Detecting Long-run Abnormal Stock Returns:
The Empirical Power and Specification of Test Statistics:
The Canadian Evidence

Matthew Robert Bogue

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ABSTRACT

Detecting Long-run Abnormal Stock Returns: The Empirical Power and Specification of Test Statistics: The Canadian Evidence

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This study empirically examines the issue of long-horizon security price performance in the Canadian equity market. It analyses the empirical power and specification of test statistics through event studies designed to detect long-run abnormal stock returns. I evaluate the performance of different approaches for developing a benchmark portfolio to calculate abnormal returns. I consider the use of five portfolio approaches, three control firm approaches, as well as two methods for measuring abnormal returns, and three time horizons. I document the empirical power of the various test statistics by inducing an abnormal return in each sample firm. Additionally, a beta shift procedure was performed to test the "goodness" of the match between sample firms and portfolios and between sample firms and control firms. I find that the CAR methods work better than the BHAR methods and that the portfolio and control firm methods return the anticipated result with approximately equal accuracy. I find that adding a constant level of abnormal return ranging from -20% to +20% in 5% increments, shows a lack of power in the t-statistics at these levels of induced abnormal return. Adding a level of abnormal return equal to +/- one to three standard deviations of sample firm's returns to the calculated abnormal return of each sample firm rejects the null hypothesis of no abnormal return. The beta shift procedure confirms that the matches between sample firms and benchmarks are good ones.

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1. Introduction

This study empirically examines the issue of long-horizon security price performance measurement in the Canadian equity market. It analyses the empirical power and specification of test statistics through event studies designed to detect long-run abnormal stock returns. I evaluate the performance of different approaches for developing a benchmark portfolio to calculate abnormal returns.

This issue is of import because it has been shown that the return to the bidder in transactions for corporate control is essentially null, or even negative in the short term (Jensen and Ruback, 1983). The question of long-term performance measurements is thus a logical extension of these results. If the returns associated with merger and acquisition activity are null or negative, the question of why corporations continue to engage in them arises. One would assume that the reason is that managers perceive these transactions as value increasing and not that they are simply pursing goals of empire building brought on by hubris. The issue of long-term performance is also important when studying other events in a corporation's life. The benchmarking techniques I will be discussing can be utilised to study the long-term effect of a plethora of firm specific events, such as stock splits, dividend initiations and omissions and so on. In addition, a finding of long-term over or underperformance in the markets would have serious implications for the efficient market hypothesis and much of the literature in finance.

In theory one would expect that the post transaction performance of bidders should be, in an efficient market, equal to zero as the market reacts quickly to the combined firm's prospects. The reality however is that the findings in this area are contradictory and there is no consensus among researchers regarding the optimal method to measure long-term performance. It is important to note that this thesis examines the issue of abnormal return measurement in long-term event study methodology. It does not actually examine the returns to Canadian bidders; rather it is concerned with finding the best methodology to do so. The remainder of this thesis is organised as follows. In section two I discuss the relevant literature in this area. I then discuss the particuiarities of the Canadian equity market and the motivations behind studying it in section three. Section four outlines the data collection process and sources of information. In section five I review the various benchmark methods I have used in the measurement of long-term returns. Section six describes the actual measurement methods used to study long-run returns; while section seven defines the statistical test for significance of these returns. In section eight I discuss the simulation method applied to the data, and I report the findings in section nine. I conclude in section ten.

2. Literature Review

This study examines the issue of long-horizon security price performance in the Canadian equity market. It has been shown in many studies in the field of finance that the return to the bidder in transactions for corporate control is essentially null, or even negative in the short term (Jensen and Ruback, 1983). The question of long-term performance measurements is thus a logical extension of these results.

Most of the research in this area focuses on transactions in the United-States. The main hypothesis is that the post-transaction performance of the bidder firm should be, in an efficient market, equal to zero as the market reacts quickly to the combined firm's prospect. The findings in this area are contradictory in many respects, and there is no consensus among academics about the optimal method to measure long-term performance. Many researchers have, using their own data set, found results which contradict the findings of their peers and as a result many of the findings in this area have been called into question. The search for an effective method for measuring abnormal returns is ongoing, and the debate about perceived market anomalies rages on.

Some researchers have found negative performance in the years following a takeover transaction (Agrawal, Jaffe and Mandelker (1992)). These findings, according to the authors, contradict the efficient market theorem and call into question much of the research on mergers and acquisitions.

> A finding of under-performance has three important implications. First, the concept of efficient capital markets is a major paradigm in finance. Systematic poor performance after mergers is, of course, inconsistent with this paradigm. Second, much research on mergers examines returns surrounding announcement dates in order to infer the wealth effects of mergers. This approach implicitly assumes that markets are efficient, since returns following the announcement are ignored. Thus, a finding of market inefficiencies for returns following mergers calls into question a large body of research in this area. Third, a finding of under-performance may also buttress certain studies showing poor accounting performance. (Agrawal, Jaffe and Mandelker, 1992)

Others, using different estimation techniques, find that the performance after the transaction is not significantly different from zero (Franks, Harris and Titman (1991), Fama (1998)). They put forward explanation such as: the "findings of poor performance after takeovers are likely due to benchmark errors rather than miss-pricing at the time of the takeover" (Franks, Harris and Titman, 1991).

Some researchers have found that performance varies through and across time. Loderer and Martin (1992) "find abnormal performance in the three years but not in five years following the acquisition. Negative performance in the second and third years after the acquisition is most prominent in the 1960s, and to a lesser extent in the 1970s, but not in the 1980s" (Loderer and Martin, 1992).

Others find that post-acquisition performance is related to the mode of acquisition (Rau and Vermaelen, 1998) and form of payment (Loughran and Vijh, 1997).

> During a five-year period following the acquisition, on average, firms that complete stock mergers earn significantly negative excess returns of –25% whereas firms that complete cash tender offers earn significantly positive

> excess return of 61.7%. Over the combined pre-acquisition and post-acquisition period, target shareholders who hold on to the acquirer stock received as payment in stock mergers do not earn significant positive excess returns. In the top quartile of target to acquirer size ratio, they earn negative returns. (Loughran and Vijh, 1997)

Rau and Vermaelen (1998) found that the bidders in merger transactions underperformed, while those who initiated tender offers overperformed in the three-year time horizon after the transaction. They also report that the "the long-term under-performance of acquiring firms is predominantly caused by the poor post-acquisition performance of low book-to-market "glamour" firms" (Rau and Vermaelen, 1998).

Other studies have employed a different approach when looking at the issue of post-transaction performance of bidders. They have "analysed the empirical power and specification of test statistics in event studies designed to detect long-run (one-to five-year) abnormal stock returns" (Barber and Lyon, 1997). Kothari and Warner (1997) find that "tests for long-horizon abnormal security returns around firm specific events are severely miss-specified" (Kothari and Warner, 1997). Barber and Lyon (1997) "document that test statistics based on abnormal returns calculated using a reference portfolio, such as a market index, are miss-specified (empirical rejection rates exceed theoretical rejection rates) and identify three reasons for this misspecification" (Barber and Lyon, 1997). They find that matching "event firms" to control firms with similar size and book-to-market ratios corrects for the misspecification and yields well specified test statistics in almost all sampling situations considered.

The potential sources of bias, in the estimation of test statistics in long-run event studies are summarised by Kothari and Warner (1997). They are : "

- Abnormal returns : Model specification : Over a long horizon, the variation in expected return estimates across different benchmark models can be large. Thus, long-horizon results are potentially very sensitve to the assumed model for generating expected returns. (Indeed this problem has been a source of fustration for a long time, Roll (1978) argued that estimates of abnormal performance can be sensitive to the choice of benchmark, and that estimates generated with inneficient benchmarks are not generally meaningful. As such, "the results of earlier studies of post-merger performance are therefore suspect, since they use benchmark portfolios (e.g., the CRSP equally-weighted or value-weighted indexes) that are known to be inneficient and hence are not appropriate for judging performance. In particular, these benchmarks generate abnormal performance that is related to firm size and dividend policy and thus are likely to generate negative performance measures for larger-than-average acquiring firms, even if their actual performance is favourable" (Franks, Harris and Titman, 1991)).
- Abnormal returns : Cumulation : (Kothari and Warner's) baseline results use the standard procedure of cumulating event window security-specific abnormal returns by adding them. An alternative procedure sometimes employed in long-horizon studies is a "buy-and-hold " procedure, in which a security's buy-and-hold return is defined as the product of one plus each month's abnormal return, minus one. Buy-and-hold returns have been recommended because additive cumulation procedures are systematically positively biased due to the bid-ask spread. (Barber and Lyon

"find that cumulative abnormal returns (summed monthly abnormal returns) yield positively biased test statistics, while buy-and-hold abnormal returns (the compound return on an "event firm" less the compound return on a reference portfolio) yield negatively biased test statistics. These apparently contradictory results occur because of the differential impact of the new listing, rebalancing, and skewness biases on cumulative abnormal returns and buy-and-hold abnormal returns. In sum CARs are a biased predictor of long-run BHARs" (Barber and Lyon, 1997)). On the other hand, Fama (1998) suggests the use of CARs instead of BHARs.

- Survival: Over time, there are changes in sets of firms that exist and have security return data. There are several aspects of survival biases. First, minimum data requirements. Second, long-horizons raise the possibility of parameter shifts, affecting both abnormal return measurements and variances. Systematic parameter shifts are likely when events are correlated with past performance. Even if true parameter shifts are not systematic, this can affect the properties of the estimators.
- Variance estimation: Even in the absence of abnormal performance, the variance of long-horizon cumulative abnormal returns and the possible range of values is wide. Estimates of this variance and hence test statistics can differ widely across different benchmark models for the variance". (Kothari and Warner, 1997)

Franks, Harris and Titman (1991), study long-term share-price performance following corporate takeovers. They propose using multi-factor benchmarks from the portfolio evaluation literature to overcome some of the known mean-variance inefficiencies of more traditional single-factor benchmarks. They conclude that:

"previous findings of poor performance after takeovers are likely due to benchmark errors rather than mispricing at the time of the takeover." (Franks, Harris and Titman, 1991) The authors use a value- and an equally-weighted index as well as two multi-portfolio benchmarks. These are a ten-factor benchmark based on a model developed by Lehmann and Modest and an eight-portfolio method based on size, dividend yield and past return. Their results clearly show that:

> the different benchmarks generate very different measures of abnormal performance. The performance measures against the equally- and value-weighted indexes are significantly different from each other and have opposite signs. The value-weighted index generates significant positive postmerger abnormal performance of over 0.3% per month whereas the equally-weighted index generates monthly abnormal performance of about -0.2%. On the other hand, the ten-factor and eight-portfolio benchmarks yield no evidence of abnormal post-merger performance. Using the eight-portfolio benchmark, the estimate of abnormal performance is 0.05% per month, with a t-value of only 0.46. (Franks, Harris and Titman, 1991)

They conclude that while acquiring firms may have poor postmerger returns measured against an equally-weighted index, their returns are not reliably different from the returns of other firms with similar attributes as captured by multi-portfolio benchmarks.

Kothari and Warner (1997) show that tests for long-horizon abnormal returns are severely misspecified. They propose the use of non-parametric and bootstrap tests to reduce misspecification.

> For example, in samples of 200 securities, procedures based on the Fama-French three-factor model show abnormal performance over a 36-month horizon for 34.8% of the samples, using two-tailed parametric tests at the 5% significance level. The results are similar using other procedures and

> the general conclusions are not sensitive to the specific performance benchmarks. Further, the tests show both positive and negative abnormal performance too often. Moreover, the abnormal performance persists throughout the horizon following a simulated event. (Kothari and Warner, 1997)

Kothari and Warner identify several sources of test misspecification, which have as a combined result that the parametric test statistics do not satisfy the assumed zero mean and unit normality assumptions. They document that the bias toward overrejection is related to both sample selection and survival. Also, they show that long-horizon BHARs are significantly right-skewed, although CARs are not.

Kothari and Warner (1997) use four expected return models: the market-adjusted model, a market model, the capital asset pricing model (CAPM) and the Fama-French three-factor model. They test the null-hypothesis that the cross-sectional average abnormal return in the event month is zero and that the average abnormal returns cumulated over different periods up to 36 months following the event month are zero. All four models are found to be severely misspecified.

> CARs over long horizons are on average positive for randomly selected securities. The distribution of test statistics has a positive mean and it is fat-tailed relative to a unit-normal distribution. The indicators of abnormal performance are stronger the longer the horizon. The four models all conclude positive abnormal performance over a three-year period in 26% to 35.2% of the samples at the 5% significance level, suggesting positive mean CARs. In contrast, negative abnormal performance is observed in only 2.4% to 8.4% of the samples. (Kothari and Warner, 1997)

Fama (1998) contends that the efficient market hypothesis survives the challenges from the literature on long-term return anomalies. He finds that anomalies are chance results, that findings of overreaction are about as common as findings of underreaction, and that post-event continuation of pre-event abnormal returns is about as frequent as post-event reversal. All of which is consistent with market efficiency and with the hypothesis that these anomalies can be due to methodology. He finds that most long-term anomalies tend to disappear with reasonable changes in technique and are thus sensitive to methodology. Fama also discusses the problems associated with long-term returns such as the bad-model problem for the generation of expected returns. He further states that "the matching approach is not a panacea for bad-model problems in studies of long-term abnormal returns " (Fama, 1998). Also he extols the virtues of average or sums of short-term abnormal returns (AARs or CARs) rather than buy-and-hold returns (BHARs) in the measurement of long-term returns.

2.1. Barber and Lyon (1997)

Barber and Lyon (1997) "analyse the empirical power and specification of test statistics in event studies designed to detect long-run (one- to five-year) abnormal stock returns". In large part this thesis investigates if the results of Barber and Lyon are applicable to the Canadian equity market. Barber and Lyon empirically evaluate the performance of different approaches for developing a benchmark portfolio to calculate abnormal returns. The first approach employs the return on a reference portfolio to calculate abnormal returns. The second approach matches "event firms" to control firms on specified firm characteristics. Barber and Lyon provide a table that summarises the recent studies of long-run abnormal stock return performance following major corporate events and the benchmarks used in each of the studies; it is replicated in table 1.

The authors used 4 (four) methods for the calculation of reference portfolios. They were:

- Ten size-based portfolios reconstituted once a year. The monthly return for each of the ten size reference portfolios was calculated by averaging the monthly returns across all securities in a particular size decile. Firms were allowed to change deciles once each year. The calculation of the size-benchmark return is equivalent to a strategy of investing in an equally weighted size decile portfolio with monthly rebalancing.

- Ten book-to-market portfolios reconstituted once a year. The returns on the ten book-to-market reference portfolios are calculated in a fashion analogous to the ten size portfolios.
- 50 size/book-to-market portfolios that are reconstituted once a year. These portfolios were formed using a two step process. First, all firms were ranked on the basis of their market value of equity. Size deciles were then created based on these rankings. Second, within each size decile, firms are sorted into quintiles on the basis of their book-to-market ratios. The returns on the 50 portfolios are calculated in a fashion analogous to the ten size portfolios and ten book-to-market portfolios.
- Equally weighted market index. The authors state that "it may be informative from an investment perspective to compare the performance of sample firms to a value weighted index. However, such comparisons are inherently flawed when developing a test for detecting log-run abnormal returns because event studies by design give equal weight (rather than value weight) to sample observations." (Barber and Lyon, 1997) The use of a value-weighted index is nevertheless considered in this study, although it is not expected to perform well due to this reason.

In the control firm approach, "event firms" are matched to a control firm on the basis of specific firm characteristics. The authors used 3 (three) methods for the assignation of control firms. They were:

- Matching an "event firm" to a control firm closest in size (as measured by market value of equity).
- Matching an "event firm" to a control firm with most similar book-to-market ratio.

- Matching an "event firm" to a control firm of similar size and book-to-market ratio. This is done by first identifying all firms with a market value of equity between 70% and 130% of the market value of equity of the "event firm", and then from this set of firms choosing the firm with the book-to-market ratio closest to that of the "event firm".

Barber and Lyon (1997) calculate abnormal returns in the following manner.

CAR Method:

Define R_{it} as the month t simple return on a "event firm",

Define $E(R_{it})$ as the month t expected return for the "event firm",

Define $AR_{it} = R_{it} - E(R_{it})$ as the abnormal return in month t.

Cumulating across τ periods yields a cumulative abnormal return (CAR):

$$CAR_{i\tau} = \sum_{t=1}^{\tau} (Rit - E(Rit)).$$

BHAR Method:

The return on a buy-and-hold investment in the sample less the return on a buy-and-hold investment in an asset/portfolio with an appropriate expected return (BHAR) is:

$$BHAR_{it} = \prod_{t=1}^{\tau} (1 + Rit) - \prod_{t=1}^{\tau} (1 + E(Rit)).$$

The authors:

> evaluate the empirical specification and power of test statistics based on both CARs and BHARs at one-, three-, and five-year horizons. (They) use the return on either a reference portfolio or a control firm as the expected return for each sample firm when calculating a CAR or a BHAR. When a sample firm is missing return data post-event, (they) use the return on the corresponding reference portfolio as the realised return. When a control firm is missing return data post-event, (they) fill the control firm's return with the corresponding reference portfolio. When reference portfolios are employed, if the portfolio assignment of a sample firm changes during the event year, the corresponding reference portfolio is also changed. When the control firm methods are used, the same control firm is used throughout the horizon of analysis.

To test the null hypothesis that the mean cumulative or buy-and-hold abnormal returns are equal to zero for a sample of n firms, the authors employ one of two parametric test statistics:

$$t_{CAR} = \overline{CAR_{i\tau}} / (\sigma(CAR_{i\tau}) / \sqrt{n})$$

$$t_{BHAR} = \overline{BHAR_{i\tau}} / (\sigma(BHAR_{i\tau}) / \sqrt{n})$$

Where $\overline{CAR_{i\tau}}$ and $\overline{BHAR_{i\tau}}$ are the sample averages and $\sigma(CAR_{i\tau})$ and $\sigma(BHAR_{i\tau})$ are the cross-sectional sample standard deviations of abnormal returns for the sample of n firms.

Table 2 is supplied by Barber and Lyon and summarises the methods described above.

Results CAR

The authors first present results based on 1000 random samples of 200 event months drawn from their population of over 1.1 million possible event months. Two important results are outlined by the authors; firstly, that the CARs calculated using reference portfolios yielded positively biased test statistics that increase over time. They attribute this positive bias to the positive mean abnormal return, a by-product of the new listing bias. Secondly, the control firm approaches yield well-specified test statistics (except for the size-matched control firm approach at the 5% significance level over a three-year horizon). They suspect random sampling variation accounts for this result. They conclude by stating that the control firm approach effectively eliminates the new listing bias.

The authors are also interested in the power of t-statistics using CARs. They document the power of t-statistics based on seven methods of calculating abnormal returns by adding a constant level of abnormal return to the calculated CAR of each "event firm". They document the empirical rejection rates at the 5% theoretical significance level of the null hypothesis that the mean sample CAR is zero across 100 simulations at induced levels of abnormal returns ranging from –20% to +20% in increments of 5%. They find that the reference portfolio methods are generally more powerful than the control firm methods, but that the power of the reference portfolio approaches is meaningless, since they yield test statistics that are misspecified at long-horizons.

Results BHAR

The authors present the specification of t-statistics using long-run buy-and-hold returns. They find that there is a significant negative bias in t-statistics based on abnormal returns calculated using the four reference portfolios. This bias is blamed on the rebalancing and skewness biases. The authors also find that the control firm approach is particularly efficient. When the control firm approaches are employed, the mean BHAR and skewness are generally both much closer to zero than when the reference portfolio approach is used. Thus, test statistics based on the control firm approach are well specified (with the exception of the book-to-market matched control firm approach at the 1% significance level at a one-year time horizon. They suspect random sampling variations account for this result.

The authors also study the empirical power of the test statistics by adding a constant level of abnormal return to the calculated annual BHAR of each "event firm". "However, with BHAR, adding 5% to the annual BHAR does not correspond to a particular pattern of monthly abnormal returns. Thus, direct comparisons of the power of t-statistics using CARs are not meaningful" (Barber and Lyon, 1997). They find two noteworthy results. Firstly, the reference portfolio methods of calculating annual BHARs yield asymmetric power functions. Secondly, though symmetric, the control firm methods are less powerful than the reference portfolio methods. Nonetheless, they authors "cannot recommend the use of the reference portfolio methods because they yield severely misspecified test statistics" (Barber and Lyon, 1997).

In conclusion, the authors identified a method of measuring long-run returns that yields well-specified test statistics. They document that matching "event firms" to control firms of similar size and book-to-market ratios yield well-specified test statistics in virtually all sampling situations that are considered.

The focus of this thesis is the Canadian market. Given the contradictory status of the literature, I have carried out specification tests using equity and accounting data to help shed light on which model is best suited to the distinctive Canadian markets (i.e., generally thinly traded smaller market capitalisation firms heavily weighted in the resource sectors). I have applied the most popular models to the Canadian data. These include those that use different benchmark portfolios based on market capitalisation or book-to-market values. Another approach used is to match the "event firm" with the "best-matched" firm in the market (based on some criteria) to test whether or not abnormal performance exists. The following section discusses the Canadian equity market and explains why it is an interesting one to study.

3. The Canadian Equity Market

The focus of this study is the Canadian equity market, specifically the Toronto Stock Exchange. The TSE is one of the twenty largest exchanges in the world. In 1994 (the mid-point of this study as far as return data is concerned) it was ranked twelfth in the world in terms of the market value of shares traded. As of 1999 it was ranked fifteenth in the world, behind NASDAQ, New York, London, Paris, Tokyo, Deutsche Borse, Taiwan, Paris, Madrid, Korea, Switzerland, Italy, Amsterdam and Chicago. When one compares the market capitalisation of domestic shares traded on the Toronto Stock Exchange (789,155 million U.S. dollars as of the end of 1999) to that of our neighbour to the south (NYSE: 11,440,767 million U.S. dollars as of the end of 1999; NASDAQ: 5,204,620 million U.S. dollars as of the end of 1999) we can see that in terms of size it is indeed a very different market (Toronto Stock Exchange FactBook, 1999).

Canada is a land of great natural resources, and this is reflected on our stock exchanges. The Canadian stock exchanges have a large amount of resource sector companies. Liquidity is also an issue in the Canadian equity markets. Although large Canadian companies are very liquid, there is a large contingent of illiquid stocks on the Canadian exchanges. The recent reforms instituted in Canada (i.e., the formation of a junior and senior exchange structure) will no doubt help mitigate these problems by segregating smaller, less liquid stocks on an exchange designed specifically for that purpose. The larger, more established companies will thus be concentrated on the Toronto Stock Exchange. This will help companies and investors alike, smaller companies will have better access to capital and investors will be less affected by the indirect transaction costs associated with illiquidity. However, the recent transformation of the Canadian equity market is not a panacea. Indeed the Toronto Stock Exchange is still dominated by a small number of heavyweights. Daily index movements are representative of only a small number of shares, and do not necessarily represent how the broader market has performed. Recently there has been a shift in the Toronto Stock Exchange; it has become a more technology company laden market, mimicking a similar move in the U.S. economy and equity market toward technology (the so-called new economy companies).

The reason I set out to explore the Canadian market is part patriotism and part science. The number of Canadian empirical studies is indeed infinitesimal compared to the amount of research done on the U.S. market. The possible reasons for this are that researchers expect the results in the Canadian market to be highly correlated with those found in the U.S. market and as such don't see the benefit of studying the Canadian markets. Another reason is the availability (or lack thereof) of data and research friendly instruments dealing with Canadian equities. Given the differences outlined above between the Canadian and U.S. markets, I find that the Canadian markets are indeed worthy of attention and will very likely yield different empirical findings than research done in the U.S. Although the Canadian and U.S. economy are very much intertwined, the very composition and structure of the Canadian markets are a possible source of different empirical results. The issues of lack of liquidity, concentration of assets in certain sectors, index composition and weighting all point to a market that will no doubt reveal itself to be very different than its U.S. counterparts. The next section describes the data collection process, sources and use of data.

4. Data

Monthly return data for all common stocks listed on the Toronto Stock Exchange and both a value and equally weighted index was collected from the TSE Western database for the years 1992 to 1997.

Fama and French (1992) show that common equity returns are related to firm size and book-to-market ratios. As such, in developing a test to detect long-run abnormal returns, I "anticipate that it will be important to control for firm size and book-to-market ratios" (Barber and Lyon, 1997).

> If assets are priced rationally...stock risks are multidimensional. One dimension of risk is proxied by size (market equity). Another dimension of risk is proxied by the ratio of the book value of common equity to its market value (book-to-market ratio). Thus, two easily measured variables, size and book-to-market ratio, provide a simple and powerful characterisation of the cross-section of average stock returns. (Fama and French, 1992)

To calculate the market capitalisation of the companies on the TSE, I collected year-end shares outstanding and price data. Wherever corporations had several classes of common shares, these were summed to calculate the total market capitalisation of the firms.

Also, in order to calculate the book-to-market ratios, total shareholders' equity and preferred shareholders' equity data was collected from the CanCorp Financials database. Values for common shareholders equity were computed by subtracting the preferred shareholders' equity from the total shareholders' equity to calculate the book value of common stock. This value was then divided by the total market capitalisation of the firm to arrive at the book-to-market ratios.

The values for market capitalisation and book-to-market ratio are calculated in December of each year, however they are only used to construct the benchmarks (be they control firms or portfolios) in April of the following year. For example, the book-to-market ratios calculated in December of 1993 are used starting in April of 1994 till March of 1995. This is done to allow time for the information to be disseminated in the market place. The end of year values are not known in the market until the publication of a firm's annual report which does not coincide with the end of the calendar year. The following section discusses the methods used to construct the various benchmark methods used in the calculation of long-run abnormal returns.

5. Benchmark Methods

Table 3 summarises the methods used in the construction of reference portfolios and the different control firm approaches utilised in this study.

The first set of reference portfolios constructed was the size decile portfolios. In December of each year, the market capitalisation of common equity was calculated for all firms trading on the Toronto Stock Exchange. These were ranked in increasing order from the smallest market capitalisation firm to the largest, and size deciles were then created.

Monthly returns were calculated for each of the ten size decile portfolios by averaging the monthly returns across all securities in each decile starting in the following month of April. Since firms are ranked in December of each year, firms are allowed to change decile once a year. "The calculation of the size-benchmark return is equivalent to a strategy of investing in an equally weighted size decile portfolio with monthly rebalancing" (Barber and Lyon, 1997).

The second set of reference portfolios was the book-to-market decile portfolios. In December of each year, the book-to-market ratio was calculated for all firms trading on the Toronto Stock Exchange. These were ranked in increasing order from the smallest market capitalisation firm to the largest, and size deciles were then created.

Monthly returns were calculated for each of the ten book-to-market ratio portfolios by averaging the monthly returns across all securities in each decile starting in the following month of April. Since firms are ranked in December of each year, firms are allowed to change decile once a year.

The third set of reference portfolios was fifty size/book-to-market portfolios that are reconstituted in December of each year. These portfolios were formed in a two step process. In December of each year, market capitalisation and book-to-market ratio were calculated for all firms trading on the Toronto Stock Exchange. The first step in forming these portfolios was to rank all the firms in terms of their market capitalisation from the largest, to the smallest and then creating size deciles. The second step was to further divide each decile into quintiles based on their book-to-market ratios.

Monthly returns were calculated for each of the fifty size/book-to-market ratio portfolios by averaging the monthly returns across all securities in each decile starting in the following month of April. Since firms are ranked in December of each year, firms are allowed to change decile once a year.

Finally, in addition to these three sets of portfolios, an equally weighted and value weighted index were considered. In sum, five different reference portfolio methods are used (ten size portfolios, ten book-to-market portfolios, fifty size/book-to-market ratio portfolios and an equally weighted and a value weighed index) in tests for long-run abnormal stock returns.

As an alternative to the use of reference portfolios, I considered the use of control firms. In the control firm approach "event firms" are matched to a control firm based on some specific characteristic. Three control firm approaches were used. The first method was to match an "event firm" to a control firm closest in term of market capitalisation. The second method was to match an "event firm" to a control firm closest in term of book-to-market ratio. The third method was to match an "event firm" to a control firm with similar market capitalisation and book-to-market ratio. The third method comprises two steps; first the identification of all firms with a market capitalisation between 70% and 130% of the market capitalisation of the "event firm"; the second was to identify from this set the firm with the book-to-market ratio closest to the "event firm's" book-to-market ratio. The next section describes the actual measurement methods used to study long-run returns.

6. CARs and BHARs

Two methods for calculating abnormal returns were used in this study, cumulative abnormal returns, and buy and hold abnormal returns. Buy-and-hold abnormal returns are defined as the difference between the buy-and-hold return on the "event firm" and the buy and hold return on the reference portfolio or control firm.

The convention in much of the research that analyses the abnormal returns has been to sum either daily or monthly abnormal returns over time. As in Barber and Lyon (1997) I:

Define R_{it} as the month t simple return on an "event firm".

Define $E(R_{it})$ as the month t expected return for the "event firm".

Define $AR_{it} = R_{it} - E(R_{it})$ as the abnormal return in month t.

Cumulating across τ periods yields a cumulative abnormal return (CAR):

$$CAR_{i\tau} = \sum_{t=1}^{\tau} (Rit - E(Rit)) .$$

The return on a buy-and-hold investment in the sample less the return on a buy-and-hold investment in an asset/portfolio with an appropriate expected return (BHAR) is:

$$BHAR_{it} = \prod_{t=1}^{\tau} (1 + Rit) - \prod_{t=1}^{\tau} (1 + E(Rit)) .$$

The following section defines the statistical tests used to gage the significance of these returns.

7. Statistical Tests for Long-run Abnormal Returns

I test the null hypothesis that the mean cumulative abnormal or buy-and-hold abnormal returns are equal to zero at one-, three-, and five-year horizons. The expected return used was the return on either the reference portfolio or the control firm in the calculation of the CARs and BHARs.

As was done in Barber and Lyon (1997), when an "event firm" or control firm is missing return data post-event, I use the return on the corresponding reference portfolio as the realised return. For example, when "event firms" are matched to control firms on size, I fill missing return data for control firms with the return on their corresponding size decile portfolio. With filling, it is assumed that investors roll their investment from the firm with the missing return into a reference portfolio.

Recall that, I consider the use of five reference portfolios (size decile, book-to-market deciles, fifty size/book-to-market-ratio portfolios, as well as an equally weighted and a value weighted index), and three methods for assigning control firms (size matched, book-to-market matched and size/book-to-market matched). When reference portfolios are employed, if the portfolio assignment of an "event firm" changes during the event year, the corresponding reference portfolio is also changed. When the control firm methods are used, the same control firm is used throughout the horizon of analysis.

The null hypothesis is tested with one of the following parametric test statistics.

$$t_{CAR} = \overline{CAR_{i\tau}} / (\sigma(CAR_{i\tau}) / \sqrt{n})$$

$$t_{BHAR} = \overline{BHAR_{i\tau}} / (\sigma(BHAR_{i\tau}) / \sqrt{n})$$

Where $\overline{CAR_{i\tau}}$ and $\overline{BHAR_{i\tau}}$ are the sample averages and $\sigma(CAR_{i\tau})$ and $\sigma(BHAR_{i\tau})$ are the cross-sectional sample standard deviations of abnormal returns for the sample of n firms.

> If the sample is drawn randomly from a normal distribution, these test statistics follow a Student's t-distribution under the null hypothesis. While CARs and BHARs are clearly nonnormal, the Central Limit Theorem guarantees that if the measures of abnormal returns in the cross-section of firms are independent and identically distributed drawings from finite variance distributions, the distribution of the mean abnormal return measure converges to normality as the number of firms in the sample increases. (Barber and Lyon, 1997)

Appendix I is composed of histograms depicting the sum of monthly returns (SUM_RET) and buy-and-hold returns (BAH) for sample A and B at the one-, three- and five-year time-horizons (refer to the simulation method section for a description of how samples were constructed) with the normal curve superimposed. We can see from these twelve histograms that the sum of monthly returns and the buy-and-hold returns follow fairly closely a normal distribution. The buy and hold returns for sample B have a much higher mean and standard deviation than the other distributions. The distribution for the buy and hold returns for sample B has an elongated right tail and seems to be concentrated to the left of the mean. Drawing more samples, as is suggested in the future research section, would no doubt help resolve any deviation from the normal distribution. Also, non-parametric test results are also reported in this thesis, and these are not subject to any normality assumptions.

In section eight I discuss the simulation method applied to the data.

8. Simulation Method

To test the specification of the test statistics based on each of the five reference portfolios, and the three control firm approaches, two samples of 45 "event firms" each were randomly selected from the population of the Toronto Stock Exchange. CARs and BHARs as well as t_{CAR} and t_{BHAR} were calculated for each benchmark method and time horizon (one-, three- and five-years). If a test is well specified, the null hypothesis of zero mean abnormal return will be rejected only if an abnormal return has been introduced into the "event firms". In addition the number of positive CARs and BHARs for each method and time horizon was calculated and a test where the null hypothesis was that the sample proportion ρ is equal to .5 was carried out. The appropriate test statistic is z and is equal to:

$$z = \frac{\rho - \pi}{\sqrt{((\pi(1-\pi))/n)}}$$

Where:
π is = .5
ρ is the sample proportion (i.e. the number of positives/45)
n is the sample size; 45

Also, a paired t-test was used to test whether the mean of the distribution of differences between "event firms" and portfolios/control firms' returns (i.e. the "monthly ARs" and "monthly BHARs") is 0. The number of significant test statistics was calculated for each benchmark method and time horizon (one-, three- and five-years).

The following section reports the results of these tests.

9. Results

Zero Abnormal Return Induced

In this section, I document the specification (size) of t-statistics in both samples when zero percent abnormal return is induced in the returns of "event firms". The results for sample A are summarised in table 4 (CARs) and table 5 (BHARs). The results for sample B are summarised in table 6 (CARs) and table 7 (BHARs). Included in these tables are the associated mean, standard deviation and skewness of the CARS and BHARs for each benchmark method and time horizon. The number of positive CARs and BHARS and whether or not it is significantly different from 50% (proportions test) is also included. Lastly, the number of significant t-statistics for the paired t-test is also presented in these tables. Recall that these t-statistics test the null-hypothesis that the mean monthly abnormal return during the event period is zero. At the five-percent significance level, we would expect to find approximately two or three significant t-statistics for the paired t-test; anything above this is statistically significant.

Sample A: Portfolio Benchmarks: CARs

These results are summarised in table 4.

The market capitalisation portfolio benchmark method yields well specified test statistics at each time horizon. The number of positive CARs at each horizon is not significantly different from fifty percent and there is a small number of significant t-statistics for the paired t-test (not significant).

The equally weighted portfolio benchmark method also yields well specified test statistics at each time horizon. The number of positive CARs is significantly different from fifty percent for the one- and five-year horizon, but not for the three-year horizon. The number of significant t-statistics for the paired t-test is statistically significant. We can thus say that the non-parametric test methods seem to be capturing abnormal performance that the parametric tests are not.

The value weighted portfolio benchmark method yields, as expected, misspecified test statistics at each time horizon. The number of positive CARs is significantly different from fifty percent for the five-year horizon, but not for the one- and three-year horizon. The number of significant t-statistics for the paired t-test is significant at the one-year horizon only.

The book-to-market ratio portfolio benchmark method yields well specified test statistics at the one- and three-year horizon, but not for the five-year time horizon. The number of positive CARs at each horizon is not significantly different from fifty percent, but the number of significant t-statistics for the paired t-test is significant.

The size/book-to-market capitalisation portfolio benchmark method yields well specified test statistics at each time horizon. The number of positive CARs at each horizon is not significantly different from fifty percent and there is a small number of significant t-statistics for the paired t-test (not significant).

Overall, the market capitalisation and size/book-to-market ratio portfolios yielded the best results. For these two benchmarking methods, all t-statistics are well specified, the null-hypothesis is never rejected and the non -parametric tests are consistent with the parametric ones (i.e. no significance).

Sample A: Control Firm Approach CARs

The market capitalisation control firm approach yields a well specified test statistic at the five-year time horizon but not at the one- and three-year time horizon. The number of positive CARs at each horizon is not significantly different from fifty percent and there is a small number of significant t-statistics for the paired t-test (not-significant). The non-parametric tests at the one- and three-year time horizons are contradicting the conclusions of the parametric tests.

The book-to-market ratio control firm approach yields well specified test statistics at each time horizon. The number of positive CARs at each horizon is not significantly different from fifty percent. There is however a significant number of significant t-statistics for the paired t-test at the one-year time horizon.

The size/book-to-market ratio control firm approach yields well specified test statistics at each time horizon. The number of positive CARs at each horizon is not significantly different from fifty percent. As was the case for the book-to-market ratio control firm, there is a significant number of significant t-statistics for the paired t-test at the one-year time horizon.

The book-to-market ratio and the size/book-to-market control firm approaches performed better than the market capitalisation approach.

Sample B: Portfolio Benchmarks: CARs

These results are summarised in table 6.

The market capitalisation portfolio benchmark method yields well specified test statistics at the one-and three-year time horizon, but not at the five-year time horizon. The number of positive CARs at each horizon is not significantly different from fifty percent, however there is a significant number of significant t-statistics for the paired t-test at the one- and three-year time horizons.

The equally weighted portfolio benchmark method yields well specified test statistics at each time horizon. The number of positive CARs at each horizon is not significantly different from fifty percent. As was the case for the market capitalisation portfolio, there is a significant number of significant t-statistics for the paired t-test at the one- and three-year time horizons.

The value weighted portfolio benchmark method yields, as expected, misspecified test statistics at each time horizon. The number of positive CARs at each horizon is significantly different from fifty percent. The number of significant t-statistics for the paired t-test is not significant, except at the one-year time horizon.

The book-to-market ratio portfolio benchmark method yields well specified test statistics at each time horizon. The number of positive CARs at each horizon is not significantly different from fifty percent. The number of significant t-statistics for the paired t-test is significant for the three-year approach.

The size/book-to-market capitalisation portfolio benchmark method yields well specified test statistics at each time horizon. The number of positive CARs at each horizon is not significantly different from fifty percent. There is however a significant number of significant t-statistics for the paired t-test.

Overall, we can see that the number of significant paired-t-tests is higher for sample B than it was for sample A. Looking only at the specification of the t-statistics and at the proportion tests, we can say that the equally-weighted, book-to-market and size/book-to-market ratio portfolios performed better than market capitalisation or value-weighted portfolio approaches. The results for sample A using the size/book-to-market ratio portfolio also performed well, but the equally-weighted and book-to-market ratio portfolio did not do as well in sample A. Also, the market capitalisation portfolio approach which performed well in sample A rejects the null hypothesis in sample B at the five-year horizon and has a significant number of positive paired-t-tests at the one- and three-year time horizons.

Sample B: Control Firm Approach CARs

The market capitalisation control firm approach yields well specified test statistics at each time horizon. The number of positive CARs at each horizon is not significantly different from fifty percent. There is a slightly higher number of significant t-statistics for the paired t-test than one would expect (significant).

The book-to-market control firm approach yields well specified test statistics at each time horizon. The number of positive CARs at each horizon is not significantly different from fifty percent. The number of positive t-statistics at the one-year time horizon is significant, but is not for the other time horizons.

The size/book-to-market ratio control firm approach yields well specified test statistics at the one- and three-year time horizon, but not at the five-year time horizon. The number of positive CARs at each horizon is not significantly different from fifty percent and there is a small number of significant t-statistics for the paired t-test.

It is hard to say which control firm method with CARs performed best in sample B as each method had at least one indication of misspecification (either for the parametric or non-parametric tests). However, the book-to-market ratio control firm approach has the smallest t-statistics and the number of positive t-statistics is significant only at the one-year time horizon. This method also showed similar results in sample A. However the size/book-to-market ratio control firm approach, which performed well in sample A did reject the null at the five-year horizon in sample B.

Overall, the expected results using the CARs (i.e. not rejecting the null hypothesis) were found for most permutations of benchmark and time horizons for both samples. The only exceptions to this were for the following. Both sample A and B rejected the null hypothesis with the value-weighted portfolio method at all time horizons. This results however was expected. The book-to-market portfolio approach at the five year time horizon rejected the null in sample A. The size control firm at the one- and three-year horizons rejected the null in sample A. In sample B, the null was rejected using the size portfolio and using the size/book-to-market ratio control firm at the five year time horizon. In sum, the expected result using CARs was found 90% of the time. When CARs were used with portfolio benchmark methods, the expected result was found 93% of the time, versus 89% of the time with the control firm methods. One should note that the unanticipated results were not the same in sample A as they were in sample B. As such, these exceptions might be due to random sampling variations. The variation between the results in sample A and B is something that would benefit from further repetitions of the simulation in order to more accurately measure if these results are universal or sample specific.

Sample A: Portfolio Benchmarks: BHARs

These results are summarised in table 5.

The market capitalisation portfolio benchmark method yields well specified test statistics at the one- and three-year time horizon but not at the five-year time horizon. The number of positive BHARs at the one- and three-year horizon is not significantly different from fifty percent, but is at the five-year horizon. There is a small number of significant t-statistics for the paired t-test (not significant).

The equally weighted portfolio benchmark method yields well specified test statistics at all horizons except the five-year time horizon. The number of positive BHARs at each horizon is significantly different from fifty percent. The number of significant t-statistics for the paired t-test is significant at the one- and five-year horizons.

The value weighted portfolio benchmark method yields misspecified test statistics at the one- and three-year approach, but surprisingly yields a well-specified test-statistic at the five-year time horizon. The number of positive BHARs at each horizon is not significantly different from fifty percent. The number of significant t-statistics for the paired t-test is significant only at the one-year horizon.

The book-to-market ratio portfolio benchmark method yields well specified test statistics at the one- and three-year horizon, but not for the five-year time horizon. The number of positive BHARs at each horizon is not significantly different from fifty percent at the one-year horizon, but is at the three- and five-year time horizon. The number of significant t-statistics for the paired t-test is significant at all time horizons.

The size/book-to-market capitalisation portfolio benchmark method yields well specified test statistics at each time horizon. The number of positive BHARs at each horizon is not significantly different from fifty percent and there is a small number of significant t-statistics for the paired t-test (not significant).

Overall, we can clearly see that the size/book-to-market ratio portfolio approach performed the best with the BHARs in sample A. This method also worked very well with the CARs in this sample. However, the market capitalisation portfolio, which worked well in the CARs, yields a misspecified test statistic and a significant number of positive BHARs at the five-year time horizon. In sum, the BHARs portfolio approach did not do as well as the CARs portfolio approach with sample A.

Sample A: Control Firm Approach BHARs

The market capitalisation control firm approach yields well specified test statistics at the five-year time horizon but not at the one- and three-year time horizon. The number of positive BHARs at each horizon is not significantly different from fifty percent and there is a small number of significant t-statistics for the paired t-test (not significant). The non-parametric tests are revealing no abnormal returns at the one- and three-year horizon, contradicting the parametric test results.

The book-to-market control firm approach yields well specified test statistics at each time horizon. The number of positive BHARs at each horizon is not significantly different from fifty percent. The number of significant t-statistics for the paired-t-test is significant at the one-year horizon, but not at the three and five-year horizon.

The size/book-to-market ratio control firm approach yields well specified test statistics at each time horizon. The number of positive BHARs at each horizon is not significantly different from fifty percent. The number of positive t-statistics is again significant only at the one-year horizon.

The results of the control firm approach using BHARs is consistent with the results I found when using CARs. The book-to-market ratio and size/book-to-market ratio control firm approaches worked best, with only the number of significant paired-t-test at the one-year time horizon showing any signs of misspecification.

Sample B: Portfolio Benchmarks: BHARs

These results are summarised in table 7.

The market capitalisation portfolio benchmark method yields well specified test statistics at the one- year time horizon but not at the three- and five-year time horizon. The number of positive BHARs at each time horizon is not significantly different from fifty percent. There is a significant number of significant t-statistics for the paired t-test at the one- and three-year time horizons.

The equally weighted portfolio benchmark method yields well specified test statistics at each time horizon. The number of positive BHARs at each horizon is not significantly different from fifty percent. The number of significant t-statistics for the paired t-test is significant only at the one-year horizon.

The value weighted portfolio benchmark method yields, as expected, misspecified test statistics at each time horizon. The number of positive BHARs at the one- and three-year horizons is significantly different from fifty percent, but not at the five-year horizon. Again, the number of significant t-statistics for the paired-t-test is significant only at the one-year horizon.

The book-to-market ratio portfolio benchmark method yields well specified test statistics at the one- and three-year horizon, but not for the five-year time horizon. The number of positive BHARs at each horizon is not significantly different from fifty percent at the one- and three-year horizon, but is at five-year time horizon. The number of significant t-statistics for the paired t-test is significant at the three-year horizon.

The size/book-to-market capitalisation portfolio benchmark method yields well specified test statistics at the one- and five-year time horizon, but not at the three-year time horizon. The number of positive BHARs at the one- and five- year time horizon is not significantly different from fifty percent, but is at the three-year time horizon. There is a significant number of significant t-statistics for the paired t-test at each time horizon.

Overall the equally-weighted portfolio approach works best with the BHARs in sample B, the only sign of an abnormal return being the number significant of paired-t-test at the one-year time horizon. This finding is consistent with that found using the equally-weighted portfolio method with CARs. The book-to-market ratio and size/book-to-market ratio portfolio methods, which worked well with the CARs, did not do as well with the BHARs in sample B. The Size/book-to-market ratio portfolio approach which worked well in sample A with BHARs, yielded a misspecified test-statistic and a significantly number of positive BHARs at the three-year time horizon, as well as a significant number of paired-t-test at each horizon.

Sample B: Control Firm Approach BHARs

The market capitalisation control firm approach yields well specified test statistics at each time horizon. The number of positive BHARs at each horizon is not significantly different from fifty percent and there is a significant number of significant t-statistics for the paired t-test all time horizons except the five-year one.

The book-to-market control firm approach yields well specified test statistics at each time horizon. The number of positive BHARs at each horizon is not significantly different from fifty percent and there is a significant number of significant t-statistics for the paired t-test at the one-year time horizon only.

The size/book-to-market ratio control firm approach yields well specified test statistics at each time horizon. The number of positive BHARs at each horizon is not significantly different from fifty percent. The number of significant t-statistics for the paired t-test at the one-year time horizon is very high and significant.

The control firm approach with BHARs in sample B worked very well, with only the number of paired-t-test indicating the presence of possible abnormal returns. The methods which worked well in sample A (book-to-market ratio and size/book-to-market ratio control firm approaches) also worked well in sample B. Both these methods showed no sign of any abnormal return, except for the number of positive paired-t-tests at the one-year time horizon.

Overall, the BHAR methods did not fare as well as the CARs. The expected result was found 81% of the time using both the portfolio and control firm methods. Using the portfolio methods alone, the anticipated result was only found 70% of the time. The control firm approach did perform better than the portfolio approach. For both samples using control firms yielded the expected result 89% of the time. For sample B alone, the expected result was found all of the time. The overall results suffer from the same problem as the CARs did, in that many of the exceptions were not found in both samples simultaneously. It is thus impossible to say, with only two samples, whether this result would hold with more replications or if it is an artefact of random sample variations.

The control firm methods performed only slightly better than the control firm methods in both samples using both abnormal return measurement methods. The portfolio methods yielded the expected result 83% of the time, whereas the control firm better did 86%. The number of significant proportion tests using the control firm method was zero, as anticipated. However, the portfolio methods did not do as well on this front. The proportion tests returned the expected result 73% (83% if we don't consider the value-weighted portfolio results) when using the portfolio benchmark method.

Results

Percent Abnormal Return Induced

This study is also interested in the power of t-statistics using CARs and BHARs. In this section, I document the power of t-statistics based on all the five portfolio benchmark methods as well as the three control firm approaches, by adding a constant level of abnormal return to the calculated cumulative abnormal return of each "event firm". For example, adding 5% to the calculated CAR for a particular "event firm" is equivalent to adding 0.42% (5%/12 months) to each of the 12 monthly returns of the "event firm". For BHARs however, "adding 5% to the annual BHAR does not correspond to a particular pattern of monthly returns. Thus, direct comparisons of the power of t-statistics using CARs and BHARs are not meaningful" Barber and Lyon, (1997). The level of induced abnormal return ranges from –20% to +20%, in 5% increments. These t-statistics test the null-hypothesis that the mean monthly abnormal return during the event period is zero. We would expect that the null-hypothesis would be rejected when an abnormal return is induced. The results are summarised in tables 8 (+/- 5%) through 15 (+/- 20%). The results show that the t-statistics are not as powerful with these levels of induced abnormal return as one would like them to be. The methods are not able to detect with accuracy that there is an abnormal return present in the "event firms".

Results

Standard Deviation(s) Induced

As mentioned above, this study is interested in the power of t-statistics using CARs and BHARs. As a result of the somewhat disappointing results found when a constant level of abnormal return ranging from –20% to + 20% was induced in both samples, I have also induced a level of abnormal return equal to +/-1 to 3 standard deviations into the return of the "event firms" in a manner analogous to the one previously used. Recall that approximately 68% of the area under the normal curve is within plus one and minus one standard deviations of the mean; 95% with plus two and minus two standard deviations of the mean; and practically all of the area under the normal curve is within plus three and minus three standard deviations of the mean. As such, by introducing a level of abnormal return that, in theory, should be significant, we will have a better idea about the power of the t-statistics. The levels of abnormal return induced in the previous section (i.e. +/- 20%) might not have been large enough to show up as significantly different from zero based on the characteristics of the distribution of "event firm" returns. These t-statistics test the null-hypothesis that the mean monthly abnormal return during the event period is zero.

The level of abnormal return induced into the "event firms" is summarised in the following table. The mean column contains the average standard deviation induced into the "event firms".

SAMPLE	MEAN	MIN.	MAX.	Std. Deviation
A	0.17773581	0.03408219	0.66653641	0.13460808
B	0.15827688	0.03334446	0.38291357	0.08982397
A+B	0.16800635	0.03334446	0.66653641	0.11420353

One can see that adding three standard deviations is equal to adding, on average, close to fifty-percent abnormal return into the "event firms". In the extreme case, adding three standard deviations is equal to adding 200% abnormal return. We can thus see that it is not surprising that the abnormal performance did not reveal itself when adding a constant level of abnormal return from –20% to +20% in 5% increments.

The results are summarised in tables 16 (+/- 1 standard deviation) through 21 (+/- 3 standard deviations). The results of these test are that most of the time the null hypothesis that the mean monthly abnormal return during the event period is zero is rejected when these levels of abnormal return are induced in the "event firms". The size/book-to-market ratio portfolio and control firm approach (both for the CARS and BHARS) for sample A is the only glaring exception to this statement. I suspect that random sampling variations account for this result. The CAR method for the measurement of abnormal returns seems to reject the null hypothesis more forcefully than the BHAR methods, and this for both samples.

Results

BETA SHIFT

In order to test the "goodness" of the match between "event firms" and portfolios and between "event firms" and control firms, I have performed a "beta shift" by multiplying each of the monthly returns of the firms in sample A and B by minus 1. In effect, I have drastically changed the beta of each "event firm" (a firm with a beta of 1 before the shift, not has a beta of minus one), without changing the variance of the returns. By transforming the returns of the "event firms", the resulting groups are the antithesis of the original groups in terms of returns. The returns of the matched portfolios and of the control firms are not transformed in any manner. The abnormal returns are calculated in the exact same fashion as for sample A and B and are labelled sample "A MINUS 1" and "B MINUS 1". If the match between sample A and B firms and portfolios and control firms was an accurate one, then the opposite group of "event firms" matched to the same portfolios or control firms should yield opposite results when testing the null hypothesis that the mean monthly abnormal return during the event period is zero.

The results for sample A MINUS 1 are summarised in table 22 (CARs) and table 23 (BHARs). The results for sample B MINUS 1 are summarised in table 24 (CARs) and table 25 (BHARs). Included in these tables are the associated mean, standard deviation and skewness of CARS and BHARs for each benchmark method and time horizon. The number of positive CARs and BHARs and whether or not it is significantly different from 50% (proportions test) is also included. Lastly, the number of significant t-statistics for the paired t-test is also presented in these tables. Recall that these t-statistics test the null-hypothesis that the mean monthly abnormal return during the event period is zero. We would expect to reject the null-hypothesis in this test. If the methods correctly reject the null-hypothesis we can say that they were successful in identifying the change (i.e. the beta shift).

The results show that all of the portfolio and control firm approaches were successful in identifying the change by rejecting the null-hypothesis of zero abnormal return. This result was anticipated and indeed shows that the match between "event firms" in sample A and B and portfolios and control firms was a good one. The number of positive CARs and BHARs for each method and time horizon is significantly different from fifty percent for group A MINUS 1; and is not significantly different for only three combinations of benchmark method, time horizon and abnormal measurement method for group B MINUS 1. The number of significant t-statistics for the paired t-test is relatively large and significant in all cases.

The only exceptions are the size/book-to-market ratio portfolio at the five-year time horizon, using BHARs. The t-statistic does not reject the null hypothesis for either sample. The market capitalisation control firm approach, using BHARs at the 5-year time horizon for group B MINUS 1 also does not reject the null hypothesis, but does for group A MINUS 1. I suspect random sampling variation accounts for this result.

The results for the t-test based on adding a constant level of abnormal return, as well as the results based on adding level of abnormal return equal to +/- 1 to 3 standard deviations to the calculated cumulative abnormal return of each "event firm" are also presented in tables. The results are summarised in tables 26 through 39. The only deviation from the result anticipated (i.e. rejection of the null hypothesis) were found when the "event firm" was matched with the value weighted portfolio, a method which I anticipated would yield biased results.

10. Discussion and Conclusion

Through the use of eight benchmark methods (five portfolio methods and three control firm methods) and two abnormal measurement methods (CARs and BHARs), long run horizon security price performance measurement in the Canadian equity market was studied.

The main hypothesis was that the mean cumulative or buy-and-hold abnormal returns are equal to zero. I randomly drew two samples of 45 "event firms" each and matched each firm in the sample to the appropriate portfolio or control firm based on specific firm characteristics. The results show that the null hypothesis cannot be rejected for most permutations of benchmark method and time horizon, for sample A and B with CARs. The exceptions to this case are the value weighed portfolio at all time horizons (this result was anticipated), the book-to-market portfolio at the five year time horizon (sample A), the market capitalisation control firm at the one- and three-year time horizon (sample A), the market capitalisation portfolio method at the five-year horizon (sample B) and the size/book-to-market control firm method at the five year horizon (sample B); all of which reject the null hypothesis of zero abnormal return, when in fact it should not have. Overall, the methods with CARs returned the expected result 90% of the time. The portfolio benchmarks with CARs returned the expected result 93% of the time; while the control firm benchmarks with CARs returned the expected result 89% of the time. The results for the portfolio methods using BHARs did not fare as well. Indeed, the null-hypothesis of zero abnormal return was rejected in the following cases; the market capitalisation portfolio method at the 5-year horizon (sample A) and at the three and five-year horizon (sample B), the equally weighted index portfolio a the 5-year horizon (sample A), the value weighted index portfolio (rejecting, as expected, at all time horizons except the five year for sample A), the book-to-market ratio portfolio at the five-year horizon (both samples), the size/book-to-market ratio portfolio at the 3-year horizon (sample B). Overall, the portfolio methods with BHARs returned the expected result only 70% of the time. However, the results for the control firm methods using BHARs did perform well. The only unanticipated result occurred for the market capitalisation control firm method at the one-and three-year time-horizon for sample A only. Overall, the control firm methods with BHARs returned the expected result 89% of the time. For sample B alone the control firm methods with BHARs returned the expected result 100% of the time.

Overall, the portfolio methods and the control firm methods perform well; the portfolio approaches yield the expected result 83% of the time, and the control firm approaches yield the expected result 86% of the time.

One can see from the results outlined above that the portfolio benchmark methods with CARs performed better than all other methods, and that the portfolio benchmarks with BHARs were the worst performers.

I also documented the power of t-statistics based on all the five portfolio benchmark methods as well as the three control firm approaches, by adding a constant level of abnormal return to the calculated cumulative abnormal return of each "event firm". The results show that the t-statistics are not as powerful with these levels of induced abnormal returns as one would like them to be. As a result of these findings, I introduced a level of abnormal return equal to +/- 1 to 3 standard deviations of the returns of each "event firm" into the return of said "event firms" in a manner analogous to the one previously used. In this manner, I am assured that the level of induced abnormal return is indeed significant and should therefore without a doubt reveal itself when testing the null hypothesis that the mean abnormal return during the event period is zero. As previously stated, the results of these tests are that most of the time the null hypothesis is rejected when these levels of abnormal return are induced in the "event firms". The only exception to this statement is the size/book-to-market ratio portfolio and control approach (for both CARs and BHARs) for sample A. This same "anomaly" is not found in sample B, and as such, I suspect it is due to random sampling variations. Also, the CAR method for the measurement of abnormal returns seems to reject the null hypothesis more forcefully than the BHAR method, and this for both samples.

The main limitation of this study is the small number of repetitions involved. Future research should remedy this problem and is discussed later. However, a symptom of this limitation is that the unexpected results (i.e. rejecting the null-hypothesis when it should not be) are often not found in both samples A and B with the same benchmarking method. When the null is rejected in one sample with a certain benchmark but not in the other, it makes drawing inferences about the accuracy of the method harder. Indeed, when this is the case, one cannot say whether the unexpected result is a universal one which would be found with any Canadian "event firm" sample, or if it is due to a random sampling variation. A large number of repetitions would help shed light on this issue and allow me to make a stronger statement vis-à-vis the universalism of the findings contained herein.

In an effort to test the accuracy of the benchmarking, I performed a "beta shift". By transforming the returns of the "event firms", the resulting groups are the exact opposites of the original groups in terms of returns, and as such should yield opposite results when testing the null hypothesis. The results confirm this hypothesis by yielding misspecified test statistics at each time horizon. Also, the results are buttressed by the number of positive CARS and BHARS for each method and time horizon being significantly differently form fifty percent for group A MINUS 1. The same is true for group B MINUS 1 except for only three permutations of benchmark method, time horizon and abnormal measurement method. In addition, the number of significant t-statistics for the paired t-test is relatively large. Lastly, the results of the t-test when a level of abnormal return was introduced into the "event firms' " returns all are consistent with the expected result of rejecting the null hypothesis of zero mean abnormal return. All of these results support the assertion that the match between "event firms" and portfolios and between "event firms" and control firms is a good one.

Future research in this area should focus on replicating the results found herein on a larger scale, perhaps developing a statistic reported by Barber and Lyon (1997); "the percentage of 1'000 random samples that reject the null of zero 12-month, 36-month, or

60-month cumulative abnormal return(s) at the 1%, 5%, and 10% theoretical significance level". A large number of repetitions would eliminate the small sample problem in this study and allow for stronger statements about the universalism of the findings about which methods work best in the Canadian equity market. Repeating the tests I have performed on a larger scale would be especially helpful in cases where there are variations between the samples when rejecting the null-hypothesis using a specific benchmark method (i.e. when the null-hypothesis is rejected in sample A but not sample B (and vice-versa). Lastly, increasing the number of repetitions will help resolve any issues associated with the assumption made about the normality of the distribution of the sum of returns and buy-and-hold returns.

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12. Tables

Table 1
Summary of studies analysing long-run abnormal stock returns following corporate events or decision

Author(s)	Corporate event studied	Return benchmark
Bernard and Thomas (1989)	Earnings announcements	Market model (a)
Ritter (1991)	Initial public offerings	Market index Size/industry control firm Size portfolio
Agrawal, Jaffe and Mandelker(1992)	Acquisitions	Size portfolio
Womack (1996)	Analyst recommendations	Size portfolio Three-factor model (b)
Ikenberry, Lakonishok and Vermaelen (1995)	Share repurchase	Market index Size portfolio Size and book-to-market portfolio
Loughran and Ritter (1995)	Initial public and Seasoned equity offerings	Market index Size control firm Three-factor model (b)
Spiess and Affleck-Graves (1995)	Seasoned equity offerings	Market index Size portfolio Size/industy control firm Size/book-to-market Control firm
Michaely, Thaler, and Womack (1995)	Dividend intiation and omission	Market index Size portfolio Size/industry portfolio
Desai and Jain (1996)	Stock splits and dividends	Size portfolio Book-to-market portfolio

Table 2
Summary of methods for calculating abnormal returns and methods for developing a return benchmark used by Barber and Lyon (1997)

Methods of calculating abnormal returns		
	CARs	BHARs
	$CAR_{i\tau} = \sum_{t=1}^{\tau}(Rit - E(Rit))$	$BHAR_{i\tau} = \prod_{t=1}^{\tau}(1+Rit) - \prod_{t=1}^{\tau}(1+E(Rit))$
Reference portfolios	Size decile portfolios Book-to-market decile portfolios Fifty size/book-to-market portfolios Equally weighted market index	Size decile portfolios Book-to-market decile portfolios Fifty size/book-to-market portfolios Equally weighted market index
Control firms	Size-matched Book-to-market matched Size/book-to-market matched	Size-matched Book-to-market matched Size/book-to-market matched

Table 3
Summary of methods for calculating abnormal returns and methods for developing a return benchmark

Methods of calculating abnormal returns		
	CARs	BHARs
	$\text{CAR}_{i\tau} = \sum_{t=1}^{\tau} (Rit - E(Rit))$	$\text{BHAR}_{i\tau} = \prod_{t=1}^{\tau} (1 + Rit) - \prod_{t=1}^{\tau} (1 + E(Rit))$
Reference portfolios	Size decile portfolios Book-to-market decile portfolios Fifty size/book-to-market portfolios Equally weighted market index Value weighted market index	Size decile portfolios Book-to-market decile portfolios Fifty size/book-to-market portfolios Equally weighted market index Value weighted market index
Control firms	Size-matched Book-to-market matched Size/book-to-market matched	Size-matched Book-to-market matched Size/book-to-market matched

TABLE 4

Specification (size) of t-statistic for CARs in sample A

Included in this table are associated mean, standard deviation and skeness of CARs at each horizon

The number of positive CARs and whether or not it is significantly different from 50% (proportions test) is included.

Also, the number of significant t-statistics for the paired-t-test are presented.

Market Capitalisation Portfolio	t-stat.	MEAN	ST.DEV.	SKEW.	# of Positive CARs	Sign. <> 50%?	Paired-t-test: # sign.
1-year	-0.53	-0.05101517	0.64812883	0.28644117	21	no	3
3-year	0.15	0.01744567	0.79202571	-0.22392775	24	no	1
5-year	-1.47	-0.38387788	1.75646240	-1.79085364	24	no	0
Equally Weighted Portfolio							
1-year	-1.21	-0.13932378	0.77558012	1.35746986	14	yes	6
3-year	-0.26	-0.03270698	0.84542588	0.48551878	18	no	5
5-year	-1.76	-0.29209824	1.11046317	0.51503292	14	yes	6
Value Weighted Portfolio							
1-year	2.17	0.25401833	0.78635501	1.23435915	26	no	6
3-year	3.57	0.46247256	0.86977048	0.61418457	29	no	2
5-year	3.33	0.55437213	1.11745507	0.71573504	33	yes	1
Book-to-market Ratio Portfolio							
1-year	-1.27	-0.15295626	0.80706412	0.87250343	18	no	7
3-year	-0.85	-0.11936582	0.94671681	-0.11713699	18	no	5
5-year	-3.16	-0.82543406	1.75204786	-0.88161529	19	no	5
Size/Book-to-market Ratio Portfolio							
1-year	0.35	0.03429608	0.65316154	0.13541641	27	no	2
3-year	0.39	0.05018642	0.85353105	-0.26917080	24	no	2
5-year	-1.23	-0.86790882	4.72540840	-4.25711582	23	no	3
Market Capitalisation Control Firm							
1-year	-2.89	-0.25092402	0.58288394	-0.45338287	17	no	2
3-year	-2.16	-0.26437688	0.82182621	-1.06911315	22	no	1
5-year	-0.90	-0.12825399	0.95529656	-0.56052707	22	no	1
Book-to-market Ratio Control Firm							
1-year	-1.83	-0.30771444	1.13028924	0.12256155	20	no	6
3-year	-1.00	-0.17802549	1.18838972	0.16385820	21	no	1
5-year	-0.32	-0.07107401	1.49375170	0.38891634	21	no	1
Size/Book-to-market Ratio Control Firm							
1-year	-1.09	-0.32663970	2.00422206	-3.68854326	21	no	5
3-year	-0.87	-0.25670732	1.98887975	-3.54782657	23	no	1
5-year	-0.99	-0.32847876	2.22513143	-2.65194269	25	no	2

TABLE 5

Specification (size) of t-statistic for BHARs in sample A.

Included in this table are associated mean, standard deviation and skeness of BHARs at each horizon

The number of positive BHARs and whether or not it is significantly different from 50% (proportions test) is included

Also, the number of significant t-statistics for the paired-t-test are presented

Market Capitalisation Portfolio	t-stat.	MEAN	ST.DEV.	SKEW.	# of Positive BHARs	Sign. <> 50%?	Paired-t-test: # sign.
1-year	-1.10	-0.18901236	1.15364543	-0.39261280	16	no	1
3-year	-1.87	-1.20983247	4.35074113	-3.43618498	16	no	1
5-year	-2.17	-15.02988819	46.45003859	-3.80142551	13	yes	0
Equally Weighted Portfolio							
1-year	-1.18	-0.18946616	1.07393431	1.37912903	13	yes	15
3-year	-1.30	-0.32673716	1.68214980	2.03838905	13	yes	1
5-year	-5.12	-2.03364232	2.66337950	1.77550261	7	yes	6
Value Weighted Portfolio							
1-year	2.42	0.37966037	1.05233584	1.55935571	23	no	6
3-year	2.21	0.53201410	1.61506302	2.16242946	24	no	2
5-year	1.70	0.61105295	2.40470745	2.18231220	23	no	1
Book-to-market Ratio Portfolio							
1-year	-1.18	-0.21603395	1.23263509	0.85330833	17	no	7
3-year	-1.97	-0.64484815	2.19304586	0.75135142	13	yes	5
5-year	-4.06	-4.29350290	7.10258720	-1.54118592	8	yes	5
Size/Book-to-market Ratio Portfolio							
1-year	0.22	0.03159343	0.98215218	-0.30751462	22	no	3
3-year	-1.42	-0.62183368	2.93879546	-2.01517898	17	no	2
5-year	-1.36	-11.74843462	57.80131665	-5.99388503	16	no	3
Market Capitalisation Control Firm							
1-year	-2.99	-0.57549009	1.29181149	-2.56718865	17	no	2
3-year	-2.42	-0.77988476	2.16393087	-1.22135036	20	no	1
5-year	-0.40	-0.29688729	4.95791957	2.79690517	19	no	1
Book-to-market Ratio Control Firm							
1-year	-1.51	-0.50389372	2.23264305	-1.69451769	18	no	6
3-year	0.10	0.07129233	4.67714979	3.77008048	20	no	1
5-year	-0.23	-0.22321323	6.63064920	-0.91206354	21	no	1
Size/Book-to-market Ratio Control Firm							
1-year	-0.97	-0.74740355	5.19321413	-5.69671132	22	no	5
3-year	-0.91	-0.62495932	4.58669666	-4.83766626	25	no	1
5-year	-1.05	-1.20927871	7.75361828	-4.31371068	24	no	2

TABLE 6

Specification (size) of t-statistic for CARs in sample B

Included in this table are associated mean, standard deviation and skeness of CARs at each horizon

The number of positive CARs and whether or not it is significantly different from 50% (proportions test) is included.

Also, the number of significant t-statistics for the paired-t-test are presented.

Market Capitalisation Portfolio	t-stat.	MEAN	ST.DEV.	SKEW.	# of Positive CARs	Sign. <> 50%?	Paired-t-test: # sign.
1-year	-0.37	-0.03075879	0.56036486	-0.08609873	25	no	5
3-year	-1.25	-0.18460293	0.99415164	-1.13633909	24	no	4
5-year	-2.34	-0.82815606	2.37705714	-2.11995402	24	no	3
Equally Weighted Portfolio							
1-year	0.95	0.08289751	0.58779582	-0.09452782	28	no	4
3-year	0.13	0.01584413	0.79188964	-0.35572971	28	no	7
5-year	-1.04	-0.16998447	1.09693265	-1.21613435	24	no	3
Value Weighted Portfolio							
1-year	3.98	0.36778718	0.62003446	0.27380358	35	yes	4
3-year	3.62	0.40400751	0.74797074	-0.17459322	33	yes	3
5-year	2.76	0.40043749	0.97478515	-1.27582534	32	yes	2
Book-to-market Ratio Portfolio							
1-year	0.08	0.00689959	0.55816711	-0.35126363	23	no	3
3-year	-1.14	-0.13212950	0.77435257	-0.46143179	24	no	4
5-year	-1.65	-0.37796361	1.53878587	-1.99615319	23	no	3
Size/Book-to-market Ratio Portfolio							
1-year	-0.79	-0.08599784	0.73204338	-1.06552502	26	no	4
3-year	-1.43	-0.23893926	1.11746087	-0.97003280	21	no	6
5-year	-1.39	-0.81145099	3.92573285	-5.70745960	25	no	4
Market Capitalisation Control Firm							
1-year	0.78	0.07821226	0.66920882	0.51957076	23	no	4
3-year	-0.71	-0.18073686	1.71302537	-3.95219043	22	no	4
5-year	-1.85	-0.59653791	2.16671089	-2.14906260	21	no	3
Book-to-market Ratio Control Firm							
1-year	-0.32	-0.03440438	0.72437159	-0.64324020	24	no	4
3-year	-0.35	-0.05744280	1.09847128	-0.74260881	24	no	2
5-year	-0.70	-0.15131131	1.45611642	-1.16865622	24	no	1
Size/Book-to-market Ratio Control Firm							
1-year	-1.32	-0.12211192	0.62123868	-0.53636920	18	no	2
3-year	-1.79	-0.28916324	1.08498909	-0.67543825	20	no	2
5-year	-2.50	-0.44078802	1.18186964	-0.75124867	18	no	2

TABLE 7

Specification (size) of t-statistic for BHARs in sample B.

Included in this table are associated mean, standard deviation and skeness of BHARs at each horizon.

The number of positive BHARs and whether or not it is significantly different from 50% (proportions test) is included.

Also, the number of significant t-statistics for the paired-t-test are presented.

Market Capitalisation Portfolio	t-stat	MEAN	ST DEV	SKEW	# of Positive BHARs	Sign. <> 50%?	Paired-t-test: # sign.
1-year	-1.58	-0.40159862	1.70240084	-1.32874399	25	no	5
3-year	-2.79	-3.48913137	8.40135818	-2.32581302	21	no	4
5-year	-2.60	-103.34330159	266.75542378	-2.93768443	20	no	2
Equally Weighted Portfolio							
1-year	1.53	0.21355768	0.93924550	0.82702029	26	no	4
3-year	-0.07	-0.01674478	1.52355473	0.91830704	21	no	3
5-year	-1.39	-0.67723255	3.26576258	0.66868943	16	no	3
Value Weighted Portfolio							
1-year	4.07	0.55433062	0.91407533	4.06811419	34	yes	4
3-year	2.97	0.56529083	1.27475743	2.97475119	30	yes	3
5-year	2.99	0.81630256	1.83042628	2.99161135	29	no	2
Book-to-market Ratio Portfolio							
1-year	0.67	0.08752459	0.87935644	0.81457104	23	no	3
3-year	-1.95	-0.46448579	1.60072724	0.07077870	17	no	4
5-year	-2.04	-2.02393324	6.65330167	-2.81404278	13	yes	3
Size/Book-to-market Ratio Portfolio							
1-year	-1.55	-0.42429311	1.84145431	-1.67023670	25	no	4
3-year	-2.48	-2.19457994	5.92634329	-1.81887388	15	yes	6
5-year	-1.58	-48.17993952	204.70968805	-4.86022244	20	no	4
Market Capitalisation Control Firm							
1-year	-0.50	-0.12523745	1.68927506	-1.03845619	23	no	4
3-year	-1.18	-0.75654875	4.29730315	-2.75117054	23	no	4
5-year	-1.02	-34.94879981	230.78662523	-6.67427338	23	no	3
Book-to-market Ratio Control Firm							
1-year	0.54	0.11843707	1.47149256	0.56746377	24	no	4
3-year	-0.08	-0.03879139	3.34696971	-2.17819911	25	no	2
5-year	-1.07	-2.27485953	14.30653938	-5.28551952	23	no	1
Size/Book-to-market Ratio Control Firm							
1-year	-1.24	-0.65797586	3.57264919	-4.71525154	21	no	9
3-year	-1.36	-0.71814453	3.53644247	-0.53066240	22	no	2
5-year	-0.11	-0.11845244	7.09714664	0.99242595	20	no	2

TABLE 8

Specification (size) of t statistic for CARs and BHARs in sample A with +/-5% induced abnormal return
All t-statistics are for a one year horizon

CARs	t-stat. AR added	t-stat AR subtracted
Market Capitalisation Portfolio	-0.01	1.05
Equally Weighted Portfolio	-0.77	-1.64
Value Weighted Portfolio	2.93	2.11
Book-to-market Ratio Portfolio	-0.85	-1.69
Size Book-to-market Ratio Portfolio	0.67	-0.16
Market Capitalisation Control Firm	-2.31	3.46
Book-to-market Ratio Control Firm	-1.53	-2.13
Size Book-to-market Ratio Control Firm	-0.92	-1.26
BHARs		
Market Capitalisation Portfolio	-0.81	-1.39
Equally Weighted Portfolio	-0.87	-1.50
Value Weighted Portfolio	2.74	2.10
Book-to-market Ratio Portfolio	-0.90	-1.45
Size Book-to-market Ratio Portfolio	0.56	0.13
Market Capitalisation Control Firm	-2.73	-3.25
Book-to-market Ratio Control Firm	-1.36	-1.66
Size Book-to-market Ratio Control Firm	-0.90	-1.03

TABLE 9

Specification (size) of t statistic for CARs and BHARs in sample B with +/-5% induced abnormal return
All t statistics are for a one year horizon

CARs	t-stat. AR added	t-stat. AR subtracted
Market Capitalisation Portfolio	0.24	0.97
Equally Weighted Portfolio	1.52	0.37
Value Weighted Portfolio	4.52	3.43
Book-to-market Ratio Portfolio	0.69	-0.52
Size Book-to-market Ratio Portfolio	-0.33	-1.25
Market Capitalisation Control Firm	1.29	0.28
Book-to-market Ratio Control Firm	-0.06	-0.58
Size Book-to-market Ratio Control Firm	-0.77	-1.86
BHARs		
Market Capitalisation Portfolio	-1.39	-1.78
Equally Weighted Portfolio	1.88	1.17
Value Weighted Portfolio	4.44	3.70
Book-to-market Ratio Portfolio	1.05	0.29
Size Book-to-market Ratio Portfolio	-1.36	-1.73
Market Capitalisation Control Firm	-0.30	-0.70
Book-to-market Ratio Control Firm	0.77	0.31
Size Book-to-market Ratio Control Firm	-1.14	-1.33

TABLE 10

Specification (size) of t-statistic for CARs and BHARs in sample A, with +/-10% induced abnormal return
All t-statistics are for a one year horizon

CARs	t-stat. AR added	t-stat. AR subtracted
Market Capitalisation Portfolio	0.52	-1.57
Equally Weighted Portfolio	-0.34	-2.08
Value Weighted Portfolio	3.34	1.71
Book-to-market Ratio Portfolio	0.10	-2.11
Size Book-to-market Ratio Portfolio	1.39	-0.68
Market Capitalisation Control Firm	-1.73	-4.04
Book-to-market Ratio Control Firm	-1.23	-2.42
Size Book-to-market Ratio Control Firm	-0.76	-1.43
BHARs		
Market Capitalisation Portfolio	-0.52	-1.68
Equally Weighted Portfolio	-0.56	-1.81
Value Weighted Portfolio	3.06	1.78
Book-to-market Ratio Portfolio	-0.63	-1.72
Size Book-to-market Ratio Portfolio	0.90	-0.47
Market Capitalisation Control Firm	2.47	-3.51
Book-to-market Ratio Control Firm	-1.21	-1.81
Size Book-to-market Ratio Control Firm	-0.84	-1.09

TABLE 11

Specification (size) of t-statistic for CARs and BHARs in sample B, with +/-10% induced abnormal return
All t-statistics are for a one year horizon

CARs	t-stat. AR added	t-stat. AR subtracted
Market Capitalisation Portfolio	0.84	-1.57
Equally Weighted Portfolio	2.10	0.20
Value Weighted Portfolio	5.07	2.89
Book-to-market Ratio Portfolio	1.29	-1.14
Size Book-to-market Ratio Portfolio	0.14	-1.71
Market Capitalisation Control Firm	1.79	-0.23
Book-to-market Ratio Control Firm	0.20	-0.83
Size Book-to-market Ratio Control Firm	-0.23	-2.41
BHARs		
Market Capitalisation Portfolio	-1.19	-1.98
Equally Weighted Portfolio	2.24	0.81
Value Weighted Portfolio	4.80	3.33
Book-to-market Ratio Portfolio	1.43	-0.10
Size Book-to-market Ratio Portfolio	-1.18	-1.91
Market Capitalisation Control Firm	-0.10	-0.89
Book-to-market Ratio Control Firm	1.00	0.08
Size Book-to-market Ratio Control Firm	-1.05	-1.42

TABLE 12

Specification (size) of t-statistic for CARs and BHARs in sample A with +/-15% induced abnormal return
All t-statistics are for a one year horizon

CARs	t-stat. AR added	t-stat. AR subtracted
Market Capitalisation Portfolio	1.02	-2.08
Equally Weighted Portfolio	0.09	-2.50
Value Weighted Portfolio	3.73	1.31
Book-to-market Ratio Portfolio	-0.03	-2.52
Size/Book-to-market Ratio Portfolio	1.89	1.18
Market Capitalisation Control Firm	-1.16	-4.61
Book-to-market Ratio Control Firm	-0.94	-2.72
Size/Book-to-market Ratio Control Firm	-0.59	1.60
BHARs		
Market Capitalisation Portfolio	-0.23	1.97
Equally Weighted Portfolio	-0.25	-2.12
Value Weighted Portfolio	3.38	1.46
Book-to-market Ratio Portfolio	-0.36	-1.99
Size/Book-to-market Ratio Portfolio	1.24	-0.81
Market Capitalisation Control Firm	-2.21	-3.77
Book-to-market Ratio Control Firm	-1.06	-1.96
Size/Book-to-market Ratio Control Firm	-0.77	-1.16

TABLE 13

Specification (size) of t-statistic for CARs and BHARs in sample B, with +/-15% induced abnormal return
All t-statistics are for a one year horizon

CARs	t-stat. AR added	t-stat. AR subtracted
Market Capitalisation Portfolio	1.43	-2.16
Equally Weighted Portfolio	2.66	-0.77
Value Weighted Portfolio	5.60	2.36
Book-to-market Ratio Portfolio	1.88	-1.73
Size/Book-to-market Ratio Portfolio	0.59	-2.16
Market Capitalisation Control Firm	2.29	-0.72
Book-to-market Ratio Control Firm	0.45	-1.09
Size/Book-to-market Ratio Control Firm	0.30	-2.94
BHARs		
Market Capitalisation Portfolio	-0.99	-2.17
Equally Weighted Portfolio	2.60	0.45
Value Weighted Portfolio	5.17	2.97
Book-to-market Ratio Portfolio	1.81	-0.48
Size/Book-to-market Ratio Portfolio	-1.00	-2.09
Market Capitalisation Control Firm	0.10	-1.09
Book-to-market Ratio Control Firm	1.22	-0.14
Size/Book-to-market Ratio Control Firm	-0.95	-1.52

TABLE 14
Specification (size) of t-statistic for CARs and BHARs in sample A, with +/-20% induced abnormal return
All t-statistics are for a one year horizon

CARs	**t-stat.** AR added	**t-stat.** AR subtracted
Market Capitalisation Portfolio	1.54	-2.61
Equally Weighted Portfolio	0.52	-2.93
Value Weighted Portfolio	4.14	0.90
Book-to-market Ratio Portfolio	0.39	-2.94
Size/Book-to-market Ratio Portfolio	2.41	-1.69
Market Capitalisation Control Firm	-0.58	5.18
Book-to-market Ratio Control Firm	-0.64	-3.02
Size/Book-to-market Ratio Control Firm	-0.42	-1.77
BHARs		
Market Capitalisation Portfolio	0.06	-2.26
Equally Weighted Portfolio	0.07	-2.43
Value Weighted Portfolio	3.70	1.15
Book-to-market Ratio Portfolio	-0.09	-2.26
Size/Book-to-market Ratio Portfolio	1.58	-1.15
Market Capitalisation Control Firm	-1.95	-4.03
Book-to-market Ratio Control Firm	-0.91	-2.11
Size/Book-to-market Ratio Control Firm	-0.71	-1.22

TABLE 15
Specification (size) of t-statistic for CARs and BHARs in sample B, with +/-20% induced abnormal return
All t-statistics are for a one year horizon

CARs	**t-stat.** AR added	**t-stat.** AR subtracted
Market Capitalisation Portfolio	2.02	-2.78
Equally Weighted Portfolio	3.24	-1.34
Value Weighted Portfolio	6.15	1.82
Book-to-market Ratio Portfolio	2.49	-2.32
Size/Book-to-market Ratio Portfolio	1.05	-2.62
Market Capitalisation Control Firm	2.80	-1.22
Book-to-market Ratio Control Firm	0.71	-1.34
Size/Book-to-market Ratio Control Firm	0.85	-3.48
BHARs		
Market Capitalisation Portfolio	-0.79	-2.37
Equally Weighted Portfolio	2.95	0.10
Value Weighted Portfolio	5.54	2.60
Book-to-market Ratio Portfolio	2.19	-0.86
Size/Book-to-market Ratio Portfolio	-0.82	-2.27
Market Capitalisation Control Firm	0.30	-1.29
Book-to-market Ratio Control Firm	1.45	-0.37
Size/Book-to-market Ratio Control Firm	-0.86	-1.61

TABLE 16

Specification (size) of t statistic for CARs and BHARs in sample A with +/- 1 standard deviation induced abnormal return
All t statistics are for a one year horizon

CARs	t-stat SD added	t-stat SD subtracted
Market Capitalisation Portfolio	0.99	-2.18
Equally Weighted Portfolio	0.06	-2.71
Value Weighted Portfolio	3.09	1.01
Book-to-market Ratio Portfolio	0.01	-2.71
Size Book-to-market Ratio Portfolio	1.95	-1.19
Market Capitalisation Control Firm	-0.84	-4.69
Book-to-market Ratio Control Firm	-0.71	-3.01
Size Book-to-market Ratio Control Firm	0.18	0.13
BHARs		
Market Capitalisation Portfolio	-0.21	-1.96
Equally Weighted Portfolio	-0.25	-2.20
Value Weighted Portfolio	3.16	1.57
Book-to-market Ratio Portfolio	-0.32	-2.06
Size Book-to-market Ratio Portfolio	1.33	-0.92
Market Capitalisation Control Firm	-2.10	-3.81
Book-to-market Ratio Control Firm	-0.94	-2.11
Size Book-to-market Ratio Control Firm	-0.72	-1.22

TABLE 17

Specification (size) of t statistic for CARs and BHARs in sample B with +/- 1 standard deviation induced abnormal return
All t statistics are for a one year horizon

CARs	t-stat SD added	t-stat SD subtracted
Market Capitalisation Portfolio	1.52	-2.21
Equally Weighted Portfolio	2.30	0.64
Value Weighted Portfolio	4.95	2.78
Book-to-market Ratio Portfolio	1.91	-2.08
Size Book-to-market Ratio Portfolio	0.81	-2.38
Market Capitalisation Control Firm	2.89	-1.58
Book-to-market Ratio Control Firm	0.54	-1.18
Size Book-to-market Ratio Control Firm	1.32	3.42
BHARs		
Market Capitalisation Portfolio	0.98	-2.15
Equally Weighted Portfolio	2.38	0.58
Value Weighted Portfolio	4.76	3.27
Book-to-market Ratio Portfolio	1.70	0.46
Size Book-to-market Ratio Portfolio	0.91	-2.15
Market Capitalisation Control Firm	0.27	-1.24
Book-to-market Ratio Control Firm	1.25	-0.20
Size Book-to-market Ratio Control Firm	0.83	-1.64

TABLE 18
Specification (size) of t statistic for CARs and BHARs in sample A with +/- 2 standard deviation induced abnormal return
All t-statistics are for a one year horizon

CARs	t-stat SD added	t-stat SD subtracted
Market Capitalisation Portfolio	2.31	-3.77
Equally Weighted Portfolio	1.12	4.39
Value Weighted Portfolio	3.83	0.36
Book-to-market Ratio Portfolio	1.12	-4.24
Size/Book-to-market Ratio Portfolio	3.27	-3.16
Market Capitalisation Control Firm	1.15	6.08
Book-to-market Ratio Control Firm	0.30	-4.24
Size/Book-to-market Ratio Control Firm	0.34	-0.25
BHARs		
Market Capitalisation Portfolio	0.69	-2.77
Equally Weighted Portfolio	0.60	1.28
Value Weighted Portfolio	3.80	0.63
Book-to-market Ratio Portfolio	0.47	2.96
Size/Book-to-market Ratio Portfolio	2.39	-2.01
Market Capitalisation Control Firm	-1.17	4.55
Book-to-market Ratio Control Firm	-0.40	-2.71
Size/Book-to-market Ratio Control Firm	-0.47	-1.46

TABLE 19
Specification (size) of t statistic for CARs and BHARs in sample B with +/- 2 standard deviation induced abnormal return
All t statistics are for a one year horizon

CARs	t-stat SD added	t-stat SD subtracted
Market Capitalisation Portfolio	3.37	-3.84
Equally Weighted Portfolio	3.43	-2.45
Value Weighted Portfolio	5.72	1.32
Book-to-market Ratio Portfolio	2.80	-3.23
Size/Book-to-market Ratio Portfolio	2.30	-3.86
Market Capitalisation Control Firm	3.91	2.96
Book-to-market Ratio Control Firm	1.34	-2.00
Size/Book-to-market Ratio Control Firm	2.43	-3.88
BHARs		
Market Capitalisation Portfolio	-0.35	-2.69
Equally Weighted Portfolio	1.14	0.44
Value Weighted Portfolio	5.36	2.36
Book-to-market Ratio Portfolio	2.63	-1.66
Size/Book-to-market Ratio Portfolio	-0.27	-2.74
Market Capitalisation Control Firm	1.05	-1.95
Book-to-market Ratio Control Firm	1.91	-0.98
Size/Book-to-market Ratio Control Firm	0.42	-2.02

TABLE 20
Specification (size) of t statistic for CARs and BHARs in sample A with +/- 3 standard deviation induced abnormal return
All t-statistics are for a one year horizon

CARs	t-stat SD added	t-stat SD subtracted
Market Capitalisation Portfolio	3.38	5.15
Equally Weighted Portfolio	1.99	6.13
Value Weighted Portfolio	4.42	1.89
Book-to-market Ratio Portfolio	2.04	-5.75
Size/Book-to-market Ratio Portfolio	4.33	-4.76
Market Capitalisation Control Firm	2.82	7.06
Book-to-market Ratio Control Firm	1.17	5.40
Size/Book-to-market Ratio Control Firm	0.49	-0.45
BHARs		
Market Capitalisation Portfolio	1.55	3.50
Equally Weighted Portfolio	1.34	-4.38
Value Weighted Portfolio	4.33	0.39
Book-to-market Ratio Portfolio	1.21	3.84
Size/Book-to-market Ratio Portfolio	3.36	-3.03
Market Capitalisation Control Firm	-0.22	5.20
Book-to-market Ratio Control Firm	0.12	3.31
Size/Book-to-market Ratio Control Firm	-0.22	-1.71

TABLE 21
Specification (size) of t statistic for CARs and BHARs in sample B with +/- 3 standard deviation induced abnormal return
All t statistics are for a one year horizon

CARs	t-stat SD added	t-stat SD subtracted
Market Capitalisation Portfolio	5.03	-5.23
Equally Weighted Portfolio	4.36	-4.40
Value Weighted Portfolio	6.35	-0.38
Book-to-market Ratio Portfolio	3.22	-3.67
Size/Book-to-market Ratio Portfolio	3.59	-5.13
Market Capitalisation Control Firm	4.32	-3.62
Book-to-market Ratio Control Firm	2.06	-2.75
Size/Book-to-market Ratio Control Firm	2.88	-3.94
BHARs		
Market Capitalisation Portfolio	0.31	-3.19
Equally Weighted Portfolio	3.82	-1.54
Value Weighted Portfolio	5.87	1.34
Book-to-market Ratio Portfolio	3.46	-2.93
Size/Book-to-market Ratio Portfolio	0.38	-3.29
Market Capitalisation Control Firm	1.83	-2.62
Book-to-market Ratio Control Firm	2.53	-1.77
Size/Book-to-market Ratio Control Firm	-0.01	-2.39

TABLE 22

Specification (size) of t-statistic for CARs in sample A MINUS 1.

Included in this table are associated mean, standard deviation and skeness of CARs at each horizon.

The number of positive CARs and whether or not it is significantly different from 50% (proportions test) is included.

Also, the number of significant t-statistics for the paired-t-test are presented.

Market Capitalisation Portfolio	t-stat.	MEAN	ST DEV.	SKEW.	# of Positive CARs	Sign. <> 50%?	Paired-t-test: # sign.
1-year	-6.51	-1.19530386	1.23109862	-0.55668169	4	yes	31
3-year	-8.02	-2.04394104	1.70863822	-1.22853857	2	yes	15
5-year	-7.53	-3.60322510	3.21163711	-1.76435177	0	yes	27
Equally Weighted Portfolio							
1-year	-9.02	-1.11870969	0.83178441	-0.20616317	3	yes	21
3-year	-14.47	-1.85119884	0.85799679	-0.36757745	1	yes	24
5-year	-19.25	-3.26943391	1.13914314	-0.57140305	0	yes	34
Value Weighted Portfolio							
1-year	-4.52	-0.55240736	0.82039660	-0.58151571	5	yes	14
3-year	-9.10	-1.17859051	0.86882974	-0.45377661	2	yes	8
5-year	-13.05	-2.17652489	1.11871575	-0.51764539	0	yes	20
Book-to-market Ratio Portfolio							
1-year	-9.09	-1.21526755	0.89685721	-0.12360861	3	yes	20
3-year	-13.21	-2.05774079	1.04526712	-0.60024065	1	yes	21
5-year	-11.48	-3.87367696	2.26275499	-1.45499630	0	yes	28
Size/Book-to-market Ratio Portfolio							
1-year	-5.28	-0.98271759	1.24816824	-0.52971312	8	yes	11
3-year	-7.51	-1.93840990	1.73183162	-1.45255900	3	yes	12
5-year	-5.00	-3.91822572	5.26055955	-3.46131515	2	yes	24
Market Capitalisation Control Firm							
1-year	-5.40	-1.21808084	1.51345271	-1.27532456	7	yes	8
3-year	-8.50	-2.14815209	1.69583131	-0.60359381	2	yes	9
5-year	-9.75	-3.41466249	2.34995694	-1.09016381	2	yes	15
Book-to-market Ratio Control Firm							
1-year	-6.31	-1.55287416	1.65034634	-2.26976856	5	yes	8
3-year	-8.65	-2.38239398	1.84748730	-2.00671619	2	yes	8
5-year	-9.39	-3.50757574	2.50491264	-1.91357350	1	yes	12
Size/Book-to-market Ratio Control Firm							
1-year	-5.12	-1.63364813	2.14218427	-2.51406538	3	yes	9
3-year	-7.20	-2.45329286	2.28570504	-2.09248275	1	yes	6
5-year	-9.29	-3.69272984	2.66734304	-1.62811734	0	yes	18

TABLE 23

Specification (size) of t-statistic for BHARs in sample A MINUS 1.
Included in this table are associated mean, standard deviation and skeness of BHARs at each horizon.
The number of positive BHARs and whether or not it is significantly different from 50% (proportions test) is included
Also, the number of significant t-statistics for the paired-t-test are presented

Market Capitalisation Portfolio	t-stat.	MEAN	ST.DEV	SKEW.	# of Positive BHARs	Sign. <> 50%?	Paired-t-test: # sign.
1-year	-5.87	-1.35183584	1.54389800	-0.40982837	4	yes	17
3-year	-3.86	-3.51329942	6.10067073	-4.52933683	0	yes	15
5-year	-2.60	-20.13805201	51.89193906	-3.34196016	0	yes	27
Equally Weighted Portfolio							
1-year	-10.22	-1.17047879	0.76854186	2.45665868	3	yes	21
3-year	-30.17	-2.10537833	0.46812191	-1.29265801	0	yes	24
5-year	-78.80	-4.99480527	0.42518618	0.24479637	0	yes	34
Value Weighted Portfolio							
1-year	-3.82	-0.40919979	0.71880154	2.65481346	5	yes	14
3-year	-15.13	-1.03032202	0.45692065	-1.40854567	1	yes	8
5-year	-37.48	-1.93096257	0.34558943	0.87912808	0	yes	20
Book-to-market Ratio Portfolio							
1-year	-9.23	-1.27926474	0.93019173	1.59147035	3	yes	20
3-year	-13.23	-0.05719048	0.02900733	-0.60175436	1	yes	21
5-year	-7.21	-7.60417221	7.07015582	-2.24240922	0	yes	28
Size/Book-to-market Ratio Portfolio							
1-year	-4.79	-1.00754766	1.41208879	0.06088292	5	yes	11
3-year	-3.61	-2.96652831	5.50594192	-4.82076335	1	yes	12
5-year	-1.90	-16.61752963	58.68494541	-5.59565675	1	yes	24
Market Capitalisation Control Firm							
1-year	-5.07	-1.48840698	1.96742231	-1.78588052	7	yes	8
3-year	-6.53	-2.54289308	2.61278938	-1.70042177	1	yes	10
5-year	-5.71	-4.34986097	5.10742724	-2.38076593	1	yes	15
Book-to-market Ratio Control Firm							
1-year	-5.03	-1.85358067	2.46980567	-2.20401540	5	yes	8
3-year	-7.03	-2.50228377	2.38712679	-1.36680640	0	yes	8
5-year	-4.58	-4.12274242	6.04439294	-4.07170706	0	yes	12
Size/Book-to-market Ratio Control Firm							
1-year	-2.79	-2.07556590	4.99317535	-5.57563236	2	yes	9
3-year	-3.98	-2.70050493	4.54653485	-4.28313181	0	yes	6
5-year	-4.09	-4.74833115	7.78763423	-4.09963485	0	yes	18

TABLE 24

Specification (size) of t-statistic for CARs in sample B MINUS 1.

Included in this table are associated mean, standard deviation and skeness of CARs at each horizon

The number of positive CARs and whether or not it is significantly different from 50% (proportions test) is included.

Also, the number of significant t-statistics for the paired-t-test are presented.

Market Capitalisation Portfolio	t-stat.	MEAN	ST.DEV	SKEW.	# of Positive CARs	Sign. <> 50%?	Paired-t-test: # sign.
1-year	-7.90	-1.88132256	1.59804826	-0.60129104	3	yes	28
3-year	-6.84	-2.03516669	1.99487432	-0.78520783	5	yes	18
5-year	-5.47	-2.67871982	3.28324824	-1.67426565	17	no	6
Equally Weighted Portfolio							
1-year	-10.20	-1.27030729	0.83550141	0.22662825	4	yes	27
3-year	-8.21	-1.33736067	1.09304471	-0.17879224	4	yes	19
5-year	-9.02	-1.52318927	1.13292713	-0.50524702	2	yes	17
Value Weighted Portfolio							
1-year	-5.70	-0.64247176	0.75547892	-0.02748133	7	yes	6
3-year	-3.70	-0.60625142	1.10017466	-0.36876353	15	yes	6
5-year	-3.51	-0.60982144	1.16450260	-0.38275918	16	no	6
Book-to-market Ratio Portfolio							
1-year	-9.65	-1.36856603	0.95175610	-0.00418411	5	yes	21
3-year	-8.52	-1.50759513	1.18764366	-0.17397463	2	yes	18
5-year	-6.66	-1.75342923	1.76486874	-1.92117333	4	yes	17
Size/Book-to-market Ratio Portfolio							
1-year	-6.54	-1.67897652	1.72248079	-0.97851215	6	yes	15
3-year	-6.30	-1.83191795	1.95051907	-1.04433961	6	yes	12
5-year	-3.63	-2.40442968	4.44155782	-5.00154270	6	yes	10
Market Capitalisation Control Firm							
1-year	-6.28	-1.79340213	1.91461343	-1.02554293	6	yes	17
3-year	-5.07	-2.05235126	2.71560748	-2.02451124	9	yes	8
5-year	-5.40	-2.46815230	3.06424858	-1.90016685	8	yes	8
Book-to-market Ratio Control Firm							
1-year	-4.85	-1.02627384	1.41906000	-0.94274438	14	yes	13
3-year	-4.58	-1.04931226	1.53524547	-0.60161860	12	yes	6
5-year	-3.93	-1.14318077	1.95301453	-0.86101977	14	yes	3
Size/Book-to-market Ratio Control Firm							
1-year	-4.73	-2.00784029	2.84471552	-2.78798615	8	yes	13
3-year	-5.20	-2.17489161	2.80566782	-2.23760141	8	yes	6
5-year	-5.82	-2.32651639	2.68314594	-2.71571425	5	yes	6

TABLE 25

Specification (size) of t-statistic for BHARs in sample B MINUS 1.

Included in this table are associated mean, standard deviation and skeness of BHARs at each horizon

The number of positive BHARs and whether or not it is significantly different from 50% (proportions test) is included.

Also, the number of significant t-statistics for the paired-t-test are presented.

Market Capitalisation Portfolio	t-stat.	MEAN	ST.DEV.	SKEW.	# of Positive BHARs	Sign. <> 50%?	Paired-t-test: # sign.
1-year	-5.89	-2.55206815	2.90867448	-1.46022096	3	yes	28
3-year	-4.44	-7.01822578	10.61363591	-1.96098179	2	yes	23
5-year	-2.75	-115.51432363	281.98540962	-2.79377603	1	yes	29
Equally Weighted Portfolio							
1-year	-11.18	-1.22301736	0.73399474	1.02575141	1	yes	30
3-year	-25.93	-2.02013043	0.52270103	2.24842309	1	yes	25
5-year	-46.67	-4.92366311	0.70769847	3.83205161	0	yes	37
Value Weighted Portfolio							
1-year	-5.36	-0.48123669	0.60178693	1.15301498	7	yes	6
3-year	-11.71	-0.94168323	0.53960152	1.84216762	1	yes	10
5-year	-13.59	-1.78591154	0.88184106	3.63530230	2	yes	27
Book-to-market Ratio Portfolio							
1-year	-9.90	-1.37496943	0.93154078	0.12629289	4	yes	21
3-year	-12.28	-2.59085330	1.41584978	-0.61134210	0	yes	24
5-year	-6.54	-6.41872816	6.58474325	-2.72296978	0	yes	31
Size/Book-to-market Ratio Portfolio							
1-year	-5.13	-2.21765294	2.90147575	-1.77621087	6	yes	15
3-year	-4.96	-4.84669510	6.56062147	-1.66495057	3	yes	18
5-year	-1.73	-56.39023749	218.63488215	-4.62378578	1	yes	26
Market Capitalisation Control Firm							
1-year	-4.20	-2.42796775	3.87556937	-2.96976795	6	yes	17
3-year	-2.83	-4.48981143	10.63114699	-4.70870283	7	yes	11
5-year	-1.18	-43.64952641	248.66726664	-6.68958306	2	yes	17
Book-to-market Ratio Control Firm							
1-year	-6.10	-1.49689113	1.64557474	-0.75263708	19	no	12
3-year	-4.69	-2.14819758	3.07007925	-4.65079906	1	yes	6
5-year	-2.26	-6.55096733	19.47756898	-4.78591431	2	yes	15
Size/Book-to-market Ratio Control Firm							
1-year	-3.55	-2.79140846	5.26812732	-3.32302916	7	yes	13
3-year	-5.37	-3.33417319	4.16726840	-1.77602997	4	yes	11
5-year	-4.54	-4.85116312	7.17578005	-4.05330173	2	yes	17

TABLE 26
Specification (size) of t-statistic for CARs and BHARs in sample A MINUS 1, with + 5% induced abnormal return
All t-statistics are for a one year horizon

CARs	t-stat. AR added	t-stat AR subtracted
Market Capitalisation Portfolio	-6.24	-6.79
Equally Weighted Portfolio	-8.62	9.43
Value Weighted Portfolio	-4.10	-4.93
Book-to-market Ratio Portfolio	-8.71	-9.47
Size/Book-to-market Ratio Portfolio	-5.01	5.55
Market Capitalisation Control Firm	-5.18	-5.62
Book-to-market Ratio Control Firm	-6.11	-6.52
Size/Book-to-market Ratio Control Firm	-4.96	-5.27
BHARs		
Market Capitalisation Portfolio	-5.66	6.09
Equally Weighted Portfolio	-9.78	10.65
Value Weighted Portfolio	-10.46	11.39
Book-to-market Ratio Portfolio	-8.87	-9.59
Size/Book-to-market Ratio Portfolio	-4.55	-5.02
Market Capitalisation Control Firm	-4.90	5.25
Book-to-market Ratio Control Firm	-4.90	-5.17
Size/Book-to-market Ratio Control Firm	-2.72	-2.86

TABLE 27
Specification (size) of t-statistic for CARs and BHARs in sample B MINUS 1, with +/-5% induced abnormal return
All t statistics are for a one year horizon

CARs	t-stat. AR added	t-stat. AR subtracted
Market Capitalisation Portfolio	-7.69	-8.11
Equally Weighted Portfolio	-9.79	-10.60
Value Weighted Portfolio	-5.26	-6.15
Book-to-market Ratio Portfolio	-9.29	-10.00
Size/Book-to-market Ratio Portfolio	-6.34	6.74
Market Capitalisation Control Firm	6.11	-6.46
Book-to-market Ratio Control Firm	-4.72	-4.98
Size/Book-to-market Ratio Control Firm	-4.62	-4.85
BHARs		
Market Capitalisation Portfolio	-5.77	-6.00
Equally Weighted Portfolio	-10.72	-11.63
Value Weighted Portfolio	-4.81	-5.92
Book-to-market Ratio Portfolio	-9.54	-10.26
Size/Book-to-market Ratio Portfolio	-5.01	-5.24
Market Capitalisation Control Firm	-4.12	-4.29
Book-to-market Ratio Control Firm	-5.90	-6.31
Size/Book-to-market Ratio Control Firm	-3.49	-3.62

TABLE 28

Specification (size) of t-statistic for CARs and BHARs in sample A MINUS 1, with +-10% induced abnormal return
All t-statistics are for a one year horizon

CARs	t-stat. AR added	t-stat. AR subtracted
Market Capitalisation Portfolio	-5.96	-7.06
Equally Weighted Portfolio	-8.21	-9.84
Value Weighted Portfolio	-3.69	5.34
Book-to-market Ratio Portfolio	-8.34	-9.84
Size Book to market Ratio Portfolio	-4.74	-5.82
Market Capitalisation Control Firm	-4.95	-5.85
Book-to-market Ratio Control Firm	-5.90	-6.72
Size/Book-to-market Ratio Control Firm	-4.80	-5.43
BHARs		
Market Capitalisation Portfolio	-5.44	6.31
Equally Weighted Portfolio	-9.34	-11.09
Value Weighted Portfolio	-9.99	-11.86
Book-to-market Ratio Portfolio	-8.50	-9.95
Size/Book-to-market Ratio Portfolio	-4.31	-5.26
Market Capitalisation Control Firm	-4.73	-5.42
Book-to-market Ratio Control Firm	-4.76	-5.31
Size Book-to-market Ratio Control Firm	-2.65	-2.92

TABLE 29

Specification (size) of t-statistic for CARs and BHARs in sample B MINUS 1, with +/-10% induced abnormal return
All t-statistics are for a one year horizon

CARs	t-stat. AR added	t-stat. AR subtracted
Market Capitalisation Portfolio	-7.47	-8.32
Equally Weighted Portfolio	-9.39	-11.01
Value Weighted Portfolio	-4.81	-6.60
Book to market Ratio Portfolio	-8.94	-10.36
Size Book-to-market Ratio Portfolio	-6.15	-6.93
Market Capitalisation Control Firm	-5.93	-6.64
Book to market Ratio Control Firm	-4.59	-5.11
Size Book to market Ratio Control Firm	-4.50	-4.97
BHARs		
Market Capitalisation Portfolio	-5.66	-6.12
Equally Weighted Portfolio	-10.26	-12.09
Value Weighted Portfolio	-4.25	-6.48
Book-to-market Ratio Portfolio	-9.18	-10.62
Size Book-to-market Ratio Portfolio	-4.90	-5.36
Market Capitalisation Control Firm	-4.03	-4.38
Book-to-market Ratio Control Firm	-5.69	-6.51
Size Book-to market Ratio Control Firm	-3.43	-3.68

TABLE 30
Specification (size) of t-statistic for CARs and BHARs in sample A MINUS 1 with + -15% induced abnormal return
All t-statistics are for a one year horizon

CARs	t-stat. AR added	t-stat. AR subtracted
Market Capitalisation Portfolio	-5.70	-7.33
Equally Weighted Portfolio	-7.81	-10.23
Value Weighted Portfolio	-3.29	-5.74
Book-to-market Ratio Portfolio	-7.97	-10.21
Size/Book-to-market Ratio Portfolio	-4.48	-6.09
Market Capitalisation Control Firm	-4.73	-6.06
Book-to-market Ratio Control Firm	-5.70	-6.92
Size/Book-to-market Ratio Control Firm	-4.65	-5.59
BHARs		
Market Capitalisation Portfolio	-5.22	-6.53
Equally Weighted Portfolio	-8.91	11.53
Value Weighted Portfolio	-9.52	-12.32
Book-to-market Ratio Portfolio	-8.14	-10.31
Size/Book-to-market Ratio Portfolio	-4.07	-5.50
Market Capitalisation Control Firm	-4.56	-5.59
Book-to-market Ratio Control Firm	-4.63	-5.44
Size/Book-to-market Ratio Control Firm	-2.59	-2.99

TABLE 31
Specification (size) of t-statistic for CARs and BHARs in sample B MINUS 1, with +/-15% induced abnormal return
All t-statistics are for a one year horizon

CARs	t-stat. AR added	t-stat. AR subtracted
Market Capitalisation Portfolio	-7.27	-8.53
Equally Weighted Portfolio	-8.99	-11.40
Value Weighted Portfolio	-4.37	-7.04
Book-to-market Ratio Portfolio	-8.59	-10.70
Size/Book-to-market Ratio Portfolio	-5.95	-7.12
Market Capitalisation Control Firm	-5.76	-6.81
Book-to-market Ratio Control Firm	-4.46	-5.24
Size/Book-to-market Ratio Control Firm	-4.38	-5.09
BHARs		
Market Capitalisation Portfolio	-5.54	-6.23
Equally Weighted Portfolio	-9.81	-12.55
Value Weighted Portfolio	-3.69	-7.04
Book-to-market Ratio Portfolio	-8.82	-10.98
Size/Book-to-market Ratio Portfolio	-4.78	-5.47
Market Capitalisation Control Firm	-3.94	-4.46
Book-to-market Ratio Control Firm	-5.49	-6.71
Size/Book-to-market Ratio Control Firm	-3.36	-3.75

TABLE 32

Specification (size) of t statistic for CARs and BHARs in sample A MINUS 1 with + 20% induced abnormal return
All t-statistics are for a one year horizon

CARs	t-stat. AR added	t-stat. AR subtracted
Market Capitalisation Portfolio	-5.42	-7.61
Equally Weighted Portfolio	-7.41	-10.64
Value Weighted Portfolio	-2.88	6.16
Book-to-market Ratio Portfolio	-7.59	10.59
Size/Book-to-market Ratio Portfolio	-4.20	-6.36
Market Capitalisation Control Firm	-4.51	6.29
Book-to-market Ratio Control Firm	-5.50	-7.13
Size/Book-to-market Ratio Control Firm	-4.49	-5.74
BHARs		
Market Capitalisation Portfolio	-5.00	-6.74
Equally Weighted Portfolio	-8.47	-11.96
Value Weighted Portfolio	-9.06	-12.79
Book-to-market Ratio Portfolio	-7.78	-10.67
Size Book-to-market Ratio Portfolio	-3.84	-5.74
Market Capitalisation Control Firm	-4.39	-5.76
Book-to-market Ratio Control Firm	-4.49	5.58
Size/Book-to-market Ratio Control Firm	-2.52	-3.06

TABLE 33

Specification (size) of t statistic for CARs and BHARs in sample B MINUS 1, with + 20% induced abnormal return
All t statistics are for a one year horizon

CARs	t-stat. AR added	t-stat. AR subtracted
Market Capitalisation Portfolio	-7.06	-8.74
Equally Weighted Portfolio	-8.59	-11.81
Value Weighted Portfolio	-3.93	-7.48
Book to market Ratio Portfolio	-8.23	-11.06
Size Book to market Ratio Portfolio	5.76	-7.32
Market Capitalisation Control Firm	-5.58	-6.99
Book to market Ratio Control Firm	-4.33	-5.37
Size Book to market Ratio Control Firm	-4.26	-5.21
BHARs		
Market Capitalisation Portfolio	-5.42	-6.35
Equally Weighted Portfolio	-9.35	-13.01
Value Weighted Portfolio	-3.13	-7.59
Book to market Ratio Portfolio	-8.46	-11.34
Size Book to market Ratio Portfolio	-4.66	-5.59
Market Capitalisation Control Firm	-3.86	-4.55
Book to market Ratio Control Firm	5.29	-6.92
Size Book to market Ratio Control Firm	-3.30	-3.81

TABLE 34

Specification (size) of t-statistic for CARs and BHARs in sample A MINUS 1; with +/- 1 standard deviation induced abnormal return.
All t-statistics are for a one year horizon

CARs	t-stat. SD added	t-stat. SD subtracted
Market Capitalisation Portfolio	-6.00	-6.93
Equally Weighted Portfolio	-8.29	-9.53
Value Weighted Portfolio	-3.60	-5.24
Book-to-market Ratio Portfolio	-8.50	-9.50
Size/Book-to-market Ratio Portfolio	-4.58	-5.89
Market Capitalisation Control Firm	-4.89	-5.83
Book-to-market Ratio Control Firm	-5.90	-6.65
Size/Book-to-market Ratio Control Firm	-4.64	-5.55
BHARs		
Market Capitalisation Portfolio	-5.40	-6.23
Equally Weighted Portfolio	-9.07	-11.07
Value Weighted Portfolio	-2.57	-4.86
Book-to-market Ratio Portfolio	-8.37	-9.88
Size/Book-to-market Ratio Portfolio	-4.13	-5.37
Market Capitalisation Control Firm	-4.61	-5.49
Book-to-market Ratio Control Firm	-4.64	-5.39
Size/Book-to-market Ratio Control Firm	-2.54	-3.04

TABLE 35

Specification (size) of t-statistic for CARs and BHARs in sample B MINUS 1; with +/- 1 standard deviation induced abnormal return.
All t-statistics are for a one year horizon.

CARs	t-stat. SD added	t-stat. SD subtracted
Market Capitalisation Portfolio	-7.57	-8.19
Equally Weighted Portfolio	-9.65	-10.63
Value Weighted Portfolio	-4.87	-6.39
Book-to-market Ratio Portfolio	-8.48	-9.73
Size/Book-to-market Ratio Portfolio	-6.16	-6.87
Market Capitalisation Control Firm	-5.68	-6.62
Book-to-market Ratio Control Firm	-4.68	-5.00
Size/Book-to-market Ratio Control Firm	-4.42	-4.89
BHARs		
Market Capitalisation Portfolio	-5.66	-6.10
Equally Weighted Portfolio	-10.48	-11.71
Value Weighted Portfolio	-4.19	-6.31
Book-to-market Ratio Portfolio	-9.28	-10.42
Size/Book-to-market Ratio Portfolio	-4.84	-5.39
Market Capitalisation Control Firm	-3.93	-4.46
Book-to-market Ratio Control Firm	-5.64	-6.51
Size/Book-to-market Ratio Control Firm	-3.36	-3.74

TABLE 36

Specification (size) of t-statistic for CARs and BHARs in sample A MINUS 1; with +/- 2 standard deviation induced abnormal return.
All t-statistics are for a one year horizon.

CARs	t-stat. SD added	t-stat. SD subtracted
Market Capitalisation Portfolio	-5.38	-7.27
Equally Weighted Portfolio	-7.30	-9.86
Value Weighted Portfolio	-2.46	-5.80
Book-to-market Ratio Portfolio	-7.68	-9.77
Size/Book-to-market Ratio Portfolio	-3.78	-6.41
Market Capitalisation Control Firm	-4.29	-6.19
Book-to-market Ratio Control Firm	-5.39	-6.92
Size/Book-to-market Ratio Control Firm	-4.12	-5.94
BHARs		
Market Capitalisation Portfolio	-4.90	-6.55
Equally Weighted Portfolio	-7.69	-11.64
Value Weighted Portfolio	-1.17	-5.67
Book-to-market Ratio Portfolio	-7.34	-10.36
Size/Book-to-market Ratio Portfolio	-3.41	-5.88
Market Capitalisation Control Firm	-4.10	-5.86
Book-to-market Ratio Control Firm	-4.22	-5.71
Size/Book-to-market Ratio Control Firm	-2.28	-3.28

TABLE 37

Specification (size) of t-statistic for CARs and BHARs in sample B MINUS 1; with +/- 2 standard deviation induced abnormal return.
All t-statistics are for a one year horizon.

CARs	t-stat. SD added	t-stat. SD subtracted
Market Capitalisation Portfolio	-7.21	-8.44
Equally Weighted Portfolio	-8.97	-10.97
Value Weighted Portfolio	-3.86	-6.94
Book-to-market Ratio Portfolio	-6.48	-9.24
Size/Book-to-market Ratio Portfolio	-5.73	-7.15
Market Capitalisation Control Firm	-4.81	-6.76
Book-to-market Ratio Control Firm	-4.47	-5.12
Size/Book-to-market Ratio Control Firm	-3.91	-4.94
BHARs		
Market Capitalisation Portfolio	-5.41	-6.31
Equally Weighted Portfolio	-9.60	-12.10
Value Weighted Portfolio	-2.76	-7.05
Book-to-market Ratio Portfolio	-8.55	-10.85
Size/Book-to-market Ratio Portfolio	-4.54	-5.64
Market Capitalisation Control Firm	-3.65	-4.71
Book-to-market Ratio Control Firm	-5.14	-6.89
Size/Book-to-market Ratio Control Firm	-3.14	-3.90

TABLE 38
Specification (size) of t-statistic for CARs and BHARs in sample A MINUS 1; with +/- 3 standard deviation induced abnormal return.
All t-statistics are for a one year horizon.

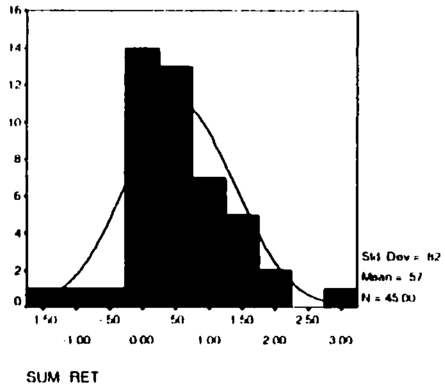
CARs	t-stat. SD added	t-stat. SD subtracted
Market Capitalisation Portfolio	-4.65	-7.55
Equally Weighted Portfolio	-6.08	-10.05
Value Weighted Portfolio	-1.15	-6.22
Book-to-market Ratio Portfolio	-6.62	-9.94
Size/Book-to-market Ratio Portfolio	-2.89	-6.85
Market Capitalisation Control Firm	-3.59	-6.50
Book-to-market Ratio Control Firm	-4.79	-7.14
Size/Book-to-market Ratio Control Firm	-3.56	-6.30
BHARs		
Market Capitalisation Portfolio	-4.33	-6.83
Equally Weighted Portfolio	-6.19	-11.97
Value Weighted Portfolio	0.24	-6.29
Book-to-market Ratio Portfolio	-6.16	-10.69
Size/Book-to-market Ratio Portfolio	-2.62	-6.33
Market Capitalisation Control Firm	-3.54	-6.19
Book-to-market Ratio Control Firm	-3.76	-6.00
Size/Book-to-market Ratio Control Firm	-2.03	-3.52

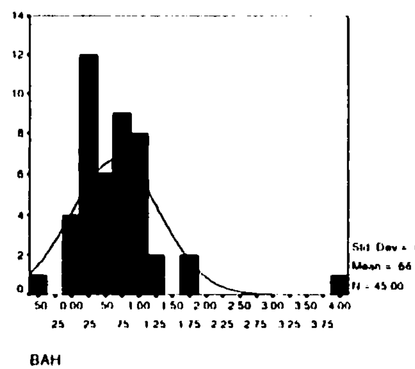
TABLE 39
Specification (size) of t-statistic for CARs and BHARs in sample B MINUS 1; with +/- 3 standard deviation induced abnormal return.
All t-statistics are for a one year horizon.

CARs	t-stat. SD added	t-stat. SD subtracted
Market Capitalisation Portfolio	-6.79	-8.67
Equally Weighted Portfolio	-8.12	-11.23
Value Weighted Portfolio	-2.67	-7.40
Book-to-market Ratio Portfolio	-4.46	-8.61
Size/Book-to-market Ratio Portfolio	-5.23	-7.40
Market Capitalisation Control Firm	-3.74	-6.78
Book-to-market Ratio Control Firm	-4.22	-5.23
Size/Book-to-market Ratio Control Firm	-3.19	-4.94
BHARs		
Market Capitalisation Portfolio	-5.16	-6.50
Equally Weighted Portfolio	-8.52	-12.38
Value Weighted Portfolio	-1.12	-7.63
Book-to-market Ratio Portfolio	-7.70	-11.21
Size/Book-to-market Ratio Portfolio	-4.21	-5.87
Market Capitalisation Control Firm	-3.36	-4.94
Book-to-market Ratio Control Firm	-4.58	-7.22
Size/Book-to-market Ratio Control Firm	-2.91	-4.06

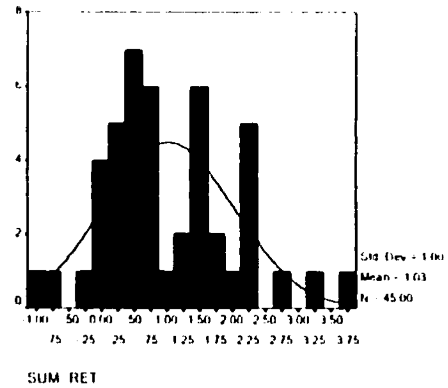
13. Appendix I

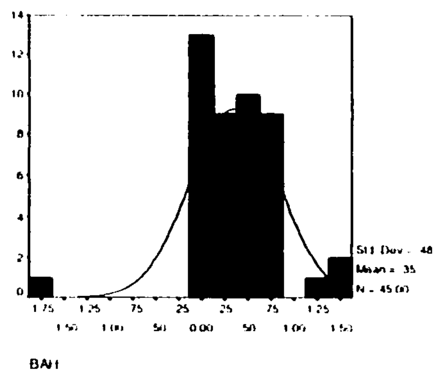
SAMPLE A - 12 MONTHS



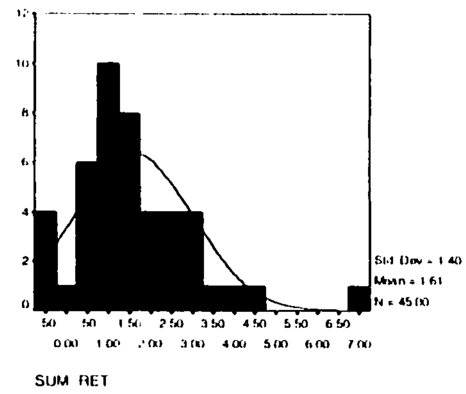


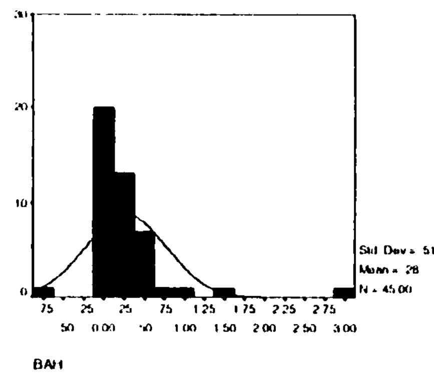
SAMPLE A - 36 MONTHS



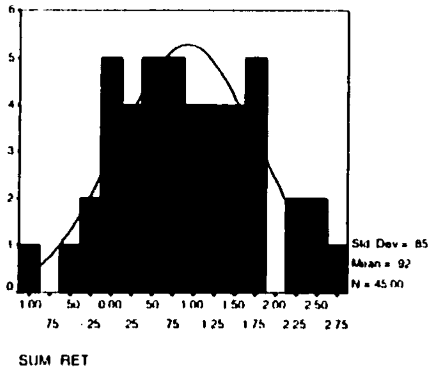


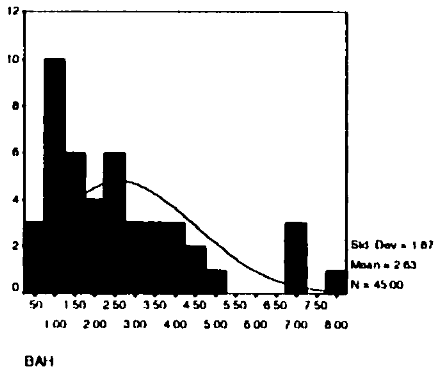
SAMPLE A - 60 MONTHS



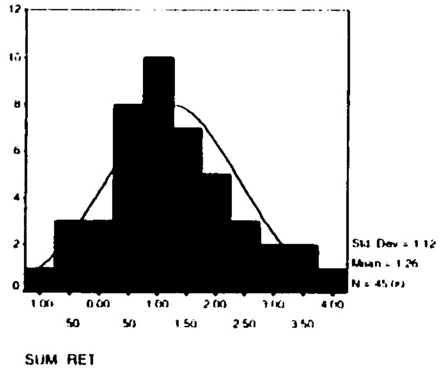


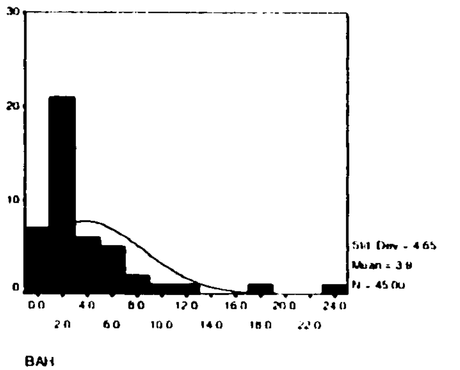
SAMPLE B - 12 MONTHS





SAMPLE B - 36 MONTHS





SAMPLE B - 60 MONTHS