PORTFOLIO PERFORMANCE EVALUATION:

A STUDY OF UK UNIT TRUSTS

by

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ABSTRACT

Beginning with Jensen(1968), the evaluation of the investment performance of managed funds has been a major topic in Finance. This has not been without controversy, especially how the risk of the fund is to be measured. Evaluating portfolio performance has been closely associated with tests of market efficiency. Practically all of the theoretical and empirical studies have been conducted in the USA. The evaluation of fund performance in the UK has been limited.

This study seeks to examine a number of issues in performance measurement using a sample of UK unit trusts. The study is organised as follows. Chapter 1 presents an overview of the performance measurement literature. The chapter describes Grinblatt and Titman's(1989) framework which provides the theoretical underpinnings of the study. Chapter 2 reports the tests of the ex ante mean-variance efficiency of a number of benchmark portfolios which are used to evaluate performance. Chapter 3 examines the performance of a sample of UK unit trusts using the Jensen(1968) measure against a number of benchmark portfolios. The chapter also considers the empirical significance of the potential timing biases in the Jensen measure. Chapter 4 presents evidence of the selectivity and timing performance of the trusts. Chapter 5 investigates the factors which may affect trust performance. These include the investment objective,

size, expense ratios of the trusts. The final chapter presents the conclusions of the study.

CHAPTER ONE

PORTFOLIO PERFORMANCE EVALUATION

The evaluation of portfolio performance of managed funds is becoming more important through the years. Managed funds such as unit trusts, investment trusts and pension funds now invest billions of pounds on behalf of other people. The investment institutions account for a large share of the UK stock market. One of the functions of investment institutions is to attempt to achieve superior performance through the acquisition and correct use of superior information. It ought to be the case that investment institutions are likely to be more informed than the ordinary individual investor given their access to information and dominant position in the market place.

Given the significance of investment institutions in the economy, it is important that their performance be evaluated. Traditionally performance is usually measured by returns and a number of performance measurement services exist which calculate fund returns and construct league tables of performance for a wide range of unit trusts, pension funds etc. Past performance can be a major tool by fund managers to attract new clients to the fund. Investors in managed funds will want to know how their investment performance compares to possible alternative investments. Fund performance is also a major topic for finance academics given the close relationship between such tests and market efficiency. The drawback of only using returns to evaluate performance is that it fails to take explicit account of the risk of the fund. Performance measures have been derived from finance theory which take account of both the risk and return of the fund.

Modern portfolio performance evaluation stems from the development of the Capital Asset Pricing Model(CAPM) in the mid 1960s. The CAPM was derived independently by Sharpe(1964), Lintner(1965) and Mossin(1966) and sought to explain the pricing of risky assets under uncertainty in equilibrium. The CAPM framework provided the basis for the development of a number of performance measures by Treynor(1965), Sharpe(1966) and Jensen(1968). Of the three performance measures, the Jensen measure has been subject to the most controversy. Roll(1977), Dybvig and Ross(1985a,b) amongst others have questioned the validity of the Jensen performance measure as a measure of superior performance. These criticisms have to some extent been countered by Grinblatt and Titman(1989).

The Jensen measure of performance is the one most widely used in this study. There are two main reasons for this. Firstly, the Jensen measure is an absolute measure of the performance of a fund against a benchmark portfolio. Secondly, it is much easier to assess the statistical significance of the Jensen performance of a fund than the other two measures. This chapter describes the theoretical framework of Grinblatt and Titman(1989) which is the basis of this study and examines the conditions under which the Jensen measure provides appropriate inferences about a fund's performance. The chapter is organised as follows. Section I introduces the performance measures of Sharpe, Treynor and Jensen. Section II presents the general framework of performance evaluation proposed by Grinblatt and Titman(1989). Section III discusses the issue of an appropriate benchmark portfolio for the Jensen measure and the effect of using an mean-variance inefficient benchmark portfolio on the Jensen measure. Section IV examines the impact that asymmetric information between investors has on the Jensen measure. Section V considers the effect that binding investment constraints can have on the Jensen measure. The final section presents concluding comments.

I CAPM BASED PERFORMANCE MEASURES

The CAPM owes its origins to mean-variance portfolio theory developed by Markowitz(1952). It is assumed that there are a large number of investors in the economy, each investor choosing a portfolio of risky assets so as to maximise their expected utility and assumed to be solely interested in the mean and variance of returns on risky assets. A mean-variance efficient portfolio is a portfolio with the smallest variance for a given mean return. Portfolios that lie on the upper segment of the efficient frontier have the highest mean return for a given level of variance and this portion is referred to as the positively efficient frontier. Sufficient conditions for investors' to be mean-variance optimisers are that asset returns are jointly normally distributed or that investors have quadratic utility functions. The assumption of quadratic utility functions appears to be counter intuitive as it suggests that investors can reach a satiation point in their utility of wealth and begin to have negative marginal utilities of wealth beyond certain levels of wealth.

The model assumes a single time period. Investors are able to evaluate the first two moments of the probability distributions connected with different portfolios and have homogenous expectations of the means, variances and covariances of asset returns. Additionally the securities trade in frictionless markets i.e. there are no taxes, transaction costs, short sales restrictions and asset shares are divisible. In the Sharpe, Lintner and Mossin version of the CAPM, investors can borrow or lend at the riskless rate of return.

The CAPM states that in equilibrium, there is a linear relationship between the expected return of any security or portfolio and its systematic risk as measured by beta. This is known as the Security Market Line(SML) as:

$$E(R_i) = R_f + \beta_i[E(R_m) - R_f] \quad (1)$$

where $E(R_i)$ is the expected return on asset i, $E(R_m)$ is the expected return on the market portfolio, R_f is the rate of return on the riskless asset and β_i is the beta on asset i and is equal to $cov(R_i,R_m)/Var(R_m)$. Additionally the CAPM implies that every investor's optimal portfolio can be represented as a combination of the riskless asset and the market portfolio. A similar linear relationship exists in mean-standard deviation space between the risk and return of efficient portfolios as follows:

$$E(R_p) = R_f + [E(R_m) - R_f]\sigma_p/\sigma_m \qquad (2)$$

σ_p and σ_m are the standard deviation of returns on portfolio p and the market portfolio. This is known as the Capital Market Line(CML).

Performance measures were subsequently developed by Treynor(1965), Sharpe(1966) and Jensen(1968). The Sharpe measure of performance uses the CML as a benchmark and is calculated for fund i by $S_i = [E(R_i) - R_f]/\sigma_i$. The Sharpe measure gives the expected risk premium per unit of total risk borne by the fund. The Sharpe measure can be used for comparison against the market or for relative comparisons across different funds. The higher the value of the Sharpe measure the better the performance of the fund. The Treynor measure of performance gives the expected risk premium per unit of systematic risk borne by the fund. It is computed by the ratio $T_i = [E(R_i) - R_f]/\beta_i$. Treynor's measure can also be used for comparison across funds with different levels of systematic risk. Since the measures of Sharpe and Treynor are both ex ante measures, it is necessary to use ex post estimates when implementing them. A drawback of the Treynor and Sharpe measures is the unavailability of a small sample statistical test of the significance of the measures. Jobson and Korkie(1981) derive asymptotic distributions and test statistics for the Sharpe and Treynor measures. They report simulation evidence which suggests that the Sharpe test statistic is reasonably accurate in small samples but the Treynor measure is less so.

Jensen(1968) presents a performance measure which seeks to evaluate the ability of a fund manager at earning higher returns than those that one expected given the level of systematic risk borne by the portfolio, through successfully forecasting future security prices. The SML relationship is adopted as the benchmark. Jensen shows that when the CAPM and market model are valid, realised returns on any security or portfolio can be written in excess return form as:

$$R_{it} - R_{ft} = \beta_i (R_{mt} - R_{ft}) + e_{it} \qquad (3)$$

where R_{it}, R_{mt} and R_{ft} are the returns on asset i, the market portfolio and the riskless asset and e_{it} is a random disturbance term.

Jensen demonstrates that a portfolio manager who is able to successfully forecast security prices will be able to systematically choose securities with $e_{it} > 0$. The possibility of superior forecasting is allowed for in the analysis by adding a constant to the above regression as:

$$r_{it} = \alpha_i + \beta_i r_{mt} + u_{it} \qquad (4)$$

where $E(u_{it}) = 0$, $E(u_{it}, r_{mt}) = 0$, r_{it} and r_{mt} reflect excess returns on fund i and the market portfolio. Funds with positive α's are deemed to be superior performers as they have earned higher returns than the CAPM predicts. Funds with negative α's reflects inferior performance as they have earned lower returns than is expected.

The Jensen α provides a measure of a portfolio's performance against an absolute benchmark and cannot be used for comparisons across different funds unless additional restrictions are placed on preferences. One of the advantages of the Jensen measure is that the statistical significance of the α can be evaluated. If the disturbance terms in equation (4) are normally distributed with mean zero, constant variance and serially uncorrelated, then the significance of the α can be assessed by a 't' test. Under the null hypothesis of no performance ability, the 't' statistic has a student t distribution with (T-2) degrees of freedom where T is the number of time series observations.

II THE FRAMEWORK OF GRINBLATT AND TITMAN(1989)

Grinblatt and Titman(1989) present a general mean-variance framework within which to evaluate portfolio performance. The main advantage of their framework is that it abstracts from the necessity of assuming the validity of any given equilibrium model. The work of Grinblatt and Titman is the theoretical underpinning of this study. The model assumes that N risky assets trade in frictionless markets i.e. no transactions costs, taxes, short sales restrictions and that a riskless asset exists. The objective is to analyse the performance of an investor over T periods. Investors are assumed to be either uninformed or informed. Excess returns on the N risky assets are assumed to be independently and identically normally distributed (i.i.d.) and are computed from the perspective of an uninformed investor.

The uninformed investor is assumed to be a mean-variance optimiser. Given that it is possible to trade in N risky assets and a riskless asset exists, the uninformed investor will choose p as the optimal portfolio of risky assets to hold. With the assumption that excess returns are i.i.d., portfolio p will have constant weights with $E(r_{pt}) = E(r_p)$ and variance σ^2_p and this will not change through time. Given the efficiency of p, the excess return on an asset can be written as:

$$r_{jt} = \beta_j r_{pt} + \epsilon_{jt} \tag{5}$$

where r_{jt} is the excess return on asset j in period t, r_{pt} is the period t excess return on a portfolio of risky assets that is mean-variance efficient from the perspective of the uninformed observer with mean r^*_p and variance σ^2_p, $\beta_j = cov(r_{jt}, r_{pt})/\sigma^2_p$ and $E(\epsilon_{jt}) = 0$ since portfolio p is efficient. Similarly a portfolio's excess return can be written as:

$$r_{it} = \beta_{it} r_{pt} + \epsilon_{it} \tag{6}$$

with $\beta_{it} = \sum_{j=1}^{N} x_{jt}\beta_j$ and $\epsilon_{it} = \sum_{j=1}^{N} x_{jt}\epsilon_{jt}$ where x_{jt} are the portfolio weights of asset j at time t.

Grinblatt and Titman note that the stationarity assumption is necessary in order to distinguish between performance and changes in the parameters of the return generating process. They point out that given the stationarity assumption, this implies that the optimal portfolio of risky assets for the uninformed investor will have constant weights and that these weights and the portfolio beta will be independent of each realised r_{pt} and r_{jt}. The conditional (on information) excess return distribution will be nonstationary and informed investors will change the weights of the portfolio in response to information. The impact of informed investors on market clearing prices is assumed to be negligible. Another advantage of the stationarity assumption is that it makes it much easier to identify a candidate benchmark portfolio which is ex ante efficient.

Informed investors are assumed to have access to two types of information.

1) Selectivity information - information which helps the investor to forecast which individual securities will perform well relative to the benchmark portfolio and occurs when $E(\epsilon_{jt}/\Phi_t)$ does not equal 0 for any one asset j for at least one t, where Φ_t is the information set of the investor at time t.

2) Timing information - information which helps the investor to forecast future returns on the benchmark portfolio and arises when $E(r_{pt}/\Phi_t)$ does not equal r_p^* for at least one t.

Grinblatt and Titman present a decomposition of the large sample Jensen measure of performance as follows

$$\alpha_i = (\beta_i - b_i)r^*_p + \text{plim}[1/T\sum_{t=1}^{T}\beta_{it}(r_{pt} - r^*_p)] + \epsilon_i \qquad (7)$$

where b_i is the least squares slope coefficient on the excess return regression of the portfolio against the benchmark, β_i can be viewed as the target beta of the fund and is equivalent to the average dynamic beta β_{it} over the sample period and r^*_p is the probability limit of the sample mean excess return of portfolio p. The three components in the above equation are referred to as the bias in beta, timing and selectivity components respectively. Grinblatt and Titman show that when the investor has no timing information, b_i is a consistent estimator of β_i. Additionally Proposition 1 of Grinblatt and Titman states that α_i will exhibit zero performance for an uninformed investor. This latter point stems from the well known mathematical property of an efficient portfolio i.e. that individual Jensen measures will be zero when a portfolio is ex ante efficient. However our main question of interest is whether the Jensen measure can correctly identify superior performers within a mean-variance world. Subsequent sections of this chapter examines the conditions under which the Jensen measure will correctly identify superior performance.

III BENCHMARK EFFICIENCY

The Jensen performance measure was developed within a CAPM framework. Roll(1977,1978) presented a major critique of the testability of the CAPM and the use of the Jensen measure in performance evaluation. Merton(1972) and Roll(1977) have shown that portfolios which lie on the efficient frontier possess certain mathematical properties. Roll points out that these results hold ex ante and for any sample of observed returns provided the covariance matrix is non-singular and all risky assets do not have the same expected return. The most important property is that for every portfolio p that lies on the efficient frontier, there is an exact linear relationship between the mean return vector and beta vector of individual assets. This can be written as :

$$R = r_{zp}e + (R_p - r_{zp})\beta \qquad (8)$$

where r_{zp} is the return on the portfolio that is uncorrelated with p, R is a (N*1) expected return vector of the N individual assets and β is a (N*1) vector of betas of the individual assets computed against portfolio p.

Roll(1977) and Ross(1977) have demonstrated the equivalence between the CAPM and the market portfolio being ex ante mean-variance efficient. Roll argued that the only testable implication of the CAPM is that the market portfolio is ex ante efficient. This is because the other properties of the CAPM e.g. beta/return linearity relationship follow from the mathematics of the efficient set. Additionally these properties are true of all efficient portfolios. As a result, the composition of the market portfolio has to be known before a proper test of the CAPM can be conducted. The corollary of this according to Roll is that since the market portfolio is unobservable the theory is untestable. Given that the theory is untestable, the use of the CAPM framework to evaluate portfolio performance is questionable since we don't know if the model is an appropriate description of reality. This point is not unique to the CAPM and is generally true of any equilibrium model which seeks to explain the pricing of risky assets under uncertainty, (see Cornell(1979)). The CAPM is not the only equilibrium model whose testability has been questioned. Shanken(1982) has questioned the testability of the Arbitrage Pricing Theory(APT).

Researchers have tried to overcome Roll's criticism by using proxies of the market portfolio. Roll points out that this approach raises two problems. The first is that the proxy used may be mean-variance efficient when the market portfolio is not. The second is that even if the proxy is inefficient, this implies nothing about the efficiency of the market portfolio. Shanken(1987) and Kandel and Stambaugh(1987) present a method of testing the

CAPM when the market portfolio is unobservable. This requires the assumption of a prior belief that the proxy and market portfolio are ex ante correlated at a certain level.

Roll(1978) took issue with the interpretation that deviations from the SML are reflective of a manager's forecasting ability. Roll contended otherwise and argued that deviations from the SML are simply a reflection of the proxy's inefficiency. If the proxy used is ex post efficient, all securities and portfolios will lie on the SML. Every managed fund's Jensen measure gross of expenses will be zero. When the proxy is ex ante efficient, there can be deviations from the ex post SML but these will be statistically insignificant and will disappear in large samples if the underlying distribution is stationary. Mayers and Rice(1979) criticise Roll for failing to allow for superior performance stemming from superior information in his analysis. When this is allowed SML deviations can also occur because of superior performance.

Perhaps the most serious issue in Roll's work for performance evaluation is the sensitivity of SML deviations to the choice of proxy for the market portfolio. Roll shows that for any inefficient proxy, it is possible to find another inefficient proxy that will reverse the rankings of the first proxy. An example will help clarify this. Consider an inefficient index A which is used to evaluate K managed funds. Define α_A as a (K*1) vector of individual Jensen measures of the K Funds. Roll demonstrates that it is possible to choose another inefficient index B so that:

$$\alpha_B = -d\alpha_A$$

where α_B is a (K*1) vector of Jensen measures of the K funds using index B and d is a scalar. This result means that index B will assign each Kth fund an opposite sign to the Jensen measure to that of index A. It is important to note that this result is derived in the absence of a riskless asset and it assumes that the number of funds evaluated is greater than the number of risky assets.

Grinblatt and Titman have addressed the question of an appropriate benchmark portfolio. A suitable benchmark portfolio is one that is ex ante mean-variance efficient with respect to the set of assets considered tradable by investors. This is because it is the optimal portfolio of risky assets for the uninformed investor to hold. This provides a way round Roll's critique of the unobservability of the market portfolio in the CAPM in that the benchmark portfolio need only be efficient with respect to the N tradable assets and not all assets. Grinblatt and Titman stress that it is the mathematical properties of the efficient benchmark portfolio which enables valid inferences to be drawn over fund performance.

It is worthwhile to consider the effect of using an inefficient benchmark portfolio on the Jensen measure. Dybvig and Ross(1985b) and Green(1986) examine in considerable detail the impact of benchmark inefficiency. The main questions addressed are:

1) What is the relationship between proxy inefficiency and deviations from the SML?

2) The differences between SML deviations of inefficient proxies.

Both papers consider the theoretical situation where the market participants share the same expectations of the expected return vector R and covariance matrix V. Ex post statistical problems are ignored. For every portfolio p that is used as a proxy, there will be a corresponding portfolio that is uncorrelated with p and has rate of return r_{zp}. Dybvig and Ross point out that unless p is efficient, r_{zp} will be arbitrarily chosen because all of the portfolios that are uncorrelated with p do not share the same expected return (Roll(1980) discusses this in detail).

Whenever p lies off the efficient frontier, the deviation from the SML of any asset i can be written as:

$$\alpha_{ip} = E(R_i) - r_{zp} - \beta_i(E(R_p) - r_{zp}) \qquad (9)$$

where $E(R_i)$ is the expected return on asset i, $E(R_p)$ is the expected return on portfolio p and β_i is the beta of asset i. One of the main results of Dybvig and Ross is Theorem 1 which states that if:

$$(E(R_i) - r_{zp})/\sigma_i > (E(R_p) - r_{zp})/\sigma_p > 0$$

then α_{ip} will plot above the SML of proxy p, where σ_i and σ_p are the standard deviations of returns on asset i and portfolio p. When the inequalities are reversed, α_{ip} plots below the SML. A corollary of Theorem 1 is that if $E(R_i) > E(R_p) > r_{zp}$ and $\sigma_i < \sigma_p$ then $\alpha_{ip} > 0$ and if $E(R_i) < E(R_p) < r_{zp}$ and $\sigma_i < \sigma_p$ then $\alpha_{ip} < 0$. This simply means that when excess returns on the proxy are positive and asset i has a better Sharpe performance measure than p then α_{ip} is positive. When excess returns on the proxy are negative and asset i has a worse Sharpe measure then α_{ip} is negative. It is important to note that if a positive α_{ip} is observed it cannot be inferred, in the situation where all investors share the same expectations, that asset i necessarily has a better Sharpe performance measure.

Green identifies the reasons why deviations occur from the SML when an inefficient proxy is used. When proxy p is inefficient, there will be a corresponding portfolio Θ on the efficient frontier with the same expected return as p. Since portfolio Θ is efficient, there will be a unique zero-beta portfolio with return $r_{z\Theta}$ associated with Θ. Green shows that:

$$\alpha_{ip} = (r_{z\Theta} - r_{zp})(1 - \beta_{ip}) + (E(R_\Theta) - r_{z\Theta})(\beta_{i\Theta} - \beta_{ip}) \quad (10)$$

where β_{ip} and $\beta_{i\Theta}$ are the betas of asset i computed with respect to portfolios p and Θ. SML deviations occur for two reasons. These are the misspecification of the zero-beta return and errors in the estimated beta from using an inefficient proxy. When a riskless asset exists, SML deviations occur because of incorrect betas.

Dybvig and Ross and Green proceed to demonstrate the relationship of an asset's position in mean-variance space and SML deviations. Dybvig and Ross concentrate on three areas of portfolio space (the space of all portfolios where the investment weights of the portfolio sum to one):

1) The global efficient frontier given R and V called G^* where G is the mean-variance space which G^* is a boundary to.

2) The mean-variance space of all portfolios that lie on the SML of proxy p termed F.

3) The efficient frontier with respect to F denoted F^*.

Theorem 2 of Dybvig and Ross notes that F^* and G^* will either be tangential at a single point or will never intersect. F^* and G^* will only meet if there is a portfolio on the SML of proxy p which also lies on the global efficient frontier G^*. An additional result is that portfolios which lie within a given region between F^* and G^* will all lie on the same side of the SML. Whether they lie above or below the SML depends upon which side of the SML the corresponding portfolios on G^* within that region lie.

Dybvig and Ross demonstrate (ignoring the impact of asymmetric information) that the usefulness of the Jensen measure in performance evaluation rests on the existence of a riskless asset. Within the Dybvig and Ross framework, the objective for the uninformed observer is to consider whether or not the portfolio manager chooses a portfolio on the positively efficient frontier. When a riskless asset exists, the entire positive efficient frontier lies above F^*. This implies that all the points of G^* have higher Sharpe performance measures than proxy p and so all efficient portfolios will have positive deviations from the SML from Theorem 1 of Dybvig and Ross.

Although efficient portfolios will have positive Jensen measure, inefficient portfolios relative to G^* can also have positive deviations from the SML because of higher Sharpe performance measures. This means that we cannot tell whether positive Jensen performance signifies good performance by the manager. The main conclusion is that negative deviations from the SML rules out the possibility of superior performance. In the absence of a riskless asset, Dybvig and Ross argue that the relationship between efficiency and SML deviations breaks down. This is because the entire positive efficient frontier may no longer lie above the line through r_{zp} and p. Thus Theorem 1 can no longer be used to justify all portfolios on the positive efficient frontier plotting above the SML. Efficient and inefficient portfolios can either plot above or below the SML.

A related question to the above discussion is the sensitivity of SML deviations to different inefficient proxies. This largely stems from Roll(1978) showing that it is possible to find two inefficient proxies that assign each portfolio an opposite sign to one another. Green analyses why two inefficient proxies may give the same asset a different α. Consider two inefficient proxies p and q with expected returns $E(R_p)$, $E(R_q)$ and corresponding zero-beta returns r_{zp} and r_{zq} and both are used to evaluate asset i. Green shows that the change in deviation between two proxies can be written as:

$$\alpha_{iq} - \alpha_{ip} = (r_{zp} - r_{zq}) + (\lambda_p - \lambda_q)\sigma_{ip} + \lambda_q(\sigma_{ip} - \sigma_{iq}) \quad (11)$$

where $\lambda_q = (E(R_q) - r_{zq})/\sigma^2_q$, σ_{ip} and σ_{iq} are the covariances between asset i and proxies p and q respectively. The second term can be rewritten as:

$$(\lambda_p-\lambda_q)\sigma_{ip}=(\sigma_{ip}/\sigma^2_q)[\lambda_p(\sigma^2_q-\sigma^2_p)+(E(R_p)-E(R_q))+(r_{zq}r_{zp})] \quad (12)$$

Green bounds the third term in (11) as:

$$\lambda_q(\sigma_{ip} - \sigma_{iq}) = \lambda_q\sigma_i[\sigma_p\sigma_q\{(\sigma_p/\sigma_q) + (\sigma_q/\sigma_p) - 2\rho_{pq}\}]^{1/2} \quad (13)$$

where ρ_{pq} is the correlation between the proxies p and q.

Green's decomposition suggests three reasons why deviations differ. These are unequal zero-beta returns, λ_p does not equal λ_q (i.e. different market price of risk of each proxy) and the proxies are imperfectly correlated. Green points out that when the proxies are close in mean and variance and the zero-beta returns are similar, the first two terms in equation (11) will approach zero. As the proxies near a correlation of 1 the third term will also tend to zero. Due to this, proxies that are close in mean-variance space and highly correlated should produce similar deviations. However the second term in (11) is proportional to σ_{ip} and from equation (13) the third term is proportional to σ_i. Green notes that this suggests that deviations between proxies are most likely to differ for those assets with extreme betas or high standard deviations. Green also shows that even if the proxies are close in mean and variance, this does not necessarily imply they are highly correlated.

Green's work clarifies the relationship between deviations of different proxies. However is it possible for two proxies to reverse each other's rankings? Dybvig and Ross show that if a riskless asset exists or when G^* and F^* intersect at the global minimum variance portfolio, there can be no reversals. Dybvig and Ross proceed to alter Roll's(1978) analysis to allow for affine reversals i.e. linear plus a constant.

Green extends the results of reversals to situations where the proxies are close in mean-variance space. Theorem 3 of Green states that for any inefficient proxy p with a return greater than the global minimum variance return, there exists two portfolios q and s with the same mean as p and arbitrarily close in variance and zero-beta returns and λ_q and $\lambda_s > 0$ such that for any assets u and v, $\alpha_{uq} - \alpha_{vq} = -(\alpha_{us} - \alpha_{vs})$. This can occur when $\lambda_p = \lambda_\Theta$.

The work of Green and Dybvig and Ross shows that the impact of proxy inefficiency is important in performance analysis. However if a riskless asset exists, then some of the difficulties will be minimised, not least that reversals in rankings will not be possible. Additionally even when the proxy is inefficient, Dybvig and Ross demonstrate a positive use of SML analysis. The essence of this is that the sign of the α provides a means of improving the mean-variance position of the benchmark portfolio. Consider an investor who holds the proxy portfolio p and is evaluating a managed fund i. The sign of α_{ip} is useful provided that $E(R_p) > r_{zp}$. When $\alpha_{ip} > 0$, the investor can move to a mean-variance superior portfolio position by buying i and selling p with the balance put in r_{zp} to keep the same expected return of p. When $\alpha_{ip} < 0$, the reverse occurs by buying more of p and short selling i. Under this interpretation, a positive Jensen measure of any fund signifies that an uninformed investor who holds the benchmark portfolio can improve his mean-variance position by buying some of fund i. Dybvig and Ross point out that this result says nothing about the investor moving totally from proxy p to fund i. Jobson and Korkie(1984) have extended this result to provide a procedure of ranking trusts to decide which is the best one to add to the existing portfolio.

IV ASYMMETRIC INFORMATION

The discussion in the previous section concentrated on the effect of benchmark inefficiency on the Jensen measure. This generally assumes that SML deviations arise only because of inefficiencies in the proxy. To allow SML deviations to occur because of superior performance the analysis has been extended to allow investors to possess different information sets. Mayers and Rice(1979) provided one of the first major works along these lines. Their analysis was really a response to Roll(1977,1978) and sought to demonstrate the validity of SML analysis. Superior performance is defined as arising from the possession and correct use of superior information. As shown in Section II, superior information can arise from two sources i.e. selectivity and timing information. This distinction between the sources of information turns out to be critical from a theoretical perspective about the validity of the Jensen measure.

Allowing asymmetric information in the analysis is difficult as most equilibrium models assume that all investors have homogenous expectations. This is usually overcome by assuming that informed investors have zero weight in the economy i.e. have no impact on equilibrium price determination. This assumption is made in most performance studies. Cornell points out the conceptual difficulties in assuming that informed investors have zero weight in the economy. Over time informed investors will accumulate wealth at a faster rate than uninformed investors and hence occupy a growing share of the market. Additionally if informed investors can be identified through SML analysis then rational investors may begin to transfer their funds to such investors and the zero-weight assumption becomes less tenable.

To illustrate what can go wrong when we move to a situation where investors have asymmetric information, Dybvig and Ross(1985a) present an example where the Jensen measure assigns a positive market timer with negative performance. It is assumed that there are only two assets: a riskless asset and a risky portfolio. The riskless asset has a return r and the returns on the risky asset x are generated by

$$x = r + \pi + s + \epsilon \qquad (14)$$

where π is the risk premium, s is the information signal that the manager receives and ϵ is the unobserved noise. It is assumed that s and ϵ are uncorrelated with zero means and variances $\sigma^2_s > 0$ and $\sigma^2_\epsilon > 0$. A simplifying assumption is made that r = 0.

The manager's task in the model is to allocate funds between the riskless asset and risky portfolio. Dybvig and Ross assume that the manager is seeking to maximise the expected utility of an exponential utility investor ($U(W) = -e^{-Aw}$ for some $A > 0$). They show that the optimal choice given the information signal s to invest in the risky portfolio is

$$\gamma(s) = (\pi + s)/\sigma^2_\epsilon A \qquad (15)$$

Abnormal returns using SML analysis on such a portfolio are:

$$\alpha_\gamma = E(\gamma(s)x) - r - \beta_\gamma(w(s)x) - r) \qquad (16)$$

where $\beta_\gamma = cov(w(s)x,\gamma(s)x)/var(w(s)x)$

w(s) - is the benchmark portfolio used to evaluate the manager and is the proportion of the index invested in risky assets. It is assumed that w(s) is known by the observer and is independent of s.

Dybvig and Ross show that the abnormal returns of the manager as seen by the observer can be written as:

$$\alpha_\gamma = \{\sigma^2_s[(\sigma^2_\epsilon + \sigma^2_s) - \pi^2]\}/\sigma^2_\epsilon A(\sigma^2_s + \sigma^2_\epsilon) \qquad (17)$$

This can be negative if $\pi^2 > (\sigma^2_\epsilon + \sigma^2_s)$ and σ^2_s, σ^2_ϵ are both greater than zero. Additionally, the manager can appear to the observer to be mean-variance inefficient as well, since from the perspective of the observer the managed portfolio return has a higher variance than a market portfolio with the same mean. Why does this arise? The reason is that the manager's portfolio no longer has normally distributed returns even although the underlying asset returns are normal. The portfolio returns include the product of portfolio choice dependent on information and asset returns which can be skewed to the right and thus are outwith the domain of mean-variance analysis. The crux of the matter is that the observer only has access to portfolio returns and is unaware of either the manager's information set and portfolio choice. Elton and Gruber(1991) have suggested a possible solution to overcome this difficulty where the observer does have information about the manager's portfolio weights. Also Kane and Marks(1988) found that the timing biases of the Sharpe performance measure becomes less important if more frequent observations are used to estimate the Sharpe measures.

Dybvig and Ross present a general model of mean-variance analysis and asymmetric information and develop conditions under which SML analysis is valid. This builds on the work of Mayers and Rice(1979) and relaxes many of their assumptions. It is assumed that an uninformed investor is seeking to evaluate the ability of an investment manager using SML analysis. All investors are assumed to have rational expectations. Agency problems between the portfolio manager and agent are ignored. Using the notation of Mayers and Rice, each period the informed investor receives any one of L messages s=1,....L and the investor's beliefs are given by the vector:

$$\pi^{Is} = (\pi^{Is}_{1},.....,\pi^{Is}_{N}) \qquad \sum_{j=1}^{N}\pi^{Is}_{j} = 1$$

which represent the probabilities assigned by the informed investor given message s to the N possible states of the world j=1,....N at the end of the period.

The informed investor is assumed to choose an efficient portfolio conditional on the information available. Uninformed investors will hold unconditional beliefs as:

$$\pi_{U} = (\pi^{U}_{1},......,\pi^{U}_{N}) \qquad \sum_{j=1}^{N}\pi^{U}_{j} = 1.$$

This is assumed to be stationary over time. Message s is defined by:

$$\nu^{s} = \pi^{I}_{s} - \pi^{u} \quad \sum_{j=1}^{N}\nu_{j}^{s} = 0$$

which is the change in the probability assessment that arises from the receipt of message s. The probability distribution of the receipt of the various messages is given by the vector:

$$q = (q_1, \ldots\ldots, q_l) \qquad \sum_{s=1}^{L} q_s = 1$$

Mayers and Rice assume that for any s

$$\nu_s \neq 0$$

Mayers and Rice argue that the rational expectations assumption holds only if:

$$\sum_{s=1,j=1}^{L\ N} q_s \nu_j^s = 0 \text{ for every S}$$

The assumption also implies that:

$$\pi_{uj} = \sum_{s=1}^{L} q_i \pi_j^{Is}$$

This implies that the uninformed expectations for a given state of the world are a weighted average of informed investor's expectations across information states. This is required as otherwise uninformed investors would change their probability assessments.

Define $\gamma(s)$ as an (N*1) vector of investment weights in the N risky assets which are assumed to sum to one and x as the random vector of asset returns. Given the receipt of message s, the informed investor's expectation of the mean and covariance matrix of returns are denoted by $\mu(s)$ and V(s). Dybvig and Ross show that the observer's perception of mean returns and covariance matrix are $E(x) = E_s[\mu(s)]$ and

$cov(x,x) = V + \Omega$ where

$$V = E_s V(s)$$

$$\Omega = E_s[(\mu(s) - E_s(\mu(s))(\mu(s) - E_s(\mu(s))'].$$

Dybvig and Ross point out that on average, the uninformed observer perceives asset returns to be more variable than the informed investor. The observer's expected covariance matrix consists of the average conditional covariance matrix V and the covariance of the conditional mean returns Ω.

Dybvig and Ross derive formulae for the means and covariances of returns with portfolios with weights which are independent of information and those which are not. Portfolios α_1 and α_2 with weights which are fixed will have a mean return $\alpha_1\mu$ and $\alpha_2\mu$, where $\mu = E_s(\mu(s))$ and covariance of $\alpha_1(V + \Omega)\alpha_2$. Portfolios $\gamma(s)$ and $\eta(s)$ whose weights are conditional on information will have the following mean and covariance of returns:

$$E(\gamma(s)x) = E_s(\gamma(s)\mu(s))$$

$$cov(\gamma(s)x,\eta(s)x)=E_s(\gamma(s)V(s)\eta(s))+cov(\gamma(s)\mu(s),\eta(s)\mu(s))$$

Dybvig and Ross show that the Jensen performance measure of the portfolio $\gamma(s)$ as viewed by the observer is:

$$\delta_\gamma = E(\gamma(s)x) - r - \beta_\gamma(E(\alpha(s)x) - r) \quad (18)$$

where $\beta_\gamma = cov(\alpha(s)x,\gamma(s)x)/var(\alpha(s)x)$. It is assumed that the index portfolio α will have weights which are independent of information. The Jensen measure conditional on the manager's information is given by:

$$\delta_{\gamma}(s) = \gamma(s)\mu(s) - r - \beta_{\gamma}(s)[\alpha(s)\mu(s) - r] \qquad (19)$$

where $\beta_{\gamma}(s) = \alpha(s)V(s)\gamma(s)/\alpha(s)V(s)\alpha(s)$.

Theorem 1 of Dybvig and Ross states that when a riskless asset exists, if portfolio $\gamma(s)$ is chosen so as to lie on the positively efficient frontier conditional on information then the conditional Jensen measure will be greater than or equal to zero. The measure will be zero when the benchmark portfolio lies on the conditional efficient frontier. Dybvig and Ross point out that if the observer's unconditional Jensen measure of the manager's portfolio is a simple average across the different information states i.e. $\delta_{\gamma} = E(\delta_{\gamma}(s))$ then it to will be greater than or equal to zero. However it is noted that difficulties may arise when δ_{γ} does *not* equal $E(\delta_{\gamma}(s))$.

Dybvig and Ross examine situations where $\delta_{\gamma} = E(\delta_{\gamma}(s))$. One case is when the manager's information does not help to predict the future mean and variance of return of the benchmark portfolio i.e. has no market timing information. Mayers and Rice demonstrated that when this is the case, an informed investor will plot above the observer's SML on average. Theorem 2 of Dybvig and Ross generalises this result under less restrictive assumptions than those made by Mayers and Rice. It states that if:

a) a riskless asset exists;

b) in each information state s the manager chooses an efficient portfolio conditional on information;

c) the manager has no information about the return and

c) the manager has no information about the return and variance of the proxy used; and

d) rational expectations;

The unconditional Jensen measure will be greater than or equal to zero, with equality only if the proxy lies on the conditional efficient frontier across all information states.

Assumptions a), b) and d) ensures that Theorem 1 holds and assumption c) also ensures that $\delta_\gamma = E(\delta_\gamma(s))$. Dybvig and Ross point out that an informed investor will always plot above the SML as long as c) is true even if the index portfolio is inefficient. However if the index portfolio is inefficient, then as shown in Dybvig and Ross(1985b) inefficient portfolios could also plot above the SML.

The analysis of Dybvig and Ross, extended by Grinblatt and Titman(1989) to a more general situation effectively implies that two separate efficient frontiers are assessed by informed and uninformed investors respectively. Grinblatt(1986/87) provides an intuitive explanation of the model. There are a large number of uninformed investors who hold homogenous expectations of means, variances and covariances of returns. There will be a small group of informed investors with different expectations whose efficient frontier will lie outside the efficient frontier assessed by uninformed investors.

With a riskless asset, portfolios p and m will be the optimal portfolios chosen by the informed and uninformed investor respectively. Since the Sharpe performance measure of p is greater that m, then we know from the work of Dybvig and Ross(1985a,b), that the Jensen measure of p computed using m as an index will be positive. When an inefficient proxy is used relative to the unconditional (on information) efficient frontier, then inefficient portfolios can also register positive Jensen performance. This highlights the importance of finding a benchmark portfolio that lies on the unconditional efficient frontier. The work of Dybvig and Ross is extremely important as it allows SML deviations to be reflective of superior information.

Grinblatt and Titman address the issue of the market timing biases in the Jensen measure. They provide an example of what can go wrong whenever the manager only has access to timing information. Assume that the investor's beta response function increases monotonically as the timing information becomes more favourable and is symmetric about the fund's target beta i.e. $\beta_i = \beta_{iT} + f(m)$, where β_{iT} is the target beta of the fund and m is the timing signal observed by the manager. It is shown that the large sample OLS estimate of beta is:

$$b_i = \beta_{iT} + (r_p^{*}/\sigma^2_p)(cov(\beta_i, r_p)$$

The corresponding estimate of the Jensen measure is $(1-r^{2*}_p/\sigma^2_p)cov(\beta_p, r_p)$. Whenever the investor acts correctly on timing information, β_{iT} is overestimated. The Jensen

Sharpe ratio on the benchmark portfolio is greater than one. If the investor perversely times the market then β_{iT} is underestimated and the Jensen measure can be positive if $r_p^* > \sigma_p$.

Further insight into the potential difficulties of the Jensen measure are given by Grinblatt and Titman in that they show that the Jensen measure is equivalent to a period weighting measure. A period weighting measure is simply a weighted sum of each period's portfolio excess returns i.e.

$$\alpha^* = \sum_{t=1}^{T} w_t r_{it}$$

where the weights are estimated to satisfy two conditions.

1) $\text{plim} \sum_{t=1}^{T} w_t r_{pt} = 0$

2) $\sum_{t=1}^{T} w_t = 1$

It is demonstrated that the weights of the Jensen measure are equal to:

$$w_t = [\sigma^2_p - (r_{pt} - r_p^*) r_p^*]/T\sigma^2_p$$

where σ^2_p is the sample variance of r_{pt} and r_p^* is the sample mean. Whenever r_{pt} is high, the weights can be negative and if the investor is a successful market timer, he could multiply negative weights with high returns and so reduce the Jensen measure.

Grinblatt and Titman suggest that by imposing the condition that $w_t > 0$, then this can be overcome. Proposition 2 demonstrates that in large samples the positive period weighting measure will be zero for an uninformed investor. For an informed investor with only selectivity information the measure will be positive. It will also be positive if $\delta\beta_i/\delta m > 0$ and the investor has independent timing and selectivity information. If the signals are correlated, then the results will hold when additional restrictions are placed on preferences e.g. constant absolute risk aversion.

The intuition behind the Grinblatt and Titman performance measure is that the weights can be viewed as marginal utilities. The condition $\sum_{t=1}^{T} w_t r_{pt} = 0$ is the first order condition for maximising the expected utility of the uninformed investor. The period weighting measure gives the marginal change in utility to an uninformed investor by adding some of the managed portfolio to the existing portfolio. If the measure is positive, then the investor will wish to add some of the evaluated portfolio to his initial portfolio. Grinblatt and Titman point out that the weights in the Jensen measure can be viewed as the marginal utilities of a quadratic utility investor. These can be negative because of negative marginal utilities at levels of wealth beyond the satiation point of such an investor.

A corollary that arises from Proposition 2 is that the Jensen measure will be positive when the investor has only selectivity information. The extension to the work by Mayers and Rice(1979) and Dybvig and Ross(1985b) is that the Jensen measure can be positive when the informed investor is not a mean-variance optimiser as the analysis allows for the possibility of nontradable assets.

The analysis of Dybvig and Ross and Grinblatt and Titman demonstrates that the Jensen performance measure can provide correct inferences about an investor's performance in a mean-variance world provided that an efficient benchmark portfolio is used and the investor only has access to selectivity information. A subsequent chapter will show that the timing biases in the Jensen measure are minimal from an empirical perspective. When an inefficient benchmark portfolio is used, the interpretation of positive Jensen performance will be ambiguous because inefficient portfolios can also exhibit positive performance.

V CONSTRAINTS ON INVESTMENTS

There is one further issue worth considering about the use of the Jensen measure in performance evaluation. This relates to the situation where investors face constraints on the investments that they can make. Best and Grauer(1990) and Grauer(1991) examine this in detail and show that when this arises deviations from the SML can occur not only because of proxy inefficiency or superior information but also due to binding constraints on investors.

Best and Grauer(1990) present a general framework of the mathematics of the efficient set when linear constraints are imposed on investors. The formulation of the mean-variance problem subject to linear constraints in the absence of a riskless asset is written as:

$$\text{Max } \{tR'X - (1/2)X'VX \;/\; AX < \text{ or } = b) \qquad (20)$$

where X is a (N*1) vector of investment weights in the portfolio, b is a m-vector representing the coefficients on the right hand side of the equation of the mth constraint, A is a (m*N) constraint matrix, t is the variable which varies to trace out the efficient frontier. Grauer gives t a number of possible interpretations e.g. an investor's risk tolerance parameter. Best and Grauer show that the optimality conditions solve the following equations as:

$$\begin{bmatrix} V & A_i' \\ A_i & 0 \end{bmatrix} \begin{bmatrix} x_i(t) \\ \lambda_i(t) \end{bmatrix} = \begin{bmatrix} 0 \\ b_i \end{bmatrix} + t\begin{bmatrix} R \\ 0 \end{bmatrix}$$

where A_i is a (k*N) matrix when the investor is only subject to k active constraints of the m constraints where the k rows are the relevant rows from the A matrix, b_i is a k-vector associated with the k constraints, $x_i(t)$ is the optimal portfolio of investment weights for a given t, $\lambda_i(t)$ are the multipliers.

Grauer considers the situation where the investor faces k constraints where the first constraint is the usual one that portfolio weights sum to one i.e. X'e = 1 (a_1 = e and b_1 = 1). Grauer writes the optimality conditions as:

$$R = (\lambda_1/t)e + (1/t)VX + \sum_{j=2}^{k}(\lambda_j/t)a_j \text{ or}$$

$$R = (\lambda_1/t)e + (R_p - \sum_{j=1}^{k}(\lambda_j/t)b_j)\beta + \sum_{j=2}^{k}(\lambda_j/t)a_j$$

where $\beta = VX/\sigma^2_p$ and $\lambda_1/t = r_{zp}$. These equations show that the expected return vector plots on a hyperplane spanned by β and the gradients of k constraints with weights λ_j and t. The deviations from the SML are a function of the third term in the above equations. When X'e = 1 is the only constraint, Best and Grauer derive the familiar SML:

$$R = (\lambda_1/t)e + (R_p - \sum_{j=1}^{k}(\lambda_j/t)b_j)\beta \quad \text{or}$$

$$R = r_{zp} + (R_p - r_{zp})\beta.$$

Grauer points out that all securities will only lie on the SML if X'e is the binding constraint. Any security and portfolio that faces extra constraints will plot off the line. Additionally, this applies to the proxy portfolio itself and will only lie on the SML if $b_j = 0$, j=2,...k. This analysis is important because it shows why it is necessary to assume that investors trade in frictionless markets. If they do not, then the Jensen performance measure may simply reflect the fact that investors face binding constraints.

SUMMARY AND CONCLUSIONS

This chapter has considered in great detail the main issues in portfolio performance evaluation. The theoretical framework of Grinblatt and Titman is the underpinning of this study. The model's main advantage is that it abstracts from the necessity of assuming an equilibrium model of asset returns. The use of an equilibrium framework to evaluate portfolio performance will suffer from Cornell's point in that before valid inferences can be drawn, the evaluator needs to know if the model is true or not. The testing of equilibrium models has been the subject of much controversy in the literature.

The key assumptions in the analysis are that a riskless asset exists, the unconditional ex ante efficiency of the benchmarks and there are no binding constraints upon investors. Given this, it is possible to assign informed investors with positive performance. When the Jensen measure is subject to timing biases, the PPW measures can be used. Perhaps the critical assumption is the existence of a riskless asset. When a riskless asset exists, some of the drawbacks of using an inefficient benchmark portfolio can be minimised.

CHAPTER TWO

THE EX ANTE MEAN-VARIANCE EFFICIENCY OF BENCHMARK PORTFOLIOS

Chapter one discussed some of the criticisms of the use of the Jensen performance measure. One of the major areas of contention is the identification of an appropriate benchmark portfolio against which managed funds can be compared. Roll(1977,1978) challenged the usefulness of the Jensen measure because of the unobservability of the market portfolio. Grinblatt and Titman(1989) show that it is possible to evaluate performance within a mean-variance world using a benchmark portfolio that is ex ante mean-variance efficient with respect to the set of assets considered tradable by investors. Hence it is unnecessary to identify and use the market portfolio as the benchmark in performance measurement.

The work of Grinblatt and Titman still raises two issues;

1) How do we actually identify such a benchmark portfolio?

2) How do we test the ex ante mean-variance efficiency of a benchmark portfolio?

Grinblatt and Titman(1987,1989) show that the benchmark portfolio need not be restricted to single portfolio benchmarks but that multiple portfolio benchmarks are equally valid. Grinblatt and Titman suggest that the CAPM and APT asset pricing models may provide candidate benchmark portfolios whose efficiency could be tested. In a UK context, this might involve testing the efficiency of market proxies such as the Financial Times All Share (FTA) index or the Financial Times 100 index (FT100) as CAPM candidate benchmark portfolios. Benchmark portfolios within an APT framework could be constructed using the methods of Lehmann and Modest(1988) or Connor and Korajcyzk(1988).

Testing the efficiency of benchmark portfolios is a necessary prerequisite before evaluating fund performance. This is because we need to know if the benchmark used is efficient or not. If the proxy portfolio is inefficient, then the interpretation of positive Jensen performance will be ambiguous since it can either reflect superior performance or inefficiencies in the benchmark. This chapter examines the ex ante mean-variance efficiency of four different benchmark portfolios used throughout this study.

The chapter is organised as follows. Section I describes the methodology used to test efficiency. Section II presents the data, sample period and the benchmarks. Section III and IV reports the empirical evidence of the efficiency of the single portfolio and multiple portfolio benchmarks respectively. Section V explains why the efficiency of some of the benchmarks is rejected more frequently than the others. Section VI considers the efficiency of the different benchmarks when short selling restrictions are imposed. The final section presents concluding comments.

I TESTING MEAN-VARIANCE EFFICIENCY

Roll(1979) argues that the key question when testing mean-variance efficiency is whether or not in the sample period the evaluated portfolio is statistically significantly dominated in mean and variance by some other portfolio. If it is, then the ex ante efficiency of the portfolio can be rejected. This is the link between ex ante expectations and ex post realisations. If the underlying distribution is assumed stationary, then in large samples an ex ante efficient portfolio will have statistically insignificant ex post inefficiency. Roll points out that no rational investor who chooses on the basis of mean and variance will pick a portfolio that is inefficient based on their expectations. The investor wants to know whether the ex post inefficiency of his portfolio is due to sampling variation or actual errors in expectations. As the number of time series observations tends to infinity, ex ante expectations of mean and variance will converge to the sample estimates of mean and variance using ex post data.

One approach to testing mean-variance efficiency uses the multivariate linear regression model;

$$r_{it} = \alpha_{ip} + \beta_i r_{pt} + \epsilon_{it} \text{ for all } i = 1,\ldots,N \qquad (1)$$

where r_{it} is the excess return on asset i in period t, r_{pt} is the excess return in period t on the evaluated portfolio p whose efficiency is being tested, ϵ_{it} is the disturbance term for period t with $E(\epsilon_{it}) = 0$ and $E(\epsilon_{it} r_{pt}) = 0$, N is the number of left hand side assets used in the equations, T is the number of time series observations. Portfolio p is being tested to see if it is efficient with respect to the efficient frontier of the N+1 assets. This specification assumes that a riskless asset exists for each period, the N left hand side assets and portfolio p are linearly independent of each other and there are no short selling restrictions. When portfolio p is ex ante mean-variance efficient then:

$$E(r_{it}) = \beta_i E(r_{pt}) \qquad (2)$$

where $\beta_i = cov(r_{it}, r_{pt})/var(r_{pt})$

Equation (2) imposes N testable restrictions on the regression model in (1). This yields the null hypothesis that if p is efficient, then:

$$H_o: \alpha_{ip} = 0 \text{ for all } i = 1,...,N. \qquad (3)$$

The null hypothesis can be tested by using procedures in Gibbons, Ross and Shanken(1989) and MacKinlay and Richardson(1991). Both approaches are used in this chapter. The advantage of the Gibbons et al test statistic is that it gives an exact small sample test of the null hypothesis. It also has a useful geometric interpretation on the mean - standard deviation of excess returns diagram. However the drawback is that it relies on restrictive distributional assumptions. The test statistic proposed by MacKinlay and Richardson(1991) relies on weaker statistical assumptions but only has asymptotic validity. This means that in finite samples inappropriate conclusions may be drawn. It will be shown in Section III that this is a real possibility.

MacKinlay and Richardson(1991) use a Generalised Method of Moments (GMM) estimation framework to test mean-variance efficiency. It assumes that a riskless asset exists each period, excess asset returns are stationary, ergodic and have finite fourth moments. GMM estimation replaces the population moments $E(\epsilon_{it}) = 0$ and $E(\epsilon_{it}r_{pt}) = 0$ of each asset i = 1,...,N with the sample moments $[1/T \sum_{t=1}^{T} \epsilon_{it}]$ and $[1/T \sum_{t=1}^{T} \epsilon_{it}r_{pt}]$. The parameters are estimated so as to set the sample moments to zero. MacKinlay and Richardson point out that this is identical to the construction of normal equations using Ordinary Least Squares (OLS) estimation and so the parameter estimates will be the same as OLS.

Hansen(1982) has shown that the resulting estimates will have an asymptotic normal distribution. MacKinlay and Richardson point out that the null hypothesis $\alpha_p = 0$ can be tested using the statistic $T\alpha_p'\Omega^{-1}\alpha_p$ where

$\alpha_p' - (\alpha_{1p},.......,\alpha_{Np})$

Ω - asymptotic covariance matrix of α_p.

Under the null hypothesis of efficiency, the GMM test statistic has an asymptotic χ^2 distribution with N degrees of freedom. The asymptotic covariance matrix of the parameter estimates can be adjusted to account for the effects of conditional heteroscedasticity (White(1980)) and serial correlation in the error terms (Newey and West(1987)).

Gibbons, Ross and Shanken(1989) develop an exact small sample test of efficiency. This requires the assumption that the disturbance terms in (1) are multivariate normally distributed with mean zero and stationary covariance matrix Σ conditional on portfolio p's excess returns. Additionally the error terms are serially uncorrelated. With these assumptions, Gibbons et al show that the test statistic Q=[(T-N-1)/N]W will have a non-central F distribution with N and (T-N-1) degrees of freedom where

$$W = (\alpha_p' \Sigma^{-1} \alpha_p)/(1 + \theta_p^2) \quad (4)$$

$\theta_p = r_p^* / \sigma_p$

r_p^* is the sample mean excess return of portfolio p, σ_p and Σ are the maximum likelihood estimates of the sample standard deviation of excess returns of portfolio p and the residual covariance matrix respectively. Under the null hypothesis of efficiency the test statistic has a central F distribution.

The Gibbons et al statistic has an interesting geometric interpretation. They show that

$$W = (\theta^{*2} - \theta_p^2)/(1 + \theta_p^2) \quad (5)$$

where θ^{*2} is the squared Sharpe measure of the tangency portfolio of the N+1 asset efficient set. W measures the difference between the squared Sharpe measures of the optimal tangency portfolio and the evaluated portfolio p relative to one plus the squared Sharpe measure of p. The nearer that portfolio p lies to the efficient frontier the closer θ^{*2} and θ^2_p will be to one another and hence the smaller the value of W. The greater the degree of inefficiency in p, the higher W becomes and the more likely the statistic is to reject the null hypothesis.

The methods of Gibbons et al and MacKinlay and Richardson can be easily extended to test the efficiency of a multiple portfolio benchmark. The null hypothesis is that the intercepts are jointly equal to zero in the following multivariate multiple regression:

$$r_{it} = \alpha_{iL} + \sum_{k=1}^{L}\beta_{ik}r_{kt} + \epsilon_{it} \quad \text{for all } i = 1,\ldots,N \qquad (6)$$

where r_{kt} is the excess return in period t of the kth portfolio in the benchmark, k=1,...L, β_{ik} is the estimated measure of systematic risk for asset i relative to the kth portfolio. Whenever there are L portfolios in the benchmark, the test is to see if there is some combination of the L portfolios which lie on the efficient frontier of the N + L assets. Using the distributional assumptions made by Gibbons et al, their test statistic becomes Q= [(T-N-L)/N]W where

$$W = \alpha'_L\Sigma^{-1}\alpha_L/(1+\theta_L^2) \qquad (7)$$

$\alpha_L' - (\alpha_{1L},\ldots\ldots,\alpha_{NL})$

θ^2_L - optimal squared Sharpe measure of the portfolios in the benchmark. The Q statistic has a central F distribution under the null hypothesis of efficiency with

N and (T-N-L) degrees of freedom. The GMM statistic can also be calculated as before except there will be an orthogonality condition between the residual term and each of the L portfolios i.e. $E(\epsilon_{it}r_{kt}) = 0$ as well as $E(\epsilon_{it}) = 0$. The GMM statistic has an asymptotic χ^2 distribution with N degrees of freedom under the null hypothesis of efficiency.

II DATA AND SAMPLE PERIOD

The mean-variance efficiency of four alternative benchmark portfolios is examined over the sample period January 1980 to December 1989. The overall sample period is split into two subperiods 1/1/80 - 31/12/84 and 1/1/85 - 31/12/89. It is assumed that the universe of assets which investors consider tradable are securities which trade on the London Stock Exchange and Unlisted Securities Market. All of the security and index return data was extracted from the London Business School(LBS) Share Price Database. Excess returns were calculated using the return on a 1 month UK Treasury Bill (collected from Datastream) as the riskless rate of return. All of the returns used in the study are continuously compounded returns.

The four benchmark portfolios evaluated are the Financial Times All Share Index (FTA), Financial Times 100 Index (FT100), an Equally-Weighted Index (EWI) and a multiple portfolio size based benchmark. The equally-weighted index was constructed from the securities that existed during the 1980s on the LBS database (companies that began in 1989 were excluded) with rebalancing on a monthly basis. The motivation for the size indices was the size based stock returns model suggested by Huberman and Kandel(1985). This is described in Section IV.

Table 1 describes the mean, standard deviation of excess returns and the squared Sharpe measure for each of the three single portfolio benchmarks. Table 1 indicates that the FTA proxy has a negative excess return in the second subperiod. For the overall sample period, the EWI proxy has the highest squared Sharpe performance measure. This is because the EWI proxy gives more predominance to small stocks than the other two proxies. Over the whole sample period small stocks tended to outperform large stocks, although this occurred mainly in the second subperiod. Also over the entire sample period and second subperiod, the FTA and FT100 proxies have similar squared Sharpe measures.

Table 1 Summary Statistics of the FTA, Equally-Weighted and FT100 Indices

	1/80-12/84	1/85-12/89	1/80-12/89
FTA			
r^*_p (% per month)	0.96	-0.26	0.35
σ_p^a (% per month)	4.8	7.1	6.2
θ^2_p	0.0392	0.00135	0.00322
EWI			
r^*_p (% per month)	0.48	0.4	0.44
σ_p^a (% per month)	3.7	5.8	4.9
θ_p^2	0.0173	0.00476	0.00819
FT100			
r^*_p (% per month)	0.47	0.2	0.34
σ_p^a (% per month)	4.9	6.1	5.5
θ_p^2	0.0094	0.0011	0.0037

a - these are the maximum likelihood estimates of σ

The number of assets to be included in the tests of efficiency are limited by the number of time series observations since N must be less than or equal to (T-2) to ensure that the residual covariance matrix is non-singular. Also N must be chosen to be considerably lower than T otherwise the null hypothesis would never be rejected. As a result, individual securities were grouped into portfolios on the basis of a number of security characteristics. This helps to address the question of whether the characteristic used to group the assets into portfolios affects the conclusions drawn.

Securities were included in the portfolios if they met the criteria. The following security characteristics were used to form portfolios.

(i) Size - beginning of the year market value as recorded on the LBS Share Price Database. Companies that had zero market values were not included.

(ii) CAPM Beta - the beta coefficient in the excess returns regression of the individual securities and the FTA index over the prior five years.

(iii) Co-skewness - the coefficient of the squared market excess return in the excess returns regression of individual securities on the FTA and FTA squared over the prior five years.

(iv) Own variance - variance of the individual security returns over the prior sixty months.

(v) Past returns - the sum of individual security returns over the prior sixty months.

Companies to be included for (ii)-(v) must have existed over the prior sixty months.

For the characteristics (i)-(v), at the start of 1980 securities were ranked on the basis of each characteristic and divided into ten portfolios in ascending order i.e. for the size effect anomaly portfolio 1 would include small companies and portfolio 10 would include large companies. The ten portfolios contained an equal number of securities except where appropriate the tenth portfolio included the extra securities. Equally-weighted portfolio excess returns were then computed over the following five years. This process was repeated at the start of 1985.

The 10 portfolios formed for each characteristic were used to test the efficiency of the different benchmarks. The efficiency of the benchmarks was tested with respect to the efficient frontier generated by the 10 portfolios and the benchmarks. These efficient frontiers will lie inside the global efficient frontier of all assets on the London Stock Exchange and Unlisted Securities Market. However if the efficiency of a benchmark is rejected against an efficient frontier generated by a subset of assets, then it will be rejected with respect to the global efficient frontier.

III THE EFFICIENCY OF THE SINGLE PORTFOLIO BENCHMARKS

This section reports the tests of efficiency for the three single portfolio benchmarks. Tables 2 and 3 present the Gibbons et al Q statistic and the GMM statistic for the tests of the efficiency of the three single portfolio benchmarks against the different efficient frontiers. The Q statistic is calculated as $[(T-N-1)/N][\alpha_p'\Sigma^{-1}\alpha_p/(1+\theta_p^2)]$ and has a central F distribution with N and (T-N-1) degrees of freedom under the null hypothesis of efficiency. The GMM statistic is similar to a Wald statistic $T\alpha_p'(Var(\alpha_p))^{-1}\alpha_p$ except that $Var(\alpha_p)$ has been corrected for the effects of any heteroscedasticity and first order serial correlation. The GMM statistics reported in Table 3 were calculated after making appropriate adjustments. It has an asymptotic χ^2 distribution with N degrees of freedom under the null hypothesis of efficiency. The values of the Q and GMM statistics are compared to corresponding critical values for the F and χ^2 distributions respectively. If the observed values of the Q and GMM statistics are greater than the critical values, then the efficiency of the benchmark portfolio is rejected. The tests of efficiency were carried out over the whole sample period and the two subperiods. Each row in the table refers to the security characteristic used to group the assets into portfolios.

Table 2 Mean-Variance Efficiency Tests of the Benchmark Portfolios Using the Q Statistic

1/80-12/84	FTA	FT100	EWI
Size	0.6	0.95	0.9
Beta	1.08	1.26	2.41*
Skewness	0.77	1.3	3.35**
Returns	1.39	2.0	2.65*
Variance	1.59	1.94	2.98**
1/85-12/89			
Size	2.91**	3.03**	5.16**
Beta	1.74	1.34	6.8**
Skewness	3.37**	3.35**	6.08**
Returns	4.48**	3.88**	10.1**
Variance	3.35**	2.55*	8.09**
1/80-12/89			
Size	2.44*	2.99**	4.19**
Beta	1.82	1.71	6.8**
Skewness	2.14*	2.95**	5.89**
Returns	4.4**	4.0**	8.18**
Variance	2.87**	2.84**	6.84**

* Significant at 5%
** Significant at 1%

Table 3 Mean-Variance Efficiency Tests of the Benchmark Portfolios Using the GMM Statistic

1/80-12/84	FTA	FT100	EWI
Size	7.21	11.63	11.07
Beta	15.47	22.8*	29.53**
Skewness	9.48	17.92	41.03**
Returns	17.47	31.13**	32.43**
Variance	20.24*	25.38**	36.52**
1/85-12/89			
Size	31.46**	33.53**	65.72**
Beta	23.88**	16.33	88.74**
Skewness	41.82**	43.05**	74.48**
Returns	58.53**	48.22**	127.72**
Variance	49.96**	34.59**	101.71**
1/80-12/89			
Size	24.05**	31.74**	46.72**
Beta	20.41*	18.47*	77.45**
Skewness	18.92*	30.68**	62.04**
Returns	57.78**	46.05**	87.21**
Variance	32.39**	32.67**	75.72**

* Significant at 5%
** Significant at 1%

The evidence in Tables 2 and 3 suggests that the efficiency of the proxies is rejected in most cases. The EWI proxy has the highest rejection rate of efficiency amongst the three proxies. Additionally the Q and GMM statistics are much higher for the EWI proxy than the other two proxies. In the first subperiod, the efficiency of the FTA and FT100 proxies is accepted across all 5 efficient frontiers using the Q statistic. However for the whole sample period, the efficiency of all three proxies is rejected in nearly every instance. The evidence of inefficient benchmarks implies that caution should be exercised when interpreting the Jensen performance of managed funds against any of these benchmarks over the whole sample period.

A number of interesting results emerge from the Tables 2 and 3. The first is the contrast between the inferences drawn by the Q and GMM statistics. In some instances, the efficiency of the proxy is accepted by the Q statistic but is rejected by the GMM statistic. This is especially true of the FTA and FT100 proxies. In the first subperiod, the GMM statistic rejects the efficiency of the FT100 proxy in three out of the five cases whereas the Q statistic rejects none. Also in the overall period, the GMM statistic rejects the efficiency of the FTA and FT100 proxies relative to beta sorted portfolios but the Q statistic does not. These contradictions could mean one of either two things. It may be that the violation of distributional assumptions in the Gibbons et al approach is so severe that it leads to an acceptance of the null hypothesis when it should be rejected as indicated by the GMM statistic. Diagnostic tests of the distributional assumptions revealed that they were frequently broken especially for the single portfolio benchmarks. Alternatively the differences may reflect aberrations in the small sample behaviour of the GMM statistic which only has an asymptotic justification.

It is possible to assess which of these reasons is causing the differences. As noted in Gibbons et al, the Wald statistic is a linear transform of their statistic i.e. TW. This statistic has an asymptotic χ^2 distribution under the null hypothesis of efficiency with N degrees of freedom. Comparing the results of the Wald statistic with the GMM statistic and Q statistic, we are able to identify the factor causing the difference. If the differences between the Q and GMM statistic are due to violation of the distributional assumptions, then we would expect to see similar differences between the Wald and GMM statistic. This is because the Wald and GMM statistics are similar except the GMM statistic has been adjusted for serial correlation and conditional heteroscedasticity. If the Wald and GMM statistics yield similar inferences, this suggests that the differences are due to small sample aberrations in the behaviour of the GMM statistic. Table 4 presents Wald and GMM statistics for the three single portfolio benchmarks for the overall sample period and the two subperiods. The GMM statistic is recorded in the first row of each investment category with the Wald statistic in parentheses below.

Table 4 demonstrates that the inferences between the Wald and GMM statistic are almost identical. It is well known that the Wald test statistic tends to reject the null hypothesis too often in small samples (see Gibbons et al, Amsler and Schmidt(1985)). Given the similarity between the Wald and GMM statistics, this leads to the conclusion that the differences between the Q and GMM statistics in Tables 2 and 3 is due to small sample problems in the GMM statistic. It also suggests that the Q statistic is fairly robust to statistical departures in their distributional assumptions. It is interesting to note in Tables 2 and 3 that the differences occur mainly for T = 60 months and when more time series observations are used, the conclusions are more accurate for the GMM statistics.

Table 4 Mean-Variance Efficiency Tests of the Benchmark Portfolios:- A Comparison Between the GMM and Wald Statistics

1/80-12/84	FTA	FT100	EWI
Size	7.21	11.63	11.07
	(7.35)	(11.63)	(11.02)
Beta	15.47	22.8*	29.53**
	(13.22)	(15.43)	(29.51)**
Skewness	9.48	17.92	41.03**
	(9.43)	(15.92)	(41.02)**
Returns	17.47	31.13**	32.43**
	(17.02)	(24.49)**	(32.45)**
Variance	20.24*	25.38**	36.52**
	(19.47)*	(23.76)**	(36.49)**
1/85-12/89			
Size	31.46**	33.53**	65.72**
	(35.63)**	(37.1)**	(63.18)**
Beta	23.88**	16.33	88.74**
	(21.31)*	(16.41)*	(83.27)**
Skewness	41.82**	43.05**	74.48**
	(41.27)**	(41.02)**	(74.45)**
Returns	58.53**	48.22**	127.72**
	(54.86)**	(47.51)**	(123.67)**
Variance	49.96**	34.59**	101.71**
	(41.02)**	(31.22)**	(99.06)**
1/80-12/89			
Size	24.05**	31.74**	46.72**
	(26.86)**	(32.92)**	(46.13)**
Beta	20.41*	18.47*	77.45**
	(20.04)*	(18.83)*	(74.86)**
Skewness	18.92*	30.68**	62.04**
	(23.56)**	(32.48)**	(64.84)**
Returns	57.78**	46.05**	87.21**
	(48.44)**	(44.04)**	(90.06)**
Variance	32.39**	32.67**	75.72**
	(31.6)**	(31.27)**	(75.3)**

* Significant at 5%
** Significant at 1%

A second point to notice from Tables 2 and 3 is that it seems to matter how securities are grouped into portfolios. The inferences about the efficiency of the proxies sometimes varies across the different efficient frontiers. This in itself is important because depending on the characteristic chosen to form portfolios it could lead to an acceptance of the efficiency of the proxy. However using a different characteristic to form portfolios to test efficiency could result in the proxy's efficiency being rejected. An example of this can be seen in Table 3 for the first subperiod where for the same group of securities variance sorted portfolios rejects the efficiency of the FT100 proxy but skewness sorted portfolios do not. The aim should be to group assets into portfolios so as to maximise the power of the test.

Univariate test results are presented in Tables 11-19 in the Appendix. The tables include the individual estimated Jensen measures and adjusted t statistics which have been corrected for heteroscedasticity and first order serial correlation where appropriate for the whole period and two subperiods. The portfolios formed in Section II can be viewed as rebalancing portfolio strategies with constant weights, based on publicly available information. These portfolios are effectively passive portfolios as the weights do not change in response to superior information. Tables 11-19 reveal that a number of passive portfolios exhibit superior Jensen performance against the three proxies. This is especially true of the EWI proxy. The univariate results of the first subperiod confirm the efficiency of the FTA proxy for that period. There are clear patterns in some of the passive portfolios. For the EWI proxy, the small size portfolio, low beta portfolios, more positively skewed portfolios, medium past returns portfolios and low variance portfolios all earn higher risk adjusted returns than what would be expected if the EWI proxy were efficient for the overall sample period. A similar pattern is reflected in the second subperiod.

The FTA and FT100 proxies show fewer significantly positive Jensen measures. However in the overall period, medium past returns and low variance portfolios outperform the proxies. It is interesting to note that there is only a significant small firm effect with the EWI index. For the FT100 proxy, it is the portfolio of large firms which exhibits significant positive performance. Additionally the small firm effect seems to be concentrated in the second subperiod. The relationship between size and the Jensen measures is nonlinear. Portfolios of small or large firms have the highest Jensen measures. Portfolios of medium sized firms have the lowest, sometimes negative Jensen measures. These results are perhaps surprising given the empirical evidence of the size anomaly commonly reported in the academic literature. One would expect that if the small firm effect was important, the bias would be reflected more in the FTA and FT100 proxies given that the EWI proxy provides more weighting to small stocks. However the Jensen performance of the portfolios of small stocks may be less than we would expect because small stocks are more likely not to survive than larger stocks. It may be that the small firm effect would become more important if the size portfolios were resorted more frequently than five yearly e.g. annually.

Gibbons, Ross and Shanken(1989) argue that it can be difficult to interpret the pattern of the estimated Jensen measures of the N assets. This is because the variance-covariance matrix of α_p contains Σ which implies that if the residuals exhibit patterns in cross correlation, this will be reflected in the estimated α's. As a result, it is difficult to distinguish whether the pattern of estimated α's is due to the residual cross-correlation or a reflection of the true pattern of α's.

The univariate results in Tables 11-19 confirm the multivariate statistical evidence. Apart from the FTA proxy in the first subperiod, all of the proxies are ex ante mean-variance inefficient. This suggests that the interpretation of positive Jensen performance by managed funds against any of the proxies will be ambiguous. However Dybvig and Ross(1985a,b) note that there are some positive uses of using an inefficient proxy under certain conditions.

IV EFFICIENCY OF MULTIPLE PORTFOLIO BENCHMARKS

The previous section showed that the efficiency of the three single portfolio benchmarks is rejected over the whole sample period. Grinblatt and Titman(1989) point out that within their general framework of performance evaluation, it is also valid to use multiple portfolio benchmarks under certain conditions. This will be the case when there is some linear combination of the portfolios which add up to a point on the ex ante efficient frontier. They also note that the Arbitrage Pricing Theory(APT) may provide candidate benchmark portfolios. The size based stock returns model advanced by Huberman and Kandel(1985) is one possible example. The motivation for the Huberman and Kandel model was the observation that the cross correlation between different size sorted portfolios exhibited certain patterns after the market effect was removed.

Huberman and Kandel found that portfolios of a similar size had high positive residual cross correlation. Portfolios of a different size had lower positive correlation and in some cases were negative when the market proxy used was the NYSE equally-weighted index. This led to Huberman and Kandel proposing a size based stock returns model where the size based indices proxy for the unobserved factors generating asset returns.

Table 5 presents the residual correlation matrices of the size sorted portfolios using the FTA and EWI proxies for the overall sample period. The lower triangular portion of the table refers to the FTA proxy and the upper triangular portion refers to the EWI proxy. Distinct patterns emerge from the Table 5. Portfolios of a similar size have highly positively correlated residuals and portfolios of a different size have lower correlation. The degree of positive residual correlation is much higher with the FTA proxy than the EWI proxy. Many of the residual correlation figures are negative for portfolios of a different size with the EWI proxy.

Table 5 Residual Correlation Matrices of Size Portfolios Using the FTA and EWI Proxies

	1	2	3	4	5	6	7	8	9	10
1		.65	.54	.38	**.01**	**.17**	**.48**	**.64**	**.78**	**.67**
2	.91		.49	.37	**.01**	**.10**	**.58**	**.70**	**.73**	**.66**
3	.90	.88		.31	.04	**.05**	**.40**	**.60**	**.73**	**.64**
4	.87	.86	.88		.08	**.08**	**.17**	**.43**	**.50**	**.53**
5	.81	.80	.84	.87		.11	.08	**.24**	**.17**	**.24**
6	.83	.83	.87	.88	.89		.18	.06	.0	**.09**
7	.74	.70	.78	.84	.86	.89		.49	.43	.28
8	.66	.62	.69	.76	.76	.83	.88		.76	.66
9	.42	.41	.46	.58	.62	.67	.76	.86		.87
10	.27	.25	.30	.38	.41	.47	.55	.68	.86	

All of the correlation figures have been rounded up to two decimal places and negative correlations are in bold.

Following Huberman and Kandel, a multiple portfolio benchmark of three size based indices was constructed. The size based indices were formed from 10 size sorted portfolios which are different from those used in the tests of efficiency. At the start of each year beginning in 1980, all securities were ranked on the basis of their beginning of year market value and divided into 10 portfolios in ascending order. The ten portfolios contain an equal number of securities except where appropriate the tenth portfolio included any additional securities. Equally-weighted portfolio excess returns were then computed over the following year. This process was repeated each year. The first size index is an equal-weighting of portfolios 1-4, the second size index is an equal-weighting of portfolios 5-7 and the third size index is an equal-weighting of portfolios 8-10.

Table 6 presents multivariate tests of the efficiency of the size based indices across the different efficient frontiers. When the efficiency of the size based indices is being tested, it is being tested with respect to the efficient frontier generated by the 10 passive portfolios and the three size based indices. Is there some combination of the portfolios in the benchmark that lies on the efficient frontier of the N+L assets? As for the single portfolio benchmarks, two test statistics are used. The Gibbons et al Q statistic has a central F distribution under the null hypothesis of efficiency with N and (T-N-L) degrees of freedom where L is the number of portfolios in the benchmark. The GMM statistic is similar to a Wald statistic except that it has been corrected for first order serial correlation and heteroscedasticity where appropriate and has an asymptotic χ^2 distribution with N degrees of freedom under the null hypothesis of efficiency. The columns in Table 6 refer to the security characteristic used to group the assets into portfolios.

Table 6 Multivariate Tests of the Efficiency of the Size Based Indices

1/80-12/84	Size	Beta	Skewness	Returns	Variance
Q	2.31*	2.89**	3.91**	3.21**	3.69**
GMM	29.93**	39.69**	51.31**	47.18**	43.14**
1/85-12/89					
Q	2.87**	4.18**	5.86**	7.41**	6.19**
GMM	56.97**	79.48**	87.53**	108.71**	95.68**
1/80-12/89					
Q	3.98**	5.08**	5.17**	6.83**	5.83**
GMM	54.74**	69.57**	70.38**	78.71**	72.28**

* Significant at 5%
** Significant at 1%

Table 6 shows that for the overall sample period and the two subperiods, the ex ante efficiency of the size based indices is rejected. The inferences from the two statistics is similar. Comparing the results in Table 6 with those in Tables 2 and 3 reveals that the size based indices have a greater rejection rate of efficiency than either the FTA or FT100 proxies and also much higher test statistics than these two proxies. An explanation of this observation will be provided in the next section.

Univariate results are recorded in Tables 20-22 in the Appendix. For the overall sample period, small and large firm portfolios, low beta portfolios, more positively skewed portfolios, medium past returns portfolios and low variance portfolios all exhibit significant positive performance. Similar patterns are repeated in the subperiods. The portfolio of high variance securities registers significant negative performance. The univariate results confirm the multivariate evidence and leads us to reject the efficiency of the size based indices.

V WHY THE EFFICIENCY OF THE EWI PROXY AND SIZE BASED INDICES ARE REJECTED MORE FREQUENTLY

One of the results from Sections III and IV is the observation that the test statistics for the efficiency of the EWI proxy and size based indices are much higher than the other two proxies. This arises because of the effect that adding either the EWI proxy or the size based indices to the original N asset set. It is possible to examine the contribution to potential performance that adding one of the proxies to the asset subsets makes. Jobson and Korkie(1982) define potential performance as the maximum attainable Sharpe performance measure within the asset set. Jobson and Korkie suggest the test statistic to examine the contribution of an asset(s) to the investor's choice set of assets as:

$$F = [(T-N-L)/L][(a-a_1)/(1+a_1)] \qquad (8)$$

where N is the number of assets in the original subset i.e. 10, L is the number of portfolios in the benchmark that are added to the subset, a_l and a are the maximum squared Sharpe performance measures of the original and new asset subsets. The statistic has a F distribution with L and (T-N-L) degrees of freedom under the null hypothesis that the proxy makes no significant contribution to the original subset. Table 7 reports F statistics of the contribution that each of the proxies makes to the different asset subsets when they are added.

Table 7 F Tests of the Benchmark's Contribution to the Original Asset Subsets

1/80-12/84	FTA	FT100	EWI	Size
Size	1.25	3.08	3.0	6.71**
Beta	0.86	0.94	10.68**	6.34**
Skewness	0.04	3.09	20.84**	10.24**
Returns	0.38	3.93	9.15**	6.11**
Variance	0.11	1.63	9.58**	6.62**
1/85-12/89				
Size	0.51	1.3	14.88**	5.92**
Beta	3.39	0.19	43.71**	15.85**
Skewness	12.85**	12.68**	33.41**	19.84**
Returns	5.32*	1.81	37.89**	15.89**
Variance	7.72**	2.27	40.48**	18.06**
1/80-12/89				
Size	0.36	4.88*	9.48**	11.9**
Beta	1.15	0.25	45.34**	18.34**
Skewness	6.26*	13.53**	40.02**	19.78**
Returns	3.41	0.5	31.51**	15.47**
Variance	4.34*	4.14*	37.45**	18.15**

* Significant at 5%
** Significant at 1%

The evidence in Table 7 indicates that it is mainly the EWI and size based indices which make significant contributions to the asset subsets. Recalling that the Gibbons et al test of efficiency compares the squared Sharpe performance of the tangency portfolio relative to the evaluated portfolio(s), the squared Sharpe performance of the optimal tangency portfolio is much greater for the EWI and size based indices than for either the FTA or FT100 proxies. This leads to higher test statistics and the impression that the EWI and size based indices are the most inefficient. The results in Table 7 should be treated with caution as the F statistic assumes that asset returns are multivariate normal which is not the case here. However the evidence from the earlier sections would suggest that the F statistic may be fairly robust to departures from normality.

VI IMPACT OF SHORT SELLING RESTRICTIONS

The multivariate test of efficiency of Gibbons, Ross and Shanken(1989) when a riskless asset exists has an interesting geometric interpretation in mean-standard deviation of excess returns space. It effectively measures the difference between the squared Sharpe measures of the optimal tangency portfolio of the N + L assets (where L is the number of portfolios in the evaluated benchmark) and the L portfolio benchmark relative to one plus the squared Sharpe measure of the L portfolio benchmark. The test assumes that investors face no short selling restrictions. However in practice, many institutional investors may not be able to short sell assets and as a result the optimal tangency portfolio of the N + L assets may be infeasible for them to hold.

To illustrate the importance of short selling, Table 8 presents the portfolio weights of the optimal tangency portfolios across different efficient frontiers. Various combinations of the N + 1 (assuming that L = 1) assets are selected to highlight this. The weights refer to the size and variance sorted frontiers and the proxies for the overall sample period. The weights were calculated as in Jobson and Korkie(1982) who show that the optimal risky portfolio in the presence of a riskless asset is given by;

$$X_m = V^{-1}R/e'V^{-1}R$$

where R is a ((N+L)*1) mean excess return vector, V is the covariance matrix of excess returns of the N+L assets, e is a ((N+L)*1) vector of ones and X_m is an ((N+L)*1) vector of investment weights which sum to 1. It can be seen from the Table 8 that all of the optimal portfolios contain short positions in some of the assets. With the size sorted portfolios and the FTA index, eight out of the eleven assets are sold short.

Table 8 Portfolio Weights in the Tangency Portfolio

Port-folio	Size & FTA	Size & EWI	Variance & FTA	Variance & FT100	Variance & EWI
1	31.35	61.2	1.52	1.47	3.08
2	-8.75	20.95	-0.26	0.0004	1.48
3	12.17	54.57	0.15	0.36	-0.35
4	-12.16	13.33	0.13	0.02	0.84
5	-12.36	18.39	0.78	0.73	1.42
6	-7.36	24.37	-0.04	0.08	1.27
7	-11.83	14.44	-0.22	-0.33	0.76
8	-29.28	-2.36	-0.54	-0.65	1.01
9	45.98	83.8	0.84	0.79	2.02
10	-3.46	13.44	-0.88	-0.85	0.36
Proxy	-3.29	-301.14	-0.48	-0.61	-10.91

An extension to the work in the earlier sections is to consider whether each of the benchmark portfolios is efficient with respect to the constrained frontiers i.e. where there is no short selling. The difficulty with such a test is that it is not particularly clear what the sampling distribution of such a test statistic would be. Jorion(1992) uses the Gibbons et al test statistic and generates an empirical distribution of the statistic through simulation.

When short selling restrictions are imposed, the beta/return linearity relationship will only hold for those assets which are included in the optimal tangency portfolios. Thus running a multivariate regression model as in previous sections is no longer possible. However when a riskless asset exists, even without short sales, there will still only be one optimal portfolio for the investor to hold. By regressing the excess returns of that portfolio on the excess returns of the proxy, we would expect that if the proxy was efficient with respect to the constrained efficient frontier then the Jensen measure of the optimal portfolio would be insignificantly different from zero. This is the intuition that will be used to examine the efficiency of the proxies relative to the constrained frontier.

The efficiency of each of the three single portfolio benchmarks was tested with respect to the constrained efficient frontiers generated by the various asset subsets described in Section 2. In order to do this, efficient frontiers of the different passive portfolios and proxies were computed using a quadratic optimisation package. The frontiers were estimated for the overall sample periods. The analysis in this section will only concentrate on the single portfolio benchmarks. Table 9 records the investment weights of the optimal tangency portfolio for the different frontiers. The efficiency of each of the proxies was also tested relative to a 26 asset set. This contained portfolios 1,2,8-10 of the size sorted portfolios, 10 past returns portfolios, 10 variance portfolios and the proxy itself. This particular combination was chosen because the variance, past returns and size sorted portfolios had the highest squared Sharpe performance measures.

Table 9 Investment Proportions in the Optimal Portfolios of the N+L Assets With No Short Sales

Efficient Frontier	FTA	FT100	EWI
Size	100% in size	portfolio 1	
Beta	2.27%, 97.73%	in beta	portfolios 1 & 2.
Skewness	100% in	skewness	portfolio 8
Past Returns	100% in	past returns	portfolio 4
Variance	100% in	variance	portfolio 1
Combined	100% in	variance	portfolio 1

It is interesting to note from Table 9 that the optimal tangency portfolio of the constrained frontier is identical for the three proxies. This is perhaps most surprising for the 26 asset universe. Apart from the beta sorted portfolios, all of the tangency portfolios contain only one asset. This is even true of the 26 asset universe. Levy(1983) found that as the number of assets used to form the constrained frontier are increased, the proportion of securities relative to the total number in efficient portfolios declines. Table 10 presents the Jensen performance measures and adjusted t statistics where the excess returns of the optimal portfolios in Table 9 are regressed on the excess returns of the respective proxy portfolio. If the proxy is efficient with respect to the constrained efficient frontier then the Jensen measures of the optimal portfolio should not be significantly different from zero. For each investment category, the first row is the estimated Jensem measure and the second row contains the adjusted t statistics.

Table 10 Jensen Measures of Constrained Tangency Portfolios

Frontier	FTA	FT100	EWI
Size	0.0067	0.0067	0.0044
	1.83	1.71	2.34*
Beta	0.0051	0.0051	0.0034
	2.08*	1.87	2.99**
Skewness	0.0057	0.0055	0.0039
	2.45*	2.83**	4.53**
Past Returns	0.0065	0.0063	0.0046
	2.52*	2.58*	5.62**
Variance	0.0056	0.0055	0.0044
	2.9**	3.13**	5.18**
Combined	0.0056	0.0055	0.0044
	2.9**	3.13**	5.18**

* Significant at 5%
** Significant at 1%

The evidence in Table 10 shows that the efficiency of each of the proxies relative to the constrained efficient frontier is rejected in nearly all cases. All of the optimal portfolios outperform the proxies and most exhibit significant positive performance against the single portfolio benchmarks. This is an extremely important result in that it demonstrates that there are feasible ex ante passive portfolio strategies which outperformed the benchmarks on an ex post basis over the 1980s. This provides further evidence on the inefficiency of the benchmarks and suggests even more that caution should be used in interpreting performance results in a mean-variance framework with such benchmarks.

VII CONCLUSIONS

This chapter has presented extensive evidence on a wide range of issues in testing mean-variance efficiency. The most important conclusion is the rejection of the ex ante efficiency of the four benchmark portfolios. This is even the case when we impose short selling constraints in the analysis. It is perhaps disappointing that none of the evaluated portfolios is efficient because it implies that inferences about fund performance in future chapters will be ambiguous. However the use of such proxies can still provide some insight about fund performance under certain conditions.

It is possible to construct other APT candidate benchmark portfolios using the methods of Lehmann and Modest(1988) or Connor and Korajcyzk(1988). Grinblatt and Titman(1988) formed multiple portfolio benchmarks from the passive portfolios similar to the ones used in this chapter. However this is vulnerable to the criticism of data mining if constructed over the same sample period as which the resulting portfolio will be tested. Rubio(1992) overcomes this by using a prior sample.

The chapter has also addressed a number of issues in the procedures of testing efficiency. It has been shown that the Gibbons et al Q statistic appears robust to violations in the distributional assumptions. Another potentially important issue is the security characteristics which are used to group assets into portfolios. Subsquent chapters will use each of the four benchmarks to evaluate the performance of a sample of UK unit trusts.

APPENDIX

Tables 11-22 report the estimated Jensen measures and adjusted t statistics of the passive portfolios. The results refer to each of the four benchmark portfolios over the whole sample period and the two subperiods. The first column in each table is the portfolio number described in Section II. Columns 2-6 are the security characteristics used to group the assets into the portfolios. The first row for each portfolio number are the estimated Jensen measures and the second row contains the adjusted t statistics.

Table 11 FTA Proxy -1/80-12/84

	Size	Beta	Skewness	PR	Variance
1	-0.0002	0.0000	0.0000	-0.0014	0.0020
	-0.0476	0.0144	-0.0054	-0.4252	1.0648
2	-0.0016	0.0007	-0.0030	-0.0006	0.0008
	-0.4744	0.2453	-1.1163	-0.2223	0.3291
3	-0.0004	-0.0001	-0.0018	0.0007	-0.0006
	-0.1399	-0.0428	-0.7215	0.3275	-0.2858
4	-0.0014	-0.0013	-0.0007	0.0011	0.0001
	-0.4551	-0.4946	-0.3174	0.4821	0.0465
5	-0.0021	-0.0026	-0.0023	-0.0009	0.0010
	-0.7842	-0.8039	-1.0195	-0.4658	0.4360
6	-0.0014	-0.0034	-0.0006	0.0010	-0.0019
	-0.6160	-1.3715	-0.2513	0.5565	-0.8830
7	-0.0018	-0.0005	0.0000	-0.0017	-0.0034
	-0.8210	-0.2100	-0.0066	-0.6881	-1.2058
8	-0.0029	-0.0020	0.0000	-0.0022	-0.0024
	-1.2762	-0.8569	-0.0174	-0.8680	-0.7725
9	-0.0008	-0.0010	-0.0009	-0.0028	-0.0012
	-0.4035	-0.4636	-0.3810	-1.1216	-0.4531
10	-0.0009	-0.0008	-0.0012	-0.0038	-0.0057
	-0.6316	-0.3655	-0.3905	-1.4174	-1.4356

Table 12 FTA Proxy - 1/85-12/89

	Size	Beta	Skewness	PR	Variance
1	0.0152	0.0107	0.0070	0.0105	0.0094
	2.4927	2.2311	1.2531	1.5423	3.2319
2	0.0102	0.0102	0.0077	0.0125	0.0086
	1.6722	2.5927	1.6264	2.3598	2.6709
3	0.0080	0.0098	0.0091	0.0105	0.0094
	1.6449	2.2006	2.0666	2.0940	3.0776
4	0.0055	0.0097	0.0088	0.0110	0.0078
	1.1135	2.1526	1.9278	2.6865	2.3575
5	0.0042	0.0103	0.0087	0.0106	0.0088
	0.9634	2.4526	2.4066	3.1339	2.4664
6	0.0044	0.0065	0.0096	0.0086	0.0086
	1.0037	1.5029	2.5832	2.1890	2.2397
7	0.0031	0.0090	0.0089	0.0086	0.0111
	0.7385	2.3264	2.4158	2.6443	2.4578
8	0.0046	0.0074	0.0105	0.0071	0.0085
	1.2937	1.9343	3.0117	2.1997	1.5622
9	0.0064	0.0083	0.0112	0.0074	0.0106
	1.7199	1.9502	2.9738	1.9599	1.7763
10	0.0069	0.0079	0.0081	0.0034	0.0064
	1.7328	1.7839	1.6268	0.8625	0.9007

Table 13 FTA Proxy - 1/80-12/89

	Size	Beta	Skewness	PR	Variance
1	0.0067	0.0050	0.0031	0.0037	0.0056
	1.8258	1.7481	0.8634	0.9294	2.9040
2	0.0035	0.0051	0.0022	0.0058	0.0050
	0.9774	2.0798	0.7171	1.8653	2.2282
3	0.0034	0.0046	0.0039	0.0056	0.0047
	1.1747	1.7692	1.3799	1.8447	2.1046
4	0.0018	0.0041	0.0041	0.0065	0.0042
	0.5497	1.3714	1.4496	2.5223	1.8346
5	0.0011	0.0037	0.0036	0.0053	0.0053
	0.3831	1.2516	1.4505	2.3323	2.1677
6	0.0015	0.0015	0.0049	0.0050	0.0035
	0.5575	0.5132	1.9550	2.0608	1.3666
7	0.0010	0.0045	0.0048	0.0035	0.0039
	0.3900	1.7116	1.9425	1.4873	1.3137
8	0.0013	0.0032	0.0057	0.0027	0.0028
	0.5294	1.2144	2.4531	1.1579	0.9076
9	0.0035	0.0042	0.0050	0.0024	0.0044
	1.3447	1.5258	1.9237	0.9207	1.2346
10	0.0038	0.0041	0.0028	-0.0002	0.0000
	1.4204	1.4423	0.8769	-0.0640	-0.0024

Table 14 FT100 Proxy - 1/80-12/84

	Size	Beta	Skewness	PR	Variance
1	0.0024	0.0023	0.0033	0.0019	0.0040
	0.6574	0.7501	0.9884	0.5087	1.9065
2	0.0010	0.0031	0.0005	0.0029	0.0042
	0.2780	1.0025	0.1496	0.8838	1.5608
3	0.0024	0.0026	0.0018	0.0042	0.0030
	0.7734	0.8612	0.5626	1.6156	1.1514
4	0.0017	0.0020	0.0027	0.0049	0.0039
	0.5082	0.6444	1.0215	1.6656	1.3729
5	0.0013	0.0007	0.0014	0.0028	0.0049
	0.4297	0.2061	0.5137	1.2147	1.7602
6	0.0021	0.0001	0.0032	0.0046	0.0019
	0.7246	0.0375	1.1188	1.9280	0.7378
7	0.0021	0.0034	0.0040	0.0017	0.0005
	0.8012	1.2562	1.4886	0.5565	0.1470
8	0.0013	0.0024	0.0038	0.0013	0.0014
	0.4905	0.8611	1.6033	0.4389	0.4018
9	0.0039	0.0039	0.0026	0.0007	0.0026
	1.6171	1.5155	0.9100	0.2178	0.7736
10	0.0040	0.0042	0.0019	0.0000	-0.0018
	2.0793	1.5778	0.5542	0.0113	-0.4102

Table 15 FT100 Proxy - 1/85-12/89

	Size	Beta	Skewness	PR	Variance
1	0.0117	0.0082	0.0032	0.0061	0.0072
	1.8122	1.5452	0.5334	0.8806	2.7058
2	0.0067	0.0075	0.0040	0.0089	0.0056
	1.0047	1.6922	0.8779	1.5929	2.1849
3	0.0048	0.0069	0.0059	0.0070	0.0062
	0.9049	1.4794	1.3208	1.4120	2.4344
4	0.0021	0.0063	0.0055	0.0078	0.0045
	0.4101	1.3619	1.3502	1.9208	1.4666
5	0.0009	0.0068	0.0056	0.0074	0.0055
	0.2090	1.6391	1.6988	2.1355	1.6438
6	0.0010	0.0029	0.0063	0.0052	0.0050
	0.2220	0.7420	1.9705	1.4974	1.4635
7	-0.0003	0.0053	0.0053	0.0053	0.0074
	-0.0687	1.6215	1.8252	1.8379	1.6373
8	0.0009	0.0037	0.0073	0.0039	0.0045
	0.3145	1.3453	2.3838	1.5202	0.7996
9	0.0025	0.0042	0.0076	0.0040	0.0065
	1.0118	1.2105	2.2479	1.3012	1.1088
10	0.0029	0.0036	0.0042	-0.0005	0.0021
	1.9235	1.0526	0.8590	-0.1482	0.2951

Table 16 FT100 Proxy - 1/80-12/89

	Size	Beta	Skewness	PR	Variance
1	0.0067	0.0050	0.0030	0.0035	0.0055
	1.7118	1.6128	0.8542	0.8556	3.1342
2	0.0035	0.0051	0.0020	0.0057	0.0048
	0.8983	1.8769	0.7206	1.7251	2.4122
3	0.0034	0.0046	0.0038	0.0054	0.0045
	1.0652	1.6466	1.3981	1.9095	2.4357
4	0.0017	0.0039	0.0039	0.0063	0.0041
	0.5408	1.4167	1.5918	2.5809	1.9450
5	0.0010	0.0035	0.0034	0.0051	0.0051
	0.3672	1.2885	1.6023	2.4148	2.3432
6	0.0014	0.0013	0.0047	0.0048	0.0033
	0.5426	0.4712	2.1162	2.3000	1.4705
7	0.0009	0.0043	0.0046	0.0033	0.0038
	0.3674	1.9657	2.1424	1.6122	1.3416
8	0.0011	0.0029	0.0055	0.0025	0.0027
	0.5291	1.4868	2.8299	1.2777	0.8225
9	0.0032	0.0040	0.0049	0.0022	0.0043
	1.9096	1.8000	2.1114	1.0182	1.2648
10	0.0034	0.0039	0.0026	-0.0004	-0.0002
	2.9283	1.7060	0.8046	-0.1689	-0.0413

Table 17 EWI Proxy - 1/80-12/84

	Size	Beta	Skewness	PR	Variance
1	0.0006	0.0008	0.0014	0.0000	0.0029
	0.2840	0.4919	0.9621	-0.0196	2.4934
2	-0.0007	0.0016	-0.0012	0.0010	0.0026
	-0.3480	1.0375	-1.0713	0.7348	2.4722
3	0.0007	0.0010	0.0000	0.0026	0.0014
	0.4939	0.8818	0.0157	2.7094	1.1394
4	-0.0002	0.0003	0.0011	0.0031	0.0021
	-0.1212	0.2591	1.0085	3.0584	1.9993
5	-0.0005	-0.0011	-0.0003	0.0013	0.0031
	-0.3583	-0.9755	-0.2987	1.2675	3.3987
6	0.0004	-0.0017	0.0015	0.0031	0.0003
	0.4761	-1.5843	1.2702	2.9270	0.2309
7	0.0004	0.0017	0.0023	0.0000	-0.0014
	0.3409	1.5433	1.9959	0.0102	-1.0590
8	-0.0005	0.0005	0.0022	-0.0004	-0.0005
	-0.3798	0.4771	2.1747	-0.4232	-0.2967
9	0.0023	0.0021	0.0009	-0.0010	0.0008
	1.0775	1.1923	0.7933	-0.8815	0.5748
10	0.0026	0.0024	0.0001	-0.0018	-0.0040
	1.0770	1.2493	0.1099	-1.3524	-1.6326

Table 18 EWI Proxy-1/85-12/89

1	0.0090	0.0060	0.0004	0.0029	0.0058
	3.4086	2.5039	0.2065	1.1392	4.8052
2	0.0039	0.0054	0.0015	0.0062	0.0038
	1.5134	3.7895	1.3270	3.7130	2.5029
3	0.0023	0.0047	0.0036	0.0045	0.0044
	1.3639	3.1500	3.2166	3.0990	2.4745
4	-0.0004	0.0039	0.0033	0.0057	0.0025
	-0.2469	3.4762	2.3109	5.1723	1.5868
5	-0.0013	0.0045	0.0036	0.0054	0.0035
	-1.0131	3.7965	3.2167	4.5794	2.4306
6	-0.0014	0.0006	0.0043	0.0031	0.0035
	-1.3147	0.4252	3.5089	2.4725	2.4306
7	-0.0024	0.0032	0.0033	0.0034	0.0049
	-1.7781	1.9622	2.0273	2.5183	4.0076
8	-0.0012	0.0016	0.0053	0.0021	0.0017
	-0.6549	0.7686	4.6452	1.2592	1.0780
9	0.0005	0.0018	0.0054	0.0020	0.0036
	0.1739	0.9011	3.4745	1.7104	2.0723
10	0.0011	0.0012	0.0015	-0.0027	-0.0012
	0.2919	0.5358	1.0695	-1.6541	-0.4265

Table 19 EWI Proxy - 1/80-12/89

	Size	Beta	Skewness	PR	Variance
1	0.0044	0.0033	0.0008	0.0010	0.0044
	2.3431	2.1748	0.6137	0.5705	5.1838
2	0.0012	0.0034	0.0000	0.0036	0.0034
	0.7187	2.9720	0.0556	3.1814	3.4770
3	0.0014	0.0028	0.0019	0.0035	0.0031
	1.1818	2.9318	2.4904	3.8035	2.7118
4	-0.0003	0.0020	0.0022	0.0046	0.0025
	-0.3300	2.4377	2.4583	5.6175	2.4538
5	-0.0008	0.0017	0.0018	0.0035	0.0035
	-0.9132	1.9082	2.2402	4.0120	3.7003
6	-0.0005	-0.0005	0.0031	0.0032	0.0016
	-0.6607	-0.6568	3.1803	3.8157	1.7784
7	-0.0009	0.0026	0.0030	0.0018	0.0018
	-0.9089	2.5694	2.8097	2.0728	1.8082
8	-0.0006	0.0013	0.0039	0.0010	0.0005
	-0.4618	1.0215	4.5346	0.9951	0.4484
9	0.0017	0.0022	0.0032	0.0006	0.0020
	0.9363	1.5673	3.2797	0.7334	1.7808
10	0.0021	0.0020	0.0006	-0.0021	-0.0028
	0.9444	1.3200	0.5774	-2.0326	-1.5374

Table 20 Size Indices - 1/80-12/84

	Size	Beta	Skewness	PR	Variance
1	0.0007	0.0013	0.0016	-0.0003	0.0032
	0.5808	0.9515	1.3860	-0.1455	2.7114
2	-0.0010	0.0018	-0.0012	0.0006	0.0027
	-0.6638	1.6224	-1.0318	0.4075	2.4600
3	0.0014	0.0015	0.0004	0.0026	0.0013
	1.1625	1.5601	0.4606	2.7560	1.2314
4	0.0009	0.0009	0.0013	0.0032	0.0026
	0.7229	0.8443	1.1167	3.1960	2.4035
5	0.0006	-0.0007	-0.0007	0.0011	0.0034
	0.6042	-0.7314	-0.7396	1.1432	4.0457
6	0.0014	-0.0015	0.0018	0.0032	0.0003
	1.6352	-1.5736	1.6642	3.4335	0.2528
7	0.0009	0.0023	0.0023	0.0002	-0.0010
	1.0041	2.9569	2.1095	0.2373	-0.7233
8	-0.0004	0.0002	0.0022	0.0000	-0.0003
	-0.4662	0.2045	2.4613	-0.0528	-0.1586
9	0.0019	0.0017	0.0010	-0.0004	0.0009
	2.6633	1.7307	0.8510	-0.3974	0.6068
10	0.0013	0.0019	0.0007	-0.0008	-0.0045
	1.0716	1.6195	0.5334	-0.6802	-2.0335

Table 21 Size Indices - 1/85-12/89

	Size	Beta	Skewness	PR	Variance
1	0.0048	0.0020	-0.0011	-0.0008	0.0057
	2.9737	1.1723	-0.6278	-0.3164	3.6694
2	-0.0011	0.0041	0.0006	0.0044	0.0047
	-0.8416	3.0943	0.5225	2.8808	3.9018
3	0.0009	0.0044	0.0030	0.0028	0.0046
	0.6468	3.2695	2.4083	1.6255	4.2267
4	-0.0004	0.0045	0.0030	0.0052	0.0034
	-0.2740	3.8034	2.0393	4.2557	3.0438
5	0.0012	0.0033	0.0039	0.0052	0.0031
	0.9936	2.9439	3.5824	4.2378	2.5356
6	-0.0001	0.0023	0.0036	0.0035	0.0022
	-0.0726	1.7782	2.5974	2.6890	2.0293
7	-0.0002	0.0039	0.0034	0.0034	0.0045
	-0.1645	2.7683	3.4804	3.7575	3.7269
8	0.0466	0.0083	0.0114	0.0080	0.0098
	0.8913	1.3700	2.0930	1.4200	1.2770
9	0.0018	0.0011	0.0049	0.0023	0.0022
	2.4268	0.7428	3.2306	2.2865	1.3666
10	0.0014	0.0006	-0.0005	-0.0017	-0.0061
	1.0231	0.3704	-0.3183	-1.3028	-2.6211

Table 22 Size Indices - 1/80-12/89

	Size	Beta	Skewness	PR	Variance
1	0.0022	0.0017	0.0002	-0.0009	0.0042
	2.1985	1.6608	0.1695	-0.5547	4.4809
2	-0.0012	0.0026	-0.0005	0.0023	0.0035
	-1.0777	3.0492	-0.6038	2.1064	4.1136
3	0.0011	0.0028	0.0018	0.0028	0.0028
	1.0904	3.5091	2.2106	2.8118	3.2078
4	0.0003	0.0024	0.0020	0.0044	0.0029
	0.3385	2.8339	2.2349	5.0528	3.5387
5	0.0009	0.0009	0.0014	0.0031	0.0034
	1.0766	0.9638	1.7496	3.6862	4.4027
6	0.0008	-0.0002	0.0029	0.0034	0.0010
	1.1383	-0.2235	2.8874	4.3570	1.3539
7	0.0005	0.0030	0.0028	0.0015	0.0015
	0.6537	3.6838	3.4948	1.9379	1.3873
8	-0.0003	0.0003	0.0037	0.0007	0.0003
	-0.5033	0.4509	4.8666	0.7472	0.3201
9	0.0020	0.0016	0.0025	0.0007	0.0013
	3.1925	1.8701	2.5386	0.7762	1.1921
10	0.0012	0.0015	-0.0002	-0.0013	-0.0053
	1.3648	1.5273	-0.2068	-1.4383	-3.1019

CHAPTER THREE

AN ANALYSIS OF UNIT TRUST PERFORMANCE

Since their development the use of risk-adjusted portfolio performance measures has been controversial. An earlier chapter highlighted that the criticisms of the Jensen(1968) performance measure have been of particular significance, with attention focusing on both the sensitivity of the Jensen measure to the choice of benchmark portfolio and the bias caused in the measure when managers have access to timing information. This chapter examines the empirical importance of the criticisms in the context of a sample of UK unit trusts as well as investigating trust performance.

The interpretation that the Jensen measure provides a measure of superior or inferior performance has been challenged by Roll(1977,1978) and Dybvig and Ross(1985a,b) amongst others. Roll showed that deviations from the SML are simply a reflection of the mean-variance inefficiency of the proxy portfolio. It follows that alternative benchmarks may yield different Jensen measures and indeed, that two inefficient proxies may assign the same fund a Jensen measure of opposite sign.

Difficulties also arise when market participants have heterogenous expectations and, in particular, when the investment manager has timing ability. The ability to successfully switch investments leads to an upward bias in the estimated portfolio beta and a corresponding downward bias in the Jensen measure. This has been shown by Jensen(1972) and others whilst examples in Dybvig and Ross(1985b) and Grinblatt and Titman(1989) demonstrate that it is theoretically possible for the Jensen measure to assign a market timer negative performance.

Grinblatt and Titman suggest possible solutions to some of these difficulties. They develop a model which abstracts from the necessity of assuming any particular equilibrium model and show that an appropriate benchmark portfolio is one which is ex ante mean-variance efficient with respect to the set of assets considered tradeable by investors. Such an assumption provides a way round the problem of identifying the market portfolio. Grinblatt and Titman demonstrate that using such a benchmark will correctly assign informed investors positive Jensen performance in a mean-variance world provided that the investor only has selectivity ability. A new class of performance measures called positive period weighting (PPW) measures are proposed in an attempt to overcome the timing biases in the Jensen measure.

The concern of this chapter is to examine empirically both the sensitivity of the Jensen measure to different benchmark portfolios and the importance of the timing biases. The remainder of the chapter is organised as follows. Section I describes the data used, the sample of unit trusts, the benchmarks and the methodology. Section II reports the results for the Jensen measures across four alternative benchmarks. Section III considers the impact of the timing bias in the Jensen measure in comparison to various positive period weighting measures. Section IV considers the causes of the Jensen measure differing across the proxies whilst Section V examines the impact of Jobson and Korkie (1984) procedure to rank trusts. Section VI presents concluding comments.

I DATA, SAMPLE AND METHODOLOGY

Unit trusts offer the empirical investigator readily accessible data and well documented features. The subject of a considerable number of investment performance league tables they provide an interesting group for comparative study whilst the large number of trusts and variety of investment objectives offer an opportunity for reducing the impact of confounding variables. Particular difficulties in performance measurement arise from international objectives as such an objective requires that a suitable international benchmark portfolio is specified when unit trusts invest a substanial proportion of their funds overseas. For this reason a sample of 120 trusts was chosen at random from the trusts with predominantly UK based assets and the Growth, General and Income Objectives detailed in the Unit Trust Year Book for 1980. In addition, to calculate Jensen statistics with reasonable accuracy a requirement of a minimum of two years of continuous data was imposed. Trusts with less than two years of monthly price data available were excluded leaving a total sample of 101 trusts. No other survivorship requirements were imposed.

Data was collected from January 1980 to December 1989. Over this period the history of many of the trusts was chequered with among other factors name changes, the transfer of unit trusts, mergers and termination. Name changes and transfers of unit trusts between management groups were treated as a continuation of the original trust. Mergers were treated as a termination of the trust. For each trust continuously compounded excess returns were calculated using beginning of the month offer prices taken from Money Management (since bid prices were unavailable), dividend information and ex-dividend dates recorded from the annual Extel UK Dividend and Fixed Interest Record, and the return on a one month Treasury Bill as the riskless return. A complete series of monthly returns could be calculated for 65 trusts. The remaining 36 trusts had incomplete return data for part of the period due to mergers, changes of objective or unavailable price and dividend data. When offer prices are calculated for a trust the price contains a number of expenses of the trusts e.g. stamp duty, brokerage, initial charges etc. This imples that the return series of the trusts are gross returns and not net returns.

The four different benchmark portfolios whose ex ante mean-variance efficiency was tested in a prior chapter are used in this chapter. These are the Financial Times All

Share (FTA) index, Financial Times 100 (FT100) index, an equally-weighted index (EWI) and the size based indices benchmark. Since we were unable to find an efficient benchmark portfolio (in the previous chapter) it is not possible to draw firm conclusions about the superior performance of unit trusts in a mean-variance framework in this chapter. However, the results are likely to be indicative of such performance.

The regression model used to estimate the Jensen performance measure for the four benchmarks was as follows:

$$r_{it} = \alpha_i + \sum_{k=1}^{L} \beta_{ik} r_{kt} + \epsilon_{it} \qquad (1)$$

where r_{it} is the excess return on unit trust i for period t, r_{kt} is the excess return on the benchmark portfolio k in period t k=1,....,L (in the case of single portfolio proxies, L=1), β_{ik} is the estimated measure of systematic risk for trust relative to the kth portfolio and ϵ_{it} is the residual term for trust i in period t with $E(\epsilon_{it}) = 0$ and $E(\epsilon_{it}, r_{kt}) = 0$. This specification assumes that a riskless asset exists for each period. This is required as Dybvig and Ross(1985b) show that little reliable meaning can be placed on the Jensen measure in the absence of a riskless asset. The null hypothesis of no performance ability is that $\alpha_i = 0$.

II UNIT TRUST PERFORMANCE

Table 1 presents summary statistics of the mean and standard deviation of the cross-sectional Jensen measures calculated across the four benchmarks, the FT All Share index, the FT100, the equally weighted index (EWI) and the size based portfolios. The first section of the table relates to the overall sample of trusts, the second section to the survivors (trusts in the continuous return data sample). The t statistics have been corrected, where appropriate, for serial correlation and heteroscedasticity (White (1980), Hansen(1982), Newey and West(1987)). These procedures rely on the asymptotic normality of the parameter estimates and so the resulting t statistics have only an asymptotic validity. For all benchmarks the Jensen measures are, on average, positive and increase when the sample is reduced by excluding trusts without a continuous series of data over the whole period. There appears to be clear evidence of survivorship bias in this second sample. It is also notable that the cross-sectional variability of the Jensen measures declines dramatically with the exclusion of the non-surviving trusts again supporting the existence of a survivorship bias.

Table 1 Summary of Unit Trust Performance

Benchmark	FTA	FT100	EWI	Size
Full Sample				
Average α	0.0026	0.0035	0.0021	0.0014
	(0.0041)	(0.0032)	(0.0034)	(0.0037)
+ α's	79	88	81	79
	(26)	(40)	(13)	(24)
- α's	22	13	20	22
	(2)	(-)	(-)	(1)
Survivors				
Average α	0.0048	0.0045	0.0031	0.0028
	(0.0021)	(0.002)	(0.0021)	(0.0023)
+ α's	63	62	60	56
	(22)	(30)	(11)	(23)
- α's	2	3	5	9
	(1)	(-)	(-)	(-)

* Standard Deviations in parentheses

Table 1 also provides a summary of the number of positive and negative Jensen measures together with the number of significant alphas in each sample. The number of trusts with significant coefficients are in parentheses. Fuller results are presented in Table 8 in the Appendix. For all benchmarks, positive alphas predominate and a considerable proportion of trusts appear to demonstrate significant positive investment performance. This is particularly noteworthy for the EWI benchmark since its weighting towards small companies suggests that the significant performance was not simply a reflection of the additional return available on small stocks (assuming that the typical unit trust was able to purchase and trade in smaller companies). An earlier chapter indicated the existence of large firm biases in the FTA and FT100 proxies. The positive performance against these proxies could be a reflection that most unit trusts invest in large companies.

Further analysis of the Table 1 data confirmed the survivorship bias. Many of the negative α's were for trusts which did not survive the entire period whilst nearly all of the significant positive α's were for trusts with a continuous series of return data over the period. This confirms the widely accepted conjecture that survivorship bias can overemphasise the degree of positive performance on the part of managed funds.

To consider the impact of alternative proxies in greater detail, Table 2 presents the correlation matrix between the benchmarks. The entries above the main diagonal of the table describe the Pearson correlation between the Jensen measures across the different benchmarks. Entries below the main diagonal indicate the rank correlations of the Jensen measure with each proxy. In all cases the Jensen measures are highly correlated across the proxies although significantly different from 1. Use of the Jensen measure to rank the trusts would result in rankings that differed according to the benchmark used. The choice of proxy affects the conclusions drawn. It is important to note that in principle the Jensen measure is not suitable for relative rankings unless additional restrictions are placed on investor's preferences. More careful scrutiny of the rankings, however, does suggest a considerably greater degree of consistency than these correlations suggest, particularly for the survivor sample. In all cases the rank correlations are higher within this sample than for the full sample whilst the rank correlations between the FTA, FT100 and EWI are at or above 0.99 (see Table 7). Table 3 displays the ranks and shows quite clearly, for example, that trusts in the top quartile according to the FTA remain in the top quartile for all the indices with only three exceptions for the size based benchmark. Similarly, trusts in the bottom quartile remain in the bottom quartile for the other benchmarks with very few exceptions. In general, the different proxies provide similar rankings of performance.

Table 2 Correlation Matrices Between the Jensen Measures (Entire Sample)

Benchmark	FTA	FT100	EWI	Size
FTA	1	0.917	0.875	0.896
FT100	0.833	1	0.919	0.938
EWI	0.854	0.881	1	0.872
Size	0.853	0.892	0.834	1

Table 3 Ranking of Trusts By The Jensen and Adjusted Jensen Measures (Survivors Only)

JENSEN				ADJUSTED		
FTA	**FT100**	**EWI**	**Size**	**FTA**	**FT100**	**EWI**
1	1	2	6	3	3	22
2	2	1	1	2	2	14
3	3	3	2	1	1	9
4	4	4	4	4	4	5
5	5	5	3	5	5	2
6	6	6	9	8	13	3
7	7	7	5	6	6	1
8	8	11	7	9	9	7
9	9	8	10	7	7	4
10	10	9	13	17	20	8
11	11	10	8	10	12	6
12	14	12	11	22	22	19
13	13	13	12	12	11	10
14	16	18	39	14	15	13
15	15	15	19	21	24	18
16	12	16	24	16	18	12
17	17	20	17	24	29	20
18	20	23	28	13	10	15
19	18	19	15	26	35	17
20	21	17	56	11	8	11
21	19	22	14	28	38	23
22	23	21	35	36	28	40
23	26	14	42	15	14	16
24	22	24	18	33	58	25
25	24	28	20	35	54	28
26	25	26	25	34	46	31
27	27	25	23	18	17	24
28	29	27	26	30	30	34
29	28	29	21	20	21	21
30	30	31	22	31	32	29
31	35	30	55	43	34	53
32	32	36	45	32	31	32
33	33	33	16	19	16	26
34	34	35	30	44	41	46
35	31	32	29	27	26	27
36	36	37	50	29	25	35
37	41	34	47	42	27	44
38	40	40	34	25	23	33
39	37	38	36	48	44	45
40	39	39	37	46	48	50
41	38	42	38	52	61	47
42	42	41	40	41	40	36
43	45	45	44	23	19	30
44	43	43	31	50	51	41
45	44	44	49	53	57	52
46	46	50	33	39	36	42
47	48	47	41	57	55	57
48	47	51	32	58	64	55
49	50	46	54	55	50	51
50	49	52	48	40	39	38
51	51	48	46	51	47	54
52	52	49	60	38	37	37
53	53	53	51	45	43	39
54	55	55	58	47	42	48
55	54	54	43	49	52	49
56	56	56	53	60	60	56
57	58	59	62	65	56	65
58	57	57	52	63	62	64
59	59	58	57	54	45	60
60	60	61	59	64	63	62
61	61	62	61	61	59	58
62	62	60	27	37	33	43
63	63	63	63	59	53	63
64	64	64	64	56	49	59
65	65	65	65	62	65	61

Despite the encouraging number of positive alphas appears to suggest that managers have superior information, care must be taken in drawing conclusions about unit trust performance. Tests from an earlier chapter have revealed that each of the proxies is mean-variance inefficient. Dybvig and Ross (1985a) and Green (1986) have demonstrated that when the proxy is inefficient with respect to the efficient frontier (as assessed by uninformed investors) then positive α's are not necessarily indicative of positive performance since inefficient portfolios may also plot above the SML. Certainly, however, given the assumption that a riskless asset exists for each period, the possibility of superior performance cannot be ruled out. In addition, Dybvig and Ross show that α's can provide guidance about marginal improvements in a portfolio although not about a total shift between one portfolio and another. Consequently, positive α's by the trusts suggests that investors who hold any of the benchmarks could improve their mean-variance position by adding a portion of the unit trust to their existing portfolio.

III TIMING BIASES IN THE JENSEN MEASURE

It is well known that the Jensen performance measure can assign negative performance to investors with market timing abilities. To overcome this difficulty Grinblatt and Titman (1989) develop a class of performance measures called period-weighting measures which are a weighted sum of the evaluated portfolio's excess returns:

$$\alpha^{*} = \sum_{t=1}^{T} w_t r_{it} \qquad (2)$$

where r_{it} is the excess return on fund i in period t and w_t is the weight for period t. The time series of weights are estimated to satisfy two conditions:

(i) the weighted sum of the benchmark portfolio excess returns must equal zero

$$\sum_{t=1}^{T} w_t r_{pt} = 0$$

(ii) and the weights must sum to one.

$$\sum_{t=1}^{T} w_t = 1$$

Grinblatt and Titman show that the Jensen measure is equivalent to a period weighting measure with weights:

$$w_t = [\sigma^2_p - (r_{pt} - r_p^{*}) r_p^{*}]/T\sigma^2_p \qquad (3)$$

where σ_p^2 and r_p^{*} are the sample variance and mean of excess returns of the benchmark portfolio p. It is clear that whenever r_{pt} is high, the weights may become negative so reducing the Jensen measure. This difficulty can be overcome by imposing the condition that $w_t>0$.

The Jensen period weights of the FTA, FT100 and EWI proxies were calculated using both an unbiased estimate and maximum likelihood estimate of the sample variance of the benchmark portfolio's excess returns. The difference between the two estimates were minimal with 120 observations. None of the weights were found to be negative. Since σ^2_p and $T\sigma^2_p$ are always positive, the weights will only be negative if:

$$(r_{pt} - r_p^{*}) r_p^{*} > \sigma^2_p$$

which can be rearranged to give the minimum excess return on the benchmark portfolio before the weights become negative:

$$r_{pt} = \sigma^2_p / r_p^* + r_p^*.$$

For the weights to be negative the monthly excess returns on the benchmark FTA index would have to be greater than 110.18%. For the FT100 and EWI proxies the figures were 89.31% and 55.01% respectively. These return figures reveal why negative weights do not occur for this particular time horizon for any of the proxies.

Grinblatt and Titman also show that given certain assumptions, the large sample least squares estimate of the fund's beta will be biased upwards when the manager has market timing ability. Assuming that the manager's response in changing portfolio beta to timing information increases monotonically with the timing signal and is symmetric around the fund's target beta, Grinblatt and Titman show that the least squares estimate of beta is:

$$b_i = \beta_{iT} + (r_p^* / \sigma^2_p) * \text{cov}(\beta_i, r_p)$$

where β_{iT} is the target beta of the fund and $\text{cov}(\beta_i, r_p)$ is the sample covariance between the fund's beta and the benchmark portfolio's excess returns and represents the timing component of the fund's performance. When $\text{cov}(\beta_i, r_p)$ is positive, the beta estimate is biased upwards with the extent of the bias determined by the mean-variance ratio of the benchmark (r^*_p / σ_p^2). If this ratio is small, then the bias in the estimated beta will be small even when the timing component is large. The mean-variance ratio for the FTA was 0.0091 and for the FT100 and EWI, 0.0112 and 0.0183 respectively. These very low ratios suggest that any potential biases due to timing in the Jensen measure are negligible (unless the sample covariance is very large). To further consider the impact of timing biases on the Jensen measure, positive period weighting(PPW) performance measures were calculated for each of the single portfolio benchmarks. The economic intuition underlying the PPW measures is as follows. Consider an uninformed investor who can trade in N risky assets and a riskless asset exists. If the investor is a mean-variance optimiser then he will choose r_p as the optimal portfolio of risky assets to hold.

Each period the uninformed investor has to decide how to split his resources between the riskless asset and the risky portfolio. With the assumption that returns are viewed by the uninformed investor as being independently and identically distributed, then this optimal combination will remain unchanged across time. The optimal choice will depend upon the form of the investor's utility function. The investor will choose the proportions so as to maximise the expected utility of end of period wealth. Grinblatt and Titman note that if we replace the summations with expectations and treat w_t as marginal utilities then $E(w_t r_{pt}) = 0$ which is the first order condition for maximising the utility of an uninformed investor. The period weighting measure will calculate the marginal change in utility of the uninformed investor by adding a portion of the evaluated portfolio to his existing one. If the measure is positive, then the uninformed investor's existing optimal position can be improved upon.

To illustrate the intuition more formally, consider an uninformed investor in period t with a power utility function of the form:

$$U(W_t) = 1/(1-b)W^{1-b}$$

where W_t is the end of period wealth and b is the coefficient of relative risk aversion. This is the utility function used by Grinblatt and Titman(1988) and Cumby and Glen(1990) in their analysis. In a mean-variance framework and given the existence of a riskless asset, the decision each period will be how to split resources between the riskless asset and the risky portfolio . End of period wealth will be equal to:

$$W_t(\gamma) = 1 + \gamma R_{pt} + (1 - \gamma) R_{ft}$$

where R_{pt} and R_{ft} are the total returns on the optimal portfolio p and riskless asset, γ is the proportion invested in the risky portfolio. Initial wealth is set equal to 1 one each period. In excess return form, this can be written as:

$$W_t(\gamma) = 1 + \gamma r_{pt}$$

where r_{pt} is the excess return on portfolio p. Substituting $W_t(\gamma)$ into the utility function yields:

$$U(W_t) = 1/(1-b)*(1 + \gamma r_{pt})^{1-b}$$

Differentiating with respect to γ gives an optimal γ as:

$$E((1 + \gamma^{*} r_{pt})^{-b} r_{pt}) = 0$$

$$E(W(\gamma^{*})^{-b} r_{pt}) = 0$$

Cumby and Glen suggest that γ^{*} is estimated by setting $\sum_{t=1}^{T} W_t(\gamma^{*})^{-b} r_{pt} = 0$. The weights in the period weighting measure are set to $w_t = W_t(\gamma^{*})^{-b}$. This satisfies the condition that $\sum_{t=1}^{T} w_t r_{pt} = 0$. The weights are then normalised to sum to one. Whenever multiple portfolio benchmarks are used, the situation becomes more complicated.

To implement their measures empirically, Grinblatt and Titman (1988) suggest a four step procedure that involves: the estimation of the optimal proportion to be invested between the benchmark portfolio and riskless asset for a given utility function, the computation of a time series of excess returns on this optimal portfolio, the calculation for the given utility function of the marginal utility of wealth (the return series are treated as wealth levels) and finally, the use of the marginal utilities as weights. Grinblatt and Titman (1989) show that in large samples the α^{*} for an uninformed investor will be zero and for an informed investor with selectivity and/or independent timing information the α^{*} will be positive.

An infinite variety of utility functions are available to us. Two commonly used functions are power and log utility functions and the PPW measures were estimated for these functions. A coefficient of relative risk aversion of 3 was assumed for the power measure. Other coefficients of relative risk aversion were tried but had no impact on the results. Using this coefficient, the optimal proportion to be invested in the FTA proxy was 0.28 with the remainder invested in the riskless asset. For the log utility function, the optimal proportion was 0.8 in the FTA. The analysis was repeated for the FT100 and the EWI proxies. In these cases the proportions were 0.34(FT100) and 0.54(EWI) for the power function and 0.96 and 1.47 respectively for the log utility function. The PPW measures were calculated only for those trusts with a complete set of monthly returns.

Table 4 presents summary statistics for the two PPW measures for the single portfolio benchmarks. The first part of the table describes the cross-sectional mean and standard deviations for the PPWs of the trusts. Comparing with similar figures in Table 1 for the Jensen measure, it can be seen that the PPWs are almost identical to the corresponding Jensen measure. Parts A) and B) of Table 4 are correlation matrices. Part A are the correlations between the PPW measures across different benchmark portfolios. Correlations below the diagonal refer to the PPW measure calculated using a log utility function and entries above the diagonal to a power utility function. Part B are the correlations between the two PPWs measures and the Jensen measure using the same benchmark portfolio. Entries below the diagonal refer to the FTA proxy and entries above the diagonal refer to the FT100 proxy. The matrices indicate that the PPWs are highly positively correlated across different benchmark portfolios. Additionally for a given benchmark portfolio, there is an exact positive correlation between the two PPWs and the Jensen measure. These results confirm the earlier evidence that the timing biases in the Jensen measure are almost non-existent.

Table 4 Summary of Unit Trust PPW Performance Measures

	FTA	FT100	EWI
PPW-Log	0.0048	0.0044	0.0031
	(0.0021)	(0.0021)	(0.0022)
PPW-Power	0.0048	0.0044	0.0031
	(0.0021)	(0.0021)	(0.0022)
A) Correlation Matrix	PPW Measures		
	FTA	FT100	EWI
FTA	1	0.998	0.995
FT100	0.999	1	0.995
EWI	0.995	0.995	1
B) Correlation Matrix			
	PPW_L	PPW_P	Jensen
PPW_L	1	1	1
PPW_P	1	1	1
Jensen	1	1	1

IV DEVIATIONS BETWEEN PROXIES

Additiional insight into the differences in the Jensen measures between the proxies can be provided by work developed in Green(1986). Green seeks to identify the factors which cause the Jensen measure of any asset to differ across benchmarks. Using equation (10) in Green, it can be shown that when a riskless asset exists this will be equivalent to:

$$\alpha_{iq} - \alpha_{ip} = (\lambda_p - \lambda_q)\sigma_{ip} + \lambda_q(\sigma_{ip} - \sigma_{iq}) \qquad (4)$$

where σ_{ip}, σ_{iq} are the covariances between asset i and proxy p and i and proxy q respectively, α_{iq} and α_{ip} are the Jensen measures of asset i using proxies q and p, $\lambda_p = r_p/\sigma^2_p$ and $\lambda_q = r_q/\sigma^2_q$. In this case differences in deviations occur for two reasons. These are that λ_p does not equal λ_q and the proxies are imperfectly correlated. The two terms on the right hand of the equation (4) can be expanded in a similar fashion to Green's equations (11) and (12) except that r_p and r_q refer to excess returns.

$$(\lambda_p - \lambda_q)\sigma_{ip} = (\sigma_{ip}/\sigma^2_q)[\lambda_p(\sigma^2_q - \sigma^2_p) + (r_p - r_q)] \qquad (5)$$

The upper bound of the second term is:

$$\lambda_q\sigma_i[\sigma_p\sigma_q(\sigma_p/\sigma_q + \sigma_q/\sigma_p - 2\rho_{pq})]^{1/2} \qquad (6)$$

where ρ_{pq} is the correlation between the proxies p and q.

Green points out that when the two proxies are close in mean and variance, the first term in (4) will approach zero. As the proxies become more highly correlated, the 2nd term in (4) tends to zero. Due to this, proxies that are highly correlated and close in mean-variance will produce similar deviations. However it should be noted that the first term is proportional to σ_{ip} and the second term to σ_i. Green stresses that this suggests that deviations across proxies will most likely differ for assets with extreme betas or high standard deviation.

Table 5 reports summary statistics for the three proxies over the entire period. It is apparent that benchmark deviations are likely to be most similar for the FTA and FT100 proxies since they are closer in mean-variance space (market price of risk) and more highly correlated with each other than with the EWI.

Table 5 Summary Statistics of Market Proxies

1/80-12/89	**FTA**	**FT100**	**EWI**
Mean*	0.35	0.34	0.44
Standard deviation	6.2	5.5	4.9
Correlation with FTA	1.0	0.9	0.875
Correlation with FT100		1.0	0.86
Correlation with EWI			1.0
Market price of risk	0.91	1.12	1.83

* % per month (excess returns)

Table 6 presents in summary form for the 65 trusts how deviations differ across the proxies. Each trust in turn was treated as asset i and the figures in Table 6 reflect the average across the 65 trusts. The second column in Table 6 is the average change in the Jensen measure for the trusts in moving from one proxy to another. The third column is the first term in equation (4) $(\lambda_p-\lambda_q)\sigma_{ip}$ and shows the change in the benchmark error $(\alpha_{iq}-\alpha_{ip})$ due to the difference in the market price of risk for the two proxies $(\lambda_p-\lambda_q)$. The fourth column is the upper bound on the second term of equation (4) and with the first term gives the range in which possible changes in the benchmark error occur. This bound will be large if dramatic changes in benchmark error can occur. The fifth column reveals by how much the maximum possible change in the benchmark error would fall if the proxies were perfectly correlated. This measures the effect of the proxies being imperfectly correlated.

Table 6 Benchmark Errors (Survivors Only)

q-p	$\alpha_{iq} - \alpha_{ip}$	$(\lambda_p-\lambda_q)\sigma_{ip}$	Bound	%
FT100-FTA	-0.0003	-0.0006	0.0017	55
EWI-FTA	*-0.0016*	*-0.0026*	*0.0031*	*31*
FTA-FT100	0.0003	-0.00056	0.0014	50
EWI-FT100	-0.0013	-0.0019	0.0028	47
FTA-EWI	0.0016	0.0021	0.0015	24
FT100-EWI	0.0013	0.0016	0.0017	40

Table 6 reveals significant differences in the contribution of the market price of risk to the benchmark errors, smallest for the FTA and FT100 and largest for the EWI and FTA as Table 5 would suggest. It also shows how the bound on the change in the benchmark error depends on the particular choice of p and q. The proxy portfolios are not interchangeable so that the assignment of the FTA as p and EWI as q is not the same as the assignment of EWI as p and the FTA as q. This reflects the dependence of the change in the benchmark error both on the standard deviation of the difference in the returns on the proxies and on the market price of risk λ_q. The higher the market price of risk, for example, when EWI is assigned as q, the greater the bound on the benchmark error is likely to be.

The Jensen measure of performance will be most accurate when the difference in the market price of risk implied by the benchmarks is small. In practical terms this requires the returns and variance on alternative indices to be broadly similar. Unfortunately even when the implied market prices of risk are similar circumstances can occur where substantial deviations in benchmark error occur due to poor correlation between the proxy portfolios although as Table 4 reveals the correlations between the indices used in this study are high. Despite this, imperfect correlation is the cause of the considerable increase in the bound on the change in the benchmark error, particularly between the FT100 and FTA where the change in the benchmark is small. Additionally the differences in the Jensen measure between the FTA or FT100 proxies with the EWI proxy is due more to the impact of differences in the mean-variance ratio.

V UNIT TRUST PERFORMANCE RANKINGS

The Jensen and positive period weighting measures cannot, in principle, be used to rank different funds unless additional restrictions are placed on investor's preferences. However, Jobson and Korkie (1984) demonstrate that an adjusted Jensen ratio can be used to rank trusts. They focus on the performance contribution that additional assets make to an existing portfolio. The performance contribution is defined as the change in the maximum attainable Sharpe performance measure of the given asset set before and after the new assets are added to the portfolio. This can be written as $\Delta a = a - a_1$ where a is the optimum Sharpe measure of the new asset set and a_1 is the highest Sharpe measure of the original asset set.

Jobson and Korkie consider the existence of a riskless asset and N risky assets where
where $N = N_1 + N_2$ assets. N_1 is the number of assets held before adding N_2 new assets. The mean and covariance matrices of the N assets are partitioned as follows:

$$R = \begin{Bmatrix} R_1 \\ R_2 \end{Bmatrix} \qquad V = \begin{Bmatrix} V_{11} & V_{12} \\ V_{21} & V_{22} \end{Bmatrix}$$

Δa can be rewritten as:

$$\Delta a = R'V^{-1}R - R_1'V^{-1}{}_{11}R_1$$

By using the formulae for partitioned matrices in Morrison(1976), Jobson and Korkie rewrite Δa as:

$$\Delta a = [r_2 - V_{21}V_{11}^{-1}r_1]'[V_{22} - V_{21}V_{11}^{-1}V_{12}]^{-1}[r_2 - V_{21}V_{11}^{-1}r_1]$$

They point out that the vector $[r_2 - V_{21}V_{11}^{-1}r_1]$ is the (N_2*1)

intercept vector of the multivariate regression model of the excess returns of the N_2 new assets on the original N_1 assets. Additionally the matrix $[V_{22} - V_{21}V_{11}^{-1}V_{12}]$ is the residual covariance matrix in such a regression. Due to this, Jobson and Korkie also write $\Delta a = \alpha' V_{22.1}^{-1}\alpha$ where $V_{22.1} = [V_{22} - V_{21}V_{11}^{-1}V_{12}]$ and α is the (N_2*1) intercept vector.

Whenever $N_1 = 1$ and $N_2 = 1$ i.e. running a simple Jensen type regression of a managed fund on the benchmark, it is possible to identify the performance contribution of adding some of the managed fund to the benchmark. Jobson and Korkie show that in this case $\Delta a = \alpha_i^2/\sigma^2_\epsilon$ where α_i is the Jensen α and σ_ϵ^2 is the residual variance of the regression. Using this result, Jobson and Korkie point out that if only one asset can be added to the existing portfolio, then will choose the one with the highest $\alpha_i^2/\sigma_\epsilon^2$. Thus can use to rank several funds in order to identify which is the best fund to add to a given benchmark portfolio.

The rankings calculated on the basis of this ratio were compared with the actual rankings of the original Jensen measures. Table 7 summarises the results. Full results of the adjusted Jensen measure are reported in Table 9 in the Appendix. It confirms the earlier evidence in Section III that the choice of proxy is important since using both the Jensen and the adjusted Jensen measure, the rankings differ across proxies. It is also apparent that the rankings provided by the adjusted Jensen measure differ from those provided by the Jensen measure, reaffirming the possible need to use the adjusted measure in performance comparisons. There remains, however, a high degree of consistency in the rankings. Funds ranked in the top quartile by the adjusted FT100 measure remain in the top quartile for the other two adjusted measures (Table 3). Across all measures, the funds ranked in the top quartile by the Jensen FT100 statistic remain in the top quartile with relatively few exceptions (three for the adjusted FTA and EWI and four for the adjusted FT100). It would appear that the Jensen measure is more robust to different proxies and adjustments than is sometimes assumed.

Table 7 Rank Correlation Matrix(Survivors Only)

	FTA-Adj Jensen	FT100-Adj Jensen	EWi-Adj Jensen	FTA Jensen	FT100 Jensen
FT100-Adj Jensen	0.948				
EWI-Adj	0.961	0.865			
FTA-Jensen	0.908	0.814	0.912		
FT100-Jensen	0.902	0.795	0.914	0.997	
EWI-Jensen	0.907	0.820	0.91	0.994	0.99

VI CONCLUSIONS

This chapter has examined two of the main criticisms of the Jensen performance measure, timing and the choice of the benchmark portfolio. For a sample of unit trusts over the period 1980-1989 the potential timing biases in the Jensen measure are shown to be negligible. Only the issue of using an appropriate benchmark portfolio appears to be relevant empirically. The results of this chapter are largely supportive of the Jensen measure. The critical issue is the need to find a benchmark portfolio which is *ex ante* mean-variance efficient. However, even if inefficient proxies are used the Jensen measure can still provide guidance about marginal improvements in performance and displays more robustness in its rankings than is generally assumed. Secondary issues raised in the chapter include the importance that survivorship bias can have upon the conclusions drawn about fund performance.

Survivorship bias overexaggerates the degree of performance. Finally, using Green's analysis it is possible to provide insights into why deviations vary across inefficient proxies.

APPENDIX

Table 8 Jensen Performance Measures Using Alternative Benchmark Portfolios

	FTA Proxy		FT100 Proxy		EWI Proxy		Size Indices	
Trust	α_i	t stat	α_i	t stat	α_i	t stat	α_i	t stat
1	0.0034	1.4487	0.0031	1.5691	0.0016	0.8387	0.0002	0.1457
2	0.0053	2.2471	0.0049	3.3797	0.0039	1.6188	0.0033	2.2058
3	0.0008	0.3391	0.0004	0.2785	-0.0008	-0.3251	-0.0011	-0.7291
4	0.0040	1.7761	0.0038	1.8671	0.0024	1.5669	0.0031	1.8765
5	0.0063	2.2632	0.0060	2.4152	0.0049	1.9450	0.0055	2.4097
6	0.0065	2.6807	0.0062	3.4135	0.0050	2.0389	0.0046	2.8514
7	0.0059	2.3694	0.0056	3.5334	0.0044	2.0952	0.0030	2.4435
8	0.0071	2.5609	0.0068	3.4928	0.0055	2.5315	0.0045	2.5765
9	0.0080	2.0129	0.0077	2.0425	0.0061	1.7064	0.0022	0.6296
10	0.0060	2.1226	0.0057	2.6876	0.0044	2.0537	0.0041	2.2688
11	0.0052	2.0153	0.0049	2.5766	0.0035	1.7381	0.0031	1.7809
12	0.0052	2.1571	0.0050	1.9332	0.0034	1.7130	0.0042	2.2066
13	0.0043	1.5615	0.0039	3.1802	0.0029	1.1967	0.0017	0.9738
14	0.0052	1.6323	0.0050	1.5962	0.0038	1.4249	0.0030	1.0942
15	-0.0001	-0.0223	0.0019	0.4168	0.0038	1.4249	0.0029	1.0080
16	0.0061	1.9873	0.0057	2.2127	0.0044	1.5164	0.0058	2.5512
17	0.0049	1.8144	0.0046	2.0011	0.0035	1.3053	0.0040	1.5584
18	0.0046	1.7299	0.0043	1.9903	0.0029	1.3378	0.0021	1.4524
19	0.0049	1.8643	0.0047	2.0567	0.0031	2.0887	0.0046	3.4706
20	0.0060	1.9994	0.0056	2.3352	0.0044	1.4520	0.0044	2.1629
21	0.0002	0.0810	0.0031	0.9476	0.0034	0.5675	-0.0033	-0.8169
22	0.0042	1.5467	0.0037	3.1762	0.0027	0.9647	0.0017	1.0138
23	0.0038	1.5184	0.0034	2.0869	0.0021	0.7613	0.0010	0.5596
24	0.0032	0.9705	0.0027	1.0927	0.0013	0.4329	-0.0002	-0.0857
25	0.0053	2.1603	0.0049	2.6881	0.0037	1.8109	0.0033	2.0816
26	0.0035	1.4474	0.0031	1.7447	0.0020	0.8161	0.0017	1.0241
27	0.0097	2.8959	0.0092	3.8743	0.0081	2.3858	0.0074	2.8174
28	0.0035	1.2030	0.0030	1.5296	0.0020	0.6941	0.0020	0.8228
29	0.0046	1.5097	0.0043	1.5662	0.0031	0.9386	0.0018	0.6710
30	0.0090	2.4926	0.0085	2.8001	0.0076	2.2085	0.0074	2.1620
31	0.0040	1.5677	0.0066	2.6911	0.0034	1.1986	0.0059	2.4297
32	0.0050	1.7355	0.0048	1.7614	0.0035	1.4330	0.0044	2.1720
33	0.0056	1.6851	0.0054	1.6464	0.0041	1.4637	0.0039	1.4770
34	0.0038	1.0031	0.0037	0.9605	0.0021	0.7167	0.0049	1.6691
35	-0.0021	-0.5845	0.0002	0.0462	0.0040	1.1331	0.0028	1.5070
36	0.0032	1.0658	0.0027	1.5501	0.0012	0.5674	0.0009	0.5077
37	0.0034	1.1533	0.0031	1.1474	0.0021	0.7188	0.0034	1.0737
38	0.0041	1.2602	0.0040	1.1402	0.0020	0.7969	0.0039	1.5735
39	0.0055	2.0536	0.0052	2.3469	0.0039	1.4545	0.0036	1.7949
40	0.0057	2.2211	0.0053	2.9207	0.0040	1.4753	0.0029	1.6573
41	-0.0006	-0.2014	-0.0007	-0.2132	-0.0024	-0.9534	-0.0006	-0.2236
42	0.0034	1.0588	0.0031	1.0664	0.0017	0.6315	0.0005	0.1912
43	-0.0100	-1.8300	-0.0072	-1.4410	-0.0059	-0.7862	-0.0133	-2.4011
44	-0.0044	-0.8019	-0.0026	-0.4515	-0.0010	-0.1949	-0.0035	-0.5790
45	0.0079	2.8292	0.0076	3.2503	0.0064	2.2383	0.0062	2.3368
46	0.0036	1.4867	0.0033	2.2038	0.0022	0.8363	0.0013	0.8718
47	0.0084	2.8436	0.0082	3.0436	0.0070	2.5967	0.0071	2.3541
48	0.0075	2.9475	0.0071	4.5126	0.0062	2.6397	0.0055	2.8375
49	-0.0004	-0.0905	-0.0006	-0.1670	-0.0025	-0.7281	-0.0032	-0.8378
50	0.0049	1.7417	0.0045	2.0377	0.0031	1.1472	0.0018	0.8259
51	0.0040	1.6105	0.0036	2.3421	0.0025	0.9335	0.0009	0.5613
52	0.0029	0.8172	0.0026	0.7774	0.0006	0.2532	0.0002	0.0674
53	0.0034	0.5048	0.0061	0.8901	0.0081	1.1206	0.0056	0.7140
54	0.0031	1.4191	0.0064	2.4728	0.0092	1.7092	0.0014	0.3843
55	0.0049	1.5437	0.0046	1.7363	0.0034	1.1684	0.0010	0.3407
56	0.0064	2.2248	0.0059	3.2104	0.0047	1.7337	0.0039	2.0986
57	0.0022	0.6198	0.0018	0.5930	0.0005	0.1318	-0.0008	-0.2857
58	0.0011	0.4380	0.0035	1.4328	0.0007	0.2790	0.0001	0.0407
59	0.0016	0.1557	0.0041	0.3876	0.0067	0.6341	0.0013	0.1443
60	0.0058	2.3623	0.0054	3.1777	0.0041	1.8723	0.0044	2.5246
61	0.0026	1.0546	0.0022	1.2238	0.0004	0.1756	0.0001	0.0441
62	0.0059	2.4137	0.0056	2.9144	0.0042	1.8284	0.0046	2.8149
63	0.0003	0.0812	-0.0001	-0.0218	-0.0021	-0.6120	-0.0030	-1.0283
64	0.0020	0.7190	0.0016	1.0398	0.0005	0.1969	-0.0001	-0.0513
65	0.0037	1.1567	0.0037	1.1173	0.0025	0.8606	0.0024	0.8896
66	0.0050	1.5821	0.0046	1.9221	0.0031	1.1312	0.0026	1.2795

67	0.0063	2.1341	0.0059	2.5240	0.0045	1.5212	0.0045	1.9295
68	0.0070	3.3525	0.0069	3.1578	0.0056	3.1842	0.0064	3.4761
69	0.0037	1.5569	0.0061	2.8853	0.0033	1.1944	0.0033	1.5721
70	0.0044	1.7431	0.0040	2.8181	0.0029	1.2218	0.0020	1.2238
71	0.0074	2.4259	0.0071	2.5321	0.0055	2.2664	0.0053	2.0791
72	-0.0075	-0.8531	-0.0043	-0.4738	-0.0051	-0.5621	-0.0075	-0.8930
73	0.0032	0.8745	0.0064	1.8957	0.0030	0.8256	0.0036	0.9480
74	0.0029	1.0312	0.0026	1.0770	0.0014	0.5280	-0.0003	-0.1202
75	0.0045	1.4016	0.0042	1.6358	0.0028	1.0826	0.0019	0.8575
76	0.0059	2.4187	0.0056	3.0856	0.0043	2.2011	0.0036	2.3108
77	-0.0045	-0.3791	-0.0034	-0.2956	-0.0076	-0.6147	-0.0050	-0.5600
78	-0.0073	-0.4842	-0.0075	-0.4983	-0.0093	-0.6108	-0.0123	-0.6850
79	-0.0010	-0.3673	0.0014	0.5460	-0.0019	-0.7277	-0.0003	-0.1278
80	0.0022	1.0075	0.0058	2.5646	0.0025	0.9599	0.0043	1.8797
81	0.0013	0.3965	0.0009	0.3841	-0.0005	-0.1447	-0.0014	-0.5433
82	-0.0022	-0.5275	0.0008	0.2028	-0.0037	-1.1216	-0.0016	-0.4925
83	0.0059	2.0791	0.0055	2.2101	0.0044	1.6223	0.0030	1.2022
84	-0.0008	-0.1660	0.0026	0.5100	0.0011	0.2323	0.0001	0.0139
85	-0.0056	-2.9381	-0.0009	-0.3902	-0.0020	-0.5548	-0.0028	-1.0709
86	-0.0034	-0.8257	0.0002	0.0411	-0.0012	-0.2411	-0.0001	-0.0209
87	0.0019	0.4864	0.0049	1.2908	0.0016	0.5324	0.0020	0.7186
88	-0.0005	-0.1347	0.0021	0.6037	-0.0005	-0.1459	-0.0014	-0.4206
89	-0.0011	-0.1406	0.0016	0.1804	0.0010	0.1017	-0.0025	-0.3148
90	-0.0035	-0.5671	0.0002	0.0359	-0.0033	-0.5546	-0.0030	-0.4810
91	-0.0073	-1.4363	-0.0053	-1.0204	-0.0042	-0.7512	-0.0078	-1.7235
92	0.0015	0.2013	0.0046	0.6446	0.0039	0.5044	0.0007	0.1098
93	0.0024	0.8364	0.0057	1.9882	0.0013	0.4829	0.0033	1.5127
94	0.0028	0.6928	0.0072	1.7648	0.0022	0.9780	0.0029	1.1861
95	0.0025	1.0370	0.0068	2.6197	0.0031	1.0492	0.0034	1.2759
96	-0.0008	-0.2050	0.0026	0.6397	0.0002	0.0760	0.0005	0.1725
97	-0.0084	-1.7847	-0.0028	-0.5552	-0.0053	-1.2220	-0.0048	-1.1447
98	-0.0022	-0.9566	0.0022	0.8398	0.0012	0.3564	0.0005	0.1953
99	0.0006	0.2090	0.0040	1.2387	0.0008	0.2821	0.0004	0.1167
100	-0.0059	-1.5747	-0.0016	-0.4198	-0.0036	-1.0464	-0.0031	-0.9985
101	-0.0079	-2.0066	-0.0036	-0.8558	-0.0048	-1.1427	-0.0060	-1.5528

Table 9 Adjusted Jensen Measures (Survivors Only)

Trust	FTA	FT100	EWI
1	0.0200543	0.021006	0.0065547
2	0.0515462	0.102770	0.0256812
3	0.0011649	0.000669	0.0009752
4	0.0344138	0.032128	0.0209759
5	0.0452149	0.049616	0.0260210
6	0.0714241	0.101276	0.0403243
7	0.0685227	0.108139	0.0400636
8	0.0766325	0.103764	0.0580908
9	0.0344457	0.035482	0.0248747
10	0.0513148	0.061439	0.0369810
11	0.0485718	0.056444	0.0255605
12	0.0395617	0.031790	0.0250796
13	0.0305330	0.080367	0.0122589
14	0.0232066	0.022036	0.0150196
16	0.0356578	0.041644	0.0196440
17	0.0291545	0.034060	0.0145555
18	0.0283297	0.033693	0.0150935
19	0.0410071	0.035979	0.0351918
20	0.0371315	0.045797	0.0196977
22	0.0296531	0.089268	0.0086069
23	0.0239781	0.039343	0.0055852
24	0.0087563	0.010156	0.0015749
25	0.0440733	0.061462	0.0286483
26	0.0197756	0.025891	0.0060622
27	0.0761247	0.108227	0.0478037
28	0.0136179	0.019901	0.0040891
29	0.0193765	0.020863	0.0075263
30	0.0578861	0.068917	0.0455788
32	0.0256056	0.026389	0.0155992
33	0.0211845	0.020033	0.0127626
34	0.0088981	0.008134	0.0036490
35	0.0419145	0.049587	0.0256197
36	0.0136963	0.020437	0.0027502
37	0.0113080	0.011199	0.0044144
38	0.0135017	0.011059	0.0054248
39	0.0388843	0.046849	0.0191955
40	0.0503255	0.077988	0.0223797
41	0.0003449	0.000386	0.0077662
42	0.0099228	0.009673	0.0034072
45	0.0750819	0.093026	0.0432509
46	0.0214142	0.032315	0.0070062
47	0.0708591	0.078791	0.0576035
48	0.0820540	0.107967	0.0494739
49	0.0000871	0.000229	0.0045147
50	0.0287182	0.035316	0.0126267
51	0.0252598	0.041810	0.0079769
52	0.0057785	0.004966	0.0004816
55	0.0177497	0.017823	0.0087726
56	0.0486111	0.078672	0.0262295
57	0.0037308	0.003306	0.0001793
60	0.0533390	0.085886	0.0299480
62	0.0562374	0.072246	0.0287463

63	0.0000580	0.000004	0.0032003
64	0.0068507	0.010213	0.0003350
65	0.0099903	0.009343	0.0052962
66	0.0240042	0.031423	0.0117462
67	0.0429493	0.054187	0.0206403
68	0.0982305	0.084814	0.0896337
70	0.0297341	0.060195	0.0128860
71	0.0548609	0.056789	0.0471967
74	0.0086919	0.008796	0.0021312
75	0.0174689	0.018432	0.0082289
76	0.0664635	0.080983	0.0409168
81	0.0017012	0.001201	0.0002467
83	0.0367467	0.041547	0.0224830

CHAPTER FOUR

THE SELECTIVITY AND MARKET TIMING PERFORMANCE OF UK UNIT TRUSTS

The previous chapter considered the overall performance of the sample of unit trusts relative to a number of alternative benchmark portfolios. In recent years, a number of authors have sought to identify the skills of investment managers at forecasting both individual security prices and general market movements. This began with work by Treynor and Mazuy(1966) and since then numerous econometric techniques have been applied to this area. Performance measures of market timing and selectivity ability separate into two main areas, those that use only portfolio return data and those which require data on portfolio holdings/actual forecasts. Grinblatt and Titman(1989) and Elton and Gruber(1991) present measures of selectivity and timing ability which use portfolio composition data. Measures which rely on such information are more powerful than the measures which only use return data.

This chapter examines the market timing and selectivity abilities of the sample of UK unit trusts. Two alternative methodologies are used which only require portfolio return data. This is because portfolio composition data was unavailable The chapter is organised as follows. Section I describes the methodology used to test for selectivity an market timing abilities. Section

II reports the results of tests of the timing and selectivity abilities of the trusts for the three single portfolio benchmarks. Section III presents results of a multi-index extension to tests of timing ability. Section IV presents concluding comments.

I METHODOLOGY

Fama(1972) suggested that a manager's forecasting ability could be split into two separate activities:

(1) Microforecasting - where the manager attempts to forecast future price movements of individual securities.

(2) Macroforecasting - where the manager forecasts future price movements of the stock market in general.

(1) is referred in the literature as selectivity ability and (2) as market timing ability. It is presumed that a manager receives information signals and acts on the basis of that information to achieve better performance.

Two methodologies are used in this chapter to evaluate the timing and selectivity abilities of the sample of UK unit trusts. These are the methods of Chen and Stockum(1986)/ Lockwood and Kadiyala(1988) and Hendriksson and Merton(1981). Both approaches make different assumptions about the forecasts made by managers which leads to the alternative econometric specifications. Although the tests are usually associated with a CAPM equilibrium framework, they are also approximately applicable to Grinblatt and Titman's(1989) more general framework.

The theoretical framework of Lockwood and Kadiyala stems from Jensen(1972) and Hendriksson and Merton's procedures from Merton(1981). In Jensen's analysis, the manager is assumed to forecast by how much the return on the market portfolio will differ from its expected return. Merton assumes that the manager simply forecasts whether or not the market portfolio will outperform riskless bonds.

Grinblatt and Titman(1989) show that given the existence of N risky assets and a riskless asset, when portfolio p is ex ante mean-variance efficient, then the excess return on a portfolio can be written as:

$$r_{it} = \beta_{it} r_{pt} + \epsilon_{it} \quad (1)$$

with $\beta_{it} = \sum_{j=1}^{N} x_{jt}\beta_j$ and $\epsilon_{jt} = \sum_{j=1}^{N} x_{jt}\epsilon_{jt}$ where x_{jt} are the portfolio weights of asset j at time t, $\beta_j = cov(r_{jt}, r_{pt})/var(r_{pt})$ and ϵ_{jt} is a residual term for asset j. Within the Jensen(1972) analysis, the kth manager's perception of the expected excess return on portfolio p can be written as:

$$E_k(r_{pt}) = E(r_p) + \pi_{pt}$$

where $E(r_p)$ is the unconditional expected excess return on portfolio p which is assumed constant through time and π_{pt} is a mean zero disturbance from the expected value of portfolio p in period t which we can call a market factor.

Jensen presents a behavioural model of market timing and selectivity. It is assumed that a portfolio is managed for a group of investors who have identical utility functions over the single period mean and variance of the portfolio's excess return. The manager incorporates his forecast of π_{pt} into his portfolio so as to maximise the expected utility of the shareholders. This ignores the possibility of agency costs between the managers and shareholders. The manager's forecast π_{pt}^* is formed on the basis of the information set $\Phi_{i,t-1}$ available to the manager at time t - 1 i.e.

$$\pi_{pt}^* = E(\pi_{pt}/\Phi_{t-1}).$$

The variance of the manager's forecast is

$$\sigma^2_k(\pi_{pt}) = Var(\pi_{pt}/\Phi_{i,t-1}).$$

Jensen initially assumes that the manager only has access to timing information. The manager has to decide each period how to split the fund's resources between the riskless asset and portfolio p. Assuming that there are no restrictions on short sales, borrowing and lending and no transactions costs, the expected excess return and variance of the portfolio will be:

$$E(r_{it}) = \gamma_t[E(r_p) + \pi_{pt}^*]$$

$$V(r_{it}) = \gamma_t^2\sigma_i^2(\pi_{pt}^*)$$

where γ_t is the portion of the fund invested in the portfolio p. Jensen shows that the optimal choice of γ_t is equivalent to:

$$\gamma_t = (1/2\sigma_i^2(\pi_{pt}))(dV(r_i)/dE(r_i))[E(r_p) + \pi_{pt}^*]$$

where $dV(r_i)/dE(r_i)$ is the slope of the indifference curve of the fund's investors between the mean and variance of excess returns (or risk tolerance). From this, the optimal choice of systematic risk for the portfolio β at each point in time can be derived as:

$$\beta_{it} = \Theta_{it}E(r_m) + \Theta_{it}\pi^*_{pt} \qquad (2)$$

where $\Theta_{it} = (1/2\sigma^2_i(\pi_{pt}))(dV(r_i)/dE(r_i))$

(This follows from the fact that $\beta_p = 1$, $\beta_{it} = \gamma_t\beta_p$ and as a result $\beta_{it} = \gamma_t$).

Θ_{it} measures the extent to which the manager will allow his forecast to alter the portfolio risk level of the fund. This is determined by how uncertain the forecast is $\sigma^2_k(\pi_{pt})$ and the willingness of the fund's investors to bear extra risk to achieve higher returns. The more uncertain the forecast and the greater the degree of risk aversion of the investors, then the smaller will be the adjustment in the risk level of the fund.

Jensen assumes that the manager's forecasts and the market factor are jointly normally distributed:

$$\pi_{pt} = d_0 + d_1\pi_{pt}^* + v_{kt} \qquad (3)$$

The constants d_0 and d_1 corrects for any systematic biases that occur in the manager's forecasts, v_{kt} is normally distributed with mean zero and $cov(\pi^*_{pt}, v_{kt}) = 0$. Whenever d_0 and d_1 do not equal 0 and 1 respectively, then the forecasts will be adjusted as follows:

$$\pi_{pt}' = d_0 + d_1\pi_{pt}^* \qquad (4)$$

$$= \pi_{pt} - v_{kt}$$

The term π_{pt}' is the adjusted forecast and it is assumed that the manager knows d_0 and d_1. Jensen points out that from equations (3) and (4), $\sigma^2_k(\pi_{pt}) = \sigma^2(v_{kt})$. Assuming that $dV(r_p)/dE(r_p)$, $E(r_p)$ and $\sigma^2(\pi_{pt})$ are all constant through time, the optimal choice of beta each period can be written as:

$$\beta_{it} = \beta_i + \theta_i \pi_{pt}'$$

where $\beta_i = \theta_i E(r_p)$ and is equivalent to the target risk level of the fund. A similar equation can be derived when the manager also has access to information about individual securities. The manager may then hold a different portfolio to portfolio p i.e. q and lever up or down in response to timing information. The only difference will be that

$$\theta_i = (\beta_q / 2\sigma^2(\pi_{pt}))(dV(r_i)/dE(r_i))$$

where β_q is the beta of portfolio q.

Jensen notes that the assumption of constant $dV(r_i)/dE(r_i)$ through time is strictly only true for investors with utility functions that exhibit constant absolute risk aversion e.g. negative exponential utility function. Jensen argues that it is not possible to disentangle selectivity and market timing abilities when managers use optimal adjusted forecasts. Lee and Rahman(1990) show that it is possible using the work of Pfleiderer and Bhattacharya(1983) who correct an error in Jensen's analysis.

Jensen shows that selectivity and timing ability can be extracted when managers only use their unadjusted forecasts π_{pt}^*. Since π_{pt}^* and π_{pt} are bivariate normally distributed, then:

$$\pi_{pt}^* = d_0' + d_1'\pi_{pt} + v_{kt}'$$

where d_0' and d_1' are regression coefficients, v_{kt} is normal with $E(v_{kt}) = 0$ and $E(v_{kt}\pi_{pt}) = 0$. Substituting into equation (3) for π^*_{pt} and assuming a constant Θ_{kt} through time, yields:

$$\beta_{it} = \beta_i + a_k\pi_{pt} + w_{kt}$$

where $a_k = \Theta_k d'_1$, $w_{kt} = \Theta_k v_{kt}$ and $\beta_i = \Theta_k(E(r_p) + d_0')$. β_i can be viewed as the target beta of the fund, $a_k\pi_{pt}$ captures the movement of the market timing activities of the manager and w_{it} is the random element of the beta term. This is the method followed by Lockwood and Kadiyala(1988) who rewrite β_{it} as:

$$\beta_{it} = \delta_{i1} + \delta_{i2}\pi_{pt} + \Phi_{it}$$

Substituting for β_{it} in equation (1) gives:

$$r_{it} = \alpha_i + \delta_{i1}r_{pt} + \delta_{i2}Q_{pt} + u_{it} \qquad (6)$$

where $u_{it} = r_{pt}\Phi_{it} + \epsilon_{it}$ and $Q_{pt} = r_{pt}\pi_{pt}$ and assume that Φ and ϵ are uncorrelated.

Chen and Stockum(1986) use a similar method to Lockwood and Kadiyala except that the fund's beta at each time period is:

$$\beta_{it} = \beta_i + \lambda_i r_{pt} + \Phi_{it}$$

where β_i is the target risk level of the fund, $\lambda_i r_{pt}$ reflects the impact of altering the portfolio beta due to timing decisions of managers and Φ_{it} is a random error term with mean zero. Chen and Stockum's regression specification becomes:

$$r_{it} = \alpha_i + \beta_i r_{pt} + \lambda_i r_{pt}^2 + u_{it} \qquad (7)$$

where $u_{it} = \Phi_{it}r_{pt} + \epsilon_{it}$.

The regression specification is based on the random coefficients model of Hildreth and Houck(1968).

Implementing either the Chen and Stockum or Lockwood and Kadiyala regression empirically is identical. The advantage of this approach is that the fund's beta can vary through time not only because of the timing activities of managers but also due to random variations. This can arise if the underlying securities held by the fund exhibits beta nonstationarity. The null hypothesis of no selectivity and timing ability are that $\alpha_i = 0$ and $\lambda_i = 0$ respectively. Significantly positive α_i and λ_i are evidence of superior selectivity and market timing abilities. The null hypothesis of no random variation in the fund's beta is that $\sigma^2_\Phi = 0$.

An alternative approach to modelling market timing has been advanced by Merton(1981) and Hendriksson and Merton(1981). It is assumed that managers simply attempt to forecast whether stocks outperform riskless bonds or vice-versa. Suppose $\gamma(t)$ is the forecast variable of the manager, $\gamma(t) = 1$ when the forecast is that $R_{pt} > R_{ft}$ and $\gamma(t) = 0$ when the forecast is that $R_{pt} \leq R_{ft}$. R_{pt} is the total return on portfolio p. Hendriksson and Merton define the following conditional probabilities:

$$p_1(t) = prob(\gamma(t) = 0/R_{pt} \leq R_{ft})$$

$$1 - p_1(t) = prob(\gamma(t) = 1/R_{pt} \leq R_{ft})$$

$$p_2(t) = prob(\gamma(t) = 1/R_{pt} > R_{ft})$$

$$1 - p_2(t) = prob(\gamma(t) = 0/R_{pt} > R_{ft})$$

$p_1(t)$ and $p_2(t)$ are the conditional probabilities of a correct forecast. The statistic $p_1(t) + p_2(t)$ measures the manager's forecasting ability. Hendriksson and Merton present both nonparametric and parametric tests to evaluate a manager's timing ability. The nonparametric tests requires access to the manager's forecasts. The parametric tests suffers from the drawback that requires an assumption of an asset return generating process.

In their parametric tests, Hendriksson and Merton assume a CAPM framework for the return generating process. It is also assumed that the portfolio manager chooses between two portfolio systematic risk levels depending on the manager's forecasts. Define η_{i1} as the target beta level of the fund when the manager's forecast is that $r_{pt} \leq 0$ and η_{i2} as the target beta level of the fund if the forecast is that $r_{pt} > 0$. The beta of fund i at any given point in time t will equal either of these two fund levels. It is important to note that the analysis can be easily extended to consider cases where the manager chooses between a wider range of fund risk levels. If the manager has rational forecasts then $\eta_{i2} > \eta_{i1}$. Hendriksson and Merton note that the unconditional expected value of β_{it} is b_i which is equal to:

$$b_i = q[p_1\eta_{i1} + (1-p_1)\eta_{i2}] + (1-q)[p_2\eta_{i2} + (1-p_2)\eta_{i1}] \quad (8)$$

where q is the unconditional probability that $r_{pt} \leq 0$. The difference between β_{it} and b_i is the unexpected value of the fund's beta and is termed Θ_{it}. The period t excess return of fund i is written as:

$$r_{it} = [b_i + \theta_{it}]r_{pt} + \lambda + \epsilon_{it} \quad (9)$$

where λ is the increase in the portfolio's returns from the manager's micro-forecasting activities.

To measure the selectivity and timing performance, Hendriksson and Merton use the regression specifications.

$$r_{it} = \alpha_i + \beta_{1i}(r_{pt}) + \beta_{2i}D_t(r_{pt}) + \epsilon_{it} \quad (10)$$

where D_t is a dummy variable which equals -1 if $r_{pt} \leq 0$ and equals 0 if $r_{pt} > 0$.

The motivation of the specification in equation (10) stems from Merton(1981). Hendriksson and Merton point out that the portfolio returns of a managed fund which follows a market timing strategy as posited will correspond to the returns of a put option investment strategy. For each dollar invested in the strategy, $(p_2\eta_{i2} + (1-p_2)\eta_{i1})$ dollars are placed in the market portfolio (or portfolio p), $(p_1+p_2-1)(\eta_{i2}-\eta_{i1})$ put options are bought on the market portfolio (or portfolio p) at an exercise price of R_{ft} and the remainder is invested in riskless assets. The insight of Merton is that market timing can be thought of as acting as insurance where the timer gains from positive market movements but is insured against losses. Hendriksson and Merton note that this implies that $(p_1+p_2-1)(\eta_{i2}-\eta_{i1})$ put options are obtained free of charge. It is shown that:

$$\text{plim } \beta_{i1} = (p_2\eta_{i2} + (1-p_2)\eta_{i1})$$

$$\text{plim } \beta_{i2} = (p_1+p_2-1)(\eta_{i2}-\eta_{i1})$$

The term $D_t(r_{pt})$ is the return on a put option on the portfolio p with exercise price R_{ft}. The coefficient β_{2i} is the number of free put options provided by the market timing strategy. The null hypothesis of no market timing ability is that $\beta_{2i} = 0$. This can occur if the manager has no forecasting ability i.e. $p_1(t) + p_2(t) = 1$ or does not act on forecasts i.e. $\eta_{i1} = \eta_{i2}$. The null hypothesis for selectivity ability is that $\alpha_i = 0$ since plim $\alpha_i = \lambda$. Significantly positive α_i and β_{2i} is evidence of superior selectivity and timing performance.

The main differences between the Hendriksson and Merton and Chen and Stockum's approaches stem from two sources. Firstly the models make different assumptions about the manager's forecasts. This leads to the alternative econometric specifications. Secondly Hendriksson and Merton attribute all beta non-stationarity to the timing activities of managers whereas Chen and Stockum allow for random beta fluctuations in the fund. The main drawback of the two methods is that it is necessary to specify a return generating model e.g. CAPM in order to measure selectivity and timing performance. If the portfolio composition of the fund or the manager's forecasts were observable, then more powerful tests of timing could be performed.

In both the Chen and Stockum and Hendriksson and Merton regression specifications, the error term is heteroscedastic. Chen and Stockum use Generalised Least

Squares(GLS) estimation to estimate equation (7). GLS estimation will be most appropriate when the adjustment for heteroscedasticity is in fact the correct one and there is no serial correlation in the residuals. An alternative approach is to estimate equations (7) and (10) by Ordinary Least Squares(OLS) estimation and correct the estimated covariance matrix of the parameters for the effects of heteroscedasticity and serial correlation using the methods of White(1980) or Newey and West(1987). The procedures of White and Newey and West will lead to adjusted 't' statistics being estimated. The adjusted 't' statistics will have an asymptotic validity. This procedure is followed in this study. Breen, Jagannathan and Ofer(1986) show that this is particularly useful when the form of heteroscedasticity is unknown. The statistical significance level of tests in this chapter are set at 5% (two-tail).

II TIMING AND SELECTIVITY PERFORMANCE-SINGLE PORTFOLIO BENCHMARKS

This section reports the results of the tests of market timing and selectivity abilities for the sample of 101 unit trusts described in the previous chapter. The evidence within this section relates to the three single portfolio benchmarks i.e. the FTA, FT100 and EWI proxies. The two regression specifications of equations (7) and (10) were estimated for each of the benchmark portfolios. Tables 8-13 in the Appendix report the selectivity and timing measures of the trusts and adjusted t statistics using the three benchmark portfolios. Standard deviations are reported in parentheses. Table 1 and 2 presents the cross-sectional means and standard deviations of the selectivity and timing performance measures for the different benchmark portfolios. Table 1 refers to the Chen and Stockum method and Table 2 to the Hendriksson and Merton method. The results are recorded for the overall sample of trusts and the trusts with continuous return data.

Table 1 Summary Statistics of Selectivity and Timing Performance Measures (Chen and Stockum)

All sample	FTA	FT100	EWI
Selectivity	0.0038	0.0056	0.0034
	(0.0043)	(0.0036)	(0.0034)
Timing	-0.303	-0.655	-0.5
	(0.703)	(0.721)	(0.981)
Survivors			
Selectivity	0.0055	0.0064	0.0043
	(0.0024)	(0.002)	(0.00269)
Timing	-0.168	-0.56	-0.4
	(0.47)	(0.54)	(0.63)

Table 2 Summary Statistics of Selectivity and Timing Performance Measures(Hendriksson and Merton)

All sample	FTA	FT100	EWI
Selectivity	0.0024	0.00783	0.00508
	(0.00519)	(0.0054)	(0.00519)
Timing	0.00703	-0.22	-0.188
	(0.2537)	(0.25)	(0.33)
Survivors			
Selectivity	0.0027	0.0086	0.005
	(0.00363)	(0.0036)	(0.0038)
Timing	0.096	-0.203	-0.112
	(0.168)	(0.187)	(0.191)

Tables 1 and 2 show that the average selectivity measures are all positive whereas the average timing measures are mainly negative. The trusts exhibit the best selectivity performance against the FT100 proxy but also the worst timing performance. This is consistent across the two methodologies. When the survivors only sample is considered, the average selectivity measures are higher and the average timing measures are less negative. The cross-sectional variability of the performance measures is also much lower for the survivors only sample. These results indicate the effect of only including surviving funds in performance measurement studies. When this is the case the conclusions about the performance of the funds will be more favourable than it would have been if non surviving funds were also included.

The results in Tables 1 and 2 are confirmed in Table

3. Table 3 reports the number of trusts with positive and negative selectivity and timing coefficients for each benchmark portfolio. The number of trusts with significant coefficients are recorded in parentheses. Columns 2 to 4 relate to the Chen and Stockum method and columns 5 to 7 to the Hendriksson and Merton method.

Table 3 Summary of Selectivity/Timing Performance

	Chen and Stockum			Hendriksson and Merton		
All Sample	FTA	FT100	EWI	FTA	FT100	EWI
α_i +	87	94	88	72	95	88
	(25)	(58)	(25)	(5)	(58)	(20)
α_i -	14	7	13	29	6	13
	(-)	(-)	(-)	(1)	(1)	(-)
Timing (+)	40	11	26	64	15	27
	(1)	(1)	(2)	(3)	(1)	(-)
Timing (-)	61	90	75	37	86	74
	(12)	(49)	(12)	(6)	(30)	(8)
Surv-ivors						
α_i +	64	65	62	50	65	59
	(20)	(50)	(24)	(2)	(45)	(17)
α_i -	1	(-)	3	15	-	6
	(-)	(-)	(-)	(-)	(-)	(-)
Timing (+)	27	4	15	50	6	18
	(-)	(-)	(1)	(2)	(-)	(-)
Timing (-)	38	61	50	15	59	47
	(2)	(36)	(8)	(1)	(21)	(2)

The evidence in Table 3 indicates that unit trusts tend to have positive selectivity ability and negative market timing ability. For both methods, the FT100 proxy has the highest number of positive selectivity coefficients and negative timing coefficients. The EWI has the second highest number of positive selectivity and negative timing terms whereas the FTA has the lowest. Comparing the two different methodologies, it would seem that for the FT100 and EWI proxies the inferences are similar. For the FTA proxy there is some difference especially for timing ability. A final point to note from the table is that there are very few trusts with significantly negative selectivity ability or significantly positive timing ability. The evidence of the survivors only sample indicates that the significant positive selectivity performance is in general found for those trusts which survive. Apart from the FT100 proxy, many of the significant negative timing measures are for trusts which die. This clarifies the evidence in Tables 1 and 2.

The use of an inefficient benchmark portfolio in the tests may have a similar effect on the selectivity and timing measures as on the Jensen measure. Since the passive portfolio strategies described in chapter 2 involve no selectivity or timing information, the selectivity and timing performance of these portfolios should not be statistically different from zero. However inefficiencies in the benchmark portfolio may cause biases in the measures. Tests (which are not reported) indicate that many of the passive portfolios exhibit positive selectivity performance and negative timing performance against the single portfolio benchmarks. This makes the interpretation of the positive selectivity performance of many unit trusts recorded in this section ambiguous.

It would appear from Tables 1 to 3 that many unit trusts exhibit superior selectivity ability but possess either inferior or no timing ability. This suggests a trade off between selectivity and timing activities of trust managers. Table 4 confirms this trade-off and reports the cross-sectional correlation between the selectivity and timing measures for each benchmark portfolio using the two methodologies. The correlations refer to both the overall sample of trusts and the survivors only.

Table 4 Cross-Sectional Correlations of Selectivity and Timing Measures

	Correlation-all	Survivors
Chen and Stockum-FTA	-0.352	-0.577
FT100	-0.469	-0.537
EWI	-0.355	-0.607
Hendriksson and Merton-FTA	-0.702	-0.844
FT100	-0.808	-0.848
EWI	-0.797	-0.821

Table 4 shows that all of the cross-sectional correlations are negative between the selectivity and timing coefficients. This indicates that a trust with a higher positive selectivity measure will more likely have a lower negative timing performance and vice-versa. Additionally the correlations are much higher for the

Hendriksson and Merton approach and the survivors only sample.

The trade-off between selectivity and timing performance has also been found in a number of academic studies in the USA (Hendriksson(1984), Chang and Lewellen(1984) and Connor and Korajczyk(1988a) amongst others). The negative correlation could be due to a number of reasons. It may be that it does reflect a genuine trade-off between the selectivity and timing performance of investment managers. However academics have been reluctant to draw this conclusion and have sought alternative explanations. Hendriksson(1984) suggests that it might be due to the misspecification of the market portfolio or the exclusion of relevant factors from the return generating process. Since the negative correlation persists across all the benchmark portfolios, this suggests that the second reason may be more appropriate. This is examined in the next section.

Jagannathan and Korajcyzk(1986) argue that the negative correlation between selectivity and timing performance can be induced by funds investing in securities with option like characteristics. They demonstrate that the same payoff pattern as predicted by the Hendriksson and Merton(1981) parametric specification can be obtained by a portfolio strategy which buys call options on the market portfolio each period. This leads to positive market timing but negative selectivity when a premium is paid on the option. Jagannathan and Korajcyzk note that this does not imply that funds invest in options. All securities have option like characteristics due to the impact of risky debt that companies hold. Funds which invest in securities that are more option like than the market proxy will have positive timing and negative selectivity. Funds which invest in less option like securities than the market proxy will have negative timing and positive selectivity. It is difficult to determine how important this explanation is in practice.

To conclude this section, tests were carried out to assess the random fluctuations in the trusts' portfolio betas for each proxy. It was noted in Section I that $\sigma^2_{\Phi i}$ captures the random element in a fund's beta. Chen and Stockum estimate $\sigma^2_{\Phi i}$ by extracting the residuals from equation (7) and running the following regression:

$$u_{it}^2 = a + br_{pt}^2 \qquad (11)$$

where a and b are parameter estimates of $\sigma^2_{\epsilon i}$ and $\sigma^2_{\Phi i}$ respectively. One of the difficulties with the estimation procedure is that there is no guarantee that the estimates will be positive. As a result negative estimates of σ^2_{ϵ} will be converted to zero (this is similar to the procedures of Chen and Stockum). Table 5 presents the results of the number of trusts with positive and negative $\sigma_{\Phi i}^2$ for each proxy. Significant coefficients are in parentheses. It can be seen from Table 5 that only for the FTA proxy is there a large number of trusts exhibiting some degree of random beta variation. Why this should be so is something of a mystery.

Table 5 Tests of Random Beta Variation

	FTA	FT100	EWI
Positive	76	29	71
	(45)	(2)	(1)
Negative	25	72	30

III TIMING AND SELECTIVITY WITH A MULTIPLE PORTFOLIO BENCHMARK

Connor and Korajcyzk(1986,1988a) have demonstrated the validity of performance measurement within an Arbitrage Pricing Theory(APT) framework. The 1988 study extends the Hendriksson and Merton methodology of selectivity and timing to an APT context. This allows the manager to possess timing information with respect to any of the factors generating returns. We can apply the approach to the size based indices as follows:

$$r_{it}=\alpha_i+\beta_{i1}r_{1t}+\ldots+\beta_{ik}r_{kt}+\gamma_{i1}D_t r_{1t}+\ldots+\gamma_{ik}D_t r_{kt}+e_{it} \quad (12)$$

where $r_{1t},\ldots.r_{kt}$ are the excess returns on the size based portfolios j=1,,,k, $\beta_{i1},\ldots..,\beta_{ik}$ are the ith fund's beta coefficients relative to each factor, D_t is a dummy variable which equals zero if $r_{jt} > 0$ and is equal to -1 when r_{jt} is less than or equal to 0.

The null hypothesis of no selectivity ability is that $\alpha_i=0$ and for no timing ability with respect to any given factor $\gamma_{ij}=0$. If $\gamma_{ij} > 0$ then this reflects that the manager has superior information about factor j. Connor and

Korajcyzk use a simplified approach in their tests and include only a put option on the market portfolio in equation (12) to test for timing ability. It is assumed that the market portfolio is a linear combination of the factor portfolios. The regression equation becomes;

$$r_{it} = \alpha_i + \sum_{j=1}^{k} \beta_{ij} r_{jt} + \gamma_i D_t r_{pt} + \epsilon_{it} \qquad (13)$$

The test for no timing ability is that $\gamma_i = 0$. Equation (13) was estimated using the three size based indices and the EWI as the market proxy. Table 6 presents a summary of the number of trusts with positive selectivity and timing coefficients (significant coefficients are in parentheses). The cross-sectional correlations are also recorded. Table 14 in the Appendix contains individual trusts' selectivity and timing measures with adjusted t statistics.

Table 6 Selectivity and Timing Performance with the Size Based Indices Benchmark

All Sample	Selectivity	Timing
Positive	78	34
	(12)	(5)
Negative	23	67
	(1)	(13)
Survivors only		
Positive	52	17
	(9)	(4)
Negative	13	48
	(1)	(12)
Correlation - all sample	0.193	
Correlation - survivors only	-0.106	

The striking feature of Table 6 is that the correlation between the selectivity and timing measures for the overall sample of trusts is now positive. This may indicate that the negative correlation of the previous section is being driven by an inappropriate return generating model. However the evidence in Table 6 still shows that the majority of trusts are unable to time the market. Most unit trusts have insignificant positive selectivity performance and insignificant negative timing performance. Additionally most of the trusts with significant positive selectivity performance are surviving trusts. This again confirms the importance of survivorship bias.

It is of interest to consider the selectivity and timing performance of the passive portfolios using the multi-index approach adopted in the section. Table 15 in the Appendix reports the selectivity and timing coefficients and adjusted t statistics of the 50 passive portfolios described in chapter 2 over the period Jan 1980 to December 1989. Table 15 provides further support of this methodology to evaluate timing ability. Only three out of the fifty timing coefficients are significantly different from zero. This implies that this regression gives the most reliable guide to the trusts' timing performance of all the methods used in this chapter. However a number of selectivity measures are significantly positive. This indicates that inefficiencies in the benchmark affect the selectivity statistic as it does for the Jensen(1968) measure. In spite of this, it is still encouraging that inefficiencies do not appear to affect the inferences drawn about timing performance if the correct return generating model is specified.

The evidence in this section of the positive selectivity performance of a number of trusts may be due to superior ability or the inefficiencies in the benchmark portfolio used. This ambiguity is the same across all of the four benchmark portfolios. There is evidence that very few trusts seem to be able to successfully time the market. Most unit trusts exhibit neutral timing performance.

To conclude this section and chapter, the sample of 101 unit trusts were grouped into three portfolios on the basis of the investment objective of the trusts as recorded in the Unit Trust Yearbook 1980. The investment objectives used were General, Income and Growth. Portfolios of trusts were also formed of only those trusts with continuous return data. The sample of 65 surviving trusts were divided into four portfolios on the basis of the investment objective of the trust as recorded in the Unit Trust Yearbook 1990. The objectives included UK General, UK Equity Income, UK Growth and Balanced. In the mid 1980s there was a reorganisation in trust objectives. Equally-weighted portfolio excess returns were calculated for all seven portfolios for the 120 months.

The regression in equation (13) was estimated for each of the seven portfolios. Table 7 presents the selectivity and timing measures of the portfolios with adjusted t statistics. The evidence in Table 7 shows that the General portfolio exhibits superior selectivity performance with both samples of trusts. The most surprising result is the significant positive timing performance of the UK Equity Income portfolio of trusts. However for the overall sample of trusts, none of the portfolios have significant timing performance.

Table 7 Selectivity/Timing Performance of Trust Objective Sorted Portfolios using the Multi-Index Approach

Whole Sample	General	Income	Growth	
Selectivity	0.0038	0.0014	0.0019	
	3.08**	1.14	1.29	
Timing	-0.07	0.08	-0.13	
	-0.87	1.61	-1.19	
Survivors	UK General	UK Eq. Income	UK Growth	Balanced
Selectivity	0.0038	0.0006	0.0022	0.0002
	3.07**	0.45	1.59	0.11
Timing	-0.022	0.18	-0.08	0.17
	-0.31	3.18**	-0.82	1.32

** Significant at 1%

IV) SUMMARY AND CONCLUSIONS

This chapter has examined the selectivity and timing performance of a sample of UK unit trusts during the 1980s. A number of issues emerge from the chapter. The first is that the negative correlation between selectivity and timing performance found in this chapter appears to be due to the misspecification of the return generating model. When the multi-index model is used, the negative correlation disappears for the overall sample of trusts. There is evidence that suggests that inefficiencies in the benchmark portfolio will cause similar biases in the selectivity performance measures as in the Jensen measures. It is encouraging that for the multi-index approach, very few of the passive portfolios exhibit significant timing ability. This suggests that inefficiencies in the benchmark have minimal effects on timing performance. If the appropriate return generating model is specified, this raises the potential of an unambiguous interpretation of timing performance even when the benchmark portfolio is inefficient.

The evidence in this chapter suggests that a number of unit trusts may possess superior stock selectivity ability but very few trusts are able to time the market. The positive selectivity performance of many trusts is consistent with the evidence in the previous chapter with the Jensen measure. This positive performance is not necessarily reflective of superior ability but it does not rule it out. It is important to keep in mind that the trust returns are gross returns and perhaps it is not surprising to see the positive performance in this chapter or the previous one. However it does suggest that many trusts would be good marginal investments for investors if they held any of the benchmark portfolios. Another feature of the chapter is the impact that survivorship bias can have on the conclusions drawn about fund performance. Including only surviving trusts in the sample tends to exaggerate the degree of positive performance. A useful extension of this study would be to evaluate the selectivity and timing performance using performance measures which require portfolio composition data. These are likely to give more accurate evidence of the selectivity and timing performance than the measures used in this study.

APPENDIX

Tables 8-14 report the selectivity and timing coefficients of the trusts using the different benchmark portfolios. The first column in each table is the number that each trust was assigned. The second and third columns are the coefficients and adjusted t statistics for selectivity performance. The fourth and fifth columns are the coefficients and adjusted t statistics for timing performance.

Chen and Stockum's Regression Specification

Table 8 Selectivity/Timing Performance of Trusts - FTA Proxy

Trust	α_i	t stat	λ_i	t stat
1	0.0052	1.9943	-0.4420	-0.9769
2	0.0051	1.8486	0.0375	0.0554
3	0.0026	1.0024	-0.4223	-0.7475
4	0.0043	1.8405	-0.0553	-0.1758
5	0.0066	2.1271	-0.0522	-0.0960
6	0.0082	3.1006	-0.3840	-0.6080
7	0.0059	2.1342	0.0038	0.0066
8	0.0064	2.0965	0.1675	0.3147
9	0.0103	2.2416	-0.5454	-0.8761
10	0.0059	1.9412	0.0193	0.0369
11	0.0032	1.1498	0.4764	1.1310
12	0.0053	1.9430	-0.0407	-0.2205
13	0.0038	1.2635	0.1293	0.2091
14	0.0067	1.8587	-0.3623	-0.8133
15	0.0018	0.3471	-0.5470	-0.8201
16	0.0052	1.5682	0.2182	0.4334
17	0.0044	1.4453	0.1219	0.4005
18	0.0056	1.9128	-0.2316	-0.3897
19	0.0063	2.3431	-0.3408	-1.0734
20	0.0067	2.0321	-0.1675	-0.2794
21	-0.0035	-0.9529	0.9345	3.9349
22	0.0047	1.5698	-0.1044	-0.1653
23	0.0046	1.6152	-0.1907	-0.2744
24	0.0048	1.3321	-0.3760	-0.5711
25	0.0052	1.8716	0.0141	0.0291
26	0.0027	0.9678	0.1709	0.2995
27	0.0095	2.6150	0.0271	0.0398
28	0.0025	0.7619	0.2234	0.3579
29	0.0053	1.4666	-0.1488	-0.3417
30	0.0122	3.0353	-0.7656	-1.2230
31	0.0064	2.1707	-0.5883	-3.5353
32	0.0036	1.1091	0.3384	0.8090
33	0.0058	1.6947	-0.0630	-0.1430
34	0.0034	0.7955	0.1028	0.2054
35	0.0038	1.4582	0.2774	0.8158
36	0.0025	0.7869	0.1686	0.3043

37	0.0022	0.6903	0.2901	0.7796
38	0.0062	1.6839	-0.4908	-1.7624
39	0.0056	1.8676	-0.0175	-0.0361
40	0.0070	2.3782	-0.3103	-0.4394
41	0.0010	0.3039	-0.3831	-1.6402
42	0.0036	0.9785	-0.0501	-0.0910
43	-0.0124	-2.2176	0.6717	0.9494
44	-0.0088	-1.3631	1.3243	1.8225
45	0.0093	2.8727	-0.3192	-0.5497
46	0.0041	1.4615	-0.1076	-0.1890
47	0.0062	1.8037	0.5398	1.4840
48	0.0082	2.7629	-0.1652	-0.2956
49	0.0100	2.3143	-2.4558	-2.4069
50	0.0067	2.1886	-0.4191	-0.7773
51	0.0047	1.6556	-0.1841	-0.3554
52	0.0065	1.7823	-0.8601	-1.4619
53	0.0034	0.4584	0.0190	0.0135
54	0.0014	0.6222	0.4984	1.3625
55	0.0096	2.4281	-1.0911	-1.4367
56	0.0057	1.7232	0.1596	0.2204
57	0.0059	1.5068	-0.8812	-1.0423
58	0.0054	2.1843	-1.0528	-3.7137
59	0.0030	0.2719	-0.4202	-0.4098
60	0.0045	1.6343	0.2987	0.5939
61	0.0023	0.7305	0.0677	0.1275
62	0.0059	2.1356	0.0062	0.0130
63	-0.0011	-0.2713	0.3304	0.4781
64	0.0018	0.5942	0.0462	0.0838
65	0.0066	1.8913	-0.6946	-1.3831
66	0.0050	1.4723	-0.0103	-0.0161
67	0.0075	2.3004	-0.2742	-0.4789
68	0.0093	4.0190	-0.5290	-2.2639
69	0.0061	2.4321	-0.6125	-1.7820
70	0.0039	1.3279	0.1160	0.1964
71	0.0101	2.9906	-0.6460	-1.0324
72	0.0022	0.2899	-2.5306	-1.4372
73	0.0082	2.0234	-1.8608	-1.8152
74	0.0025	0.7731	0.0973	0.2370
75	0.0048	1.3072	-0.0703	-0.1438
76	0.0050	1.9315	0.2018	0.5486
77	-0.0063	-0.4335	0.4220	0.3718
78	-0.0020	-0.1738	-1.2766	-1.4272
79	0.0039	1.3101	-1.2356	-4.9197
80	0.0007	0.2508	0.5833	1.4080
81	0.0067	1.9100	-1.2706	-1.3837
82	0.0024	0.5253	-1.1742	-3.4888
83	0.0042	1.3247	0.3947	1.1779
84	0.0059	1.0591	-2.3039	-3.3847
85	-0.0038	-1.8490	-0.5694	-1.3640
86	-0.0024	-0.5220	-0.3422	-0.6558
87	0.0062	1.3217	-1.6165	-3.7220
88	0.0000	-0.0125	-0.1040	-0.1981
89	0.0035	0.3262	-1.2109	-1.1808
90	0.0040	0.6245	-1.7517	-2.7081

91	-0.0074	-1.2305	0.0345	0.0474
92	0.0046	0.5494	-0.8316	-0.7678
93	0.0006	0.1866	0.6622	1.5592
94	0.0089	2.2492	-1.4197	-3.8905
95	0.0019	0.7090	0.1574	0.6940
96	0.0008	0.1792	-0.5383	-0.8805
97	-0.0091	-1.7068	0.2611	0.3813
98	-0.0024	-0.9291	0.0829	0.1463
99	0.0047	1.3363	-1.4947	-3.2400
100	-0.0059	-1.2591	-0.0070	-0.0126
101	-0.0022	-0.5489	-1.8772	-5.0103

Table 9 Selectivity/Timing Performance of Trusts - FT100 Proxy

Trust	α_i	t stat	λ_i	t stat
1	0.0062	3.1152	-0.9010	-5.7890
2	0.0063	4.3705	-0.3954	-1.6775
3	0.0036	2.3959	-0.9126	-6.4067
4	0.0052	2.3220	-0.3981	-2.5285
5	0.0071	2.7295	-0.2933	-0.9772
6	0.0093	5.6420	-0.9070	-4.7415
7	0.0068	4.2733	-0.3640	-1.6743
8	0.0077	3.8619	-0.2686	-1.5369
9	0.0117	2.8530	-1.1693	-5.1493
10	0.0071	3.1696	-0.4038	-2.0166
11	0.0047	2.0742	0.0709	0.5734
12	0.0055	1.8611	-0.1396	-0.5352
13	0.0047	3.3495	-0.2489	-2.0405
14	0.0068	2.1973	-0.5240	-1.4676
15	0.0046	0.8861	-0.8130	-1.1349
16	0.0067	2.5259	-0.2768	-0.9828
17	0.0048	1.9055	-0.0511	-0.2227
18	0.0067	3.6255	-0.7037	-3.1617
19	0.0074	3.0147	-0.7857	-4.2355
20	0.0078	3.1527	-0.6409	-3.4739
21	0.0003	0.0763	0.7381	2.6561
22	0.0055	4.6656	-0.5001	-4.8147
23	0.0060	3.5916	-0.7506	-5.8581
24	0.0054	2.1409	-0.7644	-3.8698
25	0.0062	3.2449	-0.3554	-2.6287
26	0.0036	1.8570	-0.1380	-0.5547
27	0.0105	4.6222	-0.3832	-1.6142
28	0.0033	1.5555	-0.0917	-0.5026
29	0.0061	2.0368	-0.5351	-1.9194
30	0.0124	3.8381	-1.1193	-4.3250
31	0.0089	3.3490	-0.6529	-3.2221
32	0.0048	1.6670	-0.0156	-0.0770
33	0.0068	2.0769	-0.4269	-1.6382
34	0.0024	0.5430	0.4021	0.8024
35	0.0048	2.2903	-0.0370	-0.2089
36	0.0039	2.1157	-0.3480	-1.9129
37	0.0033	1.1477	-0.0456	-0.2074
38	0.0072	1.8368	-0.9212	-2.5319
39	0.0067	2.9013	-0.4545	-2.1929
40	0.0081	4.7311	-0.8283	-3.6486
41	0.0017	0.4742	-0.6874	-1.6054
42	0.0047	1.5125	-0.4766	-1.9874
43	-0.0101	-1.9260	0.8296	1.2799
44	-0.0054	-0.8012	0.8939	1.0978
45	0.0100	4.0384	-0.6906	-2.7558
46	0.0047	2.5233	-0.4072	-2.1454
47	0.0070	2.3886	0.3535	1.5516
48	0.0085	4.4688	-0.4012	-1.3698
49	0.0103	2.8170	-3.2070	-5.8551

50	0.0076	3.3198	-0.9088	-4.9351
51	0.0053	3.1049	-0.5070	-3.4974
52	0.0077	2.4199	-1.4753	-4.6524
53	0.0072	0.9582	-0.3488	-0.2409
54	0.0057	1.9241	0.2112	0.4330
55	0.0097	3.0427	-1.4883	-3.3578
56	0.0072	3.7355	-0.3903	-2.1340
57	0.0060	2.0012	-1.2255	-2.4032
58	0.0077	3.2728	-1.2139	-4.6279
59	0.0072	0.6106	-0.9811	-0.8790
60	0.0058	3.2022	-0.1258	-0.9720
61	0.0032	1.6030	-0.2734	-1.8600
62	0.0073	3.5652	-0.4952	-2.5238
63	0.0009	0.2532	-0.2823	-0.9705
64	0.0027	1.6633	-0.3410	-2.9284
65	0.0067	1.9533	-0.8871	-1.7373
66	0.0069	2.7810	-0.6889	-2.6885
67	0.0085	3.4741	-0.7658	-3.4878
68	0.0093	3.9073	-0.6911	-3.8028
69	0.0085	3.8360	-0.7000	-2.2741
70	0.0049	3.2556	-0.2717	-2.0244
71	0.0111	3.7909	-1.1680	-4.3183
72	0.0053	0.6989	-2.6583	-1.4968
73	0.0115	2.9965	-2.0491	-2.0612
74	0.0034	1.2897	-0.2396	-0.9060
75	0.0056	2.2044	-0.4149	-1.7618
76	0.0060	3.0466	-0.1141	-0.9252
77	-0.0005	-0.0396	-0.8464	-0.7411
78	-0.0034	-0.2631	-1.2286	-2.0804
79	0.0059	2.1386	-1.3604	-5.4156
80	0.0050	1.9233	0.3090	0.7393
81	0.0069	3.0761	-1.7636	-4.0094
82	0.0054	1.2135	-1.3720	-3.6980
83	0.0049	1.8583	0.1837	1.1792
84	0.0099	1.7978	-2.7745	-3.9579
85	0.0021	0.9238	-1.1101	-2.3841
86	0.0019	0.4260	-0.6452	-1.2576
87	0.0097	1.9569	-1.9659	-3.9651
88	0.0031	0.8389	-0.2682	-0.5003
89	0.0050	0.4656	-0.9383	-0.9378
90	0.0074	1.1941	-2.0351	-3.1163
91	-0.0054	-0.8948	0.0162	0.0230
92	0.0069	0.8080	-0.6294	-0.5634
93	0.0047	1.4660	0.4133	0.9779
94	0.0132	3.2959	-1.7003	-4.5296
95	0.0072	2.5778	-0.1033	-0.3754
96	0.0056	1.2015	-1.0998	-1.6933
97	-0.0015	-0.2677	-0.5040	-0.6559
98	0.0030	1.0581	-0.2739	-0.5691
99	0.0087	2.5074	-1.8881	-4.2286
100	-0.0002	-0.0492	-0.5587	-0.9782
101	0.0031	0.7145	-2.4241	-6.5004

Table 10 Selectivity/Timing Performance of Trusts - EWI Proxy

Trust	α_i	t stat	λ_i	t stat
1	0.0031	1.7326	-0.5495	-1.4810
2	0.0051	2.2261	-0.4360	-0.6909
3	0.0027	1.2004	-1.2196	-3.2138
4	0.0023	1.4154	0.0547	0.2084
5	0.0058	2.2546	-0.3274	-0.5821
6	0.0077	3.5505	-0.9557	-1.7256
7	0.0055	2.7979	-0.3980	-0.7664
8	0.0053	2.4480	0.0631	0.1281
9	0.0072	1.8033	-0.3948	-0.7130
10	0.0046	2.0791	-0.0886	-0.1991
11	0.0025	1.2033	0.3522	0.7399
12	0.0026	1.3162	0.2650	0.7887
13	0.0054	2.2067	-0.8724	-1.9000
14	0.0043	1.5100	-0.1589	-0.2906
15	0.0051	1.4009	0.1777	0.2377
16	0.0053	1.7574	-0.3298	-0.6056
17	0.0036	1.3139	-0.0447	-0.0916
18	0.0053	2.4966	-0.8455	-2.6272
19	0.0040	2.6069	-0.3118	-1.3882
20	0.0059	1.9994	-0.5117	-0.8124
21	0.0014	0.2167	0.9786	0.9192
22	0.0059	2.2319	-1.1070	-2.0450
23	0.0051	1.9715	-1.0509	-1.7660
24	0.0043	1.4883	-1.0322	-2.0504
25	0.0042	2.0164	-0.1847	-0.4287
26	0.0023	0.9567	-0.1301	-0.2147
27	0.0114	3.3111	-1.1315	-2.1596
28	0.0041	1.3512	-0.7309	-1.4731
29	0.0047	1.2951	-0.5621	-1.0573
30	0.0114	3.2696	-1.3220	-2.1097
31	0.0059	1.9508	-0.8326	-2.0225
32	0.0018	0.7656	0.5836	1.7379
33	0.0021	0.7689	0.7002	1.2781
34	-0.0014	-0.4747	1.2030	2.0975
35	0.0022	1.0437	0.4491	1.1339
36	0.0022	0.9089	-0.3224	-1.0113
37	0.0010	0.3304	0.3883	0.8772
38	0.0027	1.0004	-0.2389	-0.6245
39	0.0045	1.6995	-0.2182	-0.3992
40	0.0064	2.6512	-0.8240	-1.1247
41	-0.0030	-1.0820	0.2271	0.7373
42	0.0016	0.5320	0.0402	0.0833
43	-0.0048	-0.6015	-0.5923	-0.4194
44	-0.0055	-1.0638	2.8988	2.6170
45	0.0100	3.5271	-1.2359	-2.5423
46	0.0032	1.3778	-0.3645	-0.5697
47	0.0053	1.8254	0.5766	1.4074
48	0.0080	3.1673	-0.6224	-1.1873
49	0.0037	1.0012	-2.1483	-1.7497

50	0.0051	1.9836	-0.6769	-1.3731
51	0.0048	1.8469	-0.8063	-1.4982
52	0.0014	0.5240	-0.2550	-0.6782
53	0.0064	0.8869	1.0766	0.4736
54	0.0082	1.5166	0.6325	0.4814
55	0.0063	1.8888	-1.0225	-1.2468
56	0.0066	2.4537	-0.6888	-1.3687
57	0.0044	1.4081	-1.3632	-1.5284
58	0.0026	1.1971	-0.6431	-0.9256
59	0.0073	0.6175	-0.4276	-0.2413
60	0.0046	2.0093	-0.1938	-0.5065
61	0.0016	0.7204	-0.4035	-1.0801
62	0.0059	2.5004	-0.5680	-1.1503
63	-0.0037	-1.1196	0.5573	0.8896
64	0.0021	0.9410	-0.5879	-1.1781
65	0.0036	1.1429	-0.3884	-0.7463
66	0.0040	1.3857	-0.3174	-0.6823
67	0.0070	2.5759	-0.8832	-1.5736
68	0.0065	3.6753	-0.2897	-0.9098
69	0.0056	2.3766	-0.7596	-1.1870
70	0.0045	1.7797	-0.5547	-1.4105
71	0.0078	3.1667	-0.7656	-1.5320
72	0.0012	0.1567	-3.1475	-1.3288
73	0.0076	1.9127	-2.8001	-2.4492
74	0.0014	0.4955	-0.0001	-0.0002
75	0.0030	1.1872	-0.0963	-0.2638
76	0.0041	2.0551	0.0765	0.1901
77	0.0030	0.3859	-3.5855	-0.9162
78	-0.0018	-0.2238	-2.4400	-1.1957
79	0.0013	0.4451	-1.0255	-1.8500
80	0.0018	0.6533	0.4006	0.7502
81	0.0054	1.9589	-2.0347	-2.2429
82	-0.0019	-0.5200	-0.5914	-1.4774
83	0.0026	0.9411	0.6048	1.3991
84	0.0041	0.8019	-1.8735	-1.7968
85	0.0001	0.0129	-1.1938	-1.7004
86	0.0008	0.1434	-1.2123	-1.3477
87	0.0021	0.6552	-0.3635	-0.5884
88	-0.0006	-0.1857	0.0449	0.0779
89	0.0068	0.6530	-2.9402	-1.5289
90	0.0025	0.4028	-1.7716	-1.9666
91	-0.0038	-0.6709	-0.2392	-0.1772
92	0.0076	1.0247	-1.8939	-1.4376
93	0.0016	0.5399	-0.1709	-0.1906
94	0.0053	2.1569	-0.9489	-2.9124
95	0.0013	0.4322	0.5596	1.0782
96	-0.0008	-0.2345	0.6121	1.0887
97	-0.0065	-1.4200	0.7746	0.6177
98	0.0014	0.4026	-0.1211	-0.1363
99	0.0032	0.9721	-1.5147	-1.9696
100	-0.0057	-1.4268	1.3612	1.8552
101	-0.0006	-0.1525	-2.4756	-2.1742

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Table 11 Selectivity/Timing Performance of Trusts - FTA Proxy

Trust	α_i	t stat	β_{2i}	t stat
1	0.0051	1.4564	-0.0776	-0.4344
2	-0.0005	-0.1208	0.2626	1.1423
3	0.0016	0.4198	-0.0334	-0.1507
4	0.0032	1.0905	0.0362	0.2548
5	0.0021	0.5040	0.1948	1.0174
6	0.0054	1.3343	0.0514	0.2213
7	0.0007	0.1830	0.2379	1.1359
8	0.0021	0.5529	0.2270	1.1394
9	0.0093	1.2589	-0.0570	-0.2086
10	0.0023	0.5655	0.1677	0.8224
11	-0.0013	-0.3763	0.2946	1.8598
12	0.0039	1.2428	0.0557	0.4984
13	-0.0014	-0.3669	0.2630	1.1592
14	0.0021	0.4087	0.1415	0.7000
15	-0.0005	-0.0653	0.0182	0.0687
16	0.0023	0.5317	0.1725	0.8550
17	0.0024	0.6287	0.1137	0.8155
18	0.0019	0.4672	0.1227	0.5489
19	0.0064	1.8921	-0.0697	-0.4557
20	0.0029	0.6120	0.1422	0.6123
21	-0.0069	-1.5830	0.3061	3.4421
22	0.0006	0.1474	0.1648	0.6941
23	0.0015	0.3676	0.1029	0.4316
24	0.0014	0.3129	0.0803	0.3237
25	0.0013	0.3759	0.1822	1.0476
26	-0.0028	-0.7698	0.2869	1.5340
27	0.0046	0.8834	0.2307	0.9028
28	-0.0028	-0.7048	0.2857	1.3565
29	0.0048	0.9969	-0.0069	-0.0372
30	0.0106	1.9686	-0.0767	-0.3025
31	0.0080	2.2887	-0.1868	-1.7510
32	-0.0015	-0.3342	0.2980	1.6853
33	0.0041	0.8265	0.0676	0.3398
34	0.0029	0.5563	0.0427	0.2019
35	0.0004	0.1400	0.2057	1.5215
36	-0.0005	-0.1318	0.1675	0.7628
37	-0.0017	-0.4394	0.2357	1.4969
38	0.0090	2.0410	-0.2213	-1.5069
39	0.0024	0.6505	0.1412	0.7744
40	0.0034	0.7832	0.1051	0.4272
41	0.0052	1.3080	-0.2639	-2.2178
42	-0.0012	-0.2358	0.2089	0.9873
43	-0.0143	-2.1025	0.1985	0.8319
44	-0.0095	-1.0312	0.2399	0.8302
45	0.0074	1.6685	0.0261	0.1240
46	-0.0002	-0.0606	0.1762	0.8734
47	0.0019	0.4632	0.2963	2.0741

48	0.0032	0.8428	0.1922	0.9480
49	0.0119	1.5139	-0.5594	-1.2520
50	0.0048	1.0941	0.0044	0.0202
51	0.0016	0.4426	0.1084	0.5780
52	0.0081	1.4279	-0.2375	-0.8325
53	0.0104	0.9639	-0.3379	-0.6641
54	0.0007	0.2079	0.1122	0.7909
55	0.0085	1.3941	-0.1606	-0.5493
56	-0.0007	-0.1640	0.3216	1.3367
57	0.0009	0.1438	0.0594	0.1838
58	0.0062	1.5853	-0.2337	-1.2211
59	0.0025	0.1722	-0.0400	-0.1050
60	0.0000	0.0068	0.2608	1.5182
61	-0.0017	-0.4331	0.1978	0.9650
62	0.0040	1.0848	0.0879	0.4417
63	-0.0072	-1.2531	0.3438	1.2471
64	-0.0021	-0.5618	0.1841	0.9070
65	0.0056	0.9781	-0.0862	-0.3606
66	0.0024	0.5217	0.1194	0.5012
67	0.0051	1.1302	0.0524	0.2334
68	0.0096	3.0248	-0.1161	-0.9567
69	0.0035	0.8939	0.0099	0.0514
70	-0.0006	-0.1661	0.2301	1.0417
71	0.0087	1.7416	-0.0613	-0.2537
72	0.0099	0.7435	-0.7476	-1.1616
73	0.0101	1.7000	-0.3612	-1.1410
74	0.0014	0.3321	0.0672	0.3862
75	0.0028	0.5776	0.0780	0.4020
76	0.0010	0.3169	0.2216	1.4886
77	0.0044	0.5683	-0.4102	-0.7642
78	0.0071	1.2442	-0.6661	-1.2394
79	0.0060	1.3549	-0.3325	-1.6317
80	-0.0023	-0.6751	0.2337	1.8644
81	0.0051	0.8654	-0.1710	-0.4849
82	0.0071	1.1970	-0.4423	-2.3427
83	-0.0010	-0.2734	0.3110	2.3455
84	0.0130	1.7569	-0.7071	-3.1886
85	-0.0022	-0.7197	-0.1680	-1.1560
86	-0.0014	-0.2379	-0.1024	-0.5508
87	0.0094	1.4457	-0.3923	-2.2153
88	-0.0045	-0.7814	0.1794	0.6575
89	0.0051	0.3676	-0.2685	-0.7157
90	0.0073	0.7103	-0.4941	-1.2147
91	-0.0096	-1.0403	0.1075	0.3657
92	0.0054	0.4059	-0.1695	-0.3893
93	-0.0010	-0.2276	0.1750	1.0761
94	0.0165	4.1180	-0.6324	-3.6158
95	0.0032	0.9191	-0.0303	-0.2219
96	0.0003	0.0604	-0.0586	-0.2339
97	-0.0121	-1.7743	0.1947	0.8656
98	-0.0029	-0.7027	0.0339	0.1746
99	0.0062	1.2485	-0.2880	-1.5766
100	-0.0075	-1.2115	0.0853	0.4377
101	0.0025	0.5118	-0.5206	-3.7079

Table 12 Selectivity/Timing Performance of Trusts - FT100 Proxy

Trust	α_i	t stat	β_{2i}	t stat
1	0.0113	4.1667	-0.4065	-4.2849
2	0.0061	2.4956	-0.0607	-0.4764
3	0.0075	3.4270	-0.3512	-4.2792
4	0.0088	3.2278	-0.2453	-2.8159
5	0.0068	1.7801	-0.0374	-0.2512
6	0.0120	4.3246	-0.2862	-2.0997
7	0.0065	2.5881	-0.0443	-0.3730
8	0.0088	3.1386	-0.1021	-0.9460
9	0.0170	2.4843	-0.4641	-2.3318
10	0.0085	2.5337	-0.1407	-1.1132
11	0.0050	1.7570	-0.0060	-0.0783
12	0.0089	2.4065	-0.1934	-1.4656
13	0.0048	2.2170	-0.0452	-0.6165
14	0.0045	0.9438	0.0243	0.1205
15	0.0024	0.3100	-0.0213	-0.0714
16	0.0093	2.4133	-0.1764	-1.1997
17	0.0066	1.8400	-0.1013	-0.8560
18	0.0081	2.6102	-0.1899	-1.2511
19	0.0129	4.1875	-0.4077	-4.3879
20	0.0095	2.7378	-0.1937	-1.4320
21	-0.0028	-0.5830	0.2625	2.4700
22	0.0068	3.9287	-0.1533	-1.9870
23	0.0088	3.6332	-0.2662	-2.6977
24	0.0076	2.4210	-0.2424	-1.8806
25	0.0072	2.7214	-0.1124	-1.2722
26	0.0027	0.9233	0.0227	0.1915
27	0.0109	3.0013	-0.0847	-0.5643
28	0.0027	1.0937	0.0138	0.1542
29	0.0112	2.5564	-0.3414	-2.4918
30	0.0157	3.5702	-0.3573	-2.1313
31	0.0117	3.3972	-0.2567	-2.5182
32	0.0042	0.9616	0.0304	0.2342
33	0.0083	1.8663	-0.1472	-0.9956
34	0.0054	0.9400	-0.0827	-0.3366
35	0.0062	2.0546	-0.0733	-0.7548
36	0.0076	3.2029	-0.2408	-2.7229
37	0.0035	0.8964	-0.0188	-0.1577
38	0.0148	2.9909	-0.5354	-3.1837
39	0.0091	2.9576	-0.1956	-1.7599
40	0.0105	3.6831	-0.2599	-1.7787
41	0.0112	2.4884	-0.5917	-3.4314
42	0.0056	1.2171	-0.1271	-0.8285
43	-0.0138	-2.1456	0.3122	1.4262
44	-0.0037	-0.3877	0.0570	0.1842
45	0.0135	3.5798	-0.2922	-1.8899
46	0.0042	1.5754	-0.0461	-0.4335
47	0.0062	1.6242	0.0958	0.7003
48	0.0076	2.4661	-0.0233	-0.1622
49	0.0188	2.5616	-0.9653	-2.2591

50	0.0114	3.6503	-0.3440	-3.3287
51	0.0076	3.1252	-0.1981	-2.1410
52	0.0153	3.7138	-0.6295	-3.7760
53	0.0158	1.3719	-0.4921	-0.9396
54	0.0051	1.2503	0.0657	0.3682
55	0.0127	2.3404	-0.4023	-1.6404
56	0.0066	2.5063	-0.0318	-0.2968
57	0.0065	1.2287	-0.2363	-0.8388
58	0.0098	2.5606	-0.3158	-1.6796
59	0.0081	0.5375	-0.1948	-0.4760
60	0.0067	2.7450	-0.0669	-0.8824
61	0.0043	1.6075	-0.1021	-1.1570
62	0.0104	3.8417	-0.2352	-2.5481
63	0.0009	0.1787	-0.0484	-0.2739
64	0.0045	1.9511	-0.1459	-1.8956
65	0.0083	1.3783	-0.2290	-0.8154
66	0.0110	3.3760	-0.3212	-2.9815
67	0.0119	3.2888	-0.2977	-2.2950
68	0.0130	4.2622	-0.3034	-2.7156
69	0.0077	2.0776	-0.0776	-0.4415
70	0.0060	2.7743	-0.0994	-1.2350
71	0.0142	3.1898	-0.3536	-1.9230
72	0.0114	0.8636	-0.7035	-1.0272
73	0.0142	2.5187	-0.4241	-1.4186
74	0.0075	1.9126	-0.2449	-1.7534
75	0.0080	1.9263	-0.1891	-1.3035
76	0.0066	2.3902	-0.0497	-0.6157
77	0.0174	2.4229	-1.0424	-1.5739
78	0.0066	0.6464	-0.7128	-2.2340
79	0.0096	2.3342	-0.4230	-2.2534
80	0.0028	0.8171	0.1605	1.2106
81	0.0098	2.0540	-0.4408	-1.5496
82	0.0132	2.2424	-0.6392	-3.6307
83	0.0041	1.1599	0.0713	0.7407
84	0.0183	2.5412	-0.8505	-3.8079
85	0.0054	1.6504	-0.3319	-2.1119
86	0.0034	0.6016	-0.1784	-0.9538
87	0.0138	1.9036	-0.4854	-2.2525
88	0.0006	0.1013	0.0773	0.2932
89	0.0024	0.1773	-0.0353	-0.0975
90	0.0127	1.2613	-0.6184	-1.4661
91	-0.0085	-0.9507	0.1530	0.5387
92	0.0046	0.3469	0.0021	0.0048
93	0.0032	0.7500	0.1353	0.8579
94	0.0221	5.1586	-0.7411	-4.1852
95	0.0106	2.6569	-0.1877	-1.1840
96	0.0068	1.1953	-0.2298	-0.8794
97	-0.0021	-0.2624	-0.0364	-0.1269
98	0.0035	0.9308	-0.0644	-0.4101
99	0.0104	2.0876	-0.3500	-1.8465
100	-0.0016	-0.2478	-0.0043	-0.0202
101	0.0096	1.7896	-0.6988	-5.1686

Table 13 Selectivity/Timing Performance of Trusts - EWI Proxy

Trust	α_i	t stat	β_{2i}	t stat
1	0.0047	1.7824	-0.1880	-1.1864
2	0.0050	1.4834	-0.0689	-0.2948
3	0.0071	2.3406	-0.4667	-2.5370
4	0.0022	1.0308	0.0098	0.0924
5	0.0054	1.4048	-0.0341	-0.1500
6	0.0097	2.8894	-0.2794	-1.1954
7	0.0051	1.7296	-0.0443	-0.2179
8	0.0042	1.4354	0.0765	0.4060
9	0.0070	1.2307	-0.0545	-0.2295
10	0.0036	1.1683	0.0477	0.2790
11	0.0018	0.6049	0.1006	0.5462
12	0.0029	1.1229	0.0284	0.2074
13	0.0080	2.2447	-0.2962	-1.4714
14	0.0014	0.3099	0.1442	0.6153
15	0.0044	0.8558	0.0778	0.3319
16	0.0074	1.7416	-0.1760	-0.8000
17	0.0055	1.4245	-0.1207	-0.5850
18	0.0062	2.0839	-0.1953	-1.2344
19	0.0057	2.9099	-0.1552	-1.6903
20	0.0063	1.5059	-0.1124	-0.4263
21	0.0026	0.3118	0.0549	0.1540
22	0.0090	2.3820	-0.3731	-1.5417
23	0.0081	2.0928	-0.3498	-1.3666
24	0.0065	1.5699	-0.3075	-1.3258
25	0.0042	1.4037	-0.0307	-0.1766
26	0.0013	0.3545	0.0384	0.1681
27	0.0141	3.1013	-0.3519	-1.4757
28	0.0073	1.7600	-0.3129	-1.4904
29	0.0086	1.7962	-0.3259	-1.4018
30	0.0138	2.7253	-0.3693	-1.2969
31	0.0105	2.6243	-0.4181	-2.2975
32	0.0000	-0.0039	0.2080	1.4480
33	-0.0016	-0.4365	0.3363	1.4986
34	-0.0008	-0.1817	0.1699	0.6493
35	0.0015	0.5175	0.1147	0.7105
36	0.0046	1.4371	-0.1952	-1.4015
37	-0.0010	-0.2503	0.1827	0.9322
38	0.0054	1.4441	-0.2027	-1.4704
39	0.0054	1.4280	-0.0893	-0.3908
40	0.0080	2.1416	-0.2343	-0.8219
41	0.0002	0.0529	-0.1511	-1.0692
42	-0.0005	-0.1183	0.1304	0.6934
43	-0.0005	-0.0522	-0.3853	-0.9435
44	-0.0072	-0.9221	0.4719	1.1340
45	0.0143	3.6554	-0.4679	-2.1326
46	0.0030	0.8170	-0.0454	-0.1783
47	0.0044	1.1329	0.1558	0.9332
48	0.0083	2.2852	-0.1222	-0.5718
49	0.0042	0.8361	-0.3992	-0.9544

50	0.0074	2.0510	-0.2522	-1.1407
51	0.0072	1.9284	-0.2781	-1.2108
52	0.0009	0.2665	-0.0176	-0.1152
53	0.0126	1.4718	-0.3449	-0.5262
54	0.0120	1.7268	-0.2029	-0.4900
55	0.0068	1.4383	-0.2004	-0.6902
56	0.0076	1.9680	-0.1715	-0.7839
57	0.0044	0.8840	-0.2311	-0.6550
58	0.0012	0.3994	-0.0290	-0.1336
59	0.0127	0.7455	-0.4516	-0.6671
60	0.0053	1.6191	-0.0718	-0.4435
61	0.0031	1.0708	-0.1598	-1.0170
62	0.0084	2.4374	-0.2439	-1.1738
63	-0.0068	-1.5317	0.2766	1.0838
64	0.0037	1.0882	-0.1931	-0.9263
65	0.0009	0.1802	0.0942	0.3996
66	0.0050	1.3172	-0.1115	-0.5454
67	0.0097	2.3664	-0.3083	-1.1942
68	0.0071	3.0637	-0.0839	-0.6058
69	0.0056	1.5063	-0.1366	-0.5011
70	0.0059	1.7493	-0.1771	-1.0538
71	0.0085	2.4135	-0.1765	-0.8578
72	0.0143	1.5312	-1.2615	-1.8178
73	0.0089	1.6117	-0.4208	-1.1487
74	0.0026	0.6201	-0.0721	-0.4103
75	0.0038	1.1478	-0.0597	-0.4000
76	0.0035	1.2420	0.0464	0.2816
77	0.0200	1.5751	-1.6040	-1.1866
78	0.0112	2.0511	-1.1744	-1.2162
79	0.0034	1.1036	-0.3126	-1.6336
80	0.0016	0.4429	0.0590	0.3428
81	0.0073	1.5357	-0.4569	-1.2257
82	0.0002	0.0471	-0.2338	-1.4261
83	0.0009	0.2327	0.2059	1.1666
84	0.0080	1.1368	-0.5022	-1.6438
85	0.0043	0.8796	-0.4462	-2.0723
86	0.0046	0.6288	-0.4303	-1.6012
87	0.0039	0.9729	-0.1691	-0.9966
88	-0.0040	-0.9034	0.1985	0.7987
89	0.0220	1.9859	-1.3727	-2.7269
90	0.0015	0.1728	-0.2721	-0.6426
91	-0.0006	-0.0854	-0.2567	-0.7182
92	0.0179	2.0442	-0.9127	-2.4469
93	0.0030	0.7821	-0.1180	-0.5403
94	0.0086	2.6790	-0.3616	-2.5906
95	0.0012	0.3371	0.1077	0.5059
96	-0.0028	-0.7415	0.2211	1.3690
97	-0.0072	-1.1853	0.1406	0.4033
98	0.0054	1.1582	-0.3012	-1.1219
99	0.0067	1.5232	-0.4293	-2.0558
100	-0.0073	-1.4330	0.2748	1.3084
101	0.0040	0.6363	-0.6270	-1.8000

Table 14 Selectivity/Timing Performance of Trusts - Size Indices

Trust	α_i	t stat	γ_i	t stat
1	0.0017	0.8645	-0.4334	-2.8223
2	0.0012	0.6226	-0.3229	-1.8261
3	0.0032	1.5592	-0.4177	-2.2960
4	0.0009	0.5129	0.3073	1.6631
5	0.0028	0.9509	0.0693	0.2665
6	0.0063	2.8125	-0.3198	-1.6139
7	0.0013	0.7857	-0.5268	-3.4486
8	0.0008	0.4114	-0.2901	-1.5008
9	0.0021	0.4521	-1.1507	-1.9062
10	0.0009	0.4240	0.2020	1.7900
11	-0.0012	-0.5681	-0.1057	-0.5942
12	0.0019	0.8432	0.3968	1.5766
13	0.0035	1.5236	-0.6482	-3.2683
14	-0.0006	-0.1527	-0.1250	-0.3684
15	0.0025	0.5599	0.5740	0.8651
16	0.0051	1.6610	0.3402	1.1762
17	0.0028	0.9247	0.0402	0.1036
18	0.0032	1.6769	-0.3133	-1.5453
19	0.0055	3.2596	0.5557	3.2783
20	0.0030	1.0244	-0.1631	-0.5500
21	-0.0024	-0.4193	-1.3179	-2.5251
22	0.0039	1.8423	-0.6896	-3.6407
23	0.0031	1.3624	-0.6581	-3.0300
24	0.0022	0.6632	-0.6623	-2.6424
25	0.0014	0.6891	-0.1417	-0.7944
26	-0.0019	-0.8890	-0.1494	-0.7055
27	0.0097	2.8558	-0.5402	-1.7809
28	0.0035	1.0970	-0.3109	-1.2808
29	0.0039	1.0493	-0.6370	-1.7828
30	0.0116	2.4112	-0.3027	-0.7878
31	0.0093	2.6449	0.3128	1.2603
32	-0.0011	-0.4046	0.4277	1.3857
33	-0.0039	-1.1839	0.1109	0.2731
34	0.0004	0.0933	1.1678	2.7625
35	-0.0013	-0.5809	-0.1570	-0.8682
36	0.0015	0.6247	-0.1987	-1.0031
37	-0.0030	-0.8514	0.4224	1.1245
38	0.0064	1.7303	0.7682	2.9064
39	0.0017	0.6167	-0.2009	-0.9735
40	0.0033	1.4372	-0.5759	-2.6457
41	0.0011	0.3039	0.7031	2.5599
42	-0.0030	-0.7219	-0.2220	-0.6634
43	-0.0058	-0.7530	-1.0558	-1.2854
44	-0.0097	-1.4062	0.2509	0.3645
45	0.0111	3.6833	-0.3835	-1.4455
46	-0.0009	-0.4268	-0.4044	-1.6596
47	0.0025	0.6756	0.1234	0.3635
48	0.0048	1.8257	-0.3755	-1.3623
49	0.0019	0.3792	-0.2671	-0.3891

50	0.0032	1.0600	-0.5610	-2.3555
51	0.0022	1.0176	-0.7397	-3.4816
52	-0.0002	-0.0503	0.0748	0.2297
53	0.0105	1.2765	0.0292	0.0381
54	0.0048	1.1280	-0.9831	-1.8767
55	0.0027	0.6478	-0.8333	-1.6345
56	0.0033	1.2988	-0.4199	-1.8203
57	0.0005	0.1454	-0.5553	-1.3569
58	-0.0009	-0.3725	-0.4276	-1.3324
59	0.0082	0.5827	1.5951	0.9472
60	0.0023	1.0811	-0.0002	-0.0008
61	0.0003	0.1577	-0.2866	-1.5464
62	0.0052	2.4213	-0.0761	-0.4499
63	-0.0105	-2.8713	-0.1081	-0.3274
64	0.0002	0.0863	-0.3454	-1.7861
65	0.0011	0.2446	0.1972	0.5193
66	0.0011	0.3845	-0.2681	-1.3480
67	0.0058	1.8691	-0.2297	-0.8142
68	0.0066	2.9815	0.3106	1.1720
69	0.0030	1.0234	-0.5020	-1.8596
70	0.0022	0.9208	-0.4126	-1.9969
71	0.0070	2.0639	-0.0277	-0.1011
72	0.0159	1.6526	1.4077	1.1178
73	0.0085	1.5439	-0.1079	-0.2473
74	-0.0009	-0.3004	-0.5551	-2.1196
75	0.0008	0.2186	-0.2350	-0.7073
76	0.0004	0.2275	-0.1886	-0.9837
77	0.0250	1.5596	1.2096	0.7773
78	0.0089	1.9937	-1.5856	-0.8465
79	0.0025	0.9012	0.0779	0.2209
80	0.0015	0.4665	-0.1740	-0.6826
81	0.0030	1.0418	-0.5918	-1.5978
82	0.0011	0.2479	0.7935	1.7475
83	-0.0023	-0.6948	-0.3617	-1.1611
84	0.0074	1.0971	-0.5438	-0.7782
85	0.0022	0.6497	-0.2025	-0.4616
86	0.0039	0.6857	0.5741	1.0443
87	0.0043	1.1057	0.5069	1.6031
88	-0.0047	-1.1083	-0.0938	-0.2735
89	0.0203	1.7226	-0.4047	-0.5085
90	0.0003	0.0333	-0.2396	-0.3307
91	-0.0034	-0.4926	-0.9349	-1.1936
92	0.0173	1.7826	0.6532	0.9227
93	0.0011	0.3029	0.2241	0.9655
94	0.0096	3.2014	0.5173	2.1498
95	-0.0011	-0.4061	-0.1604	-0.6135
96	-0.0026	-0.6526	0.3334	0.9157
97	-0.0065	-1.1620	0.4046	0.6297
98	0.0036	0.9312	-0.0925	-0.2124
99	0.0057	1.2586	-0.2421	-0.7554
100	-0.0077	-1.5633	0.5064	1.2397
101	0.0016	0.3215	-0.5520	-1.9540

Table 15 Selectivity/Timing Performance of Passive Portfolios - Size Indices

Portfolio	Size	Beta	Skewness	Returns	Variance
1 Sel	0.0031	-.000006	0.002	-0.0021	0.0034
	2.33*	-0.004	1.48	-1.05	2.65*
Timing	-0.05	0.11	-0.11	0.08	0.05
	-0.81	1.69	-2.18*	0.62	0.96
2 Sel	-0.002	0.0023	-0.0003	0.0015	0.0042
	-1.38	2.08*	-0.23	1.23	3.87**
Timing	0.05	0.02	-0.02	0.05	-0.04
	0.96	0.54	-0.35	0.78	-0.82
3 Sel	0.0015	0.0024	0.0001	0.0038	0.0016
	1.24	2.03*	0.11	3.09**	1.61
Timing	-0.03	0.03	0.1	-0.06	0.07
	-0.62	0.54	2.04*	-1.03	1.9
4 Sel	-0.0012	0.0031	0.0018	0.0039	0.0014
	-1.00	2.82**	1.36	3.55**	1.25
Timing	0.09	-0.04	0.02	0.03	0.09
	1.8	-1.08	0.27	0.61	1.92
5 Sel	0.0008	0.0005	0.0012	0.0023	0.0024
	0.74	0.43	1.12	2.09*	2.29*
Timing	0.004	0.02	0.01	0.05	0.06
	0.09	0.43	0.29	0.94	1.15
6 Sel	0.0012	0.0006	-0.0001	0.0034	0.0021
	1.29	0.41	-0.08	3.46**	2.12*
Timing	-0.03	-0.05	0.19	0.0	-0.07
	-0.61	-0.7	2.56*	-0.04	-1.38
7 Sel	0.00005	0.0035	0.0035	0.0012	0.0004
	0.05	3.14**	3.39**	1.23	0.27
Timing	0.03	-0.03	-0.05	0.02	0.07
	0.51	-0.5	-1.22	0.42	1.4
8 Sel	-0.00003	-0.0008	0.0027	0.0004	0.0017
	-0.04	-0.75	2.94**	0.35	1.38
Timing	-0.02	0.07	0.06	0.02	-0.09
	-0.48	1.37	1.58	0.26	-1.29
9 Sel	0.0018	0.0025	0.0031	0.0007	0.0017
	2.18*	2.3*	2.62*	0.71	1.17
Timing	0.01	-0.05	-0.04	0.001	-0.03
	0.2	-1.09	-0.84	0.03	-0.39
10 Sel	0.0007	0.0006	0.0004	-0.0011	-0.0055
	0.56	0.42	0.28	-1.0	-2.87**
Timing	0.03	0.06	-0.04	-0.01	0.01
	0.79	1.24	-0.47	-0.3	0.13

* Significant at 5%
** Significant at 1%

CHAPTER FIVE

THE DETERMINANTS OF UNIT TRUST PERFORMANCE

Earlier chapters have evaluated the performance of unit trusts as a whole. This chapter examines the factors which may cause the performance between the trusts to differ e.g. the size of trusts, expenses etc. Evidence from the USA suggests that some of the factors appear to be related to mutual fund performance. Grinblatt and Titman(1989a) found an inverse relationship between the size of fund and performance. The impact of expenses on performance has been fairly controversial in the literature. Jensen(1968) found that US mutual funds on average plotted below the SML over the period 1945-64 after removing the effect of expenses. Ippolito(1989) presents evidence which suggests that mutual funds exhibited positive Jensen performance net of expenses during 1965-84. Additionally there was little relationship between net returns and various expenses that mutual funds incur. The work of Ippolito has since been countered by Elton, Gruber, Das and Hklavka(1991). It still remains an open question whether funds earn enough returns to justify the expenses they charge.

Another area of controversy in the literature has been the resurgence of interest in the predictability of performance. The past performance of a fund can be a major advertising tool to attract new clients to the fund. Is the past performance of the fund related to future performance? Some recent papers in the USA (see for example Goetzmann and Ibbotson(1991), Hendricks, Patel and Zeckhauser(1990)) suggests that performance is predictable. However Brown, Ibbotson, Goetzmann and Ibbotson(1992) argue that survivorship bias may be the cause of the persistence of performance in these studies.

This chapter considers the impact of different factors on performance and also the issue of predictability in performance. Sections I to III presents the results of the impact of investment objective, size of trust, annual and initial charges on the Jensen performance of the trusts. Section IV examines the question of whether there is consistency in trust performance over time. The final section presents concluding comments.

I) TRUST OBJECTIVE AND PERFORMANCE

This section examines the relationship between the investment objective of a trust and performance. The sample of 101 trusts was grouped into three portfolios on the basis of the investment objective the trusts were assigned by the 1980 Unit Trust Yearbook. Three investment objectives were used which included General, Income and Growth. Equally-weighted portfolio excess returns were calculated over the 120 month sample period for the three portfolios. The portfolio grouping procedure was repeated for the 65 surviving trusts. In this case the trusts were grouped into four portfolios on the basis of the investment objective the trusts were assigned by the 1990 Unit Trust Yearbook. The objectives were UK General, UK Equity Income, UK Growth and Balanced. Equally-weighted portfolio excess returns were computed over the sample period for the four portfolios.

Using the four benchmark portfolios described in chapter 2, all of the equally-weighted portfolios were regressed on each of the benchmarks. Tables 1 and 2 present the estimated Jensen measures and adjusted t statistics for all of the portfolios against each benchmark. At the bottom of each table, there are two multivariate tests. The first tests whether all of the portfolio Jensen measures are jointly equal to zero. The second tests whether the portfolio Jensen measures are jointly equal to each other. The multivariate test statistics are similar to a Wald test and have asymptotic χ^2 distribution with N degrees of freedom under the null hypothesis where N is the number of restrictions being tested. It is important to note that the second test of equality will have one degree of freedom less than the first. All of the individual t statistics and multivariate statistics throughout this chapter have been corrected for the effects of first order serial correlation and heteroscedasticity using the methods of White(1980) and Newey and West(1987).

Table 1 Jensen Performance Measures of Trust Objectives (Whole Sample)

	FTA	FT100	EWI	Size
General	0.00455	0.0042	0.00295	0.0027
	1.95	3.3**	1.53	2.72**
Income	0.0046	0.00432	0.00301	0.00274
	1.96	2.89**	1.92	2.65**
Growth	0.00223	0.00191	0.00038	(0.00017)
	0.82	1.03	0.21	(0.12)
GMM	11.1*	23.34**	8.48*	18.62**
GMM	4.77	5.16	7.57*	8.09*

* Significant at 5%
** Significant at 1%

Table 2 Jensen Performance Measures for Trust Objectives(Survivors)

	FTA	FT100	EWI	Size
UK General	0.00539	0.00503	0.00383	0.00342
	2.32*	4.25**	2.00*	3.54**
UK Eq. Y	0.00546	0.00517	0.0039	0.00354
	2.37*	3.53**	1.92	3.12**
UK Growth	0.00326	0.00295	0.00137	0.0009
	1.29	1.72	0.795	0.893
Balanced	0.00448	0.00423	0.00303	0.00292
	1.93	2.35*	1.66	2.01*
Betas				
UK General	0.743	0.877	0.938	
UK Eq. Y	0.703	0.816	0.901	
UK Growth	0.825	0.947	1.077	
Balanced	0.615	0.709	0.811	
GMM	14.18**	35.14**	12.02*	20.16**
GMM	7.69	5.57	10.96*	10.87*

* Significant at 5%
** Significant at 1%

The evidence in Tables 1 and 2 shows that the objective to which a trust belongs is an important factor in performance. The General and Income trusts exhibit on average significant positive performance against the FT100 proxy and size indices for the whole sample of trusts. When only surviving trusts are included in the portfolios, significant positive performance is registered by these categories against nearly all of the benchmarks. However the Growth category of trusts has no significant positive performance at all either for the whole sample of trusts or the survivors. The multivariate tests confirm this evidence and frequently reject the hypothesis of equality of performance between the various objectives.

A second result from Tables 1 and 2 is the effect of survivorship bias. When only surviving funds are included in the portfolios, average Jensen measure are higher and more are significantly positive than when the whole sample of trusts is used. This effect of survivorship bias will be shown throughout this chapter and is consistent with evidence in earlier chapters. Table 2 also reports the portfolio betas for each investment objective. The Growth category of trusts has the highest average beta coefficient. This reflects the more risky nature of these trusts.

The variation between the performance of the different investment objectives could be due to a number of reasons. It may be that the superior performance of the General and Income trusts reflects the higher expenses that these trusts charge or some other factor. Alternatively it could reflect that these trusts have superior ability. Table 3 presents summary statistics for the whole sample of trusts for the three investment objectives. The figures include the average initial and annual charges of the trusts at the beginning of 1980, average size at the end of 1980 and the average cash portions held by the trusts through the 1980s. All of the trust data in this chapter was collected from the Unit Trust Yearbooks.

Table 3 Summary Statistics of the Trust's Characteristics Grouped by Investment Objective

	General	Income	Growth
Number of funds	37	34	30
Initial Charge	3.67%	3.75%	4.35%
Annual Charge	0.45%	0.44%	0.41%
Size(£m)	13.81	13.956	13.59
Cash	4.35%	3.92%	5.43%

The figures in Table 3 suggest that the size of the trust is not likely to be the cause of the differences between the performance. Additionally there is little evidence that the General and Income trusts have higher charges. Since the returns calculated for the trusts are gross returns, we would expect to see trusts with higher initial charges and annual fees to earn higher excess risk adjusted returns to compensate investors for these charges. However there is no indication in Table 3 that this is the case.

Another feature of Table 3 is that the Growth trusts on average tend to maintain a higher cash position than the other types of trusts. The holding of cash by trusts will lead to a downward bias in the Jensen measure because the model assumes that the trust's portfolio is fully invested. However the differences in the cash position is unlikely to be the cause of the differences. This can be illustrated by following the procedure of Jensen(1968) and Kon and Jen(1979). Jensen assumes that the cash position is invested in the riskless asset and the extra return is added to the average Jensen measure. The difference between the average cash positions of the Growth and Income trusts is 1.51%. If this is invested in 30 day Treasury Bills which have an average monthly return of 0.96%, the extra return added to the Jensen measure would be 0.0151*0.0096 = 0.00014 which scarcely affects the difference between the performance of the trusts.

It would appear that none of the preceding factors accounts for the differences in performance. Perhaps the evidence suggests either that General and Income trusts exhibit superior ability or that the results are being driven by inefficiencies in the benchmark portfolios.

<u>II) SIZE AND PERFORMANCE</u>

The size of the unit trust is another potential factor which may affect performance. Grinblatt and Titman(1989a) suggest that large mutual funds have the advantage of economies of scale over smaller funds but smaller funds may be able to buy and sell securities without affecting prices. To test the impact of size on performance, the whole sample of trusts were grouped into five portfolios on the basis of their size at the end of 1980 in ascending order i.e. portfolio 1 contained the smallest trusts within the sample. The five portfolios included an equal number of trusts except where appropriate portfolio 5 included the extra trust. Equally-weighted portfolio excess returns were calculated for the 120 months. This was repeated for the survivors only sample. Tables 4 and 5 report the estimated Jensen measures, adjusted t statistics and multivariate tests for the size sorted trust portfolios for the whole sample of trusts and survivors.

Table 4 Size and Performance(whole sample)

Portfolio	FTA	FT100	EWI	Size
1	0.00368	0.0034	0.00209	0.00208
	1.79	2.1*	1.27	1.81
2	0.00307	0.00278	0.00131	0.00114
	1.17	1.37	0.78	0.81
3	0.0039	0.00356	0.00226	0.00147
	1.57	2.33*	1.15	1.28
4	0.0036	0.00327	0.00179	0.00169
	1.41	2.12*	1.21	2.06*
5	0.00534	0.00499	0.00378	0.00325
	2.31*	4.27**	1.99*	3.58**
GMM	12.11*	27.08**	7.8	15.32**
GMM	4.98	5.32	7.6	7.64

Table 5 Size and Performance(Survivors)

Portfolio	FTA	FT100	EWI	Size
1	0.0052	0.00493	0.00355	0.00335
	2.31*	3.05**	2.34*	3.34**
2	0.00438	0.00404	0.00269	0.00219
	1.82	2.75**	1.45	2.1*
3	0.00372	0.00342	0.00201	0.00159
	1.6	2.24*	1.24	1.8
4	0.00485	0.0045	0.00327	0.00313
	2.06*	3.8**	1.74	3.39**
5	0.00578	0.00544	0.00421	0.00352
	2.48*	4.29**	2.25*	3.68**
GMM	21.12**	30.26**	15.24**	23.26**
GMM	13.16*	10.04*	12.00*	9.98*

* Significant at 5%
** Significant at 1%

Tables 4 and 5 suggest that size may be an important determinant on trust performance. For the whole sample of trusts, the largest trusts portfolio exhibits significant positive performance across all of the benchmark portfolios. Portfolios 1 and 2 show no significant positive performance. The results in Table 5 contrast with those in Table 4. The portfolios of the smallest and largest trusts have significant abnormal performance across all benchmark portfolios. The worst performers are portfolios 2 and 3. The reason for the difference in results is likely to be the impact of survivorship bias. It could be argued that small trusts are more likely not to survive the entire period than larger trusts. If this is the case, this could be causing the relatively poor performance of portfolios 1 and 2 in Table 4. The average size of trust in the complete sample at the end of 1980 is £13.795m and for the survivors is £20.127m which supports this. The multivariate tests confirms the importance of size and frequently rejects the hypothesis of the equality in performance.

For the overall sample of trusts, portfolios 1 and 2 have a large concentration of trusts belonging to the growth category whereas income and general trusts are dominant in the other portfolios. There is a possibility that the impact of size may be due to the performance of general and income and trusts. In order to test this, a sample of only general and income trusts were grouped into five quintiles on the basis of size at the end of 1980 (the extra trust was included in the portfolio of largest trusts). 120 monthly equally-weighted portfolio excess returns were calculated. Table 6 presents the Jensen measures, adjusted t statistics and multivariate tests.

Table 6 Size/Objective and Trust Performance

Portfolio	FTA	FT100	EWI	Size
1	0.00504	0.00478	0.00358	0.00338
	2.35*	3.11**	2.17*	2.87**
2	0.00396	0.00366	0.00233	0.00217
	1.7	2.47*	1.32	2.39*
3	0.00447	0.00417	0.00292	0.00241
	1.95	2.77**	1.68	2.34*
4	0.00392	0.00359	0.00216	0.00216
	1.51	2.25*	1.44	1.99*
5	0.00563	0.00527	0.0041	0.0037
	2.44*	4.55**	2.11*	3.67**
GMM	13.22	27.41**	7.97	14.35*
GMM	5.85	5.17	6.68	6.16

* Significant at 5%
** Significant at 1%

Table 6 reveals that portfolios 1 and 5 exhibit significant abnormal performance across all benchmark portfolios, although portfolios 2-4 do also to a lesser extent. These results may be related to table 5 where the portfolios 1 and 5 have similar positive performance. It appears that both large and small unit trusts outperform the benchmark portfolios. The correlation between the size of the trust and the initial and annual charges in 1980 are 0.0502 and -0.021 respectively. This suggests that there is little relationship between size and expenses and that differences in performance are not caused by expenses. Coupled with the results in Table 3, the investment objective and size of the trust are both important factors affecting performance.

III) EXPENSES AND PERFORMANCE

Investors in unit trusts will incur two charges. The first is an initial charge when the investor purchases units. This is usually about 5 to 6%. The second charge is the annual management fee of approximately 0.5 to 1.5% per year to cover the expenses of the trust. Presumably the major justification for trusts having higher charges is the better performance that such trusts earn. Ippolito(1989) examines the ideas of Grossman(1976) and Grossman and Stiglitz(1980) view of market efficiency. This recognises that there is a cost in gathering information. Informed traders will be able to pass on the cost of information gathering to clients. This implies that informed investors will earn positive abnormal returns before the removal of expenses. Secondly, there should be no relationship between the net returns of funds and expenses. On a gross return basis, we would expect trusts with higher initial charges or annual expenses to earn higher excess risk adjusted returns.

The whole sample of trusts were grouped into four portfolios on the basis of the average initial charge through the 1980s. Portfolio 1 included trusts with charges of under 4%, portfolio 2 with charges between 4 and 5%, portfolios 3 with charges equal to 5% and portfolio 4 with charges over 5%. This was repeated for the survivors only sample except that the trusts were grouped into quintiles. For each of the 8 portfolios, equally-weighted excess returns were calculated over the 120 months. Tables 7 and 8 presents the Jensen measures, adjusted t statistics and multivariate test statistics.

Table 7 Initial Charges and Performance(Whole sample)

Portfolio	FTA	FT100	EWI	Size
1	0.00478	0.00447	0.0032	0.003
	2.01*	2.8**	1.78	2.5*
2	0.00432	0.004	0.0027	0.0022
	1.75	2.81**	1.64	2.1*
3	0.00319	0.0029	0.0015	0.0009
	1.34	1.91	0.89	0.85
4	0.00363	0.0033	0.0019	0.00019
	1.55	2.3*	1.22	2.37*
GMM	6.32	10.07*	5.33	10.94*
GMM	3.68	2.95	3.52	4.38

Table 8 Initial Charges and Performance(Survivors)

Portfolio	FTA	FT100	EWI	Size
1	0.0054	0.005	0.0038	0.0034
	2.29*	3.78**	2.01*	3.19**
2	0.0052	0.0049	0.0035	0.0029
	2.2*	3.27**	2.12*	3.43**
3	0.0043	0.004	0.0027	0.0022
	1.93	2.9**	1.52	2.14*
4	0.0043	0.0039	0.0026	0.0025
	1.82	2.78**	1.52	3.03**
GMM	8.32	15.91**	8.05	17.14**
GMM	5.08	3.88	4.2	3.13

* Significant at 5%
** Significant at 1%

Tables 7 and 8 reveal that trusts with the largest average initial charges do not earn the highest excess risk adjusted returns. Instead it appears that trusts with the lowest initial charges exhibit the best performance. This is true across all benchmarks and for the survivors only sample. This suggests that trusts who charge higher initial charges do not earn a higher return to compensate investors for these expenses.

The next variable to be examined is the relationship between performance and the annual charge. The whole sample of trusts were grouped into four portfolios on the basis of the average annual charge through the 1980s. Portfolio 1 included trusts with charges of under 0.6%, portfolio 2 with charges between 0.6 and 0.7%, portfolios 3 with charges between 0.7 and 0.8% and portfolio 4 with charges over 0.8%. This was repeated for the survivors only sample. For each of the 8 portfolios, equally-weighted excess returns were calculated over the 120 months. Tables 9 and 10 presents the Jensen measures, adjusted t statistics and multivariate test statistics.

Table 9 Annual Charges and Performance(Whole Sample)

Portfolio	FTA	FT100	EWI	Size
1	0.00404	0.0037	0.0024	0.0022
	1.66	2.8**	1.26	2.13*
2	0.00418	0.0039	0.0026	0.002
	1.74	2.46*	1.49	1.5
3	0.00347	0.0032	0.0017	0.0017
	1.4	1.98*	1.18	2.31*
4	0.0043	0.004	0.0026	0.0021
	1.83	2.84**	1.52	2.24*
GMM	4.51	9.18	2.57	7.6
GMM	1.19	1.13	1.59	0.296

* Significant at 5%
** Significant at 1%

Table 10 Annual Charges and Performance(Survivors)

Portfolio	FTA	FT100	EWI	Size
1	0.0052	0.0048	0.0036	0.0032
	2.16*	3.93**	1.9	3.11**
2	0.0051	0.0048	0.0036	0.003
	2.21*	3.39**	1.96	3.09**
3	0.0041	0.0039	0.0024	0.0023
	1.84	2.61*	1.52	2.96**
4	0.0048	0.0045	0.0031	0.0026
	2.03*	3.04**	1.78	2.63*
GMM	6.15	16.82**	4.91	14.37**
GMM	2.52	1.796	2.46	1.05

* Significant at 5%
** Significant at 1%

The evidence in Tables 9 and 10 shows that there is little distinction between the expenses that trusts charge and performance. On a gross return basis, trusts with the highest average annual expenses do not outperform trusts with lower expenses. This suggests that trusts do not earn an excess risk adjusted return to justify the expenses that they charge. The results in Tables 7-10 show that on average trusts with higher charges are inferior performers. This is somewhat different from the findings of Ippolito(1989) but are consistent with Elton, Gruber, Das and Hlavka(1991).

To conclude this section, the robustness of the results were checked by running cross-sectional regressions of the trust's Jensen performance on the trust characteristics. These include simple as well as multiple regressions. Table 11 reports the estimated slope coefficients for each characteristic and adjusted t statistics across all four proxies. Examination of Table 11 suggests a negative relationship between performance and annual and initial charges. Only one of the annual average expenses coefficients is positive (FTA proxy). There is a positive relationship between size and performance. However all of the coefficients, except one, are not statistically significant. Table 11 confirms the conjecture that high expense trusts fail to obtain the necessary performance to justify the extra expenses charged.

Table 11 Cross-Sectional Relations Between Performance and Trust Characteristics

	Size	Expenses	Initial Charge
FTA-simple	0.00002	0.00053	-0.00035
	1.06	0.15	-0.73
multiple	0.00002	0.00056	-0.00046
	1.09	0.16	-1.23
FT100-simple	0.000007	-0.0012	-0.00066
	0.68	-0.55	-1.79
multiple	0.0000096	-0.0008	-0.00069
	0.66	-0.34	-2.21*
EWI-simple	0.0000085	-0.0023	-0.00045
	0.79	-1.05	-1.16
multiple	0.000011	-0.0021	-0.00045
	0.71	-0.81	-1.4
Size-simple	0.0000098	-0.00076	-0.00053
	0.84	-0.32	-1.24
multiple	0.000012	-0.00052	-0.00057
	0.81	-0.19	-1.54

* Significant at 5%

IV) CONSISTENCY OF UNIT TRUST PERFORMANCE

This section considers whether the past performance of the trust is related to future performance. If a trust has been successful in the past, this can be a major advertising tool either to attract new funds into the trust or perhaps new clients to the group or institution which runs the trust. Additionally past performance may be a significant factor in the decision whether to retain or replace fund managers. The Efficient Markets Hypothesis(EMH) suggests that if the market is efficient then past performance should be no guide to future performance.

Recent studies by Grinblatt and Titman(1988), Hendricks, Patel and Zeckhauser(1990) and Ibbotson and Goetzmann(1991) in the USA all found that the performance of mutual funds is partly predictable. Hendricks, Patel and Zeckhauser using a sample of 165 equity funds for the period 1974-88 find that funds which perform well one year continue to perform well the next year where performance is evaluated by the Jensen measure. Ibbotson and Goetzmann consider persistence in performance with a sample of 728 mutual funds during the period 1976-88 and discover that performance persists using the Jensen measure and raw returns. Brown and Draper(1992) present evidence of predictability for a sample of UK pension funds over the periods 1981-90 and 1986-90.

The interpretation of these results is controversial.

Brown, Goetzmann, Ibbotson and Ross(1992) argue that survivorship bias in the sample used can create the illusion of persistent performance. The problem is that if past performance is related to the probability of survival then we only have information on those funds that were successful. We would expect to see higher returns for those funds which survive than those which don't survive. Additionally funds which take a high risk position will be less likely to survive but if such funds do survive then it is likely to be because of the high risk strategy paying off. This can induce a relationship between volatility and returns. For the funds which survive, high volatility funds will have the best performance. This creates a bias when managers are ranked by realised returns or by the Jensen measure because it is a total risk effect. Controlling only for systematic risk may not eliminate this bias. Funds will tend to outperform others if it has a higher volatility.

Brown, Goetzmann, Ibbotson and Ross present simulation evidence which suggests that survivorship bias can lead to false inferences about persistence in performance. Grinblatt and Titman(1989a) estimate that survivorship bias accounts for approximately 0.1% to 0.4% excess returns per annum. Brown et al show that although this seems small in size, it still leads to the appearance of persistence. It is important to note that the argument depends upon how survivorship is related to past performance and whether or not surviving managers change the risk profile of the portfolio. For example, Brown et al point out that if survival depends upon cumulative performance over time rather than one period performance, then this will counteract some of the impact of survivorship bias in persistence. Ibbotson and Goetzmann(1991) argue that survivorship bias is mitigated if the performance of surviving funds is compared relative to other surviving funds. They also check the robustness of their results to survivorship bias which they find cannot explain the persistence in performance.

This section examines the predictability of unit trust performance using the sample of 65 trusts with continuous return data. Initially the persistence of trust performance by the Jensen measure will be considered. Later in this section, consistency of performance will be evaluated by other performance measures. The period 1980-89 was split into two 5 year, five 2 year and ten annual subperiods (non-overlapping). Jensen measures of performance were estimated for the 65 trusts over all the various subperiods using the FTA and EWI proxies as benchmarks.

The first test of persistence is the cross-sectional regression of the second period's Jensen measures on the first period's Jensen measures as:

$$\alpha_B = a + b\alpha_A$$

where α_A and α_B are the Jensen measures of the trusts in the first and second subperiods respectively. A significantly positive slope coefficient is evidence of persistence. Table 12 reports the estimated slope coefficients and adjusted t statistics from the cross-sectional regressions. These were run on adjacent subperiods which implies one regression for the 5 year subperiods, four regressions for the 2 year subperiods and nine for the annual subperiods.

Table 12 suggests that for the 2 year and annual subperiods there is some evidence of persistence. The results are consistent across the two benchmarks. Nearly all of the slopes are positive and for the annual subperiods three out of the nine slopes are significantly positive. The significant persistent performance is concentrated in the period 1984-88. The persistent performance can either be due to persistence in superior or inferior performance. Brown et al argue that inferior performance can persist because of institutional reasons such as immunity from regular performance reviews.

To consider whether the persistent performance in Table 12 is due to inferior or superior performance, 2*2 contingency tables were formed. The tables report the number of trusts who exhibit positive Jensen performance in the initial period continue to do so in the second period. Winners and losers are defined as trusts with positive and negative Jensen performance relative to the benchmark used. Winners in the first period can either be winners or losers in the next period. Similarly losers in the first period can either be winners or losers in the second period. Each cell in the 2*2 tables represents the number of trusts which fall within a given category. Tables 13-15 present 2*2 tables for the different subperiods and the two benchmarks. At the foot of Tables 14 and 15 there are combined tables which sum the cell numbers of the individual tables.

Brown and Draper(1992) present a simple method of assessing the statistical significance of the cells. This is described in the Appendix. What we are interested in is to test if the observed numbers that appear in a cell are statistically different from what would be expected by chance. In the case of 2*2 tables there is a 50% chance that a winner in the first period will be a winner in the second period and a 50% chance that will be a loser in the second period. This also applies to losers.

The evidence in Tables 13-15 suggests that the persistence in performance in Table 12 is due more to consistent superior performance rather than inferior performance. Across all three estimation intervals, winners tend to remain winners and losers are more likely to become winners in the next period than stay losers. This is consistent for the two proxies, although the evidence is less strong for the EWI proxy. It is important to note that survivorship bias will have an impact on the results in Tables 13-15. This is because the trusts are being compared against a benchmark. As shown in chapter 3, the survivors only average Jensen measure was higher than the whole sample average. Hence it is perhaps not surprising to see such consistency in performance.

Can we infer from these tables that the persistent performance is due to skill? This is not possible largely because of possible inefficiencies in the benchmark portfolios. Additionally we do not know the statistical significance of the Jensen measures each period. The results do suggest that many of the trusts would be good marginal investments for investors to make if they held either of the proxy portfolios.

A question of greater interest to many investment managers is how the funds perform relative to one another. Are the ranking of trusts consistent over time? To consider this question, four different methods of rankings are used. These are cumulative excess returns, Sharpe(1966) performance measure, Jensen measure and the adjusted Jensen measure as proposed by Jobson and Korkie(1984). For each of the surviving trusts, cumulative excess returns, Jensen, adjusted Jensen and Sharpe measures were estimated over the 2 year and annual subperiod. The FTA and EWI proxies were used to compute the Jensen and adjusted Jensen measures.

Table 16 presents the rank correlations between adjacent subperiods for the four ranking characteristics across the 65 trusts. Significantly positive rank correlations are evidence of persistence in performance. Apart from the adjusted Jensen measures, the evidence of persistence in performance is consistent across the Jensen measure, Sharpe measures and cumulative excess returns. Quite a few of the annual rank correlations are significantly positive. This largely covers the period 1983-88.

The results in Table 16 are confirmed by the combined 2*2 and 4*4 tables. The analysis focuses on the combined tables because of the small sample size. For each method of ranking the trusts are grouped in two ways. Firstly, the trusts were assigned into winners/losers relative to the performance of the median manager. Secondly the trusts were ranked and grouped into quartiles.

Tables 17-19 present combined 2*2 and 4*4 tables using the Jensen measure to rank the trusts. The combined 2*2 tables show that winners in one period are more likely to remain winners in the next period than become losers. Similarly trusts which are losers in the initial period are most likely to remain losers in the subsequent period. This effect is most noticeable for the annual estimation intervals. The winner-winner and loser-loser cells are higher than would be expected by chance for the annual estimation intervals.

The 4*4 combined tables suggests that when trusts are grouped into quartiles, there is consistency in the relative rankings of the trusts. In most instances, the number of trusts in the diagonal cells are higher than the off diagonal cells. Examination of the rows in the tables reveals certain patterns. For trusts in the top quartile in the initial period, as we move along the row the number of trusts falling in each consecutive cell declines (in nearly every case). When we consider the trusts who are assigned in the bottom quartile in the initial period, the number of trusts in the consecutive cells tends to increase. The results suggest that trusts who are in either the top or bottom quartiles in the initial period are most likely to remain in that quartile in the subsequent period. The observed number of trusts within these cells are usually higher than would be expected by chance.

Tables 20-22 report the combined 2*2 and 4*4 tables using the adjusted Jensen measure to rank the trusts. The results are more ambiguous than the rankings by the Jensen measure and the evidence of consistent performance is less clear cut. One cell in the 2*2 tables is higher than expected when only the significance of the diagonal cells are tested. The 4*4 also show an ambiguous pattern in the rankings especially for trusts in the top quartile.

Tables 23-25 present the combined 2*2 and 4*4 pooled tables of the relative rankings of the trusts by cumulative excess returns and Sharpe measures. The 2*2 tables show significant consistency in performance by the

Sharpe measure for trusts with good performance over both estimation intervals. Trusts which rank in the top half of trusts in one period are more likely to remain there in the subsequent period than move to the bottom half.

The 4*4 pooled tables show greater evidence of consistency in performance with both the Sharpe measure and cumulative excess returns. This is again most noticeable over the annual estimation intervals. Over the annual periods, trusts assigned in the top quartile by either the Sharpe measure or cumulative excess returns are more likely to stay in the top quartile of trusts in the following periods than to move to any of the other quartiles. Similarly trusts ranked in the bottom quartile are most likely to stay in that quartile. There is consistency in the ranking of trusts with the best and poorest performance.

Comparing the inferences across Tables 17-25 shows that the consistency in relative rankings is fairly robust to the method of ranking. Apart from the adjusted Jensen measure, the choice of ranking method leads to similar inferences. The results are strongest over the annual estimation intervals. This suggests that the winners/losers rankings in the 2*2 tables and quartile rankings in the 4*4 tables in the initial period could be a useful guide to the rankings in the subsequent period. This is especially true for the top and bottom quartiles.

It is difficult to identify the cause of the consistency in the rankings. Survivorship bias may play a part in these results but the evidence of Ibbotson and Goetzmann(1991) suggests that it cannot wholly explain the results. Grinblatt and Titman(1988) argue that survivorship bias should lead to negative persistence and not the positive persistence found in this section. They point out that using 2*2 tables, a fund's performance can be described in four ways:

1) Winner-winner,

2) Winner-loser,

3) Loser-winner,

4) Loser-loser.

1) and 4) reflect positive persistence and 2) and 3) are cases of negative persistence. If the four cases have an equal likelihood of occurring, then there is no persistence. Grinblatt and Titman argue that survivorship bias will tend to eliminate the funds in case 4) which implies that surviving funds should exhibit negative persistence.

Cross-sectional dependencies in trust returns, which are not fully eliminated by the risk adjustment procedures followed, may also partially explain the results. The observed persistence may be due more to the investment styles of the trusts than skill. One way to examine this is to repeat the tests for only trusts belonging to a specific investment objective. This is not followed here because of the small number of trusts in the sample to draw meaningful conclusions. Ibbotson and Goetzmann(1991) found that the style factor could not explain the persistence in performance.

A third possible explanation of the findings is that some portfolio managers are better than others. It is important to note that in principle the Jensen measure and cumulative excess returns should not be used to rank trusts. Persistence in the rankings by cumulative excess returns may reflect that some trusts are more risky than others. The Sharpe measure and adjusted Jensen measures are appropriate methods of ranking trusts if we assume that investors are mean-variance optimisers. There is a difference between ranking by the Sharpe measure and the adjusted Jensen measure. The Sharpe measure tells the investor which of the trusts is the best one to invest in an absolute sense. The adjusted Jensen measure presumes that the investor holds a benchmark portfolio and provides information on which trust would be the best marginal investment for the investor to make. It tells us nothing about what trust the investor should hold if no other investments are held.

The contrast in the evidence about consistency between the Sharpe measure and adjusted Jensen measure suggests that it is important how we define the correct method of ranking or what we are exactly seeking to identify by the ranking of the trusts. The evidence in this section indicates that past performance is related to future performance. Much of the consistency is concentrated over short evaluation periods. This may mean that predictability is a short rum phenomenon and evens out over the long term.

V) CONCLUSIONS

This chapter has examined the importance of a number of factors on the performance of the sample of unit trusts. The evidence indicates that the investment objective, size and expenses of a trust all affect performance. It was found that the differences between the performance of the trusts belonging to the various investment objectives could not be explained by size, expense ratios or cash balances. This could either reflect superior ability or inefficiencies in the benchmark portfolios. Another finding of the chapter is that large trusts tend to outperform smaller trusts but smaller trusts are more likely not to survive the sample period. There is also no evidence to suggest that trusts earn the returns to justify the expenses they charge. On a gross return basis, trusts with high initial charges and expenses are often inferior performers. This tends to contradict the findings of Ippolito(1989).

The chapter has also examined whether past performance is a reliable guide to future performance. The Jensen performance of the trusts shows some degree of predictability over annual and two yearly subperiod intervals during the mid 1980s. This is largely due to persistent superior performance relative to the benchmarks used. Three out of the four methods of ranking trusts show consistency in the ranking of trusts. Again this is most clearly seen over annual subperiods. Whatever the exact reason for the predictability, it is perhaps surprising to see such results.

APPENDIX

Brown and Draper present a simple method of calculating critical values. Consider a random variable X which is approximately normally distributed as N(np,npq) where n is the sample size in a given row of the table, p is the probability that a trust in a given row will fall in a cell, q is the probability that a trust will fall in the other cell(s). In the case of the 2*2 tables, p = 0.5 and q = 0.5. For 4*4 tables, p = 0.25 and q = 0.75. Using the standard normal distribution, a critical value for X can be computed as;

$$X = \mu + \sigma Z_\alpha$$

where Z_α is the value from the N(0,1) tables for a given significance level α. It is possible to perform one tailed or two tailed tests with this procedure.

Brown and Draper point out that when K cells are to be tested, a modified approach requires to be adopted. This is because the numbers between cells are not independent of each other. This leads to a greater probability of rejecting a true null hypothesis. It is suggested that the significance level should be altered as;

$\alpha^k = 0.95$ so $\alpha = (0.95)^{1/k}$ for a significance level of 5%.

For tables 14 and 15, the critical values at 5% for the combined tables are:

FTA Winners Row - 101
Losers Row - 51
EWI Winners Row -86.5
Losers Row - 43.8
For tables 17-25, the critical values of the combined tables are (assuming the numbers in each row are approximately equal):

* Significant Critical Values

2*2 Pooled Tables
2 Yearly
k=2, X=76.2
k=4, X=77.92
Annual
k=2, X=162.66
k=4, X=164.99
4*4 Pooled Tables
2 Yearly
k=4, X=23.79
k=16, X=24.62
Annual
k=4, X=47.69
k=16, X=48.94

Table 12 Cross-Sectional Regressions of Jensen Measures
FTA Proxy/EWI Proxy

Period	FTA-Slope	Adjusted t	EWI-Slope	Adjusted t
5 Yearly	0.0756	0.672	0.07	0.53
2 Yearly A	0.39	1.87	0.328	1.62
B	0.14	1.35	0.063	0.6
C	0.358	2.4*	0.377	2.88*
D	0.063	0.61	0.127	1.25
Annual A	-0.1	-1.17	-0.13	-1.34
B	0.14	0.64	0.145	0.71
C	-0.006	-0.08	-0.06	-0.58
D	0.24	1.7	0.187	1.63
E	0.48	4.62*	0.5	4.51*
F	0.155	0.61	0.078	0.286
G	0.4	3.57*	0.32	3.73*
H	0.29	3.09*	0.297	3.45*
I	0.19	0.97	0.26	1.21

* Significant at 5%

The periods in Table 12 are

	Dependent	Independent
5 Yearly	1/80-12/84	1/85-12/89
2 Yearly A	1/80-12/81	1/82-12/83
B	1/82-12/83	1/84-12/85
C	1/84-12/85	1/86-12/87
D	1/86-12/87	1/88-12/89
Annual A	1/80-12/80	1/81-12/81
B	1/81-12/81	1/82-12/82
C	1/82-12/82	1/83-12/83
D	1/83-12/83	1/84-12/84
E	1/84-12/84	1/85-12/85
F	1/85-12/85	1/86-12/86
G	1/86-12/86	1/87-12/87
H	1/87-12/87	1/88-12/88
I	1/88-12/88	1/89-12/89

All of the periods will be signified by these codes in the tables.

Table 13 2*2 Contingency Tables of Trust Performance Relative to zero-FTA Proxy/EWI Proxy

5 Yearly	Winners-FTA	Losers-FTA	Winners-EWI	Losers-EWI
Winners	39	0	50	12
Losers	25	1	2	1

Table 14 2*2 Contingency Tables of Trust Performance Relative to zero-FTA Proxy/EWI Proxy

2 Yearly	Winners-FTA	Losers-FTA	Winners-EWI	Losers-EWI
A) Winners	22	11	49	7
Losers	25	7	7	2
B) Winners	33	14	49	7
Losers	8	10	8	1
C) Winners	40	1	18	39
Losers	15	9	2	6
D) Winners	54	1	19	1
Losers	9	1	41	4
Combined				
Winners	149*	27	135*	54
Losers	57*	27	58*	13

Table 15 2*2 Contingency Tables of Trust Performance Relative to zero - FTA Proxy/EWI Proxy

Annual	Winners-FTA	Losers-FTA	Winners-Ewi	Losers-EWI
A) Winners	23	10	29	23
Losers	26	6	9	4
B) Winners	30	19	35	3
Losers	8	8	25	2
C) Winners	18	20	10	50
Losers	18	9	1	4
D) Winners	22	14	11	0
Losers	7	22	45	9
E) Winners	26	3	49	7
Losers	26	10	6	3
F) Winners	44	8	5	50
Losers	9	4	1	9
G) Winners	51	2	4	2
Losers	8	4	22	37
H) Winners	12	47	16	10
Losers	-	6	6	33
I) Winners	11	1	21	1
Losers	53	0	41	2
Combined				
Winners	237*	124	180	146
Losers	155*	69	156*	103

Critical Values of Combined Tables
FTA Winners Row-199
Losers Row-127
EWI Winners Row-181
Losers Row-145

Table 16 Rank Correlations of Subperiod Rankings

Sub-period	Jensen FTA	Jensen EWI	Ad Jen FTA	Ad Jen EWI	Sharpe	Raw
5 Yearly	0.134	0.068	0.056	-0.045		
2 Yearly						
A	0.084	0.09	0.13	0.173	0.275*	0.044
B	0.231	0.155	0.119	0.234	0.203	0.186
C	0.448*	0.424*	0.234	-0.45	0.425*	0.3*
D	-0.003	0.074	0.17	-0.161	0.081	0.013
Annual						
A	-0.161	-0.124	0.146	0.173	-0.191	-0.23
B	0.069	0.117	-0.009	0.07	0.201	0.118
C	-0.075	-0.136	-0.06	0.238	-0.172	-.29*
D	0.341*	0.326*	0.035	0.369*	0.384*	0.43*
E	0.527*	0.503*	0.009	0.26	0.5*	0.46*
F	0.372*	0.232	0.34*	-0.2	0.342*	0.39*
G	0.535*	0.456*	0.233	-0.014	0.47*	0.42*
H	0.481*	0.508*	-0.192	0.152	0.483*	0.49*
I	-0.059	-0.04	0.086	-0.128	0.087	0.033

* Significant at 5%

For the tables that follow, h1 and h2 refer to trusts that are ranked in the top and bottom halves of the trusts in the subperiod and H1 and H2 refer to trusts that are ranked in the top and bottom halves of trusts in the subsequent period. q1-q4 refer to quartile rankings in the initial period and Q1-Q4 are the quartile rankings in the subsequent period.

Table 17 2*2 Combined Tables of Relative Rankings Via the Jensen Measure Using the FTA and EWI Indices

5 Yearly	FTA- H1	H2	EWI- H1	H2
h1	19	14	18	15
h2	14	18	15	17
2 Years h1	73	59	78*	54
h2	59	69	54	74
Annual h1	175*	122	172*	125
h2	122	166*	125	173*

Table 18 4*4 Combined Tables of Relative Rankings Via the Jensen Measure Using the FTA Proxy

5 Yearly	Q1	Q2	Q3	Q4
q1	3	7	2	4
q2	7	2	3	4
q3	3	3	5	5
q4	3	4	6	4
2 Yearly				
q1	21	16	15	12
q2	15	18	18	13
q3	15	16	18	15
q4	13	14	13	28*
Annual				
q1	51*	40	25	28
q2	40	37	31	36
q3	30	36	50*	28
q4	23	31	38	61*

Table 19 4*4 Combined Tables of Relative Rankings Using the Jensen Measure of the EWI Index

5 Yearly	Q1	Q2	Q3	Q4
q1	5	3	4	4
q2	4	5	3	4
q3	3	3	6	4
q4	4	5	3	5
2 Yearly				
q1	22	13	15	14
q2	18	20	17	9
q3	10	15	20	19
q4	14	16	12	26*
Annual				
q1	52*	40	25	27
q2	33	35	37	39
q3	32	33	46	33
q4	26	36	36	54*

Table 20 2*2 Combined Tables of Relative Rankings Using the Adjusted Jensen Measure of FTA/EWI Proxies

5 Yearly	FTA- H1	H2	EWI- H1	H2
h1	17	16	17	16
h2	16	16	16	16
2 Yearly				
h1	73	59	62	70
h2	59	69	70	58
Annual				
h1	163*	134	155	142
h2	134	158	142	146

Table 21 4*4 Combined Tables of Relative Rankings Using the Adjusted Jensen Measure of the FTA Proxy

5 Yearly	Q1	Q2	Q3	Q4
q1	5	3	2	6
q2	4	5	5	2
q3	3	4	4	5
q4	4	4	5	4
2 Yearly				
q1	20	15	15	14
q2	19	16	16	13
q3	15	13	22	14
q4	10	20	11	26*
Annual				
q1	33	42	34	35
q2	38	41	30	35
q3	37	32	38	36
q4	36	29	42	46

Table 22 4*4 Combined Tables of Relative Rankings Using the Adjusted Jensen Measure of EWI Proxy

5 Yearly	Q1	Q2	Q3	Q4
q1	3	3	4	6
q2	4	5	4	3
q3	5	4	4	3
q4	4	4	4	5
2 Yearly				
q1	9	20	18	17
q2	17	14	18	15
q3	18	15	13	18
q4	20	15	15	18
Annual				
q1	34	36	32	42
q2	35	36	39	34
q3	43	35	34	32
q4	32	37	39	45

Table 23 2*2 Combined Tables of Relative Rankings Using Cumulative Excess Returns and Sharpe Performance Measures

2 Yearly	Sum- H1	H2	Sharpe-H1	H2
h1	74	58	80*	52
h2	58	70	52	76
Annual				
h1	161	126	168*	129
h2	126	162	129	159

Table 24 4*4 Combined Tables of Relative Rankings Using Cumulative Excess Returns

2 Yearly	Q1	Q2	Q3	Q4
q1	21	18	13	12
q2	17	14	17	16
q3	14	18	19	13
q4	11	14	15	27*
Annual				
q1	53*	40	26	25
q2	35	36	34	39
q3	29	38	49*	28
q4	27	30	35	61*

Table 25 4*4 Combined Tables of Relative Rankings Using Sharpe Performance Measures

2 Yearly	Q1	Q2	Q3	Q4
q1	23	18	14	9
q2	16	20	16	12
q3	11	13	20	20
q4	14	12	14	27*
Annual				
q1	53*	40	24	27
q2	37	32	41	34
q3	33	39	40	32
q4	21	33	39	59*

CHAPTER SIX

CONCLUSIONS

This study has considered a wide range of issues in performance measurement. It has been shown that the potential timing biases in the Jensen measure are negligible. However identifying an appropriate benchmark portfolio is more complex. The evidence within the study showed that the majority of unit trusts exhibited positive Jensen performance against each benchmark during the 1980s. A considerable number were statistically significant, although this varies across the benchmarks. Similar positive performance is reflected by the selectivity measures of performance in chapter 4. It is important to keep in mind that the returns used in this study are gross returns and hence it is less surprising to see such positive performance.

The questions of particular interest are whether this performance reflects superior ability, and do investment managers possess information which is not incorporated into security prices? Unfortunately this conclusion cannot be drawn because of the evidence that each of the benchmark portfolios are ex ante mean-variance inefficient. This means that the interpretation of the positive performance is ambiguous. Positive performance can either reflect superior ability or the inefficiencies in the benchmark. It was also shown in chapter 4 that inefficiencies in the benchmark have a similar effect on the selectivity measures of performance as on the Jensen measure.

The key to performance evaluation within a mean-variance framework is to identify and use an ex ante efficient portfolio. The evidence within this study suggests that this difficult. All of the evaluated portfolios were inefficient even when short selling restrictions were imposed. Work in the USA also highlights the importance of the choice of benchmark portfolio. Lehmann and Modest(1987) and Grinblatt and Titman(1988) show that inferences about mutual fund performance varied considerably across CAPM and APT benchmarks. A relevant benchmark portfolio should be one that investors are able to construct. This is frequently overlooked in performance measurement studies and applies particularly to APT motivated benchmarks. How many of the multiple portfolio benchmarks are actually feasible investment strategies is open to question.

The positive selectivity and Jensen performance by the trusts shows that many of the trusts would be good marginal investments for investors who hold the benchmark portfolio. With the assumption that a riskless asset exists, the possibility of superior performance cannot be ruled out. Given an efficient benchmark portfolio, the Jensen measure can correctly identify superior performers in a mean-variance world.

A potentially useful finding of the study is the possibility of an unambiguous measure of timing ability which only requires portfolio return data. The evidence in chapter 4 suggests that when an appropriate return generating model is specified, the negative correlation between selectivity and timing performance disappears. Perhaps more importantly, very few of the passive portfolios had timing coefficients that were significantly different from zero. This could imply that measures of timing performance are robust to inefficiencies in the benchmark. Further work could examine this in more detail. The evidence indicates that few if any unit trusts exhibit superior timing ability against any of the benchmark portfolios.

Another common feature through the study is the impact of survivorship bias. It has been noted in chapters 3 to 5, that by only including surviving trusts in the sample the conclusions drawn are likely to be affected. With a survivors only sample, trust performance will appear much more favourable. Care should be taken in interpreting performance for such samples.

Chapter 5 showed that the investment objective and size of trust are factors which affect performance. Trusts belonging to the General and Income categories tend to outperform, on average, Growth trusts. Small and large trusts also exhibit significant positive performance but small trusts are particularly susceptible to survivorship bias. Trusts with higher charges tend to be inferior performers to low charge trusts. Also the past performance of the trust does appear to be related to future performance especially over annual evaluation intervals.

Much of the work in this study could be usefully extended to other types of managed funds. Performance of funds could be evaluated by other benchmarks than the ones used in this study. Additionally performance measures which use portfolio composition data could be used to assess performance. These are likely to be more powerful than the measures used in this study.

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