues, new issues, etc.).[10]

A filter requires an investor to go long in the same stock when the market is rising, go short in the stock when prices are falling, and in some instances where short selling is not possible, to hold cash for the time between the generation of buy and sell signals. Since the short position is the negative of the long, if the long position is of positive risk then the short position must exhibit negative risk. In short, with a filter, the risk of the investment changes throughout the period of the test and consequently must differ from the risk of the BH. Since the risks of the two strategies differ, each must have a different expected return. Consequently, BH is not a valid control against which filter returns can be compared. It follows then, that the results reported by NNP as they stand are useless. In fact, judging from the authors' own conclusions and the inferences which readers might draw, they are misleading and as such, dangerous.

Transactions Costs

Notwithstanding the authors' failure to adequately control for risk, another aspect of their test is worthy of comment, and that is the role which transactions costs play in the analysis. Several observations can be made.

Firstly, it is far from clear just what relevance transactions costs have to a test of market efficiency. The efficient market model deals with the incorporation of information into the price structure – prices "fully reflecting" all available information. The model makes assertions about **price** behaviour but makes no predictions about price behaviour net of transactions costs. Whilst these costs may be relevant to some individual investors they are not relevant to a test of the efficient market model. In fact, if transactions costs account for or explain price behaviour, they provide evidence inconsistent with the model and consequently anomalous with the perfect capital markets assumption of the modern finance (investment) paradigm.

Secondly, it is questionable whether transactions costs are relevant to many market traders anyhow. Investors engage in portfolio rebalancing operations which are precipitated by other than the acquisition of new information. Consequently, the investor who is about to trade if confronted with a trading rule which yields excess returns will certainly employ it to his advantage with zero **marginal** trading costs; and portfolio rebalancing transactions are not uncommon. In addition, stock brokers face only trivial, near zero, trading costs. Any trading scheme generating excess returns would quickly be acted upon by them.

Clearly, many investors do face transactions costs which will reduce their returns. Studies which disclose these net returns are of interest to such investors, and in this regard the NNP paper makes a contribution. The point stressed here, however, is that whilst this may be so, transactions costs are misplaced in a test of market efficiency.

Interpretation of Results

Suppose that the methodology employed by NNP was free of error, and that the results contained no other biases. If this were the case then the reported returns would be a clear example of market **inefficiency**. The results from the filters are consistently and significantly below those produced from the BH control. In terms of Figure 3, the evidence would suggest the filters being consistent with investment C, yielding a negative abnormal return of $R_1 - R_3$. In other words, a naive strategy using only publicly available historical price data consistently produces less than the normal return for the level of risk involved. Such a situation is inconsistent with an efficient capital market. Yet NNP are able to conclude [7. p.22]:

> We have found no evidence to reject the efficient markets theory as there is no apparent tendency present for returns from the filter rule to systematically exceed returns from a buy-

and-hold (do nothing) strategy.

The error to which they allude is that the excess return produced by the filter must be positive to indicate market inefficiency. Figure 3 reveals that **any** abnormal returns, positive **or** negative, would provide evidence of market inefficiency.

Conclusions

In essence, NNP have provided the results of some filter tests which are interesting in their own right. For those readers who are tempted to engage in trading activities of this type they provide outcomes which should be enlightening. However, the principal purpose of the study was to provide a test of market efficiency and in pursuing this objective the study has failed badly. Because of a failure to adequately control for risk, NNP's filter and BH returns are non-comparable. The results are also unjustifiably clouded with transactions costs. In addition the authors have misinterpreted the results they did attain. In their present format the results are sterile and no implications can be drawn from them about the efficiency of the Australian capital market. The final paragraph of their paper, however, is worth reflecting upon.

FOOTNOTES

1. Hereafter NNP.
2. As reported in [5].
3. How these stocks were selected is not known. The very nature of the stocks may impart some bias into the results.
4. Emphasis added.
5. For a technical discussion of the model, see [2]. For a condensed non-technical version see [3] and [4].
6. The yield on a short-term government bond would be a good approximation to this rate.
7. For a review of this evidence see [5] and [8]. Both of these articles, however, are now dated. Much more evidence has appeared since their publication.
8. An investor could attain point A due solely to chance. The model would not deny this, but it does deny **consistent** access to point A from any investment scheme based only on public information. It asserts that consistent access to A can only be obtained via monopolistic access to information (such as inside information). It is the competitive pursuit of this type of information by investors which ensures market efficiency. If by chance a trading rule does produce excess returns, public disclosure of the rule will guarantee its demise. In an efficient market, prices also fully reflect any information contained in known trading rules.
9. For an excellent analysis of filter rules, their experimental design problems and interpretation, see Ball [1]. Points raised in this paper and other issues are discussed by Ball in depth.
10. The effects of transactions costs are discussed in the next section.

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