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Essays on Stock Market Anomalies

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ABSTRACT

Essays on Stock Market Anomalies

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Concordia University, 1991

Essay One investigates whether the behaviours of abnormal returns, betas and variances of splitting stocks are anomalous around stock split ex-dates for a large sample of stock splits on the Toronto Stock Exchange. The mean abnormal return is positive and statistically significant on split ex-dates based on an extended market model, but not significant on the ex-dates when the conditional variance equation of the return generating process is modelled by an ARCH process. The increase in the mean variance after the split ex-dates is statistically significant, and is significantly related to the increase in the relative bid-ask spread and trading volume on the split ex-date. The increases after the split ex-date in the OLS and Scholes-Williams-type mean betas are statistically significant. However, these mean beta increases are not significant when the conditional variance of the return generating process is modelled using an ARCH process.

Essay Two tests the overreaction hypothesis using monthly data for stocks listed on the Toronto Stock Exchange. It finds statistically significant continuation behaviour for one (and two) years after portfolio formation for winners and losers, and insignificant reversal behaviour over longer formation/ test periods of up to ten years. While the mean systematic

risks of the winners decrease significantly over all formation/test periods, the mean systematic risks of the losers increase significantly for only the 12 month formation/ test periods. No statistical evidence is found that the market overreaction effect is related to either the January or size anomalies. The findings are robust for various portfolio performance measures.

Essay Three tests whether the stock market overreacts to stock splits and whether stock splits are a manifestation of the overreaction phenomenon. It finds insignificant return reversal behaviour for the post-split announcement periods for the total sample and the five pre-split CAR-ranked portfolios of split and control stocks. No statistically discernable differences in the post-split performances between paired split and control stocks are identified using various portfolio performance measures.

Essay Four investigates the seasonal behaviour in the growth rates and innovations for macroeconomic variables in the Canadian stock market. A restricted nonlinear multivariate regression system for the APT is estimated using the observed macroeconomic variables. Five macroeconomic factors (lagged industrial production, lagged GDP, term structure, unexpected inflation and risk premium) are found to have significantly priced risk premia. Three factors (the U.S. composite index, the Cdn/U.S. exchange rate and the residual market factor or RMF for the TSE 300 index and the TSE/Western value-weighted

index) have insignificantly priced risk premia. The RMF has a significantly priced risk premium when it is calculated using the TSE/Western equally-weighted index.

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This dissertation is dedicated to Shuling and Xin.

CONTENTS

LIST OF TABLES

CHAPTER ONE: INTRODUCTION

During the past two decades, much empirical evidence on the persistent departures of stock prices from the predictions of the Efficient Market Hypothesis (EMH) has been presented. These persistent departures are often called "anomalies" or "regularities" because they are difficult to rationalize, tend to persist over time, and are not predicted by any of the generally-accepted paradigms in finance.[1]

The EMH maintains that financial asset prices are determined in economic equilibrium by the interaction of rational agents. In the absence of informational signalling, the decision by a company to split its stock (i.e., issue more than one new share in exchange for each old share) should have no effect on the rate of return of the splitting stock because the total market value of a firm's equity determined in economic equilibrium should be independent of the number of shares outstanding. Nevertheless, empirical evidence has shown that stock prices increase significantly on the split ex-dates [Charest (1978), Grinblatt, Masulis and Titman (1984), Lamoureux and Poon (1987), amongst others]. This price behaviour is "anomalous" because it violates the EMH prediction that no abnormal price change should occur on any publicly-known event days. Moreover, the risks of splitting stocks (namely, their variances and betas) change split ex-date [Ohlson and Penman (1985), Dravid (1987), Lamoureux and Poon (1987) and Brennan and Copeland (1988a)]. Although

variance changes may be attributable to the increase in the bid-ask spread [Conroy, Harris and Benet (1990)], the beta changes appear to be inconsistent with received theory which states that the split announcement constitutes firm-specific information, and that the split itself should have no effect on the systematic risk of the stock. Although various hypotheses have been proposed to explain the market behaviour on split announcement dates, no satisfactory explanation has been found to explain the market behaviour around split ex-dates.[2]

The EMH also predicts that capital market returns could be characterized by the absence of ex-post regularities [Fama (1970)]. Otherwise, trading strategies may be formulated, based on the knowledge of these regularities, which lead to above-normal profits. However, various regularities (or anomalies) in stock prices have been reported in the literature. One type of regularity is based on the contrarian strategy that the purchase (sale) of stocks with extremely poor (good) returns over the past few years leads to abnormal returns [De Bondt and Thaler (1985, 1987)]. This may be explained by the hypothesis that economic agents are not fully rational in that they systematically overreact to firm-specific information. Whether or not the reversal behaviour of stock prices is a characteristic of Canadian capital markets in general, and stock splits in particular, remains an unresolved issue.

Another type of regularity in stock returns is that stocks earn higher returns in January than the rest of the year [Rozeff and Kinney (1976), Reinganum (1981, 1982, 1983), Roll (1983) and Gultekin and Gultekin (1983), amongst others]. The presence of a January seasonal has contaminated the risk-return relationships predicted by two major paradigms of finance; namely, the Capital Asset Pricing Model (CAPM) and the Arbitrage Pricing Model (APT). [For evidence, see Tinic and West (1984, 1986), Gultekin and Gultekin (1987), amongst others]. Attempts to explain this anomaly have been an active area of ongoing research.[31]

Given the above anomalies (regularities) identified in the literature, the purpose of this thesis is two-fold: first, to investigate the market behaviour around stock split ex-dates, the contrarian investment strategy, and January seasonality for the Canadian stock markets; and second, to propose and test alternative models for explaining these anomalies. Lakonishok and Smidt (1988) argue that the statistical tests routinely used in financial economics are usually interpreted as if they are being applied to new data. Since most of the research on these anomalies is based on a relatively few data bases, the danger of data snooping is substantial. As noted by Lakonishok and Smidt, the best remedy for data snooping is new data. Since it is only possible to conduct joint tests of market efficiency and some model of equilibrium prices, the anomalous behaviour of stock prices

exhibited using one particular model may not be evident using a competing model. Therefore, a crucial task in financial research is to propose and test new models for explaining the observed anomalies (regularities).

The remainder of this thesis is organized as follows:

In chapter two, whether or not the behaviours of abnormal returns, betas, variances, and correlations between the split stocks and the market are anomalous around split ex-dates for a sample of Canadian stock splits are investigated. A two-beta market model is used to estimate the abnormal returns on the split ex-dates. An ARCH model is used to explicitly allow the conditional variance of the error terms of the model to change over time as a function of past error terms, the square of the bid-ask spread and trading volume, and to change to a new regime on the split ex-dates.

In chapters three and four, whether or not the overreaction phenomenon exists in the Canadian stock market, and whether or not stock splits are a manifestation of the overreaction phenomenon, are examined. Two risk-adjusted performance measures, including the Jensen and Sharpe measures and a size-based measure, are employed to test the overreaction hypothesis. The impact of risk changes and the January seasonal on the contrarian strategy is also investigated. A model of manager overreaction is developed and tested to investigate whether corporate managers overreact to past stock price performance by splitting their stocks. The

relative differences in the post-split performances of split stocks and a sample of control stocks are compared and tested to determine whether or not the market overreacts to stock splits.

In chapter five, the seasonal behaviours of growth rates and innovations of various macroeconomic variables in the Canadian stock market are investigated. A restricted nonlinear multivariate regression system for the APT (Arbitrage Pricing Model) is estimated using the observed macroeconomic variables. The relationships between the seasonal behaviour in the Canadian stock market and the fundamental forces that cause the seasonality exhibited in the APT model are then investigated.

In chapter six, the major findings of this thesis are summarized, and their implications are discussed. This is followed by a discussion of directions for future research.

CHAPTER TWO: MARKET BEHAVIOUR AROUND CANADIAN STOCK SPLIT EX-DATES

2.1 INTRODUCTION

From a theoretical viewpoint, whether or not stock splits are "cosmetic" events, and whether or not ex-date abnormal returns (AR's) and nonstationarity (e.g., risk) should be associated with such events, has been debated. Nevertheless, recent empirical evidence suggests that both ex-date abnormal returns and nonstationarity are associated with splitting stocks in the United States. For a sample of pure stock-split and stock-dividend events,[5] Grinblatt, Masulis and Titman (1984) find that a positive AR of approximately one percent occurs on the ex-date. Lamoureux and Poon (1987) find a significant AR of 0.5880 percent on the split ex-date.

Although various explanations have been proposed to explain and test the significant positive announcement effects associated with splitting stocks in the United States, such explanations are probably not applicable to the market behaviour around split ex-dates.[6] Grinblatt et al. (1984) hypothesize that firms signal information about their future earnings or equity values through their split announcement decisions. Woolridge and Chambers (1983), Grinblatt et al. (1984), and McNichols and Dravid (1990) hypothesize a version of the "trading range" hypothesis that incorporates asymmetric information and permits a signalling explanation for the increase in share prices when firms announce stock splits.

Lakonishok and Lev (1987) also hypothesize an "optimal trading range" explanation for the stock-split announcement effect. Lamoureux and Poon (1987) hypothesize that the announcement effect reflects the value of the "tax option" associated with splitting stocks caused by the distinction between short and long-term capital gains under the U.S. income tax act.[7] Brennan and Copeland (1988a) hypothesize a signalling equilibrium in which firms do not split by a factor larger than is warranted by their stock price and private information, because transaction costs per dollar are a decreasing function of share prices and of firm size.

Ohlson and Penman (1985) find that the stock return variance increases by approximately 30 percent following the split ex-date. Dravid (1987) obtains similar results for a sample of small splits and stock dividends. When either the distribution of returns is nonnormal or the conditional variance is unstable, Brown and Warner (1985) report a significant deterioration in the properties of standard event studies. Given the presence of heteroscedasticity, Morgan and Morgan (1987) and Connolly and McMillan (1988) find that the OLS results are not only suspect but that the statistical interpretation of the evidence is clearly influenced by the weighting method (alternative heteroscedasticity corrections).[8,9] According to Bollerslev, Chou and Kroner (1991), since a systematic search for the causes of the serial correlation in the conditional second moments has only begun

recently, "further developments concerning the identification and formulation of ... models justifying empirical specification for the observed heteroscedasticity remains a very important area for future research" (p.13).

The increase in stock return variances may be attributed to market micro-structure, which can be proxied by the increase in the relative bid-ask spread on the split ex-date. Roll (1984), French and Roll (1986) and Amihud and Mendelson (1987) find that measured return variances are positively related with bid-ask spreads. For American stock splits, Dravid (1989) and Conroy, Harris and Benet (1990) show that the sharp drop in stock prices at the ex-date results in an increase in the bid-ask spread and a subsequent increase in measured returns variances. Dubofsky (1991) concludes that "measurement errors created by bid-ask spreads and the 1/8 effect, and also one or more of the elements that make the NYSE different from the AMEX, explain why the estimated volatility of daily stock returns increases after the ex-split date" (p.421).

The increase in stock return variances may also be attributed to an increase in information arrival, which can be proxied by the increase in the raw trading volume on the split ex-date. Clark (1973) finds a positive relationship between squared price changes and aggregate volume data. Morgan (1976) and Westerfield (1977) find that variance changes are positively related to trading volume for large

samples of common stocks. Harris (1986, 1987) reports a positive correlation between volume and the squared price changes. According to the "attention hypothesis" of Grinblatt el al. (1984), managers obtain more publicity for their firms by splitting stocks because a higher commission will be paid to stock-brokers after split ex-date. Although Ohlson and Penman (1985) suggest that the increase in measured return variances on the split ex-date are not explained by split-adjusted trading volume, raw trading volume may be important in determining daily return variances. Specifically, if daily price changes are sampled from a mixture of heteroscedastic distributions with volume as the mixing variable, then the variance of price changes will be conditional upon raw trading volume. Furthermore, Brennan and Hughes (1990) present a model where the flow of information provided by stock-brokers is an increasing function of firm size and a decreasing function of share prices. Their model is empirically supported in that the number of analysts following a firm is negatively related to stock prices, and the change in the number of analysts following splitting firms is positively related to the split factors.

Lamoureux and Poon (1978) find that the mean beta is approximately 26 percent higher in the post-split period. Brennan and Copeland (1988b) find a permanent and highly significant increase of approximately twenty percent in the average beta after the split ex-date. These findings have been

interpreted by Brennan and Copeland (1988b) as being inconsistent with received theory which states that the split announcement constitutes firm-specific information, and the split itself should have no effect on the systematic risk of the stock.

The post-split increase in beta can be attributed to changes in at least one of the following three factors: the variance of the market, the variance of the splitting stock, and the correlation between the returns of the splitting stock and the market. Since stock splits are a firm-specific event, no a priori reason exists to expect that the whole market will become more volatile subsequent to such events. Thus, it seems reasonable to assume that the variance of the market return remains stationary before, during and after the stock split process.[10] While the existing literature finds that the second factor increases after the ex-date, no published evidence exists on whether or not the third factor also changes ex-date.[11] Due to the importance of the covariance (or correlation) structure of returns among assets for asset pricing, it is important to determine whether or not these measures change subsequent to the split ex-date.

Most of these studies do not deal with the fact that their inferences may not be robust across markets and/or due to violations of the assumptions of the SFM model, such as autocorrelation and heteroscedasticity of the error terms [as has been found, for example, by Connolly (1989)]. Furthermore,

the dangers of unintentional data snooping are substantial given that most of these studies are based on a relatively few data bases. As noted by Lakonishok and Smidt (1988), the best remedy for data snooping is new data.

Given the above deficiencies in the literature, the purpose of this chapter is to investigate whether anomalous market behaviour is associated with splitting stocks in Canada. To this end, the behaviour of abnormal returns, betas, variances and correlations between the splitting stocks and the market index are studied around the split ex-dates for a sample of 197 Canadian stock splits. The results of tests using various determinants of the AR's, unconditional variances and conditional residual variances associated with split ex-dates are also presented herein.

The remainder of this chapter is organized as follows. In the next section, the sampling procedure and the data are described. In the third section, the methodology is detailed. In the fourth section, the empirical findings are presented and discussed. In the fifth and final section, some concluding remarks are offered.

2.2 SAMPLING PROCEDURE AND DESCRIPTION OF THE DATA

Candidates for the sample of splitting stocks were identified by searching through the monthly Toronto Stock Exchange (TSE) Review for the ten year period from 1978 to 1987. To be retained in the sample, a stock split had to satisfy the following criteria: (1) a public announcement

dealing with the split was found prior to its split ex-date; (2) no concurrent firm-specific events occurred in the two trading days around the split ex-dates; (3) return data for the 60 trading days before and after ex-dates were available on the TSE/Western Data Base; (4) no missing returns were found for the ex-dates; and (5) no more than two (and typically none) of the 121 daily returns around each ex-date were missing in order to maintain the accuracy of the results [Fowler, Rorke and Jog (1980)]. The final sample of TSE stock splits consists of 197 effective dates. As is evident from panel A of Table 2.1, the event dates are spread out evenly over time.

Please place Table 2.1 about here.

For this sample of split ex-dates, the minimum split factor is 1.33 for 1, and the maximum is 7 for 1. The majority of the stocks have a split factor of two or three for one. Based on Fama et al's (1969) definition of a stock split as involving at least five new for four old shares, this study focuses on stock splits and not stock dividends. As noted in panel B of Table 1, over 95 percent of the splitting stocks closed above $5 per share on the split ex-date, and the mean and median closing prices on the split ex-date were $15.54 and $14.25, respectively.

Daily bid-ask and closing share prices, and daily trading volumes were collected manually from the TSE Daily Record on

microfilm for each studied stock. Two measures of the bid-ask spread are used herein; namely, the daily absolute bid-ask spread which is calculated by subtracting the bid from its corresponding ask price for each studied stock, and the daily relative bid-ask spread which equals the absolute bid-ask spread divided by the corresponding closing price for each studied stock. Daily trading values are calculated by multiplying the daily trading volume by daily closing share price for each studied stock.

The cross-sectional mean daily absolute and relative bid-ask spreads, trading volumes and trading values for selected trading days around split ex-dates are reported in Table 2.2. On the split ex-date, the mean absolute bid-ask spread drops by 37.5 percent, the mean relative bid-ask spread increases by 45.7 percent, the raw trading volume increases by 106 percent, and the mean trading value decreases by 14.6 percent. During the relative event periods, [-10,-1] and [+1,+10], the mean absolute and relative bid-ask spreads, and the mean trading volumes are relatively stable.

Please place Table 2.2 about here.

The distributions of mean absolute and relative bid-ask spreads, trading volumes and trading values of individual stocks during both the pre- and post-split periods are summarized in Table 2.3. T-, sign- and Wilcoxon tests of the paired differences of bid-ask spreads indicate that the

absolute (relative) bid-ask spread decreases (increases) significantly from the 60-day pre- to the 60-day post-split period (all the p-values equal 0.0000). This is consistent with the findings of Conroy et al(1990) that the mean relative bid-ask spread after the split ex-date is significantly higher than that before the split announcement date. T-, sign- and Wilcoxon tests of the paired differences of trading volume indicate that a significant increase in the raw trading volumes occurs on the split ex-date (all the p-values equal 0.0000). This is consistent with Lamoureux and Poon (1987). In contrast, the nonparametric tests of the paired differences of trading values indicate a significant decrease after the split ex-dates (p-values of 0.0226 and 0.0550, respectively). This finding is consistent with those of Copeland (1979), Murray (1985), Lamoureux and Poon (1987), amongst others, which indicate that the liquidity of splitting stocks is lower in the post-split period.

Please place Table 2.3 about here.

2.3 METHODOLOGY

To determine market- and risk-adjusted abnormal returns for each event, the following dummy-variable version of a two-beta market model is used:

$$R_{it} = \alpha_i + \beta_{i1}R_{mt}D_1 + \beta_{i2}R_{mt}D_2 + \tau_i D_3 + \epsilon_{it} \qquad (2.1)$$

where, R_{it} is the return on stock i at time t;

R_{mt} is the return on the market portfolio (as proxied by the TSE300 Composite Index);

α_i is the intercept for firm i;

β_{i1} is the beta for firm i prior to the split ex-date;

β_{i2} is the beta for firm i on and subsequent to the split ex-date;

$D_1(D_2)$ is a dummy variable with ones (zeros) before the split ex-date and zeros (ones) on and after the split ex-date;

τ_i is the parameter (measure of abnormal returns) on the split ex-date;

D_3 is the event dummy, which equals one on the split ex-date and zeros otherwise; and

ϵ_{it} is the error term (or residual) of the relationship at time t for firm i, which is assumed to be normally distributed with mean zero, constant variance and zero correlation between error terms across and over time.

Problems due to nonsynchronous trading are corrected by using a Scholes and Williams (1977) type of procedure, which involves the estimation of coefficients on lead, lagged and contemporaneous market returns. Since statistically significant autocorrelation and heteroscedasticity may exist in the error terms for daily data, a GLS procedure is used to construct the autoregressive process for the error terms and

then to estimate the regression parameters in equation (2.1). To adjust for possible heteroscedasticity in the error terms, the standard errors of the estimated coefficients of equation (2.1) were also computed using White's (1980) procedure. This procedure computes a consistent regression covariance matrix even when the form of the heteroscedasticity is unknown.

Since heteroscedasticity is present in the return series around the split ex-dates, various ARCH (Autoregressive Conditional Heteroscedastic) models are used to account for such heteroscedasticity. The ARCH model encompasses an autocorrelation correction and is robust to underlying non-normality. It incorporates heteroscedasticity in a sensible way (for a time series), and can be expanded to include other effects on conditional variances. As noted by Morgan and Morgan (1987), if heteroscedasticity in the return series is ignored, poor estimation may result and invalid inferences may be drawn.

The ARCH model introduced by Engle (1982) explicitly recognizes that the unconditional and conditional variances of the error term in equation (2.1) may differ by allowing the unconditional variance to change over time as a function of past errors. Specifically, $\epsilon_t | \phi_{t-1} \sim N(0, h_t)$, and h_t (the conditional variance of ϵ_t) follows the ARCH (q) process:

$$h_t = \alpha_0 + \sum_{i=1}^{q} \alpha_i \epsilon_{t-i}^2 \qquad (2.2)$$

where $\alpha_0 \geq 0$, $\alpha_i \geq 0$, $q \geq 0$, and ϕ_t is the information set of

all information through time t. The estimates of the coefficients of equations (2.1) and (2.2) are obtained using a maximum likelihood procedure. The order q is identified using a Ljung-Box (1978) test of autocorrelations of the squared error terms. The Berndt, Hall, Hall and Hausman (BHHH) (1974) algorithm is used to compute the covariance matrix (and, thus, the standard errors) for the parameters at convergence.

Two formulations are used herein to capture the effect of shifts of the residual variance on the split ex-date. The first formulation, which allows for a change in the constant term of equation (2.2), is given by:

$$h_t = \alpha'_0 + \alpha'_{01}D + \sum_{i=1}^{q} \alpha'_i \epsilon^2_{t-i} \tag{2.3}$$

where, D is a dummy variable with zeros before the split ex-date and ones on and after the split ex-date; and all the other terms are as defined earlier. The second formulation, which allows for a change in the constant and slope coefficients of equation (2.2), is given by:

$$h_t = \alpha_0 + \alpha_{01}D + \sum_{i=1}^{q} \alpha_i \epsilon^2_{t-i} + \sum_{i=1}^{q} \alpha_i \epsilon^2_{t-i} D \tag{2.4}$$

where all the terms are as defined earlier. Due to an increase in residual variance on the split ex-date, both the constant and slope coefficients are expected to be larger for the period starting on the split ex-date.

ARCH model of Engle (1982) restricts the conditional

variance of returns to depend upon past squared error terms (residuals) of the return generating process. An alternative explanatory variable in the conditional residual variance equation is the bid-ask spread. Roll (1984), French and Roll (1986), Amihud and Mendelson (1987), amongst others, demonstrate that the daily variance of stock returns is positively related to the bid-ask spread. Based on the theoretical developments of Glosten and Milgrom (1985) in which the price variance is proportional to the square of the bid-ask spread, Brock and Kleidon (1990) develop a model to obtain an estimate of volatility by using the magnitude of the bid-ask spread.

A second possible explanatory variable in the conditional residual variance equation is trading volume. Using daily trading volume as a proxy for the arrival time of information, Lamoureux and Lastrapes (1990) find that trading volume has significant explanatory power for a GARCH formulation of the variance of daily returns. Their model is consistent with the mixture of distribution hypothesis which implies that the conditional variance of price changes is proportional to trading volume [Clark (1973), Morgan (1976), Tauchen and Pitts (1983) and Harris (1987), among others].

Two formulations are specified herein to account for the effect of bid-ask spreads (and trading volumes) on the residual variance. The first formulation is given by:

$$h_t = \alpha^*_0 + \alpha^*_1 Z_t \qquad (2.5)$$

where Z_t denotes the squared relative bid-ask spread, and all the other terms are as defined previously. The significance of the α^{*}_{1} estimate indicates the effect of bid-ask spread on the residual variance. The second formulation, which allows for a change in the constant term of equation (2.5), is given by:

$$h_t = \alpha_0 + \alpha'_{01}D + \alpha'_1 Z_t \qquad (2.6)$$

where all the terms are as defined earlier. Due to the increase in the bid-ask spread, the α'_{01} estimate is expected to be positive and significant. Equations (2.5) and (2.6) are denoted as (2.5') and (2.6') when Z_t denotes the raw trading volume.[12]

2.4 EMPIRICAL FINDINGS

2.4.1 Abnormal Returns on Split Ex-Dates

To examine the effect of stock splits on the market value of a splitting stock, the return generating model (RGM) (2.1) was first estimated for each of the 197 events in the TSE sample (for greater details on these events, see Table 2.1 presented earlier). Based on the Ljung-Box (1978) tests of the autocorrelation and partial autocorrelation functions of the error terms, a first-order autoregressive model and/or a white noise model is the appropriate structural form for the error term for the RGM for most of the stocks. The abnormal returns (AR's) on the ex-dates are measured by the estimated coefficient of the dummy variable for each event and for the average event. The t-, sign and Wilcoxon signed rank tests are

used to ascertain whether these AR's are statistically significant. As re-iterated by Zivney and Thompson (1989), nonparametric tests assume that the distribution is unknown or nonnormal, and measure central tendency by the median. In fact, the only assumptions underlying the sign test are that the observations are independent and the population is continuous in the vicinity of the median. Furthermore, according to Zivney and Thompson (1989), the sign test appears to be more powerful than the t-test when applied to market- and risk-adjusted return methodologies.

Based on the distribution of AR's for the split ex-dates reported in Table 2.4, approximately 58 percent of the AR's are positive.[13] The mean AR of the splitting stocks of 0.79 percent is statistically significant at the 0.05 level (t-value of 3.67, p-value of 0.0003). The sign and Wilcoxon test statistics are also statistically significant at the 0.05 level (p-values of 0.0326 and 0.0060, respectively). Interestingly, this finding is robust when three variants of the Scholes and Williams adjustment for nonsynchronous trading are used. This finding, that split ex-dates have a significant and positive impact on the share market values of splitting stocks, is consistent with those, for example, of Grinblatt et al. (1984) and Lamoureux and Poon (1987), amongst others.[14]

Please place Table 2.4 about here.

To account for heteroscedasticity, RGM (2.1) was first

estimated using the MLE method with an ARCH (q) process defined by equation (2.2) for each of the 197 split events in the TSE sample. Based on Table 2.5, the AR results are consistent with those discussed earlier.

Please place Table 2.5 about here.

RGM (2.1) was next estimated using the MLE method with an ARCH (q) process defined by equation (2.3), which allows for a shift in the constant of the residual variance process on the split ex-date, for each of the 197 split ex-date events. Based on Table 2.5, the mean AR of the splitting stocks of 0.33 percent is no longer statistically significant at the 0.05 level (t-value of 1.70, p-value of 0.091)! The sign and Wilcoxon test statistics are also not statistically significant at the 0.05 level (p-values of 0.1170 and 0.1240, respectively). As expected, the coefficient of the dummy variable in the ARCH process designed to capture the increase in the constant is positive and highly significant statistically (p-values of 0.0000 for the t-, sign and Wilcoxon tests). Thus, when the significant increase in the residual variance on and after the split ex-dates is accounted for, the positive AR's associated with the split ex-date are no longer statistically significant.

RGM (2.1) was then estimated using the MLE method with an ARCH (1) process defined by equation (2.4), which allows for a shift in the intercept and slope coefficients of the

residual variance process on the split ex-date, for each of the 197 split ex-dates. Based on Table 2.5, the mean AR of the splitting stocks is further reduced to 0.18 percent. The t-, sign and Wilcoxon test statistics are all not statistically significant at the 0.05 level (p-value of 0.3400, 0.0640 and 0.4520, respectively). Thus, the magnitude and significance of the positive mean AR's associated with the split ex-dates decrease as more descriptive ARCH models are used to account for the change in the residual variance process on the split ex-dates. Furthermore, as found by Connolly and McMillan (1988), the mean AR (dummy) estimates are generally lower for the ARCH model formulation, and the two-regime ARCH (q) process.

Microstructure and information arrival explanations for the AR's were investigated next. RGM (2.1) was first estimated with ARCH process (2.5), where the squared relative bid-ask spread is used as the explanatory variable. Based on Table 2.6, the mean AR of 0.46 percent is of approximately the same magnitude as the estimate obtained earlier using the ARCH (q) process defined by equation (2.2). The estimated coefficient of the squared relative bid-ask spread in the conditional residual variance equation is positive and highly significant (p-values of 0.0000 for t-, sign-and Wilcoxon tests). RGM (2.1) was then estimated with ARCH process (2.6), which allows for a shift in the intercept of the conditional residual variance process. The mean AR of 0.35 percent is not

statistically significant at 0.05 level for the t-, sign- and Wilcoxon tests (p-values of 0.0000, respectively). The estimated shift in the intercept of the conditional variance equation, α^{*}_{1}, is positive and highly significant (p-values of 0.0000 for t-, sign-, and Wilcoxon tests, respectively). These results, which suggest that the squared relative bid-ask spread has significant explanatory power in daily residual variances, is consistent with the findings of Roll (1984), Glosten and Milgrom (1985), Amihud and Mendelson (1987), amongst others.

Please place Table 2.6 about here.

The distribution of the AR's for RGM (2.1) and ARCH process (2.5') and (2.6') are also reported in Table 2.6. Both of these ARCH processes use trading volume as an explanatory variable in the conditional residual variance equation. The mean AR's of 0.80 percent based on ARCH process (2.5') is positive and statistically significant (p-values of 0.0002, 0.0640 and 0.0030 for the t-, sign- and Wilcoxon tests, respectively). The estimated coefficient of trading volume in the conditional residual variance equation, α^{*}_{1}, is positive and highly significant (p-values of 0.0000 for the t-, sign- and Wilcoxon tests). The mean AR's of 0.79 percent based on ARCH process (2.6') is similar in magnitude and statistical significance to that for ARCH process (2.5') (p-values of 0.0007, 0.0873 and 0.0030 for t-, sign- and Wilcoxon tests,

respectively). The shift in the intercept of this conditional variance equation, α_{01}, is positive and statistically significant (p-values of 0.0000 for t-, sign- and Wilcoxon tests). These results are consistent with Lamoureux and Lastrapes (1990) who find that trading volume has significant explanatory power in the conditional residual variance equation.

2.4.2 Beta Changes Around Split Ex-dates

Beta shifts around stock split ex-dates are a relatively new anomaly which was identified by Lamoureux and Poon (1987) and Brennan and Copeland (1988). Since stock splits are believed to be nonevents, splits should have no permanent impact on the systematic risk (beta) of the splitting firm. To examine the behaviour of a splitting stock's beta around its ex-date, the paired differences of the estimated betas from RGM (2.1) for the 197 ex-day events are compared. To adjust for nonsynchronous trading, a Scholes and William's (S-W) (1977) type of beta is calculated by summing the beta coefficients from RGM (2.1), where the market return is contemporaneous, lagged one day and led one day (i.e., adj.1 in Table 2.4). This three-day beta estimator is proportional to the Scholes-William's estimator, where the constant of proportionality depends on the serial correlation of the market return (the TSE 300 Composite Index return).

The beta estimates, which are summarized in Table 2.7, can be described as follows. The mean OLS beta estimate from

RGM (2.1) for the TSE sample increases by 19 percent from 0.724 before the split ex-date to 0.863 after the split ex-date. The maximum and minimum betas also shift upwards post-split ex-date. A visual inspection of the beta distributions suggests that the beta estimates satisfy the assumption of normality in an univariate sense. Therefore, the null hypothesis that the mean difference of the paired post-split and pre-split betas is equal can be tested using a standard t-test. The resulting t-value of 2.5200 is statistically significant at the 0.05 level (p-value of 0.0120). The sign and Wilcoxon test statistics are also statistically significant at the 0.10 and 0.05 levels (p-values of 0.0823 and 0.0140, respectively).

Please place Table 2.7 about here.

The mean S-W beta estimate from RGM (2.1) increases by 18 percent from 0.845 in the pre-split ex-date period to 0.995 in the post-split ex-date period. The t-value for the mean difference of the paired beta estimates is 2.4901, which is statistically significant at the 0.05 level (p-value of 0.0140). The sign and Wilcoxon test statistics are also statistically significant at the 0.10 and 0.05 levels (p-value of 0.0640 and 0.0240, respectively). These results support the alternative hypothesis that the systematic risk of an average splitting stock after the split ex-date is different than that before the split.

The mean beta estimate for RGM (2.1) with ARCH process (2.2) increases by about three percent from 0.718 in the pre-split ex-date period to 0.740 in the post-split ex-date period. The t-value for the mean difference of the paired beta estimates of 0.3510 (p-value of 0.7300) is not statistically significant at the 0.05 level. The sign and Wilcoxon tests are also not statistically significant at the 0.05 level (p-value of 1.0000 and 0.8240, respectively).

The mean beta estimate for RGM (2.1) with ARCH process (2.3), which allows for a shift in the constant of the residual variance process on the split ex-date, and the mean beta estimate for RGM (2.1) with ARCH process (2.4), which allows for a shift in the constant and slope parameters of the residual variance process on the split ex-dates, yield similar results. None of the t-, sign- or Wilcoxon sign rank test statistics for the average difference of the paired beta estimates are statistically significant at the 0.05 level!

These findings are inconsistent with the findings of Lamoureux and Poon (1987) and Brennan and Copeland (1988b) for split stocks in the United States, and our earlier findings for the OLS and Scholes-Williams-type beta estimates. Thus, when taken with the results presented earlier, the upward shift in the traditional beta estimates on split ex-date appears to be caused by an increase in the conditional residual variance. Accounting for this increase using an ARCH process reduces the magnitude of the increase in the beta

estimates in the post-split ex-date period, and appears to explain the anomalous post-split ex-date behaviour of the betas of splitting stocks.

These findings are further supported by the beta estimates of RGM (2.1) with ARCH process (2.5) and (2.6) using the squared relative bid-ask spread and (2.5') and (2.6') which use trading volume as the explanatory variable in the conditional residual variance equation. Based on Table 2.8, none of the t-, sign- or Wilcoxon test statistics for the paired differences of these pre-and post-split betas are significant at 0.05 level, and the magnitude of beta changes are similar to that of standard ARCH estimates.

Please place Table 2.8 about here.

2.4.3 Variance Changes Around Split Ex-dates

In this section, the null hypothesis, that the post-split variances are equal to the pre-split variances, is tested. The summary statistics for the pre- and post-split variances for the two samples, and their paired differences, are reported in Table 2.9. The mean variance for the TSE sample increases by 29 percent from 0.0369 percent in the period prior to the split ex-date to 0.0437 percent in the period after the split ex-date. The mean difference of the paired variances for the TSE sample of 0.00011 is statistically significant at the 0.05 level (t-value of 2.73, p-value of 0.0070). The sign and Wilcoxon test statistics are also statistically significant

at the 0.05 level (p-values of 0.0000 and 0.0000).

Please place Table 2.9 about here

These findings support those of Ohlson and Penman (1985) and Dravid (1987). Together with the findings for the AR's and the betas of splitting stocks for split ex-dates, these findings suggest that the increased variability of stock returns after the split ex-dates is due to increased nonsystematic risk which is time dependant. This is further supported by an examination of the behaviour of the conditional residual variance ARCH processes (given in Table 2.5) which allow for a process shift on the split ex-date. Specifically, the mean increase in the estimated mean constant for ARCH process (2.3) is not only positive and statistically significant at the 0.05 level but both mean values are approximately of the same magnitude. The same observations are valid for the estimated mean increases in the estimated mean constant and slope coefficients and their relative magnitudes for the ARCH process (2.4).

To examine the determinants of the change in the variance of return on the split ex-date, the following cross-sectional regression based on Conroy et al (1990) is estimated:

$$\Delta \, VAR_i = b_0 + b_1 \, \Delta S_i + e_i \qquad (2.7)$$

where, Δ is the change in the variable from the 60-day period prior to the split ex-date to the 60-day period after the split ex-date;

VAR_i is the observed variance of return for stock i;

S_i is the squared relative bid-ask spread for stock i;

e_i is the error term of the model.

A significant b_0 estimate indicates a change in the true variance of return from the pre- to the post-split period. The b_1 estimate indicates the impact that a change in the relative bid-ask spread has on the measured variance of return. To incorporate the impact of trading volume on the variance of returns, equation (2.7) is respecified as follows:

$$\Delta VAR_i = b_0^* + b_1^* \Delta S_i + b_2^* \Delta VOL_i + e_i^* \qquad (2.8)$$

where, VOL_i is the log of the raw trading volume for firm i, and all other parameters are as defined previously. The regression results are as follows:

$$\Delta VAR_i = \underset{(3.15)}{0.000080} + \underset{(5.63)}{0.002650} \Delta S_i \qquad R^2 = 0.1399, \; F = 31.7195$$

$$\Delta VAR_i = \underset{(0.14)}{0.000011} + \underset{(6.35)}{0.002918} \Delta S_i + \underset{(3.09)}{0.000303} \Delta VOL_i \qquad R^2 = 0.2025, \; F = 24.6355$$

where the t-values are given in the parentheses.

Based on the regression results for equation (2.7), the estimated coefficient of the squared bid-ask spread, b_1, is positive and statistically significant at the 0.05 level. This is consistent with the findings of Roll (1984), French and Roll (1986), Amihud and Mendelson (1987), Dravid (1989), and Conroy et al. (1990), amongst others. The estimated intercept, b_0, of equation (2.7) is also positive and significant at the 0.05 level, as in Conroy et al. (1990). This indicates that

the true variance appears to have changed on the split ex-date. However, based on the regression results for equation (2.8), the estimated coefficient of the squared relative bid-ask spread, b_1^*, remains positive and significant at the 0.05 level, the estimated coefficient of the raw trading volume, b_2^*, is positive and significant at the 0.05 level [which is consistent with Lamoureux and Poon (1987)], and the estimated intercept, b_0^* (i.e., the change in the true variance of return) is not statistically significant the 0.05 level. These findings suggest that the increase in the variance of returns on the split ex-dates is related to the increase in both the relative bid-ask spread and raw trading volume, and not to an increase in the true variance of returns.

2.4.4 Covariance and Correlation Coefficient Shifts Around Split ex-dates

Covariances and correlation coefficients are absolute and relative measures, respectively, of the co-movement between the returns on a stock and the market. Summary statistics for the covariance and the correlation coefficient estimates for the sample for the pre- and post-split periods around split ex-dates are reported in Table 2.10. The mean covariance increases by 50 percent from 0.000026 in the pre-split period to 0.000039 in the post-split period. The t-value for the mean difference of the paired covariance estimates is 1.8236, which is statistically significant at the 0.10 level (p-value of 0.069). While the sign test statistic is not statistically

significant at the 0.10 level (p-value of 0.254), the Wilcoxon test statistic is statistically significant at the 0.10 level (p-value of 0.068). This finding is somewhat consistent with the previous findings for an increase in the mean variance of splitting stocks for this sample.

In contrast, the mean correlation coefficient for the sample decreases marginally from 0.249 in the pre-split period to 0.245 in the post-split period. The t-value for the mean difference of the paired correlation coefficients of -0.240 is not statistically significant at the 0.10 level (p-value of 0.811). The sign and Wilcoxon signed rank test statistics are also not significant at the 0.10 level (p-values of 0.8867 and 0.7070, respectively). Thus, for this sample, the post-split increase in the mean beta on the split ex-dates is attributable to the increase in the mean (residual) variance of the splitting stocks.

Please place Table 2.10 about here.

2.4.5 Diagnostic Tests of the Error Terms for Various Models

The results for five diagnostic tests of the error terms of RGM (2.1) and the ARCH processes (2.2), (2.3) and (2.4) which use squared error terms, ARCH processes (2.5) and (2.6) which use relative bid-ask spreads and ARCH processes (2.5') and (2.6') which use raw trading volume as the independent variable in the conditional residual variance equation are summarized in Table 2.11. Based on the Ljung-Box test

statistics, $Q^2(10)$, significant autocorrelation of the squared error terms is pronounced only for RGM (2.1). Based on the Kolmogorov-Smirnov test for normality, the null hypothesis that the error terms are distributed normally is rejected at the 0.05 level for at least 48 percent of the stocks for each of the models.

Please place Table 2.11 about here.

2.5 CONCLUDING REMARKS

This chapter investigated whether the behaviour of abnormal returns, betas, variances, covariances and correlations between splitting stocks and the market are anomalous around split ex-dates for a sample of 197 Canadian stock splits. A dummy variable version of a two-beta market model was used to estimate the abnormal returns on the split ex-dates. An ARCH model was used to allow the conditional variances of the market model error terms to change over time as a function of past error terms, the squared relative bid-ask spread and/or raw trading volume, and to change to a new regime on the split ex-dates.

The findings for the sample of TSE splitting stocks can be summarized as follows: First, the mean abnormal return on the ex-date is positive (but not statistically significant) when the increase in the time-varying conditional variance of the error terms is allowed to shift (upwards) to a new regime at the split ex-dates. Second, a statistically significant

increase of approximately 19 percent in the average beta occurs after the ex-dates for both the OLS and Scholes-Williams-type beta based on the market model. While these beta change results are consistent with Lamoureux and Poon (1987) and Brennan and Copeland (1988b), the change in the mean betas after the ex-dates based on the ARCH models are not statistically significant. Third, a statistically significant increase of approximately 29 percent in the average variance occurs after the split ex-date. This result is consistent with the findings of Ohlson and Penman (1985) and Dravid (1987). The increase in the variance of returns is positively and significantly related to the change in the relative bid-ask spread as in Dravid (1989) and Conroy el al. (1990). The increase in the variance of returns is also positively and significantly related to the raw trading volume, as in Lamoureux and Poon (1987). Unlike Conroy et al. (1990), no significant change is found in the true variance of returns after the split ex-date. Fourth, the change in the average correlation coefficient after the split ex-dates is not statistically significant. These results suggest that the significant increase in the mean OLS and Scholes-Williams-type beta for this sample of TSE splitting stocks is due to the increase in the measured (and not true) variance of returns on the split ex-date.

CHAPTER THREE: DOES THE CANADIAN STOCK MARKET OVERREACT?

3.1 INTRODUCTION

Tests of the market overreaction hypothesis are designed to validate a central paradigm in finance; namely, the weak form of the efficient market hypothesis. However, the empirical evidence on the reversal behaviour of stock prices is inconclusive. De Bondt and Thaler (1985) report that stocks with the lowest returns (so-called losers) over a prior period subsequently outperformed the stocks of the highest returns (so-called winners) for the same prior period. Chan (1988) and Ball and Kothari (1989) find that this winner-loser effect is due almost entirely to intertemporal changes in risks and expected returns. In contrast, De Bondt and Thaler (1987) and Zarowin (1990) find that the winner-loser effect is not explained by risk differences. Fama and French (1986) and Zarowin (1989, 1990) propose that this overreaction phenomenon may be subsumed by the well-known size effect.

Leamer (1983, 1985) persuasively argues that the application of traditional econometric procedures to a given data set may lead to a fragile (and thus not unique) inference. Thus, to test for inferential sturdiness, Leamer advocates that a form of global sensitivity analysis be used to assess if a given empirical result is robust to variable selection, random data perturbations, new data, and so on. Most of the market overreaction studies account for risk using various variants of the Jensen measure for assessing the

performance of well-diversified portfolios, and do not deal with the possibility that their inferences may not be robust across markets given that these studies rely on the CRSP databases. Thus, the purpose of this chapter is to test the overreaction hypothesis using monthly data drawn from the TSE/Western database over the 39 year period, 1950-1988. The companies included in the TSE/Western database are generally less established (and smaller) companies than those included in the CRSP database. To account for both systematic and total risk, this study uses both the Jensen (1968) and Sharpe (1966) performance measures.

The remainder of this chapter is organized as follows. In the next section, a brief review of the literature is presented. In the third section, null hypotheses are formulated. In the fourth section, the portfolio construction and sampling procedures are described. In the fifth section, the methodology is detailed. In the sixth section, the empirical findings are presented and analyzed. In the seventh and final section, some concluding remarks are offered.

3.2 REVIEW OF THE LITERATURE

Bayesian rationality prescribes a norm for individual decision-making under uncertainty. In contrast to the probability revision specified in the Bayes rule, Kahneman and Tversky (1973) find that individuals tend to overweight recent information (or dramatic changes) and underweight prior data in making decisions and forecasts. Grether (1980) finds

similar irrationality in decision-making under incentive compatible conditions.

De Bondt and Thaler (1985) note the similarity between the psychology of stock market behaviour and individual decision making. They argue that the tendency towards mean reversion in stock prices provides evidence of investor overreaction. Using NYSE stocks from 1930 to 1975, they test the overreaction hypothesis by forming portfolios of stocks with extremely good (poor) performance over prior 36 month (formation) periods. They examine the performance of these portfolios in subsequent periods (test periods) which last from 12 to 60 months. They find that the cumulative residuals of both winner and loser portfolios exhibit reversal behaviour over a three-to-five year test period. They also find that prior losers outperformed prior winners by 24 percent, and that most of the gains for losers occur in January. These findings imply a violation of the weak form of the efficient market hypothesis.

Using monthly data for NYSE stocks for the period 1981-84, Rosenberg, Reid and Lanstein (1985) test the strategy of purchasing stocks with negative performance and selling stocks with positive performance over the previous month. They find an arbitrage portfolio built on this trading strategy earns monthly profits of 1.36 percent (most of which are generated by prior losers).

Howe (1986) examines the subsequent performance of all

NYSE and AMEX stocks which fell (rose) by more than 50 percent within a week during the period 1962-86. For the subsequent ten weeks, he finds that the prior winners lose 13 percent and prior losers gain 13.8 percent. By comparing firms of similar size, Fama and French (1986) find that losers insignificantly outperform the winners except in January. They conclude that, since the size of losers tends to be smaller than average firms, the overreaction phenomenon is a manifestation of the size effect.

De Bondt and Thaler (1987) find that the winner-loser effect can not be explained by risk changes. They conclude that price reversals are due to the overreaction of investors to earnings information, and that part of the reversals may be due to the January seasonal. Brown and Harlow (1988) examine the subsequent performance of NYSE stocks with absolute excess returns of 20 to 60 percent over prior one-to-six-months periods. Over the period 1946-1983, they find large, short-run rebounds for the losers and no reversals for the winners. Unlike De Bondt and Thaler (1985, 1987), they find no evidence of overreaction over the longer term (i.e., for periods of up to three years).

For the period 1962-86, Bremer and Sweeney (1988) select three groups of Fortune 500 companies, which have one-day absolute price changes in excess of 7.5, 10 and 15 percent, respectively. After adjusting for the possible effect of the bid-ask spread, the authors find that the losers earn 2.84,

3.95 and 6.18 percent for a five-day interval for each of the three initial price-change groups. They find no price reversals for winners during the test period. Chan (1988) argues that the risks of the winner and loser stocks are not constant intertemporarily. After adjusting for beta changes in both the portfolio formation and test periods, he finds that the excess returns from selling the winners and purchasing the losers are not significantly different from zero.

Ball and Kothari (1989) find that the price reversal behaviour is due almost entirely to time-varying risks and expected returns. They find that the beta changes, which occur primarily during the portfolio formation period, are larger than those found by Chan (1988). Davidson and Dutia (1989) construct winner and loser portfolios based on the top and bottom deciles of stocks on the NYSE and AMEX which have been ranked by return performance. They find a positive relationship between the abnormal returns earned in contingent years, and 23 percent of the above-market returns for winner securities is earned in January. Since the performance of winners and losers does not revert during the test periods, their results do not support the overreaction hypothesis. Stein (1989) and Ma, Rao and Sears (1989) find that the options and treasury bond futures markets, respectively, exhibit investor overreaction.

Zarowin (1989) tests the hypothesis proposed by De Bondt

and Thaler (1987) that overreaction is due to the market's inefficient response to earnings information. He first selects firms that have experienced extremely good or bad annual earnings, and then matches the poorest earners with the best earners of equal size. He finds no return discrepancies between the two groups of stocks over the subsequent 36 month test periods. Zarowin (1990) re-examines the overreaction hypothesis by matching winners and losers of equal size. He finds that their return differences are insignificantly different from zero except in January. He finds that the winner-loser effect cannot be explained by risk changes, and that losers (winners) outperform winners (losers) when losers (winners) are smaller. Thus, he concludes that the overreaction hypothesis is subsumed by the size and seasonal phenomena.

Lehmann (1990) uses a trading strategy where purchases of short-term losers (i.e., stocks that underperform the market over the previous week) are financed by shorting winners (i.e., stocks that outperformed the market over the previous week). He uses all securities listed on the NYSE and AMEX during the period 1962-86, where each stock's portfolio weight is proportional to its previous week's excess returns. After adjusting for transaction costs, he finds that floor traders could have earned an average six-month profit of 38.8 million dollars by shorting 100 million dollars of prior winners and purchasing an equal dollar value of prior losers.

Two-thirds of these profits are generated by prior losers.

De Bondt and Thaler (1990) test whether highly trained stock market professionals (namely, security analysts) overreact to new information. They test for the tendency to make forecasts that are too extreme, given the predictive value of the information available to the forecasters. Using data on forecasted changes in earning per share (EPS) for one- and two- year time horizons from Analysts' Institutional-Broker-Estimate-System tapes for the period 1976-84, they find that the forecasted changes are too extreme to be rational.[15] They also find that one- and two-year forecasts are initially excessively optimistic, and are subsequently followed by a general tendency of downward revision.

Seyhun (1990) examines insider trading activity around the October 1987 Crash. He finds that the Crash was a surprise to corporate insiders, and that insiders were especially large buyers of stocks immediately following the Crash. He also finds that insiders exhibited greater purchases of stocks that declined more during the Crash, and that stocks that exhibited greater insider purchases during October 1987 had larger positive returns in 1988. Seyhun concludes that this evidence suggests that overreaction was an important aspect of the Crash.

3.3 NULL HYPOTHESES

Five null hypotheses are proposed to investigate the overreaction phenomenon in Canadian markets. The first null

hypothesis, H_{01}, states that extreme stock price movements will be followed by a movement in the opposite direction (the so-called "directional effect"). The more extreme the initial price movement, the greater the subsequent adjustment will be. Tests of H_{01} will investigate whether or not Canadian markets exhibit the same tendency of mean reversion as found in American markets [De Bondt and Thaler (1985), Fama and French (1988), Poterba and Summers (1988), amongst others].

The second hypothesis, H_{02}, states that stocks with extremely negative prior performance will outperform stocks with extremely positive prior performance over a subsequent (test) period (the so-called "winner-loser effect"). Tests of H_{02} will investigate the overreaction phenomenon under the arbitrage argument. The failure to reject H_{01} and H_{02} will imply that weak-form inefficiency exists in the Canadian market.

Three competing hypotheses (H_{03}, H_{04} and H_{05}) are also proposed to investigate whether or not any empirical evidence in support of market overreaction is related to three explanations proposed in the literature. The third null hypothesis, H_{03}, states that the winner-loser effect will diminish after controlling for beta changes from the formation period to the test period (the so-called "time-varying risk effect"). Tests of H_{03} will investigate whether or not any identified overreaction phenomenon is due to intertemporal changes in systematic risk [Chan (1988)]. If the estimation technique fully captures the effect of time-varying risk, the

abnormal returns generated from an arbitrage portfolio of winner and loser stocks should be driven towards zero.

The fourth null hypothesis, H_{04}, states that a large portion of any identified price reversal (especially for losers) will occur in January (the so-called "January effect"). Tests of H_{04} will investigate whether or not the winner-loser effect is related to the January seasonal [De Bondt and Thaler (1985)]. The existence of significant arbitrage profits during February to December will reject this hypothesis.

The fifth null hypothesis, H_{05}, states that the winner-loser effect will diminish after controlling for the market values of the firms studied (the so-called "size effect"). Tests of H_{05} will relate the overreaction phenomenon to the size anomaly [Fama and French (1986) and Zarowin (1989, 1990)]. If true, the return differences between winners and losers during the test period should vanish for stocks having similar market values.

3.4 SAMPLE SELECTION AND PORTFOLIO CONSTRUCTION PROCEDURES

Data drawn from the TSE/Western monthly return file for the period 1950-88 are used herein. As in previous studies, winners and losers are identified as the top and bottom deciles of firms ranked by performance. Performance is measured by the market-adjusted excess returns summed over y (e.g., 36) months prior to the portfolio formation year. More formally, the performance of stock j is given by:

$$CAR_j = \sum_{t=-y}^{0} (R_{jt} - R_{mt}) \tag{3.1}$$

where, CAR_j is the cumulative market-adjusted excess returns for stock j over the period from -y months prior to the portfolio formation month 0;

R_{jt} is the realized returns on stock j at time t; and

R_{mt} is the realized returns on the market at time t (as proxied by the equally-weighted index on the TSE/Western database).

In conformity with recent practice, only nonoverlapping portfolio formation (test) periods are used herein. Specifically, portfolios of winners and losers are formed at the end of every December for each y/12 years over the period 1950-88 based on the CAR_j rankings over the previous y months. The performance of each portfolio is tested over the subsequent y months. Such portfolios are formed and tested for y values of 12, 24, 36, 60, 96 and 120 months in order to test price reversal behaviour for various formation/test periods. The 12, 24, 36 month periods are of interest for losers given the contention of Benjamin Graham that "the interval required for a substantial undervaluation to correct itself averages approximately 1.5 to 2.5 years" [Graham (1959), p.37]. Furthermore, the number of independent replications is inversely related to the length of the formation (test) period.

If a stock is delisted after portfolio formation, it is

dropped permanently from the sample. As in previous studies, a stock is retained in the sample for the test period as long as it has values for two consecutive months. Distributions of closing prices at the end of the formation month for the winners, losers and total sample for formation periods (y) of one, two, three, five, eight, and ten years are reported in Table 3.1. As expected, losers have lower mean and median prices at portfolio formation periods than either the winners or the total sample of all stocks on the TSE/Western monthly return file for all the portfolio formation periods.

Please place Table 3.1 about here.

The size-ranked portfolios are formed using the Fama and French (1986) procedure. At the beginning of each test period, all the firms that have price and shares-outstanding data are sorted into quartiles based on their market values. Within each quartile, stocks are assigned into top and bottom twenty percentiles based on their CAR performances over y (e.g., 36) months as calculated using equation (3.1). This allows for the comparison of similar-sized winner and loser portfolios for the test periods. Unlike Fama and French (1986), quartiles are used instead of deciles so that a sufficient number of stocks are available to construct the size-comparable winner and loser portfolios. This is necessary because only a limited number of firms have information on shares outstanding on the TSE/Western database for the earlier time periods.[11]

3.5 METHODOLOGY

The following extended market model (in excess-return form) is specified to account for risk shifts and to capture the effect of investor overreaction:

$$R_{it}-R_{ft} = \alpha_{i1}(1-D_1)+\alpha_{i2}D_1+\beta_{i1}(R_{mt}-R_{ft})+\beta_{i2}(R_{mt}-R_{ft})D_1+\epsilon_{it} \qquad (3.2)$$

where, R_{it} is the return on the [loser (L), winner (W) or arbitrage or arb (A)] portfolios at time t;

R_{ft} is the risk-free rate (as measured by the 90 day T-Bill rate) at time t;

D_1 is a dummy variable, which has a value of one in the test period and zero otherwise;

α_{ik} is the Jensen performance index; that is, the measure of abnormal performance for portfolio i in the formation period when k=1, and in the test period when k=2;

β_{i1} is the systematic risk of portfolio i over the formation (F) and test (T) periods;

β_{i2} is the change in the systematic risk of portfolio i during the test (T) period; and

ϵ_{it} is the disturbance term of the relationship at time t for portfolio i, which is assumed to be distributed normally with zero mean, constant variance and zero correlation between residuals both across and over time.

Equation (3.2) is estimated using an OLS procedure when the disturbance term follows a white-noise process, using a

GLS procedure when the disturbance term follows an autoregressive process, and using an ARCH procedure of Engle (1982) when the conditional variance of the disturbance terms is heteroscedastic. Problems due to nonsynchronous trading are corrected by using a Scholes and Williams (1977) type of procedure which involves the estimation of coefficients on lead, lagged and contemporaneous market returns.

The null hypothesis ($\alpha_{12}=0$) implies the absence of investor overreaction. The alternative hypothesis ($\alpha_{12}\neq 0$) indicates investor overreaction. Specifically, a significant $\alpha_{12}>0$ ($\alpha_{12}<0$) for losers for the test period indicates price reversal (continuation) behaviour, and a significant $\alpha_{12}<0$ ($\alpha_{12}>0$) for winners for the test period indicates price reversal (continuation) behaviour.

To investigate the robustness of the results, the Sharpe (1966) portfolio performance measure is also used to test the differential performance between winners and the market, losers and the market, and winners and losers. For the portfolios studied herein, the Sharpe measure has two advantages over the Jensen measure for testing the overreaction hypothesis. First, the Sharpe measure is superior for portfolios which are not well diversified (such as the winner and loser portfolios). Second, the Sharpe measure avoids the problems associated with beta estimation [Roll (1978)] and beta nonstationarity [Chan (1988) and Ball and Kothari (1989)].

The Sharpe (1966) performance measure for portfolio i, Φ_i, is given by:

$$\Phi_i = \mu_i / \sigma_i \tag{3.3}$$

where, μ_i is equal to the mean excess-return, $R_{it}-R_{ft}$, for portfolio i (i.e., the mean excess return for portfolio i over the risk-free rate); and

σ_i is the population standard deviation of the excess rate of return (i.e., total risk) for portfolio i.

One weakness of the Sharpe measure is that it cannot be used for relative comparisons on a statistical basis. The reason is that, since both μ_i and σ_i (for all i) are generally unknown and have to be replaced by their sample estimates, the resulting estimate for Φ_i, Φ_i, is then itself a random variable. To overcome this weakness, Jobson and Korkie (JK) (1981) developed a statistical methodology to test the Sharpe measure of portfolio performance. The JK test is essentially a parametric test which uses the following transformed difference of the Sharpe measures for portfolios i and v:

$$Sh_{iv} = \sigma_i\mu_v-\sigma_v\mu_i \tag{3.4}$$

where, μ_i a . μ_v are the population mean excess rates of return for portfolios i and v, respectively; and

σ_i and σ_v are the population standard deviations of excess rates of return for portfolios i and v, respectively.

In a bivariate context, the variance of Sh_{iv}, θ_{iv}, is given by:

$$\theta_{iv}=\frac{1}{N}\left[2\sigma_i^2\sigma_v^2-2\sigma_i\sigma_v\sigma_{iv}+\frac{1}{2}\mu_i^2\sigma_v^2+\frac{1}{2}\mu_v^2\sigma_i^2-\frac{\mu_i\mu_v}{2\sigma_i\sigma_v}(\sigma_{iv}^2+\sigma_i^2\sigma_v^2)\right] \tag{3.5}$$

where σ_{iv} is the population covariance of excess returns for portfolios i and v; and N is the number of observations.

Replacing the population parameters by their sample estimates, JK (1981) show that $\hat{Sh}_{iv}$ is asymptotically normal with mean Sh_{iv} and variance θ_{iv} as defined by equations (3.4) and (3.5). The statistical significance of the null hypothesis, H_0: $Sh_{iv}=0$, is tested using the following standard Z_{iv} statistic:

$$Z_{iv} = Sh_{iv}/(\theta_{iv})^{1/2} \tag{3.6}$$

where ^ denotes a sample estimator.[17]

The following model is specified to investigate whether or not any identified overreaction phenomenon is related to the January seasonal:

$$R_{it}-R_{ft} = \alpha_{i3}(1-D_2)+\alpha_{i4}D_2+\beta_{i3}(R_{mt}-R_{ft})+e_{it} \tag{3.7}$$

Where, α_{i3} is the mean abnormal return in January for portfolio i (where i=W for winners and L for losers);

α_{i4} is the mean abnormal returns for non-January months for portfolio i;

D_2 is a dummy variable, which has a value of zero in January and a value of one in non-January months;

β_{i3} is the systematic risk of portfolio i;

e_{it} is the disturbance term of portfolio i at time t;

and all the other variables are as defined earlier.

The null hypothesis ($\alpha_{i3}=0$) implies the absence of abnormal returns in January. The null hypothesis ($\alpha_{i1}-\alpha_{i3}=0$) implies that the abnormal returns earned during non-January months are not different from those for January. The alternate hypothesis ($\alpha_{i1}-\alpha_{i3}\neq 0$) implies that the winner-loser effect can not be attributed to the January seasonal.

The estimates of the regression parameters for equations (3.2) and (3.7) for all the replications for a specific formation/test period length are weighted averages of the parameters in the individual formation/test periods. Since the weights are proportional to the length of the formation/test period, the last replication for a formation/test period of 60 (90 and 120) months has lower weight because it has 12 months less of data. As in Chan (1988), the fact that formation/test periods (each with T_1 observations) are non-overlapping is used in aggregating the t-statistics. By the independence assumption and the central limit theorem, and under the null hypothesis, an aggregate test statistics, U, can be calculated from the t-values for the individual replications for a specific formation/test period length. As the number of replications, J, gets large, the following U-statistic approaches a standard normal distribution [Chan (1988)]:

$$U = J^{1/2} \sum_{j=1}^{J} t_j[(T_j-3)/(T_j-1)]^{1/2} \sim N(0,1) \qquad (3.8)$$

Similarly, by the independence assumption and the central limit theorem, and under the null hypothesis, an aggregate test statistic, U^*, can be calculated from the Z-values derived from equation (3.6) for the individual replications for a specific formation/test period length. As the number of replications, J, gets large, the following U^*-statistic approaches a standard normal distribution:

$$U^* = J^{1/2} \sum_{j=1}^{J} Z_j[(T_j-3)/(T_j-1)]^{1/2} \sim N(0,1) \qquad (3.9)$$

Standard t-, sign and Wilcoxon signed rank tests are used to ascertain whether the estimates of the regression parameters for equation (3.1) and the arbs (losers-winners) for equations (3.2) and (3.7) are statistically significant. As re-iterated by Zivney and Thompson (1989), nonparametric tests assume that the distribution is unknown or non-normal, and measure central tendency by the median. In fact, the only assumptions underlying the sign test are that the observations are independent and the population is continuous in the vicinity of the median. Furthermore, according to Zivney and Thompson (1989), the sign test appears to be more powerful than the t-test when applied to market- and risk-adjusted return methodologies.

3.6 EMPIRICAL RESULTS

3.6.1 Does the TSE Exhibit Price Reversal Behaviour?

The market-adjusted returns for the winners, losers and arbs (losers-winners), and their respective test statistics, are reported in Table 3.2. As expected, based on the formation-period results given in panel A, all mean CAR estimates are of the correct sign, and all of the t-statistics and most of the sign and Wilcoxon test statistics are statistically significant at 0.05 level. Based on the test-period results given in panel B, the winner and loser portfolios exhibit continuation behaviour for test periods of 12 and 24 months. However, the mean CAR's are statistically significant at the 0.05 level for only the 12 month test periods for the winners and arbs. This result is somewhat consistent with findings of De Bondt and Thaler (1985) and Poterba and Summers (1988) for U.S. markets. For longer test (and formation) periods, the winner and loser portfolios exhibit price reversal behaviour in that the winners (losers) tend to underperform (outperform) the market. While the mean CAR's increase monotonically with the length of the test period (y) for the winners, losers and arbs, only the mean CAR for the losers for the 60 month test period is statistically significant at the 0.05 level. Although these results are biased (as will be discussed next), they qualitatively (but not statistically) support the overreaction hypothesis.

Please place Table 3.2 about here.

As noted by De Bondt and Thaler (1985), the results in Table 3.2 are likely to underestimate both the true magnitude and statistical significance of the overreaction effect (especially for the winners). The CAR calculations assume that the systematic risks of the winners, losers and market are all equal to one. However, as noted by Chan (1988) and Ball and Kothari (1989), the results in Table 3.2 are likely to overestimate both the true magnitude and statistical significance of the overreaction effect because beta increases (decreases) for the losers (winners) in the test period.

The Jensen performance measures (α's) and the aggregated t-statistics (U-statistics) calculated using equation (3.8) for the winners, losers and arbs are reported in Table 3.3. The Jensen measures are calculated using equation (3.2). Based on the formation-period results given in panel A, all of the α estimates are of the correct sign, and all of the U- and t-statistics, and most of the sign and Wilcoxon test statistics are statistically significant at the 0.05 level. These results are consistent with those discussed above for the CAR's. Based on the test-period results given in panel B, the winner and loser portfolios exhibit continuation behaviour for test periods of 12 and 24 months. However, the α estimates are statistically significant at the 0.05 level for only the 12 month test periods for the arbs. This result is somewhat

weaker than that discussed above for the CAR's. For longer test (and formation) periods, the winners and losers exhibit price reversal behaviours in that the winners (losers) tend to underperform (outperform) the market. While the magnitudes of the alpha estimates increase monotonically with the length of the test period (y) for the winners, losers and arbs, only the estimated α's for the winners, losers and arbs for the 120 month test periods are statistically significant at the 0.05 level based on the U- and t-statistics. These "unbiased" results are almost identical to those discussed above for the CAR's. These "unbiased" results also do not support the overreaction hypothesis at conventional levels of significance.

Please place Table 3.3 about here.

As discussed in section five, the Sharpe measure is a superior measure of portfolio performance for portfolios which are not perfectly diversified (such as those studied herein). The transformed Sharpe measures ($\dot{Sh}$'s) and the aggregated Z-statistics ($\dot{U}$-statistics) from the JK test for the winners versus the market, the loser versus the market and losers versus the winners are reported in Table 3.4. The $\dot{Sh}$'s and $\dot{U}$-statistics are calculated using equations (3.4), (3.5), (3.6) and (3.9). Based on the formation-period results given in panel A, all of the $\dot{Sh}$'s are statistically significant at the 0.05 level. These results are

consistent with those discussed above for the CAR's and the α's. Based on the test-period results given in panel B, the winners and losers exhibit continuation behaviours for test periods of 12 and 24 months, respectively, when compared to the market. For longer test (and formation) periods, the winners and losers exhibit reversal behaviours in that the winners (losers) underperform (outperform) the market. Similarly, the losers continue to underperform the winners for test periods of 12 and 24 months, and outperform the winners for longer test periods. However, the U^*-statistics are only statistically significant at the 0.05 level for the winners versus the market and for the losers versus the winners for the 120 month test periods. These results, which account for the total risk of exploiting the contrarian investment strategy, also do not support the overreaction hypothesis at conventional levels of significance.

Please place Table 3.4 about here.

3.6.2 Do Risk Changes Explain the Overreaction Phenomenon?

The differences in the CAR, Jensen and Sharpe performance measures may be due to changes in the systematic risks and/or volatilities of the winners and losers from the formation to the test (F-to-T) periods. The estimated betas for the winners, losers and arbs for the formation periods, and the changes in their estimated betas from the formation to the test periods based on equation (3.2) are reported in Table

3.5. Based on panel A, the winners have significantly higher betas than the losers except for the 120 month formation periods. Based on panel B, the F-to-T change in the mean beta of -16.24 percent for the winners for the 36 month test periods is somewhat smaller than the change of -22.2 percent found by Chan (1988) for the CRSP database. The F-to-T increase in the mean beta of 10.97 percent for the losers for the 36 month test periods is substantially smaller than the statistically significant increase of 23.1 percent found by Chan (1988) for CRSP database. The F-to-T changes in the mean betas of the arbs is positive for all test periods of 12, 24 and 36 months. However, the statistically significant F-to-T increase in the mean beta of 27.21 percent for the arb portfolios for the 36 month test periods is substantially smaller than the statistically significant increase of 45.3 percent found by Chan (1988) for the CRSP database. Thus, the similar conclusions of little market overreaction on the TSE reached by using the CAR and Jensen performance measures appear to be due to the insignificant increase in the mean F-to-T betas for the loser portfolios.

Please place Table 3.5 about here.

The estimated mean variances for the portfolios of winners and losers for the formation (F) and test (T) periods are reported in Table 3.6. For all test period lengths, the winner portfolios (panel A) have higher mean variances than

the loser portfolios (panel B) for the F periods, and for the T periods. For all test period lengths, the winner portfolios have lower and the loser portfolios have higher mean variance in the their test periods compared to their formation periods. The only F-to-T change, which is statistically significant at the 0.05 level, is for the loser portfolios for the 12 month formation/test periods. These variance results explain the similarity in the conclusions reached using the three types of performance measures.

Please lace Table 3.6 about here.

3.6.3 Is the overreaction phenomenon related to the January Effect?

The abnormal returns earned in January and in the remaining eleven months of the test periods, which are calculated using Equation (3.7), are reported in Table 3.7. Based on a comparison of panels A and B, the winner portfolios outperform the loser portfolios in January for test periods of 12, 24 and 36 months and in non-January months for test periods of 12 and 24 months. Based on panel A, the abnormal returns for the winner portfolios for January and the remaining eleven months are only statistically significant at the 0.05 level (and positive) for the January month in the 12, 24 and 36 month test periods. The abnormal returns for the winner portfolios, which arbitrage non-January versus January months, are also only statistically significant at the 0.05

level (and negative) for the 12, 24 and 36 month test periods.

Please place Table 3.7 about here.

Based on panel B, the abnormal returns for the loser portfolios for January and the remaining eleven months are only statistically significant at the 0.05 level (and positive) for the remaining months for the 120 month test period. The abnormal returns for the loser portfolios, which arbitrage non-January versus January months, are only statistically significant at the 0.05 level (and positive) for the 12 month test periods. These results provide little support for the January anomaly as an explanation of the overreaction hypothesis. In fact, the January findings seem to support the short-run continuation (12 and 24 month) behaviours of the winners and losers. Thus, no statistically significant evidence is found to support the notion that the market overreaction effect is related to the January effect. This finding appears to be robust across the three types of performance measures used herein.

3.6.4 Is the Overreaction Phenomenon Related to Firm Size?

The market-adjusted returns (CAR's) for the four size-based portfolios of winners, losers and arbs for the 36 month formation/test periods, and their respective test statistics, are reported in Table 3.8. Based on the formation-period results given in panel A, all of the mean CAR estimates are of the correct sign, and all of the test statistics are

statistically significant at the 0.05 level. Based on the test-period results given in panel B, the smallest-sized portfolios of winners and losers exhibit continuation and reversal behaviours, respectively, which are statistically significant at the 0.05 level for the 36 month formation/test periods. The differences in their mean and median CAR's are not statistically significant at the 0.05 level. The remaining size-based portfolios of winners and losers exhibit reversal behaviours. However, their mean CAR's and the differences in their mean and median CAR's are not statistically significant at the 0.05 level.

Please place Table 3.8 about here.

The Jensen performance measures (α's) and their aggregated t-statistics (U-statistics) calculated using equation (3.8) for the four size-based portfolios of winners and losers are reported in Table 3.9. The mean and median differences of the α estimates over the 36 month formation/test periods and their respective test statistics are also reported in Table 3.9. Based on the formation-period results given in panel A, all of the mean α estimates are of the correct sign, and all of the test statistics are statistically significant at the 0.05 level. Based on the test-period results given in panel B, the smallest-sized portfolios of winners and losers exhibit continuation and reversal behaviours, respectively, which are statistically

significant at the 0.05 level for the 36 month formation/test periods. The differences in their mean and median α estimates are not statistically significant at the 0.05 level. The remaining size-based portfolios exhibit reversal behaviours. However, their mean α estimates and the mean and median differences in their α estimates are not statistically significant at the 0.05 level.

Please place Table 3.9 about here.

The transformed Sharpe measures (Sh's) and the aggregated Z-statistics (U*-statistics) from the JK test for the four size-based portfolios of winners versus the market, losers versus the market and losers versus winners for the 36 month formation/test periods are reported in Table 3.9. Based on the formation-period results given in panel A, all of the Sh's are of the correct sign, and all (but two) of the U*-statistics are statistically significant at the 0.05 level (specifically, the two smallest-sized portfolios of winners versus the market). Based on the test-period results given in panel B, the smallest-sized portfolio of winners and losers exhibit reversal behaviours. However, none of these Sh estimates are statistically significant at the 0.05 level. Thus, no statistically significant evidence is found to support the notion that the market overreaction effect is related to firm size. This inference appears to be robust across the three types of performance measures used herein.

Please place Table 3.10 about here.

3.7 CONCLUDING REMARKS

The empirical evidence on the reversal behaviour of American stock prices appears to be dependent on the test methodology used. While Chan (1988) and Ball and Kothari (1989) find that the winner-loser effect is due almost entirely to intertemporal changes in systematic risks and expected returns, De Bondt and Thaler (1987) and Zarowin (1990) find that the winner-loser effect is not explained by risk differences. Fama and French (1986) and Zarowin (1989, 1990) find that the overreaction phenomenon is a manifestation of the size (and seasonal) effect.

As a further test of inferential sturdiness, this study tests the overreaction hypothesis using monthly data from the TSE/Western Database over the 39 year period, 1950-1988. To account for the possibility that winner-loser portfolios may not be well diversified, this study uses the Sharpe (1966) performance measure, along with market-adjusted abnormal returns (CAR's) and the Jensen (1968) performance measure.

Statistically significant continuation behaviours are found for the one (and often two) year test periods for winners and losers, and insignificant reversal behaviours are found for winners and losers over longer formation/test periods of up to ten years. Since qualitative but not statistically significant evidence in support of the

overreaction hypothesis exists for the market studied herein, the inferences from the studies of American stock markets may not be robust across markets.

While the systematic risks of the winners decrease significantly over all test periods, the systematic risks of the losers increase significantly for only the 12 month formation/test periods (i.e., the test periods which exhibit continuation and not reversal behaviour). The insignificant increases in the systematic risks of the losers over formation/test periods longer than 12 months differ from the findings for American markets [e.g., see Chan (1988)]. The only significant change in variance from the formation to test periods occurs for the losers for the 12 month formation/test periods.

Unlike the findings for American stock markets [Fama and French (1986) and Zarowin (1989, 1990)], no statistical evidence is found that the market overreaction effect is related to either the January or size anomalies for the Canadian stock market. While winners have significant and positive α estimates for January for test periods of 12, 24 and 36 months, losers have insignificant α estimates for January for longer test periods.

Unlike the findings for American stock markets, the findings for the Canadian stock market presented herein are robust for various performance measures. These are the market-adjusted CAR, and the Jensen (1968) and Sharpe (1966)

portfolio performance measures.

Perhaps the findings reported herein are due to the examination of a more current (and shorter) time period. Specifically, while the studies of American stock markets examine the overreaction effect over the 45 year period, 1930-75, the findings reported herein for the Canadian stock market examine the overreaction effect over the 39 year period, 1950-88.

CHAPTER FOUR: MARKET OVERREACTION AND STOCK SPLITS

4.1 INTRODUCTION

The market overreaction hypothesis proposes that stocks with the lowest returns (so-called losers) over a prior period subsequently outperformed the stocks of the highest returns (so-called winners) for the same prior period [De Bondt and Thaler (1985)]. Stocks which split are generally drawn from the population of winners based on price (return) performance over some prior period. According to Lakonishok and Lev (1987), split stocks are characterized by an unusual historical growth in earnings and market values prior to their splits. Fama, Fisher, Jensen and Roll (1969), Charest (1978), and Grinblatt, Masulis and Titman (1984), amongst others, have also documented the significant price appreciation associated with splitting stocks during the pre-split period.

The mean reversion behaviour of the portfolio of winners in the test period may also characterize the post-split behaviour of split stocks. The evidence on the post-split return performance of splitting stocks is mixed. Fama et al. (1969) find that the Cumulative Abnormal Returns (CAR's) remain stable for dividend-increasing stocks and decline for dividend-decreasing stocks post-split. This pattern is not surprising since value and dividend changes should be highly correlated for the post-split periods. For a sample of American splits, Bar-Josef and Brown (1970) find that stock prices decline in the post-split period. Although prices

increase slightly after the split announcements, Charest (1978) finds significantly negative CAR's three years after the American split announcements. For a sample of Canadian splits, Charest (1980) finds that stock prices not only revert to their pre-split level by approximately 12 months after the split announcement but that prices continue to decline for the full test period of 24 months.

Several hypotheses have been proposed in the literature to explain the positive market reaction around split announcements. The signalling hypothesis proposes that managers convey favourable information to the market by splitting their stocks. For example, Fama et al. (1966) suggest that stock splits signal an increase in future dividends. However, significant price adjustments are found on the announcement dates for non-dividend-paying splitting firms [Foster and Vickery (1979), Woolridge (1983), and Grinblatt, Masulis and Titman (1984), amongst others]. Grinblatt et al. (1984) propose that managers convey information about future earnings by splitting their stocks. Lakonishok and Lev (1987) and Asquith, Healy and Palepu (1989) find that the earnings growth of splitting firms in the post-split period is much lower than that in the pre-split period. The trading range hypothesis proposes that managers move their stock prices to an optimal trading range that benefits small investors by splitting their stocks. Evidence that does not support this hypothesis includes the decline in liquidity of

the splitting stocks after the split ex-dates [Copeland (1978), Lakonishok and Lev (1987), Lamoureux and Poon (1987), Kryzanowski and Zhang (1991b), amongst others]. The attention hypothesis proposes that managers obtain more publicity for their firms by splitting their stocks [Grinblatt et al. (1984)]. Brennan and Hughes (1990) present a model where the flow of information provided by stock-brokers is an increasing function of firm size and a decreasing function of share prices.

Many unresolved questions arise based on the price behaviour around stock splits. Do corporate managers overreact to their company's past earnings growth and stock price appreciation by splitting their stocks or do they have superior information on the future prospects of their company which they attempt to signal to the market? Does the poor performance of Canadian stocks post-split indicate that investors subsequently altered their price expectations towards mean reversion? If managers overreact to ex-post earnings and price changes, are their future performance forecasts excessively optimistic, given the information available at the time of the forecast? If managers correctly convey information on the future prospects of their firms by splitting their stocks, then stock price continuation can be expected post-split. On the other hand, if managers incorrectly assess future prospects based on past performance, then stock price reversal can be expected post-split.

From the viewpoint of investors, most stock splits have exhibited high price appreciation pre-split. If investors expect a continuation of such price performance based on the announcement of a stock split, they may react with excessive optimism and an unwarranted increase in prices. If during the post-split period they realize that their high expectations were unrealistic, prices will correct themselves. This correction process may be the cause for the poor performance of Canadian stocks in the post-split period.

Thus, the purpose of this chapter is to investigate whether or not corporate managers overreact to the recent ex-post performance of their firms by splitting their stocks, and whether or not the stock market overreacts to stock split announcements. Since any reversal behaviour identified for split stocks may be merely a manifestation of the general overreaction hypothesis which predicts no differences for any particular subset of winners, the post-split performance of splitting stocks relative to that of nonsplitting stocks with similar performance over the same prior periods needs to be tested to determine if they are significantly different for those subsequent periods. If no performance differences are found, and both exhibit similar reversal behaviour, then the evidence will support the general overreaction hypothesis.

The remainder of this chapter is organized as follows. In the next section, null hypotheses are formulated. In the third section, the portfolio construction and sampling

procedures are described. In the fourth section, the methodology is detailed. In the fifth section, the empirical findings are presented and analyzed. In the sixth and final section, some concluding remarks are offered.

4.2 NULL HYPOTHESES

Three null hypotheses based on the overreaction hypothesis are formulated to explain the behaviour of managers and investors around stock splits. The first null hypothesis, H_{01}, states that pre-split price (return) performance and post-split price (return) reversal are both positively correlated with the magnitude of the split factor. This hypothesis is based on the notion that the market infers the private information about the future prospects of splitting firms, which is being signalled by managers, from the observed split factors [McNichols and Dravid (1989) and Brennan and Hughes (1990)]. If the split factor is indeed an information medium, it may also reflect the information on the extent of manager overreaction. Thus, tests of H_{01} will also determine whether or not managers overreact to ex-post information by splitting their stocks. If the split decision is made as a response to transitory growth in earnings and prices, the observed split factors may be positively correlated with the pre-split returns because price appreciation will be a decision variable in making a stock split, and negatively correlated with post-split returns.

The second hypothesis, H_{02}, states that the returns of

split stocks will exhibit mean reversion during the post-split period. Tests of H_{02} will investigate whether or not splitting stocks exhibit the same tendency of mean-reversion as the population of winners. A rejection of H_{02} will partially reject the general overreaction hypothesis because this hypothesis predicts no performance differences between any particular subset of winners. Failure to reject H_{02} implies overreaction, and that stock splits may be indeed cosmetic events.

The third hypothesis, H_{03}, states that no differences exist in the return performances during the post-split period between split and non-split stocks (where both groups have similar pre-split performances). Tests of H_{03} will determine whether or not a decision to split a stock affects subsequent return performance. A rejection of H_{03} will imply that stock splits not only add value to a stock on the announcement date but also provide a positive signal about long-term performance. If both split and non-split stocks exhibit similar ex-post, mean-reversion behaviour, then stock splits do not signal added value to a stock in the long run, and the positive market reactions on the proposal and ex-dates are largely transitory.

4.3 SAMPLE SELECTION AND PORTFOLIO CONSTRUCTION PROCEDURES

The announcement dates for 237 stock splits are identified from the Toronto Stock Exchange Daily Record in microfilm for the period 1968-74, and from the Canadian Business Index in print for the period 1975-87. Monthly

returns for the split stocks are drawn for the 36 months before and after the split announcement month (month 0) from the TSE/Western monthly return file.[18]

The total sample is divided into five portfolios based on their pre-announcement (pre-split) performances. The first portfolio, P1, consists of stocks with the poorest performance relative to the market during the 36 month, pre-split period. The fifth portfolio, P5, has the best performance relative to the market for the pre-split periods. The pre-split performance of each stock j was calculated using:

$$CAR_j = \sum_{-36}^{0} (R_{jt} - R_{mt}) \qquad (4.1)$$

where, CAR_j is the cumulative market-adjusted excess returns for stock j for the period -36 to announcement month 0;

R_{jt} is the realized returns on stock j at month t; and

R_{mt} is the realized returns on the market (as proxied by the equally-weighted TSE/Western index) for month t.

For each split stock, a corresponding control stock was chosen that satisfied the following criteria: (1) the stock did not split during the 1968-1987 period, and (2) the stock had the closest performance using equation (4.1) to that of the split stock during the pre-split period of the split stock. This allows for a comparison of the performances of the split and control firms during the post-split periods of

the split stocks. The price characteristics of the samples of split and control stocks as of the split announcement months are reported in Table 4.1. The mean price of \$35.12 for the split stocks is substantially higher than that (\$18.287) of the control stocks. However, the price characteristics of this sample of control stocks are similar to those of the market given in Kryzanowski and Zhang (1991c).

Although five-year pre- and post-split periods are also used for the 136 pairs of split and control stocks, these results are not reported herein due to space constraints.[19] These results are qualitatively similar to those reported herein for the three-year pre- and post-split periods, and are available upon request.

Please place Table 4.1 about here.

4.4 METHODOLOGY

The following extended market model (in excess-return form) is specified to account for risk shifts and to capture the effect of investor overreaction:

$$R_{it}-R_{ft} = \alpha_{i1}(1-D_1)+\alpha_{i2}D_1+\beta_{i1}(R_{mt}-R_f)+\beta_{i2}(R_{mt}-R_f)D+\epsilon_t \qquad (4.2)$$

where, R_{it} is the return on the [spl (S), control (C) or arbitrage or arb (D)] portfolio at time t;

R_{ft} is the risk-free rate (as measured by the 90 day T-Bill rate) at time t;

D_1 is a dummy variable, which has a value of one in the post-split period and zero otherwise;

α_{ik} is the Jensen performance index; that is, the measure of abnormal performance for stock i in the pre-split period when k=1, and in the post-split period when k=2;

β_{i1} is the systematic risk of stock i over the pre-split and post-split periods;

β_{i2} is the change in the systematic risk of stock i during the post-split period;

ϵ_{it} is the error term of the relationship at time t for stock i, which is assumed to be distributed normally with zero mean, constant variance and zero correlation between residuals both across and over time.

Since equation (4.2) represents a system of seemingly unrelated regressions (SUR) [Zellner (1962)] for each pair of split and control stocks, it was estimated as such. Since the regressors are identical for each firm in the pair, generalized least squares (GLS) estimates of the coefficients are identical with those using ordinary least squares on the equations separately. While no efficiency gains are obtained by using SUR, estimating (4.2) as a system [Hughes and Ricks (1984)] facilitates the construction of tests on the coefficients (specifically the α's) for the two firms for each pair. Furthermore, the use of SUR incorporates the contemporaneous dependence of the error terms and heteroscedasticity across the pair of equations into the test

statistics.

The null hypothesis ($\alpha_{i2}=0$) implies the absence of investor overreaction. The alternative hypothesis $\alpha_{i2}<0$ ($\alpha_{i2}>0$) for the post-split period indicates price reversal (continuation) behaviour.

To investigate the robustness of the results, the Sharpe (1966) portfolio performance measure is also used to test the differential performance between split firms and the market, control firms and the market, and split and control firms. For the portfolios studied herein, the Sharpe measure has two advantages over the Jensen measure for testing the overreaction hypothesis. First, the Sharpe measure is superior for portfolios which are not well diversified (such as the winner and loser portfolios). Second, the Sharpe measure avoids the problems associated with beta estimation [Roll (1978)] and beta nonstationarity [Chan (1988) and Ball and Kothari (1989)].

The Sharpe (1966) performance measure for portfolio i, Φ_i, is given by:

$$\Phi = \mu_i / \sigma \qquad (4.3)$$

where, μ_i is equal to the mean excess-return, $R_{it}-R_{ft}$, on portfolio i (i.e., the mean excess return for portfolio i over the risk-free rate); and

σ_i is the population standard deviation of the excess rate of return (i.e., total risk) for portfolio i.

One weakness of the Sharpe measure is that it cannot

be used for relative comparisons on a statistical basis. The reason is that, since both μ_i and σ_i (for all i) are generally unknown and have to be replaced by their sample estimates, the resulting estimate for Φ_i, $\hat{\Phi}_i$, is itself a random variable. To overcome this weakness, Jobson and Korkie (JK) (1981) developed a statistical methodology to test the Sharpe measure of portfolio performance. The JK test is essentially a parametric test which uses the following transformed difference of the Sharpe measures for portfolios i and v:

$$Sh_{iv} = \sigma_i\mu_v - \sigma_v\mu_i \qquad (4.4)$$

where, μ_i and μ_v are the population mean excess rates of return for portfolios i and v, respectively; and

σ_i and σ_v are the population standard deviation of excess rates of return for portfolios i and v, respectively.

In a bivariate context, the variance of Sh_{iv}, θ_{iv}, is given by:

$$\theta_{iv} = \frac{1}{N}\left[2\sigma_i^2\sigma_v^2 - 2\sigma_i\sigma_v\sigma_{iv} + \frac{1}{2}\mu_i^2\sigma_v^2 + \frac{1}{2}\mu_v^2\sigma_i^2 - \frac{\mu_i\mu_v}{2\sigma_i\sigma_v}(\sigma^2_{iv} + \sigma_i^2\sigma_v^2)\right] \qquad (4.5)$$

where σ_{iv} is the population covariance of excess returns for portfolios i and v; and N is the number of observations.

Replacing the population parameters by their sample estimators, JK (1981) show that $\hat{Sh}_{iv}$ is asymptotically normal with mean Sh_{iv} and variance θ_{iv} as defined by equations (4.4) and (4.5). The statistical significance of the null

hypothesis, H_0: $Sh_k=0$, is tested using the following standard Z_k statistic:

$$Z_k = Sh_k/(\hat{\sigma}_k)^{1/2} \qquad (4.6)$$

where ^ denotes a sample estimator.[30]

The following Tobit model is specified to investigate the relationship between the split factor and manager overreaction:

$$SF = \begin{cases} \tau_0+\tau_1*RET_t+\tau_2*DP_t+\tau_3*FE_t+USF & \text{if } RHS>0 \\ 0 & \text{otherwise} \end{cases} \qquad (4.7)$$

where, SF is the split factor;

RET_t is the pre-split excess return summed over t months before the split announcement month 0;

$DP_t = P_0-P_{-t}$, is the difference in the prices on the announcement month 0 and month -t (i.e., t months prior to the announcement month);

FE is the post-split excess return of the split stock summed over t months after the announcement month 0;

τ_i are the parameters of the model (i=0...3);

USF is the error term, which is assumed to be normally distributed with zero mean and constant variance;

RHS is equal to $\tau_0+\tau_1*RET_t+\tau_2*DP_t+\tau_3*FE_t+USF$.

Equation (4.7) is estimated as a standard Tobit model using the maximum likelihood estimation (MLE) method [for more

details, see Amemiya (1986)]. If managers overreact to the pre-split price performances of their firms by splitting their stocks, then τ_1 and τ_2 are expected to be positive. If a price reversal is related to manager overreaction, then τ_3 is expected to be negative.

3.5 EMPIRICAL RESULTS

As discussed above, the Jensen Performance Indices (α's) are market- and risk-adjusted excess returns. The α's for the split and control stocks during the 36-month periods before and after the split announcement months are reported in Table 4.2.[21] Based on the α's presented in panel A, the two samples exhibit similar performances during the pre-split announcement periods. The portfolios of lowest CAR performers (P1) for the split and control stocks underperform the market, while the portfolios of higher CAR performers (P2 through P5) and the total samples outperform the market. All of the α's presented are significant at the 0.05 level with the exception of the α's for the portfolios P1 and P2 for the control stocks. The mean α's for the paired differences for the total and CAR-ranked portfolios are only statistically significant at the 0.05 level based on the t-test for the highest CAR performers (P5) during the pre-split periods.

Please place Table 4.2 about here.

Based on the α's for the split and control stocks during the post-split periods reported in panel B of Table 4.2, the

total sample of split stocks exhibits a negative (but not statistically significant) mean α of 0.23 percent (t-value of -1.48).Consistent with Charest (1980), this result indicates that split stocks have a reversion in their post-split performances. However, the magnitude of this reversal is not statistically significant at 0.05 level. The total sample of control stocks also underperforms the market over the same period, which indicates a price reversal for this sample of stocks which is also not statistically significant. The paired differences in the mean α's for the split and control stocks are negative but not statistically significant based on the t-, sign- and Wilcoxon signed rank tests.

An examination of five CAR-ranked portfolios of split stocks reveals a negative relationship between the pre- and post-split α performances. The lowest pre-split CAR performers (P_1) outperform the market during the post-split announcement periods. However, none of their post-split performances are statistically significant at the 0.05 level for the t-test. Similarly, for the control stocks, the lowest pre-split CAR performers (P_1) outperform the market while the higher CAR performers (P_3, P_4 and P_5) underperform the market during the post-split period. However, only the α of -1.04 percent for portfolio P5 for the control stocks is significant at the 0.05 level. These α reversal behaviours for the CAR-ranked portfolios of split and control stocks are comparable to those reported by Kryzanowski and Zhang (1991c) for winner stocks.

The differences in post-split performances for the five CAR-ranked portfolios are not statistically significant at the 0.05 level based on the t-, sign and Wilcoxon tests. This suggests that few differences exist in the post-split market- and risk-adjusted excess return ($\dot{\alpha}$) behaviours for the split and control stocks.

The transformed Sharpe Performance Indices, and Z-statistics from the JK test for the split and control stocks during the pre- and post-split periods, are reported in Table 4.3. Consistent with the findings reported above for the $\dot{\alpha}$'s, the Sharpe index results reported in panel A of Table 4.3 indicate that the total sample of split and control stocks outperform the market during the 36-month pre-split periods. For these periods, the lowest pre-split CAR performers (P_1 and P_2) underperform the market, and the highest pre-split CAR performers (P_4, P_4 and P_5) outperform the market. Based on the Sharpe index results in panel B of Table 4.3, the total samples of both split and control stocks underperform the market during the 36-month post-split periods. However, the Sharpe index result is only significant (at the 0.10 level) for the total sample of split stocks. All of the pre-split, CAR-ranked portfolios underperform the market during the post-split period. Only one of the Z-statistics for these portfolios is significant at the 0.10 level (namely, P_5 for the split stocks). Furthermore, the differences in the post-split Sharpe performance measures for the paired split and

control stocks for the total portfolio and pre-split CAR-ranked portfolios are not statistically significant at the 0.10 level. Again, this suggests that little difference exists in the total risk-adjusted performances of split and control stocks in the 36-month post-split periods.

Please place Table 4.3 about here.

The regression results for the estimation of the Tobit equation (4.7) on manager overreaction are as follows:

$$SF = \underset{(25.72)}{2.2275} + \underset{(0.51)}{0.0868}\ RET_{36} + \underset{(6.08)}{0.0239}\ DP_{36} - \underset{(-0.80)}{0.0491}\ FE_{36} + USF$$

The estimate of the coefficient, τ_1 (τ_3), indicates a positive (negative) relationship between the split factor and pre-(post-) split CAR's. However these estimated coefficients are not statistically significant at the 0.10 level. The estimates of the coefficient, τ_2, suggests that the split factor is significantly and positively related to the change in pre-split prices. The null hypothesis that the coefficients of equation (4.7) are jointly equal to zero is tested using a likelihood ratio test. The chi-square value of 10.05 is statistically significant at the 0.10 level. Thus, the data provides some weak support for the null hypothesis of manager overreaction.

4.4 CONCLUDING REMARKS

This paper investigates whether or not corporate managers overreact by splitting stocks based on the ex-post

performances of their firms, and whether or not the stock market overreacts to stock splits. A sample of 237 Canadian stock splits over the 20-year period, 1968-87, is studied. Market-adjusted returns (CAR's) are used to form five portfolios of both split and control stocks. The Jensen and Sharpe performance indices are used to measure the 36-month post-split performances of the split and control stocks.

Nonsignificant return reversal behaviour is identified for the post-split announcement periods for the total sample and the pre-split CAR-ranked portfolios of split and control stocks. Thus, the evidence qualitatively (but not statistically) supports the overreaction hypothesis. No statistically discernable differences in the post-split performances between paired split and control stocks are identified. Since the split factor is significantly related only to the change in the pre-split prices, the data only weakly supports the hypothesis of manager overreaction.

CHAPTER FIVE: ECONOMIC FORCES AND SEASONALITY IN SECURITY RETURNS

5.1 INTRODUCTION

Modern finance theory stresses the exclusive importance of pervasive or systematic "state variables" in explaining asset prices. Fama and Schwert (1977), Nelson (1976), Geske and Roll (1983), among others, have examined the relationship between stock returns and inflation. Fama (1981) finds that stock returns are significantly related to real production activities. However, these early studies do not indicate whether or not these macroeconomic variables are priced sources of risk in the stock market. Chen, Roll and Ross (1986) find that innovations in five macroeconomic variables (the spread between long- and short-term interest rates, change in expected inflation, unexpected inflation, industrial production, and the spread between high and low grade bonds) are significantly priced risks in the U.S. market for the period 1953-1983. Berry, Burmeister and McElroy (1988) and McElroy and Burmeister (1988) find that these factors together with the residual market factor (RMF) explain U.S. stock returns over the period 1972-1982. Brown and Otsuki (1989) find that innovations in seven macroeconomic variables (including the money supply, the production index, inflation, exchange rate, crude oil prices, overnight call rate, and the residual market factor) are significantly priced risks in the Japanese equity market over the period 1980-1988. Although

Gunay and Burnie (1989) find that the factor scores of interest rates, industrial production and inflation are associated with the factor scores of Canadian stock returns, this association does not necessarily imply that these factors are priced sources of risk. Since Kryzanowski and To (1983) find that Canadian and American factor structures differ, different macro variables may be priced risks in the Canadian versus the U.S. market.

The traditional two-step approach used to estimate asset pricing relations [Black, Jensen and Scholes (1972) and Fama and MacBeth (1973)] uses time series data to first estimate factor sensitivities (the APT factor loadings), and then to estimate factor prices via a cross-sectional regression of returns using estimated factor sensitivities as explanatory variables. By recasting the APT as a nonlinear multivariate regression system with cross-equation restrictions, McElroy and Burmeister (1988) develop a new paradigm for estimating the sensitivities and factor loadings simultaneously. These estimates are strongly consistent and robust to the problems inherent in the traditional two-step procedure.

Various types of security returns seasonality have been uncovered.[22] Rozeff and Kinney (1976) find that U.S. stock returns are significantly higher in January. Banz (1981) and Reinganum (1983) find that the returns on NYSE and ASE firms with small market values exceed the returns on those firms with large market values. Keim (1983) finds that most of the

excess returns for small firms is concentrated in January. Roll (1983) identifies similar regularities at the turn of the year. Gultekin and Gultekin (1983) document a similar January pattern for the value-weighted stock market indices for a number of industrialized countries (including Canada). Cadsby (1988) and Cadsby and Tapon (1988) identify a negative average return for the month of October for the daily returns on the equally-weighted NYSE index for the period 1963-1985, and for the daily returns on the TSE index over the period 1977-1987.

Relationships have also been observed between the calendar dates and risk premia for various asset pricing models. Rozeff and Kinney (1976) find that the CAPM risk premium is relatively larger in January than in the other months. For the two-parameter CAPM using NYSE data, Tinic and West (1984, 1986) find that the positive relationship between risk and return is unique to January. Tinic and Barone-Adesi (1988) and Corhay, Hawawini and Michel (1987) find similar results for Canada and a number of European countries, respectively. Gultekin and Gultekin (1987) find that the estimates of the risk premia from the APT model tend to be significant only for January. Cho and Taylor (1987) identify a January effect in the factor structure of stock returns. Cadsby and Tapon (1988) find that the CAPM risk premium is significant in both January and during the rest of the year for daily CRSP data over the period 1963-1983. For a two parameter CAPM model, Cadsby (1988) finds that the January

effect on returns and risk premia disappears from the Canadian market over the period 1977-87. Ritter and Chopra (1989) argue that the CAPM risk-return relationship does not exhibit a January seasonal for the period 1935-86 when the value-weighted index is employed in beta estimation.

Several explanations have been advanced to explain the January seasonal. Since the fiscal and calendar year-ends correspond for most firms, Rozeff and Kinney (1976) postulate that the annual reports of firms reveal new information about future earnings. However, since the market predicts a significant portion of annual corporate earnings [Ball and Brown (1968)], the residual information contained in these reports is unlikely to explain totally the abnormal returns in January. Another popular explanation is the tax-loss-selling hypothesis, which asserts that by realizing capital losses during December investors temporarily drive security prices below their equilibrium level at year-end. Abnormal returns result in January when this selling pressure is relieved. Evidence consistent with this hypothesis includes Branch (1977), Dyl (1977) and Roll (1983). However, a January seasonal is present even in the absence of tax-loss selling for various international markets [Brown, Keim, Kleidon and March (1983), Berges, McConnell and Schlarbaum (1984) and Tinic and Barone-Adesi (1988)].

The fundamental forces that determine security returns exhibit seasonal patterns. Using a multifactor pricing model

for U.S. data over the period 1958-77, Chan, Chen and Hsieh (1985) find that the spread between low- and high-grade bonds, which is the most significant variable in their model, reveals a strong January seasonal. Unlike Gultekin and Gultekin (1987) and Cho and Taylor (1987), Burmeister and McElroy (1988) present empirical evidence supporting the APT relationship which is not appreciably affected by the inclusion or the exclusion of a January seasonal for a sample of 70 American stocks over the period 1972-82. Chang and Pinegar (1989) find a February and August peak in American industrial production for the period 1953-85. Since the reported data may lag the change in actual production by at least a partial month, one of the seasonal peaks in industrial production coincides with the January seasonal in the stock market. The fundamental forces, if any, that drive the seasonality inherent in most asset pricing models have not yet been identified. Based on the seminal work of Burmeister and McElroy, it may be possible to explain the January anomaly within the APT framework by using observed macroeconomic variables if the January seasonal can be related to the macroeconomic variable(s).

Thus, given the above deficiencies in the literature, the purpose of this chapter is three-fold: first, to identify the macroeconomic variables that determine stock returns in Canada; second, to estimate the APT model for Canadian securities as a restricted nonlinear multivariate regression system using observed macroeconomic variables; and third, to

investigate the fundamental economic forces that cause the seasonality exhibited by the APT model for Canadian securities.

The remainder of this chapter is organized as follows: the APT as a nonlinear multivariate regression system is discussed in the next section. The macroeconomic variables and their measurement are discussed in the third section. The procedures for forming portfolios is described in the fourth section. The empirical findings are presented and analyzed in the fifth section. Some concluding remarks are offered in the last section.

5.2 FACTOR STRUCTURE AND MODEL SPECIFICATION

Assume that the returns for asset i in period t, R_{it}, can be represented as the following linear factor model (LFM):

$$R_{it} = \alpha_{it} + \sum_{k=1}^{K} \beta_{ik} F_{kt} + \epsilon_{it} \qquad (5.1)$$

where F_{kt} is a set of macroeconomic factors; β_{ik} is the sensitivity of asset i to factor k; $E(\epsilon_{it})=E(F_{kt})=0$; and $E(\epsilon_{it}\epsilon_{vs})=\sigma_{iv}$ for i=v and t=s, and is equal to zero otherwise. Since only the Kth factor is unobservable, as in McElroy and Burmeister (1988), the error component in (5.1) is given by:

$$\epsilon_{it} = \beta_{iK} F_{Kt} + u_{it} \qquad (5.2)$$

where β_{iK} is the sensitivity of asset i to the unobserved common shock to all returns K, and u_{it} is the asset specific shock or idiosyncratic noise for asset i. Factor K is assumed to be mean zero, constant variance, serially uncorrelated and

uncorrelated with the L=K-1 observed factors. If a well-diversified portfolio with return R_{mt} exists, then it can also be represented as a linear function of the same macroeconomic factors as in (5.1) as follows:

$$R_{mt} = \alpha_{mt} + \sum_{k=1}^{L} \beta_{mk} F_{kt} + \beta_{mK} F_{Kt} + \epsilon_{mt} \tag{5.3}$$

where $\epsilon_{mt} = \sum_{i=1}^{N} w_i \epsilon_{it}$ and w_i's are the portfolio weights summing to One. Since the variance of ϵ_{mt} approaches zero as the number of assets, N, tends to infinity, ϵ_{mt} is a degenerate random variable at zero. Furthermore, since F_{kt} is unobserved and β_{mK} is not identified, F_{Kt} may be normalized such that β_{mK} equals unity. Hence, the return on this well-diversified portfolio may be written as:

$$R_{mt} = \alpha_{mt} + \sum_{k=1}^{L} \beta_{mk} F_{kt} + F_{Kt} \tag{5.4}$$

where F_{Kt} is unobservable and is the error term in (5.4). In practice, R_{mt} may be proxied by a broad market index, and F_{Kt} represents the residual market factor risk to all returns.

The APT restricts the intercept in (5.1) as follows:

$$\alpha_{it} = \delta_{0t} + \sum_{k=1}^{L} \beta_{ik} \delta_{ik} + \beta_{iK} \delta_{iK} \tag{5.5}$$

where δ_{0t} is the risk-free return, δ_{ik} and δ_{iK} represent the vector of risk premia associated with the macrovariables and the RMF, respectively. Equation (5.4) is also restricted as follows:

$$\alpha_{mt} = \delta_{0t} + \sum_{k=1}^{L} \beta_{mk}\delta_{tk} + \delta_K \tag{5.6}$$

where the parameters are as defined previously.

McElroy and Burmeister (1988) note that equations (5.1), (5.4), (5.5) and (5.6) can be estimated using standard two step nonlinear system estimation techniques. First, estimate equation (5.4) by ordinary least squares (OLS) to obtain the estimate of the unobserved RMF, F_{Kt}; and second, estimate the following nonlinear system of equations:

$$E_{it} = \sum_{k=1}^{l} \beta_{ik}\delta_{tk} + \beta_{iK}\delta_{tK} + \sum_{k=1}^{L} \beta_{ik}F_{tk} + \beta_{iK}F_{Kt} + e_{it} \tag{5.7}$$

where $E_{it}=R_{it}-\delta_{0t}$, using nonlinear seemingly unrelated regression (NLSUR), iterated nonlinear seemingly unrelated regression (ITNLSUR), iterated nonlinear weighted least squares (ITNLWLS), or iterated three-stage least squares (ITNL3LS). As discussed in Gallant (1987), the appropriate estimation method depends upon the assumptions about the e_{it} in equation (5.7). When the errors are correlated across assets, NLSUR yields the estimates that are consistent and asymptotically normal. If the errors are also jointly normal, then ITNLSUR produces tail equivalent maximum likelihood estimators. For a diagonal error structure, ITNLWLS estimates are maximum likelihood estimators. Finally, ITNL3LS may be employed to stabilize the covariance matrix when the assumption of $\epsilon_{mt}=0$ is questionable. Although the β's in equation (5.7) can be specified as being time dependent, this is not done herein and

is left for future research.

As shown in Burmeister and McElroy (1988), to investigate the impact of a January effect on this model, the intercept in (5.1) may be replaced by $\alpha_{it}+\Phi_i D_t$, where $D_t=1$ in January and zero otherwise, and Φ_i represents asset i's sensitivity to the January effect. Similarly, a January dummy variable may be incorporated into (4.7) as follows:

$$E_{it} = \Phi_i D_t + \sum_{k=1}^{L} \beta_{ik}\delta_{ik} + \beta_{iK}\delta_{iK} + \sum_{k=1}^{L} \beta_{ik}F_{ik} + \beta_{iK}F_{Kt} + e_{it} \qquad (5.8)$$

A significant Φ_i implies that the January seasonal is not explained by the model given the selected set of variables. If the restriction $\Phi_i=0$ can not be rejected, then the explanatory power of the dummy variable is captured by the macroeconomic factors, assuming that a January effect exists. If this is the case, then a backward stepwise selection of the model variables may be carried out to investigate directly the linkage between the macroeconomic factors and the January anomaly.

5.3 THE MACROECONOMIC VARIABLES AND THE MEASUREMENT OF THEIR INNOVATIONS

Since no generally acceptable theory exists for linking stock returns to the economy, no unique and universally accepted selection of macrovariables is possible. As a result, the selection criteria includes general economic theory, intuition, macrovariables previously identified in the literature, data availability and the appearance of the

macrovariables in the popular financial media. Variables included to capture changes in the real sector include industrial production, gross domestic product, total labour income, average workweek, new orders, residential construction index, building permits, retail trade, total new motor vehicle sales, total loans outstanding, personal loans outstanding, business loans outstanding, the percentage change in price per unit labour cost, and the inventory to shipment ratio. Variables included to capture price level changes include two measures of unexpected inflation.[21] Variables included to capture the impact of changes in capital market conditions include money supply, yield on Treasury Bills, long-term corporate and Government of Canada bonds, the TSE300 Index, and unexpected changes in the risk premium and the term structure. Variables included to capture the impact of changes in the foreign sector include total imports, total exports, the Canada/U.S. foreign exchange rate, and the U.S. composite index of 12 leading indicators. All of the data series for the selected macroeconomic variables were drawn from Statistics Canada's CANSIM Mini Base (for a listing of the variables, see Table 5.1). The first differences in the logarithms of the seasonally unadjusted monthly values (herein, referred to as growth rates) were calculated for most of the variables for the period from February 1956 through March 1988.

Please place Table 5.1 about here.

The change in the risk premium (RISK) is defined as:

$$RISK(t) = CBOND(t) - LBOND(t)$$

where CBOND is the yield on the McLeod, Young, Weir bond index (an average yield for ten industrial bonds), and LBOND is the average yield on long-term Government of Canada bonds with maturities of ten years and over. The change in the term structure (TERM) is defined as:

$$TERM(t) = LBOND(t) - TBILL(t-1)$$

where LBOND is as defined previously, and TBILL is the average monthly yield on Government of Canada 90 day Treasury Bills. Although these two variables are not mean zero (since the term structure is usually upward sloping and the average risk premium for holding the more risky corporate bonds instead of less risky government bonds is always positive), many of the previous American studies have used these variables directly as innovations. In this study, the real innovations of these variables will be used to ensure that they are both zero mean and serially uncorrelated, as innovations should be.

The series for each of the macroeconomic variables were fitted using a multivariate state space procedure which is attributable to Akaike (1976), and has been used by Burmeister and McElroy (1987) and Brown and Otsuki (1989). The summary statistics for the innovations for a maximum lag structure of ten are reported in Table 5.2. Most of the innovations appear to be a white noise process (i.e., normally distributed with a zero mean). Based on the t-test, the null hypothesis of zero

mean can not be rejected for all the variables. Based on the D-statistics from the Kolmogorov-Smirnov test for normality [Stephens (1974)], the innovations are normally distributed for all but three series (namely, retail trade, exchange rate and term structure). Based on Fisher's Kappa statistic for a test that each series is a white noise process [Fuller (1974)], the null hypothesis cannot be rejected for all but six series (money supply, gross domestic product, industrial production, building permits, total labour income, and exports). The strong seasonality for these series could not be eliminated by differencing, taking higher order lags, or using their seasonally adjusted variants. Based on the Ljung-Box statistics, none of the series exhibited statistically significant serial correlation at the 0.05 percent level.

Please place Table 5.2 about here.

5.4 PORTFOLIO FORMATION PROCEDURES

Size-ranked portfolios were formed to increase the desired dispersion in stock returns as follows: first, the market value of each stock on the TSE/Western monthly database was determined by multiplying the December-end price by the number of shares outstanding; second, stocks were ranked according to their beginning-year market values; and third, fifty portfolios were created each year with an approximately equal number of securities in each portfolio. An equally-weighted average rate of return was computed for each of the

fifty portfolios for each month beginning with January 1956 and ending in December 1988. Summary statistics describing the mean returns and market capitalizations of these portfolios are presented in Table 5.3.

Please place Table 5.3 about here.

5.5 EMPIRICAL FINDINGS

5.5.1 Seasonality in the Macroeconomic Factors

To test for a January seasonal, the following regression was estimated for each macro series x:

$$S_x = \alpha_x + \sum_{j=2}^{12} \beta_j D_j + e_x \qquad (5.9)$$

where S_x is the growth rate or innovation for the xth macroeconomic variable, and D_j is the dummy variable for month j where "2" designates February and "12" designates December. The constant term, α_x, represents the estimated average growth rate or innovation for January, and β_j indicates the difference in the estimates between January and month j. The error term, e_t, is assumed to be normally distributed with zero mean and unit variance. F-statistics under the hypothesis of $\beta_2=\beta_3=...=\beta_{12}=0$ indicate how significantly the growth rates or innovations from February to December jointly differ from that in January.

The regression results for the growth rates for each macroeconomic variable are presented in Table 5.4. The monthly returns on the TSE 300 index returns for February through

December are significantly lower than those for January, reflecting the well-known January effect. The monthly returns on the value-weighted (V-W) and equally-weighted (E-W) indices from the TSE/Western Data Base exhibit the same pattern as the TSE 300 index. The inflation growth rate peaks in June and July. The money supply and building permit growth rates are not only negative in January but are significantly lower than for the other months of the year. Similarly, the labour income growth rate drops insignificantly in December. The GDP growth rate decreases in January, and reaches a trough in October. Exports have a negative growth rate in January. The growth rate for the workweek decreases significantly in December, and that for industrial production reaches a peak in September. The growth rates of the remaining macroeconomic variables appear to exhibit no significant departures during non-January months versus January.

Please place Table 5.4 about here.

The regression results for the innovations for each macro-economic variable are reported in Table 5.5. Seven macroeconomic variables (money supply, building permits, imports, exports, GDP, total labour income and workweek) exhibit strong seasonalities, which are similar to those for their growth rates. Money supply innovations have a significant decrease in November, and total labor income innovations appear to have a significant July trough. The

seasonal patterns in January of the innovations for a number of macroeconomic variables are reversed. These variables include GDP, imports, exports, new orders, industrial production, total loans outstanding, personal loans outstanding and business loans outstanding. Such changes are not unexpected because the innovations are defined as the forecasting errors. As Chen, Roll and Ross (1985) have noted, the failure to filter out the expected movements in an independent variable must be traded off with the errors introduced by the misspecification of the estimating equation.

Please place Table 5.5 about here.

To further examine the seasonality in the macroeconomic variables, the data were partitioned into three eleven-year subperiods from February 1956 to December 1966, January 1967 to December 1977 and January 1978 to March 1988. From Table 5.6, different subperiod seasonal patterns are found for the three market indices. While the E-W TSE/Western index has the highest return in January during each subperiod, the TSE300 and V-W TSE/Western indices have the highest returns in January only during the first two subperiods (1956-66 and 1967-77). An October effect appears in the 1956-66 period for the E-W TSE/Western index, and during the 1967-77 period for all three market indices. This suggests that seasonality changes over time, and that the E-W market index may reveal more anomalous behaviour than a V-W market index [as found by

Ritter and Chopra (1989)]. This may be due to the size effect [Banz (1981) and Reinganum (1983)].

Please place Table 5.6 about here.

5.5.2 Stepwise Selection of the Macroeconomic Variables

To determine which factors are pervasive at the market level, equation (5.4) was estimated using the returns for each of the three market indices. Due to the lag in the release of aggregate economic information for about one month, equity market returns may be associated with last period's changes in some measures of real economic activity. Following Fama (1981) and Chen, Roll and Ross (1986), leading variables of six and twelve months are also included in the model to capture the change in current stock prices which anticipate future economic activity.

Due to the large number of variables in the model, a series of stepwise regressions were run to select the regressors. The left and right panels of Table 5.7 report the results using growth rates and innovations of the macroeconomic variables, respectively, as the explanatory variables. The market tends to be positively related to the U.S. composite leading index, lagged industrial production, lagged building permits, lagged price changes in labor cost, money supply, unexpected inflation and average workweek. The unexpected change in the risk premium is positive but not significant. A negative relationship exists between the market

and exchange rates, term structure, lagged exports, labor income, and lagged GDP. These results are generally consistent with previous studies. Together, these factors explained approximately twenty percent of the variation in the returns on the market.

Please place Table 5.7 about here.

The selected variables using portfolio returns include the U.S. composite leading index (USINDEX), Cdn/US exchange rate (EX), lagged industrial production (LINDUS), term structure (TERM), unexpected inflation (UNINFL), risk premium (RISK), lagged GDP (LGDP), and residual market factor (RMF). The correlations between these innovations and the RMF are reported in Table 5.8. The RMF's are calculated using equation (5.4) for the TSE 300, and the E-W and V-W TSE/Western indices. Compared to Chen, Roll and Ross (1986), the correlations between the innovations are low. Thus, multicollinearity does not appear to be a problem for this set of factors.

Please place Table 5.8 about here.

5.5.3 Model Estimation Results

The estimated risk premia for the general factor pricing model [equation (5.7)] are reported in Table 5.9 for alternative RMF's for both nonlinear ordinary least squares (NOLS) and nonlinear seemingly unrelated regression (NSUR)

with a full error covariance matrix. The remarkable differences in the results confirm the importance of accounting for residual covariances in asset pricing studies.[24] Over the total sample period, the most significant priced factors are unexpected changes in the term structure (TERM), risk premium (RISK), inflation (UNINFL), lagged industrial production (LINDUS) and lagged GDP (LGDP). Unexpected changes in the U.S 12 leading indicators (USINDEX) and Cdn/US exchange rate (EX) lack the power to explain the cross-sectional differences in excess returns. The residual market factor (RMF), when proxied by the TSE300 index and the V-W index, has a positive but insignificant risk premium. The E-W index RMF has a positive risk premium which is significant at the 0.10 level. As noted by Chen, Roll and Ross (1986), an E-W index may be priced differently from a V-W index in the presence of macrovariables. They found that the V-W NYSE index has a negative (but insignificant) risk premium, while the E-W NYSE index has a positive (but insignificant) risk premium for the total period and each subperiod. In contrast, McElroy and Burmeister (1988), and Brown and Otsuki (1989) report a positive and significant risk premium for the RMF of an E-W index. These results also appear to be sensitive to the number of equations in the estimated system. An earlier test using five, ten, and twenty size-ranked portfolios produced insignificant risk premia estimates. Thus, the significance of the estimates appears to be sensitive to the number of

equations included in the system.

Please place Table 5.9 about here.

To investigate the behaviour of the risk premia over time, the risk premia were estimated for each of the subperiods. Based on Table 5.9, the largest changes for the risk premia estimates occur for two macrofactors, EX and LGDP. In contrast, the estimates for USINDEX, TERM, LINDUS, UNINFL, RISK and RMF preserve the same sign in each subperiod.

Based on Table 5.10, the largest estimated factor loadings occur for the RMF (for each of the three market indices) and USINDEX [as in Chen, Roll and Ross (1986)]. This result suggests that the RMF explains the major portion of the intertemporal movement in security returns. When these two factors are deleted from the model, the R-square values are reduced from a range of 0.14 to 0.54 to a range of 0.05 to 0.10. Since few differences exist between the NOLS and NSUR estimates, accounting for the residual covariances appears to primarily affect the estimates in the cross-sectional restrictions rather than of the factor loadings. The finding that the factor loadings are time-varying confirms the factor analytic results reported in the literature [e.g., Cho and Taylor (1987)].

Please place Table 5.10 about here.

5.5.4 Seasonality of the Model Estimates

By adding a dummy variable to the model, whether or not the APT can explain the January or October anomaly can be investigated. An initial run did not allow for a "price" for January [i.e., equation (5.8) was estimated without imposing a cross-sectional restriction on the January dummy]. The result was that the estimated RMF risk premium turned negative, as reported in Burmeister and McElroy (1988). Equation (5.8) was then re-estimated allowing for risk premia for the seasonal dummies. Based on Table 5.11, the January dummy has a significantly negative risk premium and significantly positive factor loadings for the whole period. These results are attenuated during the subperiods of 1967-77. The estimated risk premium and factor loadings for the January dummy are not significantly different from zero for 1977-88 for the TSE 300 and V-W index RMF's. This is consistent with the results for the three market indices presented earlier.

Please place Table 5.11 about here.

Estimates of the risk premium and factor loadings for the October dummy are insignificant for the total sample period. This result is inconsistent with that reported by Cadsby (1988) using daily TSE returns. Based on the dummy variable estimates, October yields a negative risk premium, which is marginally significant only during the 1978-88 subperiod.

To investigate whether the January and October seasonals are related to the macrofactors, equation (5.8) was estimated by adding one dummy variable at a time and comparing the new estimates with the estimates obtained earlier for equation (5.7). The null hypothesis is that, if the seasonal dummy is related to one or more macrofactors, then the estimates of these factors should be suppressed when a dummy variable is added to the model. The estimated risk premia and mean factor loadings for the alternative RMF's are reported in Tables 5.12 and 5.13, respectively. The RMF risk premium is most significantly affected by the inclusion of a January dummy. The drop in the market risk premium is 11.7, 16.1 and 12.3 percent for the TSE300, the V-W TSE/Western index, and the E-W TSE/Western index, respectively. The estimates for the other macrofactors are generally unaffected. This result suggests that the January seasonal remains a market phenomenon, and that the macrofactors employed in this study exhibit little power to explain this anomaly. The estimates with and without an October dummy are basically similar. This corroborates with the results reported earlier that an insignificant October effect occurred over the thirty-year period 1956-88.

Please place Tables 5.12 and 5.13 about here.

5.6 CONCLUDING REMARKS

This chapter tests for seasonality in the growth rates and innovations of a number of macroeconomic variables. Only

seven macroeconomic variables exhibit strong seasonality. The macroeconomic variables selected in a stepwise regression based on the returns for fifty size-ranked portfolios were lagged industrial production, lagged GDP, term structure, unexpected inflation, risk premium, U.S. composite index, Cdn/US foreign exchange rate, and the residual market factors (RMF's) for three indices. As was found by Chen, Roll and Ross (1986), the first five macrofactors have significantly priced risk premia. The risk premium for the RMF is positive but not significant when the RMF is calculated using the TSE300 or the V-W TSE/Western index, and only marginally significant (at the 0.10 level) when calculated using the E-W TSE/Western index. This result is somewhat consistent with McElroy and Burmeister (1988) and Brown and Otsuki (1989) who use a RMF for an E-W index.

The largest estimated factor loadings occurred for the RMF and the U.S. composite index of twelve leading indicators [as in Chen, Roll and Ross (1986)]. While the estimated RMF risk premium is significantly affected by the inclusion of a January dummy, the estimates for the other macrofactors are generally unaffected. This implies that the January seasonal remains a market phenomenon, and that the macrofactors employed in this study exhibit little power to explain this anomaly.

CHAPTER SIX: MAJOR FINDINGS, IMPLICATIONS AND DIRECTIONS FOR FUTURE RESEARCH

This thesis investigated stock market anomalies around stock split ex-dates, the contrarian investment strategy and the January seasonality for the Canadian stock market. The major findings of this thesis can be summarized as follows: first, no statistically significant abnormal returns are identified around stock split ex-dates when the increase in the time-varying conditional residual variance is allowed to shift to a new regime on the split ex-date. The increase in the measured variance of returns is found to be significantly related to the change in the relative bid-ask spread and trading volume. The increase in the systematic risk of splitting stocks on the split ex-dates is found to be attributed to the increase in the measured variance of returns on the split ex-dates. These results explain the anomalies observed around stock split ex-dates in Canadian (and probably U.S.) markets.

Second, no significant evidence of a profitable contrarian strategy exists for the Canadian stock market. The return differences between winners and losers for Canada are much smaller than those found for the United States. Unlike the U.S market, significant continuation behaviours are found for one- (and often two-) year test periods for winners and losers in the Canadian market. Nonsignificant return reversal behaviours are also found for split (and control) stocks for

the post-split announcement periods. This result only qualitatively (and not statistically) supports the overreaction hypothesis. The evidence only weakly supports the hypothesis of manager overreaction.

Third, the seasonality in the growth rates and innovations of a number of macroeconomic variables are unable to explain the January seasonal exhibited in Canadian stock returns. The estimated risk premium for the residual market factor (RMF) for the APT is significantly affected by the inclusion of a January dummy, while the estimates for the other macroeconomic factors are generally unaffected. This implies that the January seasonal remains a market phenomenon, and that the macroeconomic factors employed herein exhibit little power to explain this anomaly.

Several directions for future research emerge from this research. First, the research methodology employed herein for stock split ex-dates should be applied to the American data. Since that database contains more than a thousand stock split events, it will provide additional evidence on the robustness of the results reported herein for other markets. Second, shorter investment horizons should be examined to test the contrarian investment strategy. For a horizon as short as a few days, the risk (or size) of a firm is unlikely to change significantly. Also, seasonalities related to monthly returns will also not be a problem for such tests. If a contrarian investment strategy is found to be profitable for shorter time

horizons, other factors may be important in explaining the overreaction phenomenon. To-date, no published evidence exists on the profitability of short-horizon contrarian investment strategies for the Canadian stock market. Third, the relationships between stock returns and the macroeconomic factors should be investigated using the APT framework with time-varying risk premia. While the research reported herein assumes that the risk premia and the factor structures are stable over the estimation period, numerous studies find that both the risk premia and the factor loadings are time-varying. For example, Kryzanowski and Koutoulas (1991) find that two macroeconomic factors (namely, the Canadian/U.S. exchange rate and the Canadian composite index of leading indicators) have significant time-varying risk premia. Extending the current study to capture time variation will allow for a "better" test of seasonal anomalies for the APT.

FOOTNOTES

1. The term "anomaly" may be traced back to Kuhn (1970). Kuhn hypothesized that any normal science evolves along the following four stages: the dominance of a paradigm, the discovery of anomalies that do not conform to the paradigm, the construction of competing paradigms and the replacement of old paradigms.

2. For a survey of various explanations for stock splits, see Section 4.1 of this thesis.

3. For a survey on the January seasonal, see Section 5.1 of this thesis.

4. For more evidence on stock market regularities, see papers in Schwert (1983), Dimson (1988), and De Bondt and Thaler (1989).

5. Pure events are those events with no other important announcements in the three days around the event date, and no cash dividends declared in the previous three years.

6. For empirical evidence on the market's reaction to split announcements on the Toronto Stock Exchange during the period 1978-87, see Kryzanowski and Zhang (1991a).

7. Since no distinction is made between short- and long-term capital gains under the Canadian income tax act, no value may be attached to this type of tax option for splitting stocks in Canada. However, a less worthwhile type of tax option is still present in Canada.

8. Standard hypothesis test procedures may be invalidated given heteroscedasticity because such test procedures are based on the assumption of constant error variance.

9. For example, Chester and Jewitt (1987) demonstrate that the White consistent covariance matrix procedure is easily biased by outliers.

10. To test this assertion, the average return variances for the TSE 300 Composite Index for the pre- and post-split periods were compared. This was based on a sample of 100 split effective dates which were randomly drawn from the TSE sample. For this sample, the null hypothesis that the market returns in each period were equal could not be rejected at the five percent level (t-value of 1.07 and p-value of 0.28).

11. A beta shift is compatible with various possible combinations of changes in these two factors.

12. Another formulation to account for the effect of bid-ask spread (and trading volume) was also specified by incorporating the bid-ask spread and trading volume simultaneously on the conditional residual variance equation. Since the bid-ask spread and trading volume for this sample of stocks are correlated, ranging from -0.2545 to 0.4921, the estimates of ARCH coefficients became very large. This formulation was subsequently dropped from the final report.

13. Nineteen (three) of the individual AR's are positive (negative) and statistically significant at the 0.05 level. In contrast, when heteroscedastic-consistent standard errors are used, 79 (51) of the individual AR's are positive (negative) and statistically significant at the 0.05 level.

14. This result is robust to the deletion of the 32 splitting stocks which were interlisted on non-Canadian stock exchanges. The mean and median AR's of this sample of 165 split ex-dates are 0.0086 and 0.0023, respectively. The AR's are significant at the 0.05 level for the t-, sign- and Wilcoxon tests (p-values of 0.0004, 0.0430, and 0.0050, respectively).

15. This is the same pattern of overreaction uncovered by Kahneman and Tversky (1973) for the predictions of naive undergraduates.

16. The number of stocks with December 31 data on both prices and shares outstanding on the TSE/Western database increased over the period as follows: 137 in 1950, 194 in 1955, 255 in 1960, 296 in 1965, 369 in 1970, 444 in 1975, 988 in 1980, 1267 in 1985 and 1581 in 1988. The number increased dramatically from 444 firms in year-end 1975 to 1042 firms in year-end 1976.

17. The tests reported herein used the consistent estimates of the variances and covariances of portfolio returns under conditions of nonsynchronous trading derived by Kryzanowski and Sim (1990).

18. The overreaction hypothesis does not constrain the portfolio to be formed around split-announcement dates. The split announcement months were chosen to facilitate comparisons with the previous findings published in the literature.

19. Only 136 of the 237 stock splits had complete data for the full ten year period centered on their split announcement months.

20. The tests reported herein use the consistent estimates of the variances and covariances of portfolio returns under conditions of nonsynchronous trading derived by Kryzanowski and Sim (1990).

21. Although the CAR's are also calculated for the total sample and the five CAR-ranked portfolios of split and control stocks during the pre- and post-split periods, they are not reported herein due to space constraints. They differ from the results for the Jensen indices (α's) as follows: First, all of the CAR's are significant at the 0.05 level for the pre-split periods. Second, only the mean CAR for differences of the paired split and control stocks for the portfolio P5 is significant at the 0.05 level for pre-split periods. Third, portfolio P3 of control stocks has a negative (but not significant) CAR for the pre-split period. Fourth, the negative CAR for portfolio P5 of control stocks for the post-split period is not significant at the 0.05 level. Fifth, although mean CAR's of the differences for the paired split and control stocks for portfolios P1, P4 and P5 have a different sign for the post-split periods, none of these mean CAR's are significant at the 0.05 level.

22. The literature on day-of-the-week and day-of-the-month seasonals is not reviewed herein.

23. One measure of unexpected inflation is the innovations obtained from fitting the inflation series using a state space procedure, which is discussed subsequently. The other measure uses a variant of the Fama and Gibbons (1984) procedure.

24. Similar results have been found for options by Rahman, Kryzanowski and Sim (1987).

TABLE 2.1

The characteristics of the sample of split ex-dates for stocks listed on the Toronto Stock Exchange (TSE) are reported in this table. The closing prices P_{-1} and P_{+1} represent the closing prices one day before and after the split ex-date, respectively. On the split ex-dates, three stocks closed at less than one dollar per share, and nine stocks closed at less than five dollars per share.

Panel A: Time Series of the Number of Split Ex-dates by Year

Year	Ex-date
1978	7
1979	15
1980	23
1981	18
1982	3
1983	15
1984	20
1985	18
1986	46
1987	32
Total	197

Panel B: Distributions of the Split Factors and the Closing Stock Prices on the Days Surrounding the Split Ex-dates

	Split Factors	P_{-2}	P_{-1}	P_0	P_{+1}	P_{+2}
Number of events	197	197	197	197	197	197
Closing stock prices						
Minimum	1.33	0.230	0.320	0.110	0.110	0.115
25 percentile	2.00	23.440	23.120	10.687	10.750	10.750
Median	2.00	31.750	31.620	14.250	14.125	14.250
Mean	2.45	36.400	36.520	15.536	15.525	16.270
75 percentile	3.00	43.620	43.560	19.062	19.250	19.188
Maximum	7.00	152.000	150.000	48.375	48.750	47.750
Standard deviation	0.78	22.980	23.210	7.582	7.672	7.737

TABLE 2.2

The mean daily absolute bid-ask spread, relative bid-ask spread, trading volume and trading value for selected trading days around the split ex-dates. The absolute spread is measured in dollars, the relative spread in decimal change, the trading volume in number of shares, and the trading value in thousands of dollars. The trading value for each firm is calculated by multiplying its daily closing share price by the number of its shares traded during that day.

	Cross-sectional Means			
Event Time	Absolute Spread	Relative Spread	Trading Volume	Trading Value
-60	0.4553	0.0166	16,726	649.1
-30	0.4410	0.0154	14,537	623.6
-10	0.4479	0.0142	11,553	505.4
- 5	0.4735	0.0164	11,954	529.1
- 4	0.4634	0.0151	11,552	512.3
- 3	0.4604	0.0140	12,431	503.6
- 2	0.4376	0.0141	10,659	484.5
- 1	0.4823	0.0153	13,381	599.1
0	0.3014	0.0223	27,605	511.5
+ 1	0.3001	0.0219	29,090	504.1
+ 2	0.2692	0.0193	28,947	552.0
+ 3	0.2690	0.0204	33,164	651.6
+ 4	0.2910	0.0215	27,734	560.5
+ 5	0.2927	0.0219	27,746	593.4
+10	0.2771	0.0214	33,934	610.7
+30	0.2781	0.0183	23,993	518.6
+60	0.3088	0.0221	22,956	447.6

TABLE 2.3

The distributions of the daily absolute bid-ask spreads, relative bid-ask spreads, trading volumes and trading values, and tests of their statistical significance based on the t-, sign and Wilcoxon signed rank tests, are presented below. The pre- and post-split periods consist of the 60 trading days before and after the split effective dates, respectively. The absolute spread is measured in dollars, the relative spread in decimal change, the trading volume in number of shares, and the trading value (i.e., daily trading volume times daily closing share price) in thousands of dollars. The p-values are given in the parentheses.

	Absolute Spread			Relative Spread			Trading Volume			Trading Value		
	Pre-Split Period	Post-Split Period	Paired Diff-erence	Pre-Split Period	Post-Split Period	Paired Diff-erence	Pre-Split Period	Post-Split Period	Paired Diff-erence	Pre-Split Period	Post-Split Period	Paired Diff-erence
Panel A: Distributions of Absolute Spread, Relative Spread, Trading Volume and Trading Value												
Number	197	197	197	197	197	197	197	197	197	197	197	197
Minimum	0.0368	0.0102	-2.0508	0.0013	0.0019	-0.0049	70	99	-63,407	0.3	0.3	-2,874.9
25 Percentile	0.2627	0.1896	-0.2415	0.0044	0.0064	0.0010	617	962	134	18.7	14.5	-26.9
Median	0.3814	0.2521	-0.1073	0.0062	0.0093	0.0023	1,443	2,774	914	54.1	50.8	- 2.6
Mean	0.4591	0.2865	-0.1726	0.0076	0.0105	0.0029	3,564	6,896	3,332	188.9	181.1	- 7.8
75 Percentile	0.5445	0.3803	-0.0421	0.0093	0.0124	0.0043	3,650	6,830	3,047	202.9	255.9	15.7
Maximum	2.5487	0.7845	0.1940	0.0384	0.0499	0.0127	75,423	79,745	56,181	3,785.3	3,239.5	1,485.3
Standard Deviation	0.3011	0.1348	0.2334	0.0051	0.0064	0.0029	7,703	12,156	9,687	434.8	415.5	278.2
Panel B: Tests of Statistical Significance												
t-test			-10.38			13.82			4.83			-0.40
			(0.0000)			(0.0000)			(0.0000)			(0.6900)
Sign test												
Median			-0.1073			0.0023			914			26
Above Zero			13			176			158			82
Below Zero			184			21			39			115
			(0.0000)			(0.0000)			(0.0000)			(0.0226)
Wilcoxon Signed			543.5			18,253.0			17,250.0			8,211.0
Rank Test			(0.0000)			(0.0000)			(0.0000)			(0.0550)

TABLE 2.4

The distributions of the Abnormal Returns (AR's) for the split ex-dates, and tests of their statistical significance, for RGM(21) and three formulations of the Scholes and Williams adjustment for nonsynchronous trading are presented below. "Adj.1" allows for a one-day lead and lag in market returns, "Adj.2" allows for a one-day lag in market returns, and "Adj.3" allows for one- and two-day leads and lags in market returns. The p-values are given in the parentheses.

	Thin-trading Adjustment			
	None	Adj. 1	Adj. 2	Adj. 3
Panel A: Distribution of the AR's				
Number of events	197	197	197	197
Abnormal return (AR)				
Minimum	-0.0612	-0.0472	-0.0468	-0.0462
25 percentile	-0.0111	-0.0108	-0.0107	-0.0095
Median	0.0037	0.0025	0.0027	0.0034
Mean	0.0079	0.0077	0.0084	0.0081
75 percentile	0.0201	0.0197	0.0200	0.0190
Maximum	0.1269	0.1250	0.1197	0.1228
Standard deviation	0.0302	0.0295	0.0302	0.0291
Number positive	115	114	117	114
Number negative	82	83	80	83
Panel B: Tests of Statistical Significance				
t-test	3.6700	3.6635	3.9000	3.8900
	(0.0003)	(0.0003)	(0.0001)	(0.0001)
Sign test				
Median	0.0037	0.0025	0.0027	0.0034
Above Zero	114	113	112	116
Below Zero	83	84	85	81
p-value	(0.0326)	(0.0461)	(0.0640)	(0.0154)
Wilcoxon signed	11948.5	11943.5	12059.5	12251.0
rank test	(0.0060)	(0.0060)	(0.0040)	(0.0020)

TABLE 2.5

The distributions of the Abnormal Returns (AR's) for the split ex-dates for the RDM(2.1) with ARCH processes(2.2), (2.3) and (2.4), and tests of their statistical significance, are reported below. For the ARCH process(2.2), an ARCH (q=0) was used for 41 (21 percent) of the ex-dates, an ARCH (q=1) for 79 (40 percent) of the ex-dates, an ARCH (q=2) for 38 (19 percent) of the ex-dates, and an ARCH ($q \geq 3$) for 39 (20 percent) of the ex-dates. The distributions of the intercept estimates ($\hat{\alpha}_0^*$ and $\hat{\alpha}_0'$), the dummy variable intercept estimates ($\hat{\alpha}_{01}^*$ and $\hat{\alpha}_{01}'$) and the dummy variable slope estimates ($\hat{\alpha}_1''$, $\hat{\alpha}_2''$ and $\hat{\alpha}_3''$) for ARCH ($q \leq 3$) processes (2.3) and (2.4), and tests of their statistical significance, are also reported below. The p-values are given in the parentheses.

	ARCH Process (2.2)	ARCH Process (2.3)			ARCH Process (2.4)					
	AR	AR	$\hat{\alpha}_0^*$	$\hat{\alpha}_{01}^*$	AR	$\hat{\alpha}_0'$	$\hat{\alpha}_{01}'$	$\hat{\alpha}_1''$	$\hat{\alpha}_2''$	$\hat{\alpha}_3''$
Panel A: Distributions of the AR's, and the Intercept and Slope Coefficient Estimates										
Number of events	197	197	197	197	197	197	197	197	197	197
Abnormal return (AR)										
Minimum	-0.0501	-0.0682	-0.0198	0.0292	-0.0534	0.0081	-0.1364	-0.9938	-0.9353	-1.0018
25 percentile	-0.0100	-0.0111	0.0116	0.0060	-0.0123	0.0123	0.0004	-0.0052	0.0009	-0.0354
Median	0.0041	0.0027	0.0164	0.0112	0.0024	0.0169	0.0103	0.0923	0.1335	0.1244
Mean	0.0047	0.0033	0.0186	0.0115	0.0018	0.0190	0.0103	0.1751	0.1942	0.1649
75 percentile	0.0173	0.0163	0.0231	0.0173	0.0140	0.0241	0.0163	0.4062	0.4319	0.3781
Maximum	0.1216	0.1110	0.1050	0.0522	0.1224	0.0830	0.1527	1.5202	1.1351	1.2442
Standard deviation	0.0240	0.0278	0.0113	0.0097	0.0256	0.0107	0.0191	0.3799	0.3245	0.3399
Panel B: Tests of Statistical Significance										
t-test	2.76	1.70	23.09	16.63	0.97	24.90	7.54	6.47	8.40	6.81
	(0.0063)	(0.0910)	(0.0000)	(0.0000)	(0.3400)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Sign test										
Median	0.0041	0.0027	0.0165	0.0113	0.0024	0.0169	0.0103	0.0923	0.1335	0.1244
Above Zero	119	87	1	22	112	196	159	138	149	134
Below Zero	78	110	196	175	85	1	38	59	48	63
p-value	(0.0044)	(0.1170)	(0.0000)	(0.0000)	(0.0640)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Wilcoxon signed	11687.0	10983.0	19377.0	18617.0	10354.0	19488.0	17761.5	14929.0	16019.0	14807.0
rank test	(0.0160)	(0.1240)	(0.0000)	(0.0000)	(0.4520)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)

TABLE 2.6

The distributions of the abnormal returns (AR's) and the estimates of the coefficients of the explanatory variables ($\hat{\alpha}_1^*$ and $\hat{\alpha}_1'$) and of the intercept dummy variable of the residual variance processes (25) [(25')] and (26) [(26')], and tests of their statistical significance based on the t-, sign and Wilcoxon signed rank test, are reported below. The estimation period consists of the 121 trading days centered on the split ex-dates. The squared bid-ask spread is the relative bid-ask spread times itself. The p-values are given in the parentheses.

	Squared Relative Spread					Raw Trading Volume				
	ARCH Process (25)		ARCH Process (26)			ARCH Process (25')		ARCH Process (26')		
	AR	$\hat{\alpha}_1^*$	AR	$\hat{\alpha}_{01}'$	$\hat{\alpha}_1'$	AR	$\hat{\alpha}_1^*$	AR	$\hat{\alpha}_{01}'$	$\hat{\alpha}_1'$
Panel A: Distributions of the AR's and the Coefficient Estimates										
Number of Events	197	197	197	197	197	197	197	197	197	197
Minimum	-0.0639	-0.4048	-0.0613	-0.0066	-0.3285	-0.0556	-0.0075	-0.0689	-0.0068	-0.0180
25 Percentile	-0.0104	0.2704	-0.0116	0.0003	0.0774	-0.0097	0.0014	-0.0086	0.0010	-0.0002
Median	0.0007	0.6057	0.0003	0.0084	0.4727	0.0035	0.0042	0.0017	0.0039	0.0077
Mean	0.0046	0.6717	0.0035	0.0097	0.5027	0.0080	0.0059	0.0079	0.0053	0.0084
75 Percentile	0.0189	0.8644	0.0177	0.0153	0.7859	0.0216	0.0083	0.0199	0.0085	0.0159
Maximum	0.1083	1.1764	0.1068	0.0514	1.1045	0.1076	0.0518	0.1022	0.0315	0.0573
Standard Deviation	0.0264	0.5607	0.0287	0.0103	0.4825	0.0293	0.0072	0.0321	0.0060	0.0125
Panel B: Tests of Statistical Significance										
t-test	2.44	16.82	1.84	13.24	14.62	3.85	11.47	3.44	12.36	9.41
	(0.0160)	(0.0000)	(0.0670)	(0.0000)	(0.0000)	(0.0002)	(0.0000)	(0.0007)	(0.0000)	(0.0000)
Sign test										
Median	0.0007	0.6057	0.0003	0.0084	0.4727	0.0035	0.0042	0.0017	0.0039	0.0077
Above Zero	111	183	110	169	176	112	169	111	161	140
Below Zero	86	14	87	28	21	85	28	86	36	57
	(0.1152)	(0.0000)	(0.1170)	(0.0000)	(0.0000)	(0.0640)	(0.0000)	(0.0873)	(0.0000)	(0.0000)
Wilcoxon Signed	11124.0	19165.5	11028.0	16853.0	18540.5	12154.0	18434.0	12173.0	18106.0	16135.0
Rank Test	(0.0970)	(0.0000)	(0.1110)	(0.0000)	(0.0000)	(0.0030)	(0.0000)	(0.0030)	(0.0000)	(0.0000)

TABLE 2.7

The distributions of various beta estimates for the TSE sample of splitting stocks and tests of their statistical significance, based on the 60 trading days before and after the split ex-dates, are reported below. The OLS estimates are based on RGM(21); the S-W estimates are based on RGM(21) and nonsynchronous trading adj.1 (i.e., one trading day leads and lags in the market return); the ARCH Eq.(22) estimates are based on RGM(21) and the ARCH process (22); the ARCH Eq.(23) estimates are based on RGM(21) and the ARCH process (23); and the ARCH Eq.(24) estimates are based on RGM(21) and the ARCH process (24). The p-values are given in the parentheses.

	OLS Estimates			S-W Estimates			ARCH Eq.(22) Estimates		ARCH Eq.(23) Estimates		ARCH Eq.(24) Estimates	
	Pre-split Period	Post-split Period	Paired Differences	Pre-split Period	Post-split Period	Paired Differences	Pre-split Period	Paired Differences	Pre-split Period	Paired Differences	Pre-split Period	Paired Differences
Panel A: Distributions of the Beta Estimates												
Number of events	197	197	197	197	197	197	197	197	197	197	197	197
Beta estimates												
Minimum	-2.5158	-1.7396	-1.2396	-1.2007	-0.9572	-1.8517	-3.5533	-1.7125	-1.7823	1.8767	-1.1955	-3.2131
25 percentile	0.3008	0.3086	-0.3867	0.3386	0.3528	-0.4608	0.2283	-0.4902	0.2492	-0.4444	0.3431	-0.3623
Median	0.6943	0.7507	0.0987	0.7769	0.9120	0.1249	0.6691	0.0335	0.7185	0.0057	0.7359	0.0292
Mean	0.7240	0.8631	0.1391	0.8451	0.9948	0.1497	0.7176	0.0223	0.7248	0.0844	0.7775	0.0993
75 percentile	1.0919	1.3287	0.6860	1.2742	1.4821	0.7462	1.1924	0.4615	1.1735	0.6182	1.0945	0.5839
Maximum	3.4500	4.3647	1.8501	4.2199	4.5568	2.0012	4.3666	1.8975	3.4446	2.1073	5.0713	2.0123
Standard deviation	0.7239	0.8730	0.7747	0.7131	0.9057	0.8438	0.8016	0.9015	0.7374	0.7605	0.7293	0.7758
Panel B: Tests of Statistical Significance												
t-test			2.5200			2.4901		0.3510		1.56		1.80
			(0.0120)			(0.0140)		(0.7300)		(0.1200)		(0.0740)
Sign test												
Median			0.0987			0.1249		0.0249		0.0057		0.0292
Above Zero			111			112		99		100		103
Below Zero			86			85		98		97		94
p-value			(0.0873)			(0.0640)		(1.0000)		(0.8867)		(0.5203)
Wilcoxon signed rank test			11716.0			11565.5		9930.0		10634.0		10884.0
			(0.0140)			(0.0240)		(0.8240)		(0.2710)		(0.1220)

TABLE 2.8

The distributions of the estimates of the pre-split betas and the paired differences between the pre-split and post-split betas, and tests of their statistical significance based on the t-, sign and Wilcoxon signed rank test, are reported below. The estimation periods consist of the 121 trading days centered on the split ex-dates. The residual variances are modelled using two different ARCH processes [specifically (25) or (25') and (26) or (26')]. The squared spread is the relative bid-ask spread times itself. The p-values are given in the parentheses.

	Squared Relative Spread				Trading Volume			
	ARCH Process (25)		ARCH Process (26)		ARCH Process (25')		ARCH Process (26')	
	Pre-Split Period	Paired Differences	Pre-Split Period	Paired Differences	Pre-Split Period	Paired Differences	Pre-Split Period	Paired Differences
Panel A: Distribution of the Beta Estimates								
Number of Events	197	197	197	197	197	197	197	197
Beta Estimates								
Minimum	-1.8650	-1.9394	-1.6225	-1.9880	-1.7847	-2.1041	-1.6328	-2.1100
25 Percentile	0.2520	-0.3623	0.2734	0.4272	0.2887	-0.4213	0.2730	-0.3917
Median	0.6779	0.0769	0.6823	0.0575	0.6271	0.0658	0.6434	0.0911
Mean	0.7197	0.0858	0.7322	0.0603	0.6731	0.0548	0.6650	0.1180
75 Percentile	1.1662	0.5268	1.1851	0.4336	1.0445	0.6063	1.0748	0.6490
Maximum	3.4622	2.0610	3.8586	1.9401	3.6712	2.4241	3.1318	2.2887
Standard Deviation	0.7043	0.7050	0.7291	0.6943	0.6740	0.9222	0.6710	0.9088
Panel B: Tests of Statistical Significance								
t-test		1.71		1.22		0.83		1.82
		(0.0890)		(0.2200)		(0.4100)		(0.0700)
Sign test								
Median		0.0769		0.0575		0.0658		0.0911
Above Zero		107		108		104		109
Below Zero		90		89		93		88
		(0.2543)		(0.1997)		(0.4762)		(0.1542)
Wilcoxon Signed Rank Test		11147.5		10717.0		10799.0		11581.0
		(0.0825)		(0.2280)		(0.1910)		(0.0820)

TABLE 2.9

The distributions of the variances of return for the TSE sample of splitting stocks and tests of their statistical significance, based on the 60 trading days before and after the split ex-dates, are presented in this table. The p-values are given in the parentheses.

	Variances		
	Pre-split Period	Post-split Period	Paired Differences
Panel A: Distributions of the Variance Estimates			
Number of dates	197	197	197
Variances			
Minimum	0.000009	0.000029	-0.00295
25 percentile	0.000123	0.000190	-0.00001
Median	0.000199	0.000291	0.00001
Mean	0.000339	0.000437	0.00011
75 percentile	0.000347	0.000477	0.00023
Maximum	0.004818	0.005204	0.00410
Standard deviation	0.000570	0.000511	0.00056
Panel B: Tests of Statistical Significance			
t-test			2.73
			(0.0070)
Sign test			
Median			0.0001
Above Zero			138
Equal Zero			0
Below Zero			59
p-value			(0.0000)
Wilcoxon signed rank test			14451.5
			(0.0000)

TABLE 2.10

The distributions of the covariances and correlation coefficients of return for the TSE sample of splitting stocks, based on the 60 trading days before and after the split ex-dates, are presented in this table. The p-values are given in the parentheses.

	Covariances			Correlation Coefficients		
	Pre-split Period	Post-split Period	Paired Differences	Pre-split Period	Post-split Period	Paired Differences
Panel A: Distributions of the Covariance Estimates and the Correlation Coefficient Estimates						
Number of events	197	197	197	197	197	197
Covariances/Correlations						
Minimum	-0.000021	-0.000040	-0.000260	-0.389	-0.228	-0.368
25 percentile	0.000005	0.000006	-0.000015	0.098	0.091	-0.164
Median	0.000013	0.000014	0.000004	0.221	0.224	-0.040
Mean	0.000026	0.000039	0.000013	0.249	0.245	-0.004
75 percentile	0.000027	0.000031	0.000025	0.378	0.370	0.140
Maximum	0.000322	0.000776	0.000760	0.801	0.845	0.408
Standard deviation	0.000044	0.000098	0.000100	0.214	0.221	0.225
Panel B: Tests of Statistical Significance						
t-test			1.8239			-0.2400
			(0.0688)			(0.8100)
sign test						
Median			0.000004			-0.040
Above Zero			107			97
Below Zero			90			100
p-value			(0.2543)			(0.8867)
Wilcoxon signed			11214.0			100053.0
rank test			(0.0680)			(0.7070)

TABLE 2.11

Diagnostic tests for the error terms of RGM(2.1) and ARCH processes (2.2), (2.3) and (2.4) which use squared error terms, (2.5) and (2.6) which use squared relative bid-ask spreads and (2.5') and (2.6') which use raw trading volumes as explanatory variables in the conditional residual variance equation. "Normal" is the Kolmogorov-Smirnov test of normality, where the critical value at the 0.05 level is 0.0800. "Q(10)" is the Ljung-Box test of the autocorrelations of error terms for ten lags, where the critical value at the 0.05 level is 18.3070. "$Q^2(10)$" is the Ljung-Box test of the autocorrelations of the squared error terms for ten lags. Cross-sectional average test statistics are reported in the parentheses. The number of equations that are significant at the 0.05 level are reported in the braces.

Equation	Skewness	Kurtosis	Normal	Q(10)	$Q^2(10)$
(2.1)	0.4519 (0.6192)	3.3675 (1.4173)	0.0821 (0.0301) {104}	6.9210 (4.8831) {2}	11.7820 (7.9050) {54}
(2.2)	0.4105 (0.3219)	3.0802 (1.0501)	0.0795 (0.0309) {92}	5.8600 (5.1500) {2}	6.2010 (5.4413) {2}
(2.3)	0.4230 (0.3308)	3.1224 (1.1783)	0.0806 (0.0307) {99}	5.0044 (6.2100) {2}	6.7005 (5.8126) {2}
(2.4)	0.4184 (0.3393)	3.1609 (1.2452)	0.0801 (0.0304) {102}	6.2300 (5.8800) {2}	6.6410 (5.7700) {2}
(2.5)	0.3935 (0.3790)	3.0993 (1.4834)	0.0790 (0.0299) {94}	7.1800 (5.0020) {7}	8.5500 (5.6914) {6}
(2.6)	0.4026 (0.3883)	3.1141 (1.5246	0.0805 (0.0300) {97}	7.9110 (5.4100) {6}	8.7920 (5.7080) {6}
(2.5')	0.3884 (0.3115)	3.1650 (1.5906)	0.0794 (0.0280) {102}	8.2990 (5.3820) {9}	9.4120 (5.6000) {8}
(2.6')	0.3902 (0.3261)	3.0084 (1.6103)	0.0802 (0.0293) {102}	8.1280 (5.1540) {7}	9.6820 (5.8400) {8}

TABLE 3.1

Summary statistics on the distributions of the closing prices at the end of the formation periods for the Winner and Loser subsamples and the Total sample of all stocks are reported below.

	Portfolio Formation Period (months)					
Closing Prices	12	24	36	60	96	120
Panel A: Winner Subsample						
Minimum	0.025	0.055	0.070	0.120	0.320	0.850
25 percentile	1.400	1.900	1.865	4.650	6.220	7.575
Mean	11.075	12.800	16.680	16.850	18.250	24.135
Median	5.250	7.000	8.625	11.625	12.125	16.625
75 percentile	14.220	16.935	16.500	22.720	23.750	31.065
Maximum	270.000	242.000	204.000	163.000	148.250	198.000
Standard deviation	18.395	12.797	16.681	19.991	22.093	30.936
Panel B: Loser Subsample						
Minimum	0.010	0.050	0.065	0.105	0.080	0.170
25 percentile	0.900	0.935	1.035	1.550	3.213	3.275
Mean	7.942	8.110	8.027	8.433	14.570	14.137
Median	2.950	3.250	3.750	4.500	8.125	11.000
75 percentile	9.375	10.500	10.000	13.625	21.500	16.875
Maximum	748.000	150.000	99.000	82.000	66.875	66.500
Standard deviation	21.361	12.859	8.027	9.332	15.558	14.137
Panel C: Total Sample of All Stocks						
Minimum	0.010	0.030	0.010	0.028	0.050	0.100
25 percentile	3.700	3.850	3.800	3.800	4.375	5.281
Mean	16.896	17.273	17.403	17.338	16.047	19.407
Median	10.850	11.000	11.000	11.000	10.625	12.750
75 percentile	22.500	22.750	23.000	23.000	24.000	24.000
Maximum	1500.000	1500.000	1500.000	900.000	700.000	900.000
Standard deviation	27.304	30.290	31.766	27.237	24.420	31.202
No. of stocks	22633	10260	6916	3897	2113	1645
No. of independent replications	38	18	12	7	4	3

TABLE 3.2

The Cumulative Abnormal Returns (CAR's) for the formation and test periods for the Winners (W), Losers (L) and Arbs (A) (i.e., Losers-minus-Winners), and tests of their statistical significance, are reported below. The CAR are market-adjusted returns calculated using equation (31). The t-statistics are reported in the parentheses. An "a", "b" and "c" represents statistical significance at the 0.10, 0.05 and 0.01 levels, respectively. The statistical significance of the median is tested using the sign test. The last replication for each of the test periods of 60, 90 and 120 months has one less year of data.

	Portfolio Formation/Test Period (months)					
Portfolio/ Statistic	12	24	36	60	96	120
Panel A: Formation Period						
Mean CAR_W	0.7346	1.1233	1.2020	1.5283	1.8900	2.2050
	(18.8200)^c	(13.6200)^c	(12.0000)^c	(12.0900)^c	(6.9600)^c	(5.3500)^b
Mean CAR_L	-0.5624	-0.7858	-0.9183	-1.1437	-1.2070	-1.2526
	(-25.1600)^c	(-12.4500)^c	(-26.2400)^c	(-23.9300)^c	(-23.9700)^c	(-30.0000)^c
Mean CAR_A	-1.2971	-1.9091	-2.1200	-2.6720	-3.0980	-3.4570
	(-26.7500)^c	(-18.5600)^c	(-18.5800)^c	(-23.9900)^c	(-13.0500)^c	(-8.9300)^c
Median CAR_A	-1.2490^c	-1.8840^c	-2.0080^c	-2.2623^b	-2.8510	-2.9312
Wilcoxon	741.0^c	171.0^c	78.0^c	21.0^b	10.0^a	6.0
No. of independent replications	38	18	12	7	4	3
Panel B: Test Period						
Mean CAR_W	0.1276	0.0939	-0.0283	-0.0361	-0.1260	-0.5800
	(4.4600)^c	(1.8800)^a	(-0.2100)	(-0.5182)	(-1.3052)	(-3.4300)^a
Mean CAR_L	-0.0475	0.0196	0.1200	0.2935	0.3044	0.3400
	(-1.800)^a	(0.5400)	(1.7020)	(4.5200)^c	(1.6021)	(1.4900)
Mean CAR_A	-0.1751	-0.0742	0.1483	0.3218	0.4304	0.9200
	(-4.4900)^c	(-1.6500)	(1.8000)^a	(1.9400)^a	(2.1300)^a	(2.6400)^a
Median CAR_A	-0.1583 ^{c}	-0.0587	0.1266	0.3060	0.4000	0.8600
Wilcoxon	96.0^c	56.0	41.0	19.0	10.0	6.0
No. of independent replications	38	18	12	7	4	3

TABLE 3.3

The Jensen Performance Indices ($\hat{\alpha}$'s) for the formation and test periods for the Winners (W), Losers (L) and Arbs (A) (i.e., Losers-minus-Winners), and tests of their statistical significance, are reported below. The indices are obtained by estimating equation (32). The U-statistics, which are the t-statistics aggregated over the independent replications for given formation/test period lengths using equation (38), are reported in the braces; and the t-statistics are reported in the parentheses. An "a", "b" and "c" represents statistical significance at the 0.10, 0.05 and 0.01 levels, respectively. The statistical significance of the median is tested using the sign test. The U-statistics are adjusted for the absence of one year of data for the last replication for each of the test periods of 60, 90 and 120 months.

Portfolio/ Statistic	Portfolio Formation/Test Period (months) 12	24	36	60	96	120
Panel A: Formation Period						
Mean $\hat{\alpha}_W$	0.0506	0.0359	0.0277	0.0193	0.0144	0.0139
	{4.2476}^{c}	{17.9226}^{c}	{13.9141}^{c}	{8.2873}^{c}	{14.4683}^{c}	{7.0561}^{c}
Mean $\hat{\alpha}_L$	-0.0445	-0.0327	-0.0250	-0.0189	-0.0123	-0.0096
	{-4.8003}^{c}	{-22.6868}^{c}	{-17.9981}^{c}	{-15.1000}^{c}	{-7.9786}^{c}	{-6.9425}^{c}
Mean $\hat{\alpha}_A$	-0.0951	-0.0687	-0.0527	-0.0382	-0.0267	-0.0235
	(-20.9300)^c	(-22.7400)^c	(-24.0000)^c	(-12.7000)^c	(-18.4500)^c	(-13.2100)^c
Median $\hat{\alpha}_A$	-0.0933^c	-0.0629^c	-0.0509^c	-0.0412^b	-0.0261	-0.0195
Wilcoxon	157.0^c	138.0^c	72.0^c	21.0^b	10.0^a	6.0
No. of independent replications	38	18	12	7	4	3
Panel B: Test Period						
Mean $\hat{\alpha}_W$	0.0063	0.0021	-0.0008	-0.0011	-0.0025	-0.0062
	{0.5271}	{0.5401}	{-0.3185}	{-0.4025}	{-1.1000}	{-2.6929}
Mean $\hat{\alpha}_L$	-0.0073	-0.0061	0.0017	0.0033	0.0034	0.0039
	{-0.7959}	{-1.3224}	{1.6514}	{1.9187}	{1.9024}	{2.7239}
Mean $\hat{\alpha}_A$	-0.0137	-0.0037	0.0003	0.0044	0.0059	0.0101
	(-4.0000)	(-1.6600)	(1.4042)	(1.6800)	(1.7200)	(4.0400)
Median $\hat{\alpha}_A$	-0.0133^c	-0.0039	0.0002	0.0041	0.0050	0.0084
Wilcoxon	132.0^c	52.5	46.0	17.0	9.0	6.0
No. of independent replications	38	18	12	7	4	3

TABLE 3.4

The Transformed Sharpe Performance Indices ($\hat{Sh}$) for the formation and test periods for the Winners (W) versus Market (M), the Losers (L) versus the Market (M) and the Losers (L) versus the Winners (W), and the JK tests of their statistical significance, are reported below. The $\hat{Sh}$ values are calculated using equation (34). The Z-statistics are calculated using equation (36). The U*-statistics, which are the Z-statistics aggregated over the replications for specific formation/test period lengths using equation (39), are reported in the braces. An "a", "b" and "c" represents statistical significance at the 0.10, 0.05 and 0.01 levels, respectively. The U*-statistics are adjusted for the absence of one year of data for the last replication for each of the test periods of 60, 90 and 120 months.

Portfolio/ Statistic	Portfolio Formation/Test Period (months) 12	24	36	60	96	120
Panel A: Formation Period						
$\hat{Sh}_{W,M}$	0.0020	0.0014	0.0010	0.0006	0.0004	0.0004
	{2.8067}^{c}	{2.9416}^{c}	{2.9553}^{c}	{2.0953}^{b}	{2.1489}^{b}	{1.9196}^{a}
$\hat{Sh}_{L,M}$	-0.0019	-0.0015	-0.0011	-0.0009	-0.0006	-0.0005
	{-3.9758}^{c}	{-4.9131}^{c}	{-5.1877}^{c}	{-5.6338}^{c}	{-4.8321}^{c}	{-4.9042}^{c}
$\hat{Sh}_{L,W}$	-0.0061	-0.0045	-0.0032	-0.0023	-0.0015	-0.0012
	{-4.0572}^{c}	{-4.7322}^{c}	{-4.9281}^{c}	{-4.6323}^{c}	{-4.2284}^{c}	{-4.0118}^{c}
No. of independent replications	38	18	12	7	4	3
Panel B: Test Period						
$\hat{Sh}_{W,M}$	0.0002	-0.0000	-0.0001	-0.0001	-0.0003	-0.0004
	{0.1973}	{-0.3004}	{-0.5771}	{-0.5127}	{-0.9651}	{-2.1301}^{b}
$\hat{Sh}_{L,M}$	-0.0005	-0.0002	-0.0001	0.0001	0.0001	0.0001
	{-1.1057}	{-0.6354}	{-0.3806}	{0.1738}	{0.3865}	{0.6458}
$\hat{Sh}_{L,W}$	-0.0009	-0.0002	0.0002	0.0003	0.0004	0.0007
	{-0.8577}	{-0.2038}	{0.2366}	{0.7263}	{1.4962}	{2.4506}^{b}
No. of independent replications	38	18	12	7	4	3

TABLE 3.5

The estimated betas ($\hat{\beta}_{i1}$) for the formation periods and the estimated changes in the betas ($\hat{\beta}_{i2}$) for the test periods for the Winner (W), Loser (L) and arbitrage (L-W) portfolios, and tests of their statistical significance, are reported below. The beta estimates are calculated using equation (32). The U-statistics, which are the t-statistics aggregated over the independent replications for given formation/test period lengths using equation (38), are reported in the braces; and the t-statistics are reported in the parentheses. An "a", "b" and "c" represents statistical significance at the 0.10, 0.05 and 0.01 levels, respectively. The statistical significance of the median is tested using the sign test. The U-statistics are adjusted for the absence of one year of data for the last replication for each of the test periods of 60, 90 and 120 months.

Portfolio/ Statistic	Portfolio Formation/Test Period (months) 12	24	36	60	96	120
Panel A: Formation Period						
Mean $\hat{\beta}_{W1}$	1.7407	1.6439	1.5483	1.5265	1.5449	1.4461
	{5.9089}^{c}	{16.0700}^{c}	{13.1400}^{c}	{15.8120}^{c}	{10.1500}^{c}	{10.6300}^{c}
Mean $\hat{\beta}_{L1}$	0.9952	1.1014	1.0359	1.0467	0.9448	0.9262
	{4.5167}^{c}	{14.7100}^{c}	{15.8200}^{c}	{15.1300}^{c}	{10.0308}^{c}	{20.9800}^{c}
Mean ($\hat{\beta}_{L1}-\hat{\beta}_{W1}$)	-0.7455	-0.5425	-0.5123	-0.4797	-0.6001	-0.5199
	(-5.3400)^c	(-3.9900)^c	(-3.2000)^c	(-3.3200)^b	(-8.6200)^c	(-3.2400)^a
Median ($\hat{\beta}_{L1}-\hat{\beta}_{W1}$)	-0.6280^c	-0.4780^c	-0.5800^b	-0.3905^b	-0.5706	-0.4090
Wilcoxon	61.0^c	16.0^c	6.0^c	4.0^b	2.0^a	1.0
No. of independent replications	38	18	12	7	4	3
Panel B: Test Period						
Mean $\hat{\beta}_{W2}$	-0.2374	-0.2246	-0.1624	-0.3163	-0.2462	-0.1583
	{-4.8290}^{c}	{-2.6776}^{c}	{-2.1991}^{b}	{-3.4535}^{c}	{-2.2935}^{b}	{-1.8124}^{a}
Mean $\hat{\beta}_{L2}$	0.1859	0.0724	0.1097	-0.0283	0.0042	-0.0675
	{4.3080}^{c}	{1.2000}	{1.4800}	{-0.8780}	{0.6909}	{-1.4707}
Mean ($\hat{\beta}_{L2}-\hat{\beta}_{W2}$)	0.4234	0.2971	0.2721	0.2879	0.2504	0.0908
	(3.1800)^c	(2.6200)^b	(3.9900)^c	(1.4500)	(1.3500)	(0.4100)
Median ($\hat{\beta}_{L2}-\hat{\beta}_{W2}$)	0.5950^c	0.3535	0.3392	0.2224	0.1390	0.1624
Wilcoxon	574.0^c	138.0^b	72.0^c	17.0	7.0	4.0
No. of independent replications	38	18	12	7	4	3

TABLE 3.6

The estimated variances for the formation (Var_F), test (Var_T) and formation minus-test periods (VAR_{F-T}) for the Winner (W) and Loser (L) portfolios, and tests of their statistical significance, are reported below. The t-statistics are reported in the parentheses. An "a", "b" and "c" represents statistical significance at the 0.10, 0.05 and 0.01 levels, respectively. The statistical significance of the median is tested using the sign test.

Portfolio/ Statistic	Portfolio Formation/Test Period (months) 12	24	36	60	96	120
Panel A: Winner Portfolios						
Mean Var_F	0.0087	0.0075	0.0070	0.0065	0.0062	0.0061
Mean Var_T	0.0065	0.0064	0.0059	0.0045	0.0047	0.0045
Mean (Var_F-Var_T)	-0.0023 (-1.4100)	-0.0011 (-0.6500)	-0.0011 (-0.6600)	-0.0021 (-1.5800)	-0.0015 (-0.5600)	-0.0016 (-3.8100)
Median (Var_F-Var_T)	0.0020	-0.0009	-0.0010	-0.0018	-0.0012	-0.0010
Wilcoxon	289.0	62.0	30.0	15.0	5.0	3.0
No. of independent replications	38	18	12	7	4	3
Panel B: Loser Portfolios						
Mean Var_F	0.0025	0.0033	0.0029	0.0026	0.0019	0.0016
Mean Var_T	0.0041	0.0037	0.0035	0.0033	0.0030	0.0026
Mean (Var_F-Var_T)	0.0016 (2.6100)[c]	0.0005 (0.7000)	0.0006 (0.7744)	0.0006 (1.3000)	0.0011 (1.2100)	0.0093 (0.9700)
Median (Var_F-Var_T)	0.0013	0.0003	0.0004	0.0006	0.0008	0.0008
Wilcoxon	586.0[c]	104.0	50.0	16.0	8.0	2.0
No. of independent replications	38	18	12	7	4	3

TABLE 3.7

The Jensen Performance Indices ($\hat{\alpha}$'s) for January ($\hat{\alpha}_{i3}$), the other months ($\hat{\alpha}_{i4}$) and January-minus-the-other-months ($\hat{\alpha}_{i3}-\hat{\alpha}_{i4}$) for the test period for the Winners and Losers, and tests of their statistical significance, are reported below. The indices are obtained by estimating equation (37). The U-statistics, which are the t-statistics aggregated over the independent replications for given formation/test period lengths using equation (38), are reported in the braces; and the t-statistics are reported in the parentheses. An "a", "b" and "c" represents statistical significance at the 0.10, 0.05 and 0.01 levels, respectively. The statistical significance of the median is tested using the sign test. The U-statistics are adjusted for the absence of one year of data for the last replication for each of the test periods of 60, 90 and 120 months.

Portfolio/ Statistic	Portfolio Formation/Test Period (months) 12	24	36	60	96	120
Panel A: Winner Portfolio						
Mean $\hat{\alpha}_{i3}$	0.0727	0.0315	0.0277	0.0012	-0.0039	-0.0105
	{2.2402}^{b}	{4.5832}^{c}	{3.4283}^{c}	{0.6308}	{-0.8154}	{-0.8154}
Mean $\hat{\alpha}_{i4}$	0.0020	-0.0004	-0.0023	-0.0014	-0.0017	-0.0058
	{0.2407}	{-0.8502}	{-1.4902}	{-0.3925}	{-1.0865}	{-1.0865}
Mean ($\hat{\alpha}_{i4}-\hat{\alpha}_{i3}$)	-0.0707	-0.0319	-0.0300	-0.0026	0.0022	0.0047
	(-6.6100)^c	(-3.2700)^c	(-2.8800)^b	(-0.4100)	(0.4400)	(1.5700)
Median ($\hat{\alpha}_{i4}-\hat{\alpha}_{i3}$)	-0.0486^c	0.0202^c	-0.0339	-0.0024	0.0026	0.0044
Wilcoxon	715.0^c	155.0^c	66.0^b	11.0	2.0	3.0
No. of independent replications	38	18	12	7	4	3
Panel B: Loser Portfolios						
Mean $\hat{\alpha}_{i3}$	-0.0615	-0.0009	0.0057	0.0121	0.0025	0.0010
	{-1.4883}	{-0.0158}	{1.2674}	{1.8032}^{a}	{0.5419}	{0.1116}
Mean $\hat{\alpha}_{i4}$	-0.0072	-0.0016	-0.0002	0.0026	0.0037	0.0041
	{-0.5094}	{-1.1851}	{-0.2454}	{1.2692}	{1.3323}	{2.4449}^{b}
Mean ($\hat{\alpha}_{i4}-\hat{\alpha}_{i3}$)	0.0543	-0.0007	-0.0059	-0.0095	0.0012	0.0031
	(4.6700)^c	(-0.0800)	(-0.8100)	(-0.6100)	(1.0600)	(0.4200)
Median ($\hat{\alpha}_{i4}-\hat{\alpha}_{i3}$)	0.0478^c	-0.0009	-0.0062	-0.0082	0.0009	0.0029
Wilcoxon	153.0^c	89.0	51.0	12.0	5.0	1.0
No. of independent replications	38	18	12	7	4	3

TABLE 3.8

The Cumulative Abnormal Returns (CAR's) for formation and test periods of 36 months for the size-based portfolios of Winners (W), Losers (L) and Arbs (A), and tests of their statistical significance, are reported below. The CAR are market-adjusted returns calculated using equation (3.1). The t-statistics are reported in the parentheses. An "a", "b" and "c" represents statistical significance at the 0.10, 0.05 and 0.01 levels, respectively. The statistical significance of the median based on the sign test is reported with the median CAR's for the arbs. Q1 and Q4 refer to the smallest- and largest-sized quartile portfolios, respectively.

Portfolio/ Statistic	Size-based Portfolio Q1	Q2	Q3	Q4
Panel A: Formation Period				
Mean CAR_W	0.8038	0.7266	0.7928	0.5770
	(6.2800)[c]	(7.3400)[c]	(7.6900)[c]	(11.1200)[c]
Mean CAR_L	-0.8523	-0.6356	-0.5457	-0.4172
	(-13.2800)[c]	(-10.6600)[c]	(-9.9700)[c]	(-6.9400)[c]
Mean CAR_A	-1.6561	-1.3622	-1.3385	-1.0010
	(-11.3700)[c]	(-10.0800)[c]	(-8.6300)[c]	(-9.7300)[c]
Median CAR_A	-1.5540[c]	-1.3630[c]	-1.3400[c]	-0.9943[c]
Wilcoxon	78.0[c]	72.0[c]	72.0[c]	65.0[c]
Panel B: Test Period				
Mean CAR_W	0.1456	-0.0320	-0.0215	-0.0502
	(2.1500)[b]	(-0.6500)	(-0.4200)	(-0.7800)
Mean CAR_L	0.1858	0.0150	0.0125	0.0049
	(2.6100)[b]	(0.2900)	(0.3500)	(0.1500)
Mean CAR_A	0.0401	0.0470	0.3400	0.0551
	(0.4500)	(1.0700)	(0.7600)	(0.7800)
Median CAR_A	0.0702	0.0663	0.0650	0.0480
Wilcoxon	44.0	60.0	52.0	54.0

TABLE 3.9

The Jensen Performance Indices ($\hat{\alpha}$'s) for formation and test periods of 36 months for the size-based portfolios of Winners (W), Losers (L) and Arbs (A), and tests of their statistical significance, are reported below. The indices are obtained by estimating equation (3.2). The U-statistics, which are the t-statistics aggregated over the 12 independent replications using equation (3.8), are reported in the braces; and the t-statistics are reported in the parentheses. An "a", "b" and "c" represents statistical significance at the 0.10, 0.05 and 0.01 levels, respectively. The statistical significance of the median based on the sign test is reported with the median $\hat{\alpha}$'s for the arbs. Q1 and Q4 refer to the smallest- and largest-size quartile portfolios, respectively.

Portfolio/ Statistic	Size-based Portfolio			
	Q1	Q2	Q3	Q4
Panel A: Formation Period				
Mean $\hat{\alpha}_W$	0.0158	0.0164	0.0184	0.0135
	{5.1173}^{c}	{9.3364}^{c}	{10.7889}^{c}	{10.6434}^{c}
Mean $\hat{\alpha}_L$	-0.0244	-0.0167	-0.0129	-0.0097
	{-12.1906}^{c}	{-11.2645}^{c}	{-10.5571}^{c}	{-8.7123}^{c}
Mean $\hat{\alpha}_A$	-0.0402	-0.0331	-0.0314	-0.0232
	(-10.6400)^c	(-11.5700)^c	(-8.4900)^c	(-9.3600)^c
Median $\hat{\alpha}_A$	-0.0024^c	-0.0334^c	-0.0329^c	-0.0256^c
Wilcoxon	78.0^c	78.0^c	74.0^c	75.0^c
Panel B: Test Period				
Mean $\hat{\alpha}_W$	0.0044	-0.0024	-0.0014	-0.0025
	{2.4000}^{b}	{-1.5200}	{-1.1400}	{-1.1800}
Mean $\hat{\alpha}_L$	0.0077	0.0009	0.0013	0.0008
	{2.5900}^{c}	{0.6300}	{0.8200}	{0.8500}
Mean $\hat{\alpha}_A$	0.0033	0.0033	0.0026	0.0034
	(0.9600)	(1.7100)	(1.1400)	(1.4100)
Median $\hat{\alpha}_A$	0.0028	0.0048^b	0.0006	0.0043
Wilcoxon	28.0	60.5^a	51.0	57.5

TABLE 3.10

The Transformed Sharpe Performance Indices ($\hat{Sh}$'s) for formation and test periods of 36 months for the size-based portfolios of the Winners (W) versus the Market (M), the Losers (L) versus the Market (M) and the Losers (L) versus the Winners (W), and the JK tests of their statistical significance, are reported below. The $\hat{Sh}$ values are calculated using equation (3.4). The Z-statistics are calculated using equation (3.6). The U*-statistics, which are the Z-statistics aggregated over the 12 independent replications using equation (3.9), are reported in the braces. An "a", "b" and "c" represents statistical significance at the 0.10, 0.05 and 0.01 levels, respectively. Q1 and Q4 refer to the smallest- and largest-size quartile portfolios, respectively.

Portfolio/ Statistic	Size-based Portfolio			
	Q1	Q2	Q3	Q4
Panel A: Formation Period				
$\hat{Sh}_{W,M}$	0.0004	0.0006	0.0006	0.0005
	{ 0.5792 }	{ 1.9227 }[a]	{ 2.1381 }[b]	{ 2.5728 }[b]
$\hat{Sh}_{L,M}$	-0.0011	-0.0008	-0.0006	-0.0005
	{-4.0954 }[c]	{-3.8672 }[c]	{-3.4619 }[c]	{-2.9778 }[c]
$\hat{Sh}_{L,W}$	-0.0029	-0.0019	-0.0017	-0.0011
	{-3.1468 }[c]	{-3.8713 }[c]	{-3.4599 }[c]	{-3.8514 }[c]
Panel B: Test Period				
$\hat{Sh}_{W,M}$	0.0001	-0.0002	-0.0001	-0.0002
	{ 0.0630 }	{-0.7966 }	{-0.7087 }	{-1.0600 }
$\hat{Sh}_{L,M}$	0.0001	0.0002	0.0001	0.0001
	{ 0.0886 }	{ 0.9524 }	{ 0.5514 }	{ 0.6356 }
$\hat{Sh}_{L,W}$	0.0002	0.0001	0.0001	0.0001
	{ 0.1998 }	{ 0.3313 }	{ 0.5000 }	{ 0.5794 }

TABLE 4.1

Summary statistics on the distributions of the closing prices on the split-announcement months for the split and control stocks, based on their total samples and their subsamples ranked according to their market-adjusted returns during the 36-month pre-split periods, are presented below.

Closing Prices	Total	P1	P2	P3	P4	P5
Panel A: Split Stocks						
Minimum	0.525	14.500	8.750	11.000	3.350	0.525
25 percentile	20.565	27.815	18.405	22.344	23.000	18.750
Mean	35.120	39.568	33.553	35.856	36.856	29.775
Median	30.000	37.375	29.500	28.000	31.875	25.750
75 percentile	42.875	52.875	42.375	42.750	47.500	35.250
Maximum	161.000	94.750	83.000	113.250	161.000	88.000
Standard deviation	20.790	17.750	18.504	22.835	25.219	17.634
No. of stocks	237	44	48	48	48	49
Panel B: Control Stocks						
Minimum	0.160	0.250	0.172	0.160	0.205	0.180
25 percentile	3.815	7.125	3.850	3.900	2.925	3.455
Mean	18.105	27.615	17.450	16.900	15.186	14.287
Median	10.250	10.625	10.400	11.125	10.850	9.875
75 percentile	28.125	32.250	31.875	26.875	23.625	24.125
Maximum	235.000	235.000	60.500	101.125	88.000	78.815
Standard deviation	23.239	39.946	17.543	19.681	15.538	15.024
No. of stocks	237	44	48	48	48	49

TABLE 4.2

The Jensen Performance Indices ($\hat{\alpha}$'s) for the split stocks (S), the control stocks (C) and their differences (D), and tests of their statistical significance, are reported below. The t-values are reported in the parentheses. An "a", "b" and "c" represents statistical significance at the 0.10, 0.05 and 0.01 levels, respectively. The statistical significance of the median $\hat{\alpha}_D$ is tested using the sign test.

	Portfolios					
Portfolio/Statistic	Total	P1	P2	P3	P4	P5
Panel A: 36-month Pre-Announcement Period						
Mean $\hat{\alpha}_S$	0.0103	-0.0056	0.0036	0.0089	0.0115	0.0306
	(6.22)[c]	(-3.76)[c]	(2.98)[c]	(5.04)[c]	(2.02)[b]	(7.20)[c]
Mean $\hat{\alpha}_C$	0.0085	-0.0016	0.0006	0.0075	0.0136	0.0217
	(7.11)[c]	(-1.41)	(0.29)	(4.89)[c]	(5.61)[c]	(6.05)[c]
Mean $\hat{\alpha}_D$	-0.0018	0.0039	-0.0031	-0.0014	0.0020	-0.0089
	(-1.14)	(1.89)[a]	(-1.37)	(-0.58)	(0.33)	(-2.18)[c]
Median $\hat{\alpha}_D$	-0.0019[a]	0.0008	-0.0003	-0.0022	-0.0035[a]	-0.0068[a]
Wilcoxon	11623.0[a]	578.5	488.5	465.0	450.0	422.5
Panel B: 36-month Post-Announcement Period						
Mean $\hat{\alpha}_S$	-0.0023	0.0006	0.0017	-0.0026	-0.0045	-0.0053
	(-1.48)	(0.31)	(0.78)	(-0.73)	(-1.13)	(-1.21)
Mean $\hat{\alpha}_C$	-0.0047	0.0012	0.0002	-0.0057	-0.0066	-0.0104
	(-1.81)[a]	(0.69)	(0.08)	(-1.80)[a]	(-1.57)	(-3.27)[c]
Mean $\hat{\alpha}_D$	-0.0024	0.0006	-0.0015	-0.0031	-0.0021	-0.0050
	(-1.14)	(0.24)	(-0.41)	(-0.68)	(-0.36)	(-0.89)
Median $\hat{\alpha}_D$	-0.0022	-0.0007	0.0014	-0.0009	-0.0063	-0.0100
Wilcoxon	12248.0	477.0	509.5	548.0	562.0	511.0

TABLE 4.3

The Transformed Sharpe Performance Indices ($\hat{Sh}$) for the pre- and post-announcement periods for the split stocks (S) versus the market (M), the control stocks (C) versus the market (M) and split stocks (S) versus the control stocks (C), and the JK tests of their statistical significance, are reported below. Portfolio P1 represents the stocks with the lowest market-adjusted performance (CAR's) during the 36-month pre-split periods. The Z-statistics are reported in the braces. An "a", "b" and "c" represents statistical significance at the 0.10, 0.05 and 0.01 levels, respectively.

	Portfolios					
Portfolio/Statistic	Total	P1	P2	P3	P4	P5
Panel A: 36-month Pre-Announcement Period						
$\hat{Sh}_{S,M}$	0.000028	-0.000114	-0.000040	0.000073	0.000055	0.000190
	{2.3018}[b]	{-5.4723}[c]	{-1.4593}	{1.7849}[a]	{1.3333}	{5.0231}[c]
$\hat{Sh}_{C,M}$	0.000022	-0.000139	-0.000081	0.000048	0.000072	0.000104
	{2.0015}[b]	{-4.6482}[c]	{-2.3205}[b]	{1.3217}	{1.7600}[a]	{2.1105}[b]
$\hat{Sh}_{S,C}$	0.000060	0.000010	0.000060	0.000050	0.000210	0.000340
	{1.6133}	{0.9314}	{0.9440}	{0.5709}	{1.2574}	{1.5004}
Panel B: 36-month Post-Announcement Period						
$\hat{Sh}_{S,M}$	-0.000040	0.000021	0.000020	-0.000012	-0.000024	-0.000054
	{-1.7609}[a]	{0.6219}	{0.7347}	{-0.6555}	{-0.6210}	{-1.6968}[a]
$\hat{Sh}_{C,M}$	-0.000002	0.000010	-0.000013	-0.000032	-0.000012	-0.000061
	{-0.4413}	{0.2814}	{-0.2917}	{-1.2088}	{-0.3274}	{-1.5155}
$\hat{Sh}_{S,C}$	0.000040	0.000020	0.000080	0.000080	0.000130	0.000180
	{1.4967}	{0.2815}	{0.9134}	{1.2016}	{1.4578}	{1.3879}

TABLE 5.1

Description of the Macroeconomic Variables

Variable	Description
GDP	Gross domestic product
INCOME	Total labor income (all industries)
INDUS	Industrial production
WORKWEEK	Average work week (hours)
ORDER	New orders of durable goods
LCOST	Percentage change in price per unit labor cost in manufacturing
ISRATIO	Inventory/shipment ratio for finished goods in manufacturing
CONST	Residential construction index
PERMIT	Building permits
RETAIL	Retail trade
CARS	Total new motor vehicle sales
TLOAN	Total loans outstanding (Canadian chartered banks)
PLOAN	Personal loans outstanding
BLOAN	Business loans outstanding
UNINFL	Unexpected change in inflation based on the Fama and Gibbons (1984) procedure
UNINFL2	Unexpected change in inflation based on the multivariate state space procedure
M1	Money supply (M1)
TBILL	Government of Canada 91 day Treasury Bill (monthly average)
CBOND	McLeod, Young, Weir bond yield (10 industrials)
GBOND	Government of Canada bond yield average (10 years and over)
TSE300	TSE 300 stock index
RISK	Unexpected change in risk premium
TERM	Unexpected change in term structure
EX	Exchange rate (Cdn/US)
IMPORT	Total imports
EXPORT	Total exports
USINDEX	U.S. composite index of 12 leading indicators

TABLE 5.2

Summary Statistics for the Innovations Based on the Multivariate State Space Procedure

Variable	Mean	Std. Dev.	T-value	D:normal	Fisher's Kappa	Q (6)	P-value	P_1	P_2	P_3	P_4
GDP	.000175	.0364	.0869	.0786	18.0810	8.82	.184	-.032	-.074	.106	.067
INCOME	.000079	.0155	.1005	.0355	14.0519	9.73	.136	-.072	-.088	.012	.045
INDUS	-.000007	.0117	-.0105	.0396	7.5480	11.25	.081	-.038	-.077	-.047	.084
WORKWEEK	.000006	.0068	.0194	.0752	8.5943	3.05	.812	-.001	-.004	.007	.018
ORDER	-.000480	.0686	-.1377	.0533	5.7854	1.63	.950	-.012	-.009	-.021	.042
LCOST	.000110	.1040	.0208	.0888	5.7204	4.96	.549	-.020	.040	.064	-.057
ISRATIO	-.000018	.0226	-.0156	.0399	6.3924	4.53	.605	.001	.024	-.007	.063
CONST	-.000019	.0953	-.0040	.0590	6.1087	10.08	.122	.019	.066	-.038	-.018
PERMIT	.003602	.1426	.4962	.0382	10.5410	4.41	.622	-.029	-.021	-.038	.002
RETAIL	.000025	.0452	.0109	.1006	6.4821	3.12	.794	.001	-.007	.013	-.045
CARS	-.000162	.0830	-.383	.0606	5.5040	1.06	.983	.001	.012	-.036	.011
TLOAN	-.000007	.0088	-.0156	.0646	4.9179	4.45	.616	.018	-.058	.046	.013
PLOAN	.000017	.0054	.0609	.0678	6.1322	7.11	.311	.012	-.066	.025	-.050
BLOAN	-.000012	.0115	-.0213	.0543	5.6553	5.07	.535	.016	-.059	.019	-.005
UNINFL	-.000438	.0068	-1.2361	.0592	5.4412	7.01	.320	-.002	.026	-.016	.006
UNINFL2	-.000034	.0033	-.1984	.0372	4.7658	8.55	.201	.073	.060	.068	.076
M1	.000097	.0247	.0773	.0475	27.5701	11.12	.085	.043	-.011	-.073	-.117
RISK	.000004	.0014	-.0578	.0867	5.0030	4.97	.510	-.001	-.047	-.026	.057
TERM	.000020	.0048	.0813	.1146	4.3471	5.46	.486	.071	.012	-.017	-.075
EX	-.000009	.0071	-.0225	.1068	5.9992	6.23	.398	.023	-.075	.057	.039
IMPORT	.000065	.0441	.0293	.0582	7.2799	3.14	.791	-.004	-.006	.014	.055
EXPORT	-.001158	.0813	-.2797	.0294	10.6870	8.50	.204	.028	-.034	-.096	-.022
USINDEX	.000012	.0081	.0291	.0297	7.4848	4.85	.563	-.009	.026	-.021	.047

TABLE 5.3

Distributions of the Mean Returns and the Market-value Capitalizations for the Fifty Size-ranked Portfolios over the Period 1956:2-1988:3

	Mean Returns	Mean Market-value Capitalizations[a]
Minimum	0.0032	0.1049
5 percentile	0.0054	0.4508
10 percentile	0.0074	1.3676
25 percentile	0.0090	6.3193
median	0.0123	28.5873
75 percentile	0.0138	93.0859
90 percentile	0.0165	247.6236
95 percentile	0.0200	452.2060
Maximum	0.0231	1517.8722

[a] In millions of dollars.

TABLE 5.4

Seasonality in the Growth Rates of the Macroeconomic Variables for the Period, 1956-88

Variable	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	F-value	Prob.	R^2
GDP	-0.0442	0.0887	0.0563	0.0757	0.0538	0.0526	0.0064	0.0824	0.2161	-0.1065	0.0523	0.0089	129.126	0.0001	0.8190
	(-6.649)[a]	(9.522)	(6.044)	(8.060)	(5.721)	(5.600)	(0.686)	(8.770)	(22.993)	(-11.330)	(5.559)	(0.950)			
INCOME	-0.0116	0.0181	0.0245	0.0266	0.0475	0.0437	0.0024	0.0150	0.0369	0.0123	0.0051	-0.0015	114.169	0.0001	0.7705
	(-7.312)	(8.149)	(11.026)	(11.896)	(21.233)	(19.548)	(1.088)	(6.724)	(16.484)	(5.484)	(2.283)	(-0.673)			
INDUS	0.0026	-.0004	.0093	.0012	.0008	.0012	-.0004	.0026	.0071	-.0011	.0033	.0026	1.123	.3422	.0378
	(1.103)	(-.119)	(.282)	(.366)	(.254)	(.355)	(-.127)	(.799)	(2.137)	(-.343)	(.994)	(.785)			
WORKWEEK	.0024	-.0026	-.0035	-.0022	-.0020	-.0023	-.0031	-.0023	-.0024	-.0024	-.0018	-.0061	0.8880	0.5528	0.0255
	(1.623)	(-1.253)	(-1.669)	(-1.037)	(-.961)	(-1.109)	(-1.498)	(-1.100)	(-1.155)	(-1.142)	(-.874)	(-2.913)			
ORDER	.0011	-.0075	.0077	-.0046	.0071	.0072	.0038	.0036	.0024	-.0036	.0062	.0020	0.129	.9996	.0038
	(0.0750)	(-0.3800)	(0.3890)	(-0.2310)	(0.3580)	(0.3600)	(0.1900)	(0.1800)	(0.1250)	(-0.1810)	(0.3100)	(0.0960)			
LCOST	.0575	.0246	.0470	.0622	.0681	.0693	.0709	.0396	.0375	.0315	-.0134	0.0175	.146	.9993	.0043
	(.794)	(.242)	(.463)	(.608)	(.666)	(.678)	(.693)	(.388)	(.366)	(.308)	(-.131)	(.171)			
ISRATIO	-.0066	.0068	.0071	.0055	.0073	.0098	.0056	.0092	.0051	.0064	.0072	.0102	.411	.9508	.0119
	(-1.572)	(1.154)	(1.212)	(.940)	(1.234)	(1.654)	(.962)	(1.55)	(.871)	(1.080)	(1.228)	(1.735)			
CONST	0.0169	-0.0182	-.0066	-.0069	-.0294	-.0184	-.0088	-.0108	-.0028	-.0309	-.0093	-.0320	.425	.9447	.0123
	(.991)	(-.756)	(-.276)	(-.289)	(1.213)	(-.758)	(-.362)	(-.446)	(-.116)	(-1.279)	(-1.386)	(-1.323)			
PERMIT	-0.3737	0.5171	0.7404	0.5927	0.4777	0.3497	0.3176	0.3599	0.3569	0.4162	0.2628	0.1646	61.408	0.0001	0.6436
	(-15.022)	(14.638)	(21.208)	(16.846)	(13.580)	(9.940)	(9.028)	(10.230)	(10.145)	(11.831)	(7.472)	(4.680)			
RETAIL	.0089	-.0056	-.0034	-.0113	-.0039	-.0030	-.0156	.0019	-.0102	-.0074	-.0085	-.0069	.303	.9844	.0088
	(1.000)	(-.448)	(-.276)	(-.899)	(-.314)	(-.239)	(-1.235)	(.152)	(-.811)	(-.585)	(-.675)	(-.543)			
CARS	-.0104	.0197	.0273	.0160	.0075	.0177	.0115	.0113	.0133	.0131	.0365	.0018	.380	.9630	.0111
	(-.626)	(.848)	(1.173)	(.429)	(.321)	(.755)	(.490)	(.486)	(.566)	(.561)	(1.555)	(.079)			
TLOAN	0.0077	.0016	.0025	.0004	.0008	.0017	.0013	.0025	.0002	.0005	.0010	.0029	.244	.9936	.0071
	(3.888)	(.590)	(.902)	(.158)	(.294)	(.621)	(.474)	(.908)	(.095)	(.166)	(.347)	(1.043)			
PLOAN	.0106	-.0004	-.0002	0.0005	.0002	.0010	.0001	.0003	.0001	.0010	-.0008	.0001	.0112	.9998	.0033
	(6.544)	(-.159)	(-.100)	(.230)	(.108)	(-.431)	(.058)	(.144)	(.048)	(.436)	(-.335)	(.026)			
BLOAN	0.0071	0.0010	.0033	-.0004	0.0001	-.0001	.0012	.0037	-.0005	.0015	-.0001	.0034	.425	.9446	.0123
	(2.931)	(.289)	(.978)	(-.120)	(.026)	(-.037)	(.369)	(1.066)	(-.157)	(.433)	(-0.040)	(0.999)			

TABLE 5.4 (cont'd.)

Seasonality in the Growth Rates of the Macroeconomic Variables for the Period, 1956-88

Variable	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	F-value	Prob.	R^2
UNINFL	0.0008	-0.0012	-0.0006	-0.0009	-0.0013	-0.0003	-0.0020	-0.0032	-0.0029	0.0015	-0.0002	-0.0040	1.738	0.0631	0.0486
	(0.711)	(-0.732)	(-0.383)	(-0.583)	(-0.775)	(-1.189)	(-1.168)	(-1.948)	(-1.732)	(0.937)	(-0.111)	(-2.389)			
UNINFL2	0.0035	0.0002	0.0006	0.0010	0.0009	0.0022	0.0021	0.0007	-0.0014	0.0008	0.0010	-0.0006	2.156	0.0162	0.0596
	(5.031)	(0.185)	(0.669)	(1.402)	(0.895)	(2.665)	(2.121)	(0.747)	(-1.464)	(0.814)	(1.063)	(-0.600)			
M1	-0.0326	0.0060	0.0382	0.0530	0.0392	0.0507	0.0527	0.3412	0.0407	0.0412	0.2859	0.0706	55.112	0.0001	0.6185
	(-12.254)	(1.613)	(10.226)	(14.087)	(10.435)	(13.479)	(14.008)	(9.074)	(10.825)	(10.950)	(7.601)	(18.782)			
TBILL	.0692	-.0009	-.0009	-.0012	-.0012	-.0007	-.0001	.0008	.0005	.0001	-.0008	.0004	.012	1.000	.0003
	(10.408)	(-.097)	(-.101)	(-.132)	(-.132)	(-.072)	(-.001)	(.088)	(.057)	(.014)	(-.082)	(.042)			
CBOND	.0895	-.0010	-.0006	-.0009	-.0007	-.0001	.0013	.0012	.0017	.0006	-.0003	-.0001	.025	1.000	.0007
	(15.510)	(-.127)	(-.076)	(-.107)	(-.088)	(-.017)	(.155)	(.152)	(.210)	(.073)	(-.043)	(-.015)			
GBOND	.0799	-.0010	-.0003	-.0006	-.0003	.0003	.0018	.0014	.0019	.0088	-.0004	-.0004	0.034	1.000	.0010
	(14.533)	(-.132	(-.042)	(-.085)	(-.040)	(.041)	(.235)	(.180)	(.252)	(.113)	(-.050)	(-.049)			
TSE300	0.0337	-0.0341	-0.0176	-0.0386	-0.0446	-0.0478	-0.1509	-0.0316	-0.0454	-0.0671	-0.0249	0.0018	3.124	0.0005	0.0842
	(2.932)	(-2.116)	(-1.089)	(-2.371)	(-2.738)	(-2.941)	(-0.928)	(-1.944)	(-2.787)	(-4.121)	(-1.530)	(0.110)			
RISK	-.0096	.0001	.0003	.0002	.0004	.0005	.0006	.0002	.0002	.0003	-.0001	-.0003	.103	.9998	.0003
	(-13.297)	(.017)	(.287)	(.207)	(.395)	(.444)	(.541)	(.155)	(.243)	(.277)	(-.040)	(-.249)			
TERM	.0106	-.0001	.0006	.0006	.0009	.0010	.0018	.0058	.0014	.0007	.0004	-.0008	.083	1.000	.0024
	(4.404)	(-.033)	(.181)	(.171)	(.272)	(.291)	(.537)	(.169)	(.418)	(.219)	(.112)	(-.226)			
EX	-0.0002	0.0007	0.0006	0.0001	0.0017	0.0011	0.0004	0.0004	0.0003	0.0008	0.0007	0.0028	0.295	.9861	.0086
	(-.161)	(.337)	(.303)	(.047)	(.848)	(.588)	(.184)	(.211)	(.139)	(.415)	(.377)	(1.367)			
IMPORT	0.0133)	0.0051	-0.0023	0.0006	-0.0169	-0.0011	-0.0086	-0.0118	-0.0005	-0.0103	0.0050	-0.0179	0.820	0.6208	0.0236
	(1.512)	(0.415)	(-0.187)	(0.054)	(-1.356)	(-0.093)	(-0.695)	(-0.949)	(-0.047)	(-0.828)	(0.405)	(-1.433)			
EXPORT	-0.0492	0.0133	0.1405	0.0567	0.1656	0.0356	-0.0199	0.0060	0.1110	0.1257	0.0605	0.0032	19.080	0.0001	0.3595
	(-3.441)	(0.658)	(6.937)	(2.780)	(8.116)	(1.747)	(-0.979)	(0.297)	(5.439)	(6.161)	(2.967)	(0.160)			
USINDEX	0.0035	0.0011	0.0011	-0.0015	-0.0007	-0.0021	-0.0009	-0.0005	-0.0007	-0.0018	-0.0024	-0.0006	0.421	0.9462	0.0122
	(2.015)	(0.452)	(0.450)	(-0.604)	(-0.306)	(-0.871)	(-0.396)	(-0.190)	(-0.283)	(-0.728)	(-0.970)	(-0.256)			

[a] The t-values are given in the parentheses.

TABLE 5.5

Seasonality in the Innovations of the Macroeconomic Variables for the Period, 1956-88

Variable	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	F-value	Prob.	R^2
GDP	.0162	-.0123	-.0245	.0231	-.0111	-.0479	-.0340	-.0430	.0452	-.0191	-.0347	-.0331	31.376	.0001	.5236
	(3.280)[a]	(-1.780)	(-3.550)	(3.314)	(-1.604)	(-6.882)	(-4.887)	(-6.175)	(6.493)	(-2.741)	(-4.990)	(-4.747)			
INCOME	-.0060	.0083	-.0001	.0142	.0268	.0099	-.0110	.0117	.0169	.0069	.0049	-.0152	35.828	.0001	.5131
	(-3.099)	(3.028)	(-.010)	(5.176)	(9.744)	(3.605)	(-4.037)	(4.269)	(6.161)	(2.508)	(1.787)	(-5.523)			
INDUS	-.0012	-.0009	.0007	.0015	.0011	.0014	-.0002	-.0027	.0070	.0008	.0027	.0031	1.156	.3173	.0389
	(-.540)	(-.290)	(.224)	(.458)	(.361)	(.430)	(-.055)	(-.847)	(2.227)	(.241)	(.841)	(.995)			
WORKWEEK	-0.0005	-0.0001	-0.0008	-0.0002	-0.0003	0.0004	-0.0008	-0.0004	-0.0004	-0.0001	0.0003	-0.0034	0.716	0.7242	0.0206
	(0.422)	(-0.029)	(-0.512)	(-0.140)	(-0.204)	(0.244)	(-0.499)	(-0.236)	(0.276)	(-0.073)	(0.226)	(-2.040)			
ORDER	-0.0016	-0.0088	0.0016	-.0074	0.0019	0.0074	0.0063	0.0055	0.0040	-0.0029	0.0032	0.0027	0.178	0.9983	0.0052
	(-0.131)	(-0.512)	(0.097)	(-0.427)	(0.109)	(0.428)	(0.367)	(0.315)	(0.232)	(-.164)	(.186)	(.159)			
LCOST	-.0018	.0249	.0186	.0064	.0049	.0009	-.0005	-.0298	-.0007	.0062	-.0368	.0278	1.097	.3624	.0312
	(-.099)	(.967)	(.722)	(.247)	(.187)	(.034)	(-.019)	(-1.146)	(-.027)	(.238)	(-1.417)	(1.070)			
ISRATIO	-.0088	.0044	.0057	.0053	.0070	.0093	.0051	.0076	.0041	.0052	.0064	.0098	.406	.9530	.0118
	(-1.447)	(.784)	(.998)	(.9[illegible]4)	(1.221)	(1.620)	(.900)	(1.329)	(.721)	(.909)	(1.132)	(1.724)			
CONST	.0243	-.0081	-.0233	-.0354	-.0495	-.0342	-.0173	-.0169	-.0113	-.0388	-.0221	-.0354	.740	.7007	.0213
	(1.437)	(-.342)	(-.985)	(-1.482)	(-2.070)	(-1.429)	(-.722)	(-.710)	(-.472)	(-1.620)	(-.925)	(-1.483)			
PERMIT	-.1711	.1548	.2258	.1810	.1590	.2020	.1808	.2294	.1862	.2444	.1769	.1547	7.263	.0001	.1760
	(-7.366)	(4.760)	(6.928)	(5.511)	(4.847)	(6.152)	(5.505)	(6.984)	(5.669)	(7.444)	(5.385)	(4.710)			
RETAIL	.0049	-.0021	-.0003	-.0078	-.0038	-.0019	-.0126	-.0001	-.0078	-.0064	-.0085	-.0073	.258	.9919	.0075
	(.606)	(-.186)	(-.024)	(-.687)	(-.335)	(-.162)	(-1.105)	(-.009)	(0.679)	(-.564)	(-.745)	(-.640)			
CARS	-.0118	.0126	.0231	.0134	.0072	.0124	.0075	.0078	.0073	.0084	.0314	.0075	.316	.9816	.0092
	(-.793)	(.604)	(1.109)	(.640)	(.343)	(.594)	(.357)	(.374)	(.351)	(.401)	(1.500)	(.359)			
ILOAN	-.0019	.0029	.0027	.0013	.0012	.0025	.0016	.0039	.0006	.0013	.0014	.0033	.546	.8718	.0158
	(-1.223)	(1.301)	(1.241)	(.574)	(.565)	(1.152)	(.721)	(1.750)	(.280)	(.588)	(.659)	(1.503)			
PLOAN	-.0007	.0011	.0001	.0021	.0001	.0001	.0006	.0016	.0002	.0023	-.0008	.0016	1.030	.4192	.0294
	(-.749)	(.783)	(.027)	(1.517)	(.051)	(.078)	(.419)	(1.167)	(.185)	(1.697)	(-.609)	(1.207)			
BLOAN	-.0017	.0023	.0036	.0003	.0007	.0007	.0013	.0051	-.0001	.0023	.0006	.0036	.668	.7699	.0193
	(-.849)	(.806)	(1.233)	(.119)	(.242)	(.243)	(.479)	(1.780)	(-.021)	(.798)	(.222)	(1.241)			

TABLE 5.5 (cont'd.)

Seasonality in the Innovations of the Macroeconomic Variables for the Period, 1956-88

Variable	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	F-value	Prob.	R^2
UNINFL2	.0008	-.0012	-.0006	-.0010	-.0013	-.0003	-.0020	-.0032	-.0029	.0016	-.0002	-.0040	1.738	.0631	.0486
	(.711)	(-.732)	(-.383)	(-.583)	(-.775)	(-.205)	(-1.189)	(-1.948)	(-1.732)	(.937)	(-.111)	(-2.389)			
M1	-.0176	.0005	.0141	.0241	.0141	.0380	.0473	.0245	.0053	.0059	-.0108	.0497	44.178	.0001	.5651
	(-6.006)	(.119)	(3.435)	(5.832)	(3.403)	(9.186)	(11.443)	(5.921)	(1.284)	(1.416)	(-2.627)	(12.019)			
RISK	.0002	-.0002	-.0001	-.0004	.0001	-.0002	-.0001	-.0006	-.0002	-.0002	-.0004	-.0006	.704	.7356	.0203
	(.943)	(-.496)	(-.086)	(-1.231)	(.059)	(-.675)	(-.210)	(-1.582)	(-.516)	(-.666)	(-1.216)	(-1.581)			
TERM	.0008	-.0011	.0003	-.0005	-.0004	-.0006	.0002	-.0021	-.0002	-.0014	-.0012	-.0021	.0243	.5957	.0243
	(.993)	(-.971)	(-.240)	(-.446)	(-.366)	(-.534)	(.167)	(-1.765)	(-.130)	(-1.209)	(-.997)	(-1.753)			
EX	-.0011	.0012	.0010	.0004	.0023	.0012	.0006	.0007	.0006	.0012	.0010	.0030	.360	.9698	.0105
	(-.799)	(.631)	(.493)	(.192)	(1.160)	(.612)	(.299)	(.334)	(.305)	(.622)	(.542)	(1.545)			
IMPORT	-0.0093	0.0098	0.0190	0.0199	0.0177	0.0002	0.0079	0.0052	0.0019	0.0090	0.0053	0.0175	0.899	0.5422	0.0258
	(-1.195)	(0.888)	(1.731)	(1.800)	(1.603)	(0.023)	(0.714)	(0.472)	(0.173)	(0.820)	(0.485)	(1.582)			
EXPORT	-0.0041	-0.0076	-0.0455	0.0024	-0.0597	0.0690	0.0581	0.0209	-0.0305	0.0002	0.0178	0.0113	8.299	0.0001	0.1966
	(-0.320)	(-0.413)	(-2.480)	(0.131)	(-3.226)	(3.730)	(3.143)	(1.134)	(-1.649)	(0.015)	(0.965)	(0.613)			
USINDEX	.0009	.0006	.0003	-.0025	-.0010	-.0021	-.0008	-.0005	-.0008	-.0022	-.0022	-.0002	.591	.8369	.0171
	(.640)	(.272)	(.167)	(-1.238)	(-.486)	(-1.407)	(-.370)	(-.264)	(-.378)	(-1.071)	(-1.086)	(.105)			

[a] The t-values are given in the parentheses.

TABLE 5.6

Monthly Seasonality in Three Stock Market Indices for the Total Period and Three Subperiods

Period	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.[a]	Nov.	Dec.	F-value	Prob.	R^2
Panel A: TSE 300 Index															
1956-88	0.0239	-0.0201	-0.0131	-0.0179	-0.0251	-0.0288	-0.0136	-0.0159	-0.0369	-0.0318	-0.0047	-0.0026	2.2830	0.0105	0.0631
	(3.10)	(-1.86)	(-1.2121)	(-1.64)	(-2.30)	(-2.64)	(-1.25)	(-1.45)	(-3.38)	(-2.89)	(-0.43)	(-0.24)			
1956-66	0.0230	-0.0295	-0.0048	-0.0086	-0.0217	-0.0374	-0.0112	-0.0324	-0.0407	-0.0245	-0.0161	-0.0027	1.7780	0.0649	0.1412
	(2.11)	(-1.96)	(-0.32)	(-0.51)	(-1.44)	(-2.48)	(-0.74)	(-2.15)	(-2.70)	(-1.63)	(-1.07)	(-0.18)			
1967-77	0.0434	-0.0381	-0.0439	-0.0480	-0.0643	-0.0484	-0.0342	-0.0437	-0.0507	-0.0521	-0.0403	-0.0197	1.2990	0.2345	0.1168
	(2.96)	(-1.84)	(-2.12)	(-2.34)	(-3.10)	(-2.34)	(-1.65)	(-2.11)	(-2.45)	(-2.52)	(-1.95)	(-0.95)			
1978-88	0.0106	0.0013	0.0028	0.0001	0.0065	-0.0103	-0.0001	0.0286	-0.0249	-0.0229	0.0354	0.0073	1.1830	0.3067	0.1058
	(0.69)	(0.06)	(0.13)	(0.01)	(0.29)	(-0.47)	(-0.00)	(1.29)	(-1.13)	(-1.01)	(1.61)	(0.33)			
Panel B: Value-Weighted (V-W) Index															
1956-88	0.0254	-0.0186	-0.0096	-0.0174	-0.0217	-0.0243	-0.0145	-0.0135	-0.0351	-0.0322	-0.0034	-0.0001	2.2840	0.0105	0.0631
	(3.55)	(-1.75)	(-0.91)	(-1.63)	(-2.02)	(-2.27)	(-1.35)	(-1.26)	(-3.27)	(-2.98)	(-0.32)	(-0.01)			
1956-66	0.0234	-0.0270	-0.0017	-0.0094	-0.0193	-0.0345	-0.0123	-0.0305	-0.0369	-0.0241	-0.0105	0.0013	1.8150	0.0584	0.1437
	(2.23)	(-1.86)	(-0.12)	(-0.65)	(-1.33)	(-2.38)	(-0.85)	(-2.10)	(-2.55)	(-1.66)	(-0.72)	(0.09)			
1967-77	0.0472	-0.0415	-0.0434	-0.0499	-0.0617	-0.0446	-0.0348	-0.0424	-0.0524	-0.0551	-0.0421	-0.1786	1.3010	0.2333	0.1170
	(3.20)	(-1.99)	(-2.08)	(-2.39)	(-2.95)	(-2.14)	(-1.66)	(-2.03)	(-2.51)	(-2.64)	(-2.01)	(-0.86)			
1978-88	0.0107	0.0063	0.0095	0.0041	0.0117	-0.0030	-0.0014	0.0324	-0.0222	-0.0219	0.0347	0.0088	1.2200	0.2822	0.1087
	(0.72)	(0.30)	(0.45)	(0.19)	(0.54)	(-0.14)	(-0.06)	(1.51)	(-1.03)	(-0.99)	(1.61)	(0.41)			
Panel C: Equally-Weighted (E-W) Index															
1956-88	0.0510	-0.0436	-0.0325	-0.0398	-0.0468	-0.0512	-0.0378	-0.0374	-0.0550	-0.0544	-0.0379	-0.0198	4.3120	0.0001	0.1128
	(6.83)	(-4.16)	(-3.11)	(-3.77)	(-4.43)	(-4.85)	(-3.58)	(-3.54)	(-5.29)	(-5.11)	(-3.59)	(-1.87)			
1956-66	0.0458	-0.0414	-0.0211	-0.0274	-0.0453	-0.0616	-0.0352	-0.0456	-0.0514	-0.0488	-0.0391	-0.0196	2.9770	0.0016	0.2158
	(4.56)	(-2.98)	(-1.52)	(-1.97)	(-3.26)	(-4.44)	(-2.54)	(-3.28)	(-3.69)	(-3.51)	(-2.81)	(-1.41)			
1967-77	0.0823	-0.0701	-0.0771	-0.0866	-0.0917	-0.0775	-0.0666	-0.0802	-0.0835	-0.0847	-0.0819	-0.0512	2.3530	0.0122	0.1933
	(5.09)	(-3.06)	(-3.37)	(-3.79)	(-4.01)	(-3.39)	(-2.91)	(-3.51)	(-3.65)	(-3.71)	(-3.58)	(-2.24)			
1978-88	0.0298	-0.0261	-0.0072	-0.0101	-0.0088	-0.0223	-0.0175	0.0098	-0.0380	-0.0369	0.0001	0.0021	1.2460	0.2655	0.1108
	(2.27)	(-1.40)	(-0.39)	(-0.53)	(-0.46)	(-1.17)	(-0.92)	(0.51)	(-1.99)	(-1.88)	(0.00)	(0.11)			

[a]October 1987 has been removed

TABLE 5.7

Stepwise Selection of the Macroeconomic Variables (1956-86)

	Growth Rates			Innovations		
	TSE300	V-W	E-W	TSE300	V-W	E-W
INTERCEPT	.0097	.01282	.0133	.0085	.0115	.0149
	(2.1056)	(2.9501)	(3.0106)	(3.1014)	(4.3321)	(5.685)
USINDEX	1.6159	1.5883	1.3429	1.3417	1.3279	1.2122
	(6.0227)	(5.9868)	(5.5954)	(3.7488)	(4.4189)	(4.1685)
EX	-.6586	-.5858	-.5351	-.7129	-.5874	-.5574
	(-2.2093)	(-1.9878)	(-1.8062)	(-2.2996)	(-1.9189)	(-1.8512)
TERM	-1.7733	-1.8277		-1.7410	-1.8688	
	(-3.0163)	(-3.1447)		(-2.9862)	(-3.2438)	
TERM(-1)	1.2436	1.2938				
	(2.1925)	(2.3091)				
INDUS(-1)	.4148	.4454	.3737	.5352	.4350	.5098
	(2.0244)	(2.1995)	(1.9253)	(2.2310)	(2.2104)	(2.4819)
PERMIT(-1)	.2041	.0251		.0345	.0338	
	(2.0285)	(2.1271)		(1.9273)	(1.9144)	
EXPORT(-1)	-.0565	-.0572	-.0365	.0565	.0635	.0546
	(-2.1899)	(-2.2431)	(-1.5020)	(1.7625)	(2.0158)	(1.7388)
UNINFL	1.7927	1.6956	.8018	1.7088	1.7187	
	(4.0485)	(3.8730)	(2.2185)	(3.9445)	(4.0478)	
LCOST	-.0472	-.0451				
	(-1.7481)	(-1.6891)				
LCOST(-1)	.0603	.0570				
	(2.2169	(2.1189)				
UNINFL(-1)	.6084	.6459		.5831	.6917	.8729
	(1.5964	(1.7146)		(1.6269)	(1.9556)	(2.4060)
M1	.1629	.1785				
	(1.5573)	(1.7263)				
INCOME	-.4323	-.3844	-.5565	-.2348		-.3604
	(-3.1554)	(-2.8389)	(-3.9162)	(-1.5089)		(-2.3478)
GDP(-1)	-.0910	-.0979	-.0573	-.1180	-.1443	-.1501
	(-2.9449)	(-3.1993)	(-1.6902)	(-1.6666)	(-2.1409)	(-2.2041)
M1(-1)			.2255			
			(2.3963)			
WORKWEEK				.6907	.5268	.6816
				(1.9298)	(1.4957)	(1.9200)
USINDEX(-1)				.7835	.7596	.8616
				(2.5789)	(2.6076)	(2.9720)
PLOAN(-1)				-.8413	-.8624	.6788
				(-1.8131)	(-1.8801	(1.4805)
RETAIL						.0799
						(1.6542)
INCOME(-1)				-.2803	-.2157	-.3813
				(-1.8201)	(-1.4447)	(-2.4986)
RISK	.8335	.9413	1.5905	.8812	1.1111	1.4518
	(.502)	(.573)	(.972)	(.515)	(.657)	(.850)

TABLE 5.8

Correlations Between the Innovations for the Selected Macrovariables and the Alternative Residual Market Factors (RMF's)

	USINDEX	EX	TERM	LINDUS	UNINFL	RISK	LGDP	TSE300 RFM	V-W RFM	E-W RFM
USINDEX	1.0000									
EX	.0501	1.0000								
TERM	.0835	-.0679	1.0000							
LINDUS	-.0052	.0235	-.0891	1.0000						
UNINFL	-.1020	.1454	-.1323	.0232	1.0000					
RISK	.0161	.0038	.1391	.0301	-.0095	1.0000				
LGDP	-.0600	-.0069	.0077	.1227	-.1008	.0344	1.0000			
TSE 300 RFM	.0000	-.0000	.0000	.0000	-.0000	.0033	.0000	1.0000		
V-W RFM	.0000	-.0000	.0000	.0000	-.0000	.0013	.0000	.9455	1.0000	
E-W RFM	-.0000	-.0000	.0000	-.0000	-.0000	.0003	.0000	.8544	.8569	1.0000

TABLE 5.9

Estimates of the Risk Premia for the General Factor Pricing Model Given by Equation (5.7)

Period	USINDEX	EX	TERM	LINDUS	UNINFL	RISK	LGDP	RMF
Panel A: RMF calculated using the TSE 300 Index								
NOLS Estimates								
1956-88	.0010	.0125	-.0061	.0032	.0072	-.0002	.0043	.0315
	(1.29)[a]	(1.38)	(-1.20)	(1.46)	(1.54)	(-1.44)	(.37)	(1.55)
SUR Estimates								
1956-88	.0023	.0071	-.0052	.0059	.0062	-.0008	.0178	.0088
	(.59)	(1.28)	(-1.97)	(2.33)	(3.06)	(-2.32)	(2.61)	(.81)
1956-66	.0037	-.0015	-.0012	.0071	.0035	-.0003	-.0002	.0100
	(.85)	(-.34)	(-1.39)	(1.98)	(2.88)	(-1.84)	(-.34)	(1.41)
1967-77	.0022	.0089	-.0025	.0066	.0037	-.0006	.0082	.0081
	(.68)	(1.45)	(-1.69)	(3.01)	(2.70)	(-2.08)	(1.98)	(1.20)
1978-88	.0020	.0064	-.0071	.0084	.0085	-.0002	.0089	.0088
	(.75)	(1.52)	(-2.71)	(2.75)	(3.10)	(-1.35)	(1.86)	(1.45)
Panel B: RMF calculated using the value-weighted TSE/Western Index								
NOLS Estimates								
1956-88	.0080	.0095	.0006	.0027	.0068	-.0031	.0073	.0264
	(1.23)	(1.55)	(.54)	(1.85)	(1.31)	(-.86)	(1.25)	(1.33)
SUR Estimates								
1956-88	.0075	.0115	-.0065	.0049	.0086	-.0009	.0084	.0062
	(.69)	(1.62)	(-1.95)	(2.26)	(2.74)	(-1.89)	(2.51)	(1.62)
1956-66	.0057	-0.404	-.0076	.0044	.0058	-.0004	-.0006	.0076
	(1.20)	(-1.32)	(-1.60)	(1.89)	(1.78)	(-1.54)	(-1.27)	(1.08)
1967-77	.0059	.0476	-.0095	.0052	.0094	-.0060	.0135	.0080
	(.72)	(.75)	(-1.68)	(2.31)	(2.68)	(-2.69)	(3.25)	(1.84)
1978-88	.0028	.0034	-.0056	.0048	.0156	-.0001	.0077	.0063
	(1.09)	(1.01)	(-3.01)	(2.64)	(5.40)	(-1.91)	(1.98)	(1.70)
Panel C: RMF calculated using the equally-weighted TSE/Western Index								
NOLS Estimates								
1956-88	.0085	.0062	-.0013	.0071	.0039	-.0001	.0069	.0220
	(1.16)	(1.08)	(-1.10)	(1.87)	(1.15)	(-.64)	(1.83)	(1.41)
SUR Estimates								
1956-88	.0097	.0084	-.0092	.0076	.0104	-.0011	.0079	.0073
	(1.61)	(1.36)	(-2.33)	(2.50)	(3.07)	(2.19)	(2.35)	(1.82)
1956-66	.0093	-.0023	-.0095	.0061	.0089	-.0005	.0044	.0064
	(1.55)	(-1.07)	(-1.80)	(1.95)	(1.62)	(-1.41)	(1.48)	(1.48)
1967-77	.0031	.0077	-.0026	.0082	.0111	-.0010	.0100	.0104
	(.88)	(1.45)	(-1.48)	(2.53)	(3.46)	(-2.31)	(3.27)	(2.88)
1978-88	.0071	.0048	-.0062	.0026	.0065	-.0006	.0045	.0081
	(2.45)	(1.63)	(-3.16)	(1.91)	(2.14)	(-1.79)	(1.89)	(1.77)

[a] T-statistics are given in the parentheses

TABLE 5.10

Estimates of the Mean Factor Loadings for the General Pricing Model Given by Equation (5.7)

Period	USINDEX	EX	TERM	LINDUS	UNINFL	RISK	LGDP	RMF
Panel A: RMF calculated using the TSE 300 Index								
NOLS Estimates								
1956-88	1.3562	-.5630	-.3600	.6062	-.7683	-.6410	-.2131	.8521
	(3.13)[a]	(-1.29)	(-.54)	(1.85)	(-1.26)	(-.95)	(-2.03)	(9.67)
SUR Estimates								
1956-88	1.3552	-.5408	-.4490	.5987	-.7257	-.7520	-.2130	.8538
	(3.22)	(-1.26)	(-.52)	(1.98)	(1.86)	(-.92)	(-2.06)	(9.70)
1956-66	1.1005	-.6631	-.2165	.5054	-.348	-.7466	-.2688	.6671
	(1.98)	(-.96)	(-.44)	(1.76)	(-1.39)	(-.93)	(-1.60)	(5.26)
1967-77	1.293	-.9855	-.2874	.4196	-.1922	-.3304	-.1899	.8834
	(2.16)	(-1.04)	(-.38)	(1.84)	(-1.68)	(-.73)	(-1.62)	(5.99)
1978-88	1.6424	-.3581	-.1933	.6011	-.8135	-.6955	-.2240	.9180
	(3.10)	(1.66)	(-.62)	(1.75)	(1.99)	(-1.21)	(-1.03)	(6.87)
Panel B: RMF calculated using the value-weighted TSE/Western Index								
NOLS Estimates								
1956-88	1.3569	-.5846	-.2293	.7538	-.7343	-.4105	-.2423	1.0466
	(3.49)	(1.44)	(-.55)	(2.24)	(-1.34)	(-1.01)	(-2.56)	(12.45)
SUR Estimates								
1956-88	1.3782	-.5968	-.3086	.6845	-.7493	-.3963	-.2432	1.0475
	(3.72)	(-1.47)	(-.53)	(2.24)	(-1.33)	(-.99)	(-2.57)	(12.38)
1956-66	1.2092	-.7599	-.6653	.5602	-.9223	-.1366	-.2262	1.0751
	(1.27)	(-.64)	(-.11)	(.89)	(-.33)	(-.01)	(-1.22)	(3.21)
1967-77	1.2285	-.5921	-.3427	.6747	-.6368	-.6062	-.2706	1.0612
	(2.59)	(-.75)	(-.16)	(2.16)	(-.91)	(-.66)	(-1.68)	(8.88)
1978-88	1.1407	-.5847	-.2798	.6538	-.7180	-.7172	-.2146	1.0123
	(2.97)	(-1.27)	(-.48)	(1.81)	(1.68)	(-.99)	(-1.18)	(8.51)
Panel C: RMF calculated using the equally-weighted TSE/Western Index								
NOLS Estimates								
1956-88	1.3815	-.5790	-.5795	.6778	-.7697	-.7567	-.2250	.9438
	(3.25)	(-1.40)	(-.52)	(1.84)	(-1.38)	(1.03)	(-2.33)	(9.86)
SUR Estimates								
1956-88	1.3815	-.5683	-.3390	.6392	-.7351	-.6750	-.2465	.9510
	(3.27)	(-1.35)	(-.51)	(2.08)	(-1.23)	(-1.04)	(-2.43)	(9.91)
1956-66	1.0610	-1.2170	-.4560	.4220	-.7700	-.2920	-.1988	.9062
	(3.02)	(-.98)	(-.11)	(1.77)	(-.36)	(-.13)	(-1.07)	(3.88)
1967-77	2.1770	-.9950	-.8920	.8336	-1.2620	-.2410	-.3026	.9730
	(3.01)	(-.99)	(-.35)	(1.95)	(-1.17)	(-.50)	(-1.79)	(9.35)
1978-88	1.0357	-.5912	-.3660	.6639	-.8458	-.6476	-.2883	.9518
	(2.24)	(-1.18)	(-.63)	(1.61)	(-1.52)	(-1.19)	(-1.44)	(8.39)

[a] The mean t-statistics are reported in the parentheses

TABLE 5.11

Estimates of the Risk Premia and Mean Factor Loadings for the January and October Dummy Variables

	January Dummy		October Dummy[c]	
Period	Risk Premium[a]	Mean Factor Loading[b]	Risk Premium	Mean Factor Loading
Panel A: RMF calculated using the TSE 300 Index				
1956-88	-.2449	.0276	-.0001	.0051
	(-2.90)	(1.98)	(-1.62)	(.46)
1956-66	-.0615	.0180	-.0025	.0044
	(-1.82)	(1.79)	(-.96)	(.64)
1967-77	-.1018	.0221	-.0040	.0065
	(-1.86)	(2.16)	(-1.12)	(.31)
1978-88	-.1102	.0119	-.0064	-.0231
	(-1.58)	(1.33)	(-1.64)	(-1.35)
Panel B: RMF calculated using the value-weighted TSE/Western Index				
1956-88	-.2216	.0265	-.0035	.0058
	(-2.09)	(2.18)	(-.10)	(.17)
1956-66	-.0508	.0164	-.0076	.0059
	(3.18)	(1.87)	(-1.09)	(.23)
1967-77	-.1693	.0201	.0008	.0064
	(-4.11)	(2.15)	(.77)	(.61)
1978-88	-.1131	.0080	-.0079	-.0002
	(-.76)	(1.07)	(-1.47)	(.05)
Panel C: RMF calculated using the equally-weighted TSE/Western Index				
1956-88	-.1655	.0207	-.0004	.0023
	(-2.65)	(1.88)	(-1.30)	(.17)
1956-66	-.1521	.0107	-.0833	.0044
	(1.96)	(1.37)	(-1.25)	(.23)
1967-77	-.2741	.0361	-.0875	.0048
	(-4.39)	(2.48)	(.56)	(.13)
1978-88	-.1725	.0125	-.0659	-.0075
	(-2.28)	(1.88)	(-1.82)	(-.24)

[a] T-statistics are reported in the parentheses

[b] The mean t-statistics are reported in the parentheses

[c] October 1987 has been removed

TABLE 5.12

Comparison of the Risk Premia With and Without the Seasonal Dummy for the Period 1956-88

Estimation	USINDEX	EX	TERM	LINDUS	UNINFL	RISK	LGDP	RMF
Panel A: RMF calculated using the TSE 300 Index								
Without Seasonal Dummy	.0023 (.59)[a]	.0071 (1.28)	-.0052 (-1.97)	.0059 (2.33)	.0062 (3.06)	-.0008 (-2.32)	.0178 (2.61)	.0088 (.81)
With January Dummy	.0021 (.69)	.0076 (1.28)	-.0050 (-1.90)	.0052 (2.26)	.0062 (3.01)	-.0008 (-2.05)	.0182 (2.59)	.0062 (.72)
With October Dummy	.0020 (.64)	.0072 (1.27)	-.0059 (-1.96)	.0058 (2.33)	.0064 (3.05)	-.0008 (2.32)	.0180 (2.61)	.0060 (.70)
Panel B: RMF calculated using the value-weighted TSE/Western Index								
Without Seasonal Dummy	.0075 (.69)	.0115 (1.62)	-.0065 (-1.95)	.0049 (2.26)	.0086 (2.74)	-.0009 (-1.89)	.0084 (2.51)	.0062 (1.62)
With January Dummy	.0070 (.67)	.0118 (1.79)	-.0063 (-1.84)	.0046 (2.05)	.0089 (2.29)	-.0007 (-1.80)	.0088 (2.15)	.0057 (1.50)
With October Dummy	.0073 (.80)	.0102 (1.60)	-.0068 (-1.92)	.0043 (2.10)	.0084 (2.24)	-.0006 (-1.90)	.0085 (2.01)	.0058 (1.65)
Panel C: RMF calculated using the equally-weighted TSE/Western Index								
Without Seasonal Dummy	.0097 (1.61)	.0084 (1.37)	-.0092 (-2.33)	.0076 (2.29)	.0104 (3.08)	-.0011 (-2.16)	.0079 (2.38)	.0073 (1.82)
With January Dummy	.0103 (1.62)	.0079 (1.16)	-.0088 (-2.17)	.0072 (2.45)	.0100 (2.65)	-.0094 (-2.03)	.0085 (2.17)	.0064 (1.77)
With October Dummy	.0092 (1.63)	.0074 (1.38)	-.0086 (-1.96)	.0081 (2.04)	.0106 (2.27)	-.0089 (-1.98)	.0083 (2.21)	.0061 (1.79)

[a] T-statistics are given in the parentheses

TABLE 5.13

Comparison of the Mean Factor Loadings With and Without the Seasonal Dummy for the Period 1956–88

Estimation	USINDEX	EX	TERM	LINDUS	UNINFL	RISK	LGDP	RMF
Panel A: RMF calculated using the TSE 300 Index								
Without Seasonal Dummy	1.3552	-.5408	-.4490	.5987	.7257	-.7520	-.2130	.8538
	(3.28)[a]	(-1.26)	(-.51)	(1.98)	(1.86)	(-.92)	(-2.06)	(9.70)
With January Dummy	1.3877	-.4878	-.4669	.5412	.6573	-.6815	-.1974	.7539
	(3.36)	(-1.06)	(-.68)	(1.96)	(1.83)	(-.90)	(-1.98)	(9.62)
With October Dummy	1.3485	-.5368	-.4720	.5861	.6890	-.7416	-.2201	.9015
	(3.10)	(-1.06)	(-.64)	(1.97)	(1.85)	(-.89)	(-2.16)	(9.81)
Panel B: RMF calculated using the value-weighted TSE/Western Index								
Without Seasonal Dummy	1.3782	-.5968	-.3086	.6845	-.7493	-.3963	-.2432	1.0475
	(3.72)	(-1.47)	(-.53)	(2.24)	(-1.33)	(-.99)	(-2.57)	(12.38)
With January Dummy	1.3641	-.6008	-.2797	.6757	-.7503	.3739	-.3876	1.0505
	(3.48)	(-1.42)	(-.5462)	(2.41)	(-1.4578)	(.98)	(-2.46)	(12.10)
With October Dummy	1.3810	-.5848	-.3100	.6816	-.7525	.4400	-.2452	1.2550
	(3.48)	(-1.47)	(-.55)	(2.24)	(-1.34)	(1.01)	(-2.57)	(12.45)
Panel C: RMF calculated using the equally-weighted TSE/Western Index								
Without Seasonal Dummy	1.3815	-.5683	-.3390	.6390	-.7351	-.6750	-.2465	.9610
	(3.25)	(-1.35)	(-.51)	(2.08)	(-1.23)	(1.04)	(-2.43)	(9.91)
With January Dummy	1.3551	-.5408	-.3782	.6210	-.7256	-.6030	-.2129	.8403
	(3.14)	(-1.26)	(-.52)	(2.15)	(-1.29)	(-.92)	(-2.06)	(9.72)
With October Dummy	1.3538	-.5424	-.3518	.6561	-.7965	-.5147	-.2514	.8674
	(3.19)	(-1.45)	(-.50)	(2.01)	(-1.24)	(-.95)	-2.18)	(9.85)

[a] The mean t-values are reported in the parentheses

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