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**OPTIMAL REBALANCING PERIOD AND OPTIMAL SIZE
FOR MARKET NEUTRAL PORTFOLIOS**

by
SUSANA YU

A dissertation submitted to the Graduate Faculty in Business in partial fulfillment of the requirements for the degree of Doctor of Philosophy, The City University of New York.

2002

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THE CITY UNIVERSITY OF NEW YORK

ABSTRACT**OPTIMAL REBALANCING PERIOD AND OPTIMAL SIZE FOR
MARKET NEUTRAL PORTFOLIOS**

by
Susana Yu

Adviser: Professor Avner Wolf

The first part of the research uses contemporary data (CRSP and COMPUSTAT data from 1989-2000) to test the validity of the 3-factor model as presented in Fama-French (1996). The performances of three different market neutral (long/short equity) trading strategies are examined. I investigate whether the behavior of returns on factors, price momentum and earnings momentum portfolios can be explained by factors related to size and book-to-market.

In the second study, the trading strategy that provides the best performance is chosen to determine the optimal portfolios rebalancing period and the optimal portfolio size. In this case, further tests on the market neutral (long/short equity) portfolio in the price momentum strategy are performed. In addition to the transaction cost for institutional ownership, return on the short-sale portfolio is further adjusted by using the technique expressed in Alexander (1993). The final study compares the effects of the trading mechanism on the selection of the winner and loser portfolios in the formation period. 2-year transaction data from July 1997 to June 1999 are used in this study.

Transaction costs play a role in determining the optimal holding period for the portfolios. Optimal holding periods for the long, short and market neutral (long/short equity) portfolios changes as transaction costs are included. The optimal holding period(s) ranges from six to nine months depending upon the type of portfolios being considered. Optimal efficiency occurs somewhere between 20-80 securities in the portfolios, and loss

of efficiency with more than 100 securities in the portfolios. The adjusted short and market neutral portfolios' returns exhibit similar graphical patterns as the ones in original short and market neutral portfolios. However, these adjusted portfolio returns are amplified.

The evidence in the final study suggests that Open-to-Open portfolios have higher average returns, greater dispersion of average returns and smaller average market capitalization than the Close-to-Close portfolios. It is found that the market neutral portfolio's return under the Trade Price Method is between 200-300 basis points higher than the portfolio's return under the Bid-Ask Price Method; but the timing of the trade execution does not affect the average monthly portfolio returns significantly. Firms in the loser portfolios have a wider spread. The range of the average quote spreads and that of the effective spreads are wider for the loser portfolio. These results can be interpreted as being consistent with the components of the bid-ask spread suggested by Benston and Hagerman (1974) and Glosten (1987).

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CHAPTER 1. INTRODUCTION

Market-neutral long/short equity strategy is not new. This technique has been widely used by institutional investors and some private hedge funds such as AG. J Power Limited Partnership, Argos International Hedge Funds, and Riposte Capital Partner Limited Partnership. As a whole, market-neutral strategy (categorized by hedge fund research) has done well in the past six years. It has out-performed the average in bearish markets, and hasn't done so badly in bullish intervals. An index of hedge funds that pair long and short trades averaged a compound annual return of 14.6% (net of fees) over the six years through December 31, 1995, compared to 13% of the S&P 500 market indexes.

With more and more hedge funds companies capitalizing on executing market neutral strategy, mutual fund companies have also started to create a new category of stock fund with similar strategies. Barr Rosenberg Market Neutral Fund, which started in December 1997, has already scooped up nearly \$200 million in assets despite no advertising. The Montgomery U.S. Market Neutral Fund opened on July 1, 1998, and registration statements for at least two similar funds, the Value Line Hedged Opportunity Fund and the Euclid Market Neutral Fund, have been filed with the Securities and Exchange Commission.

The basic market-neutral equity strategy starts with one dollar of capital, purchases a long position, and sells a stock short. I replicate the techniques presented by Fama-French (1996). I purchase (sell short) the portfolio with the smallest (biggest) size and highest (lowest) book-to-market equity ratio during the period of 1990-1999. The alpha for the long portfolio is 1.34% per month and it is statistically different from zero (t-statistics=3.45). On the other hand, the alpha for the short portfolio is -0.06% per month

yet it is not statistically different from zero (t -statistics=-0.39). Hence, the market neutral long-short strategy in this case is +1.40% per month during the period of 1990-1999. In contrast, Fama and French (1996) showed that buying the portfolio with the smallest size and highest book-to-market equity will earn the same risk-adjusted return as the portfolio with largest size and lowest book-to-market equity. Both portfolios each earn an average of 0.20% per month. Hence, their risk-adjusted return for the market neutral equity strategy will be zero percent per month from 1963-1993.

With the knowledge that the market neutral (long/short) portfolio was able to earn positive risk adjusted monthly returns in the past 10 years, and with more institutional investors adopting the market-neutral strategy in their portfolios, I am encouraged to investigate the impacts of factors, price momentum and earning momentum trading strategies in market neutral equity portfolios. The first objective of this research is to examine whether the behavior of these returns on our market neutral portfolios can be explained in the context of the Fama-French (1996) three-factor model.

More in depth portfolio testing in the strategy that yields the highest risk-adjusted return is performed. My second objective is to determine the optimal size (in terms of number of stocks) and the optimal holding period for the portfolios. Effects of transaction costs for institutional ownership, short rebate and interest received from the collateral in the short portfolio (as suggested by Alexander 1993) are also considered.

In reality, it may be difficult, if not impossible, to purchase or sell short all of the securities derived from the previous strategies. Short sale restriction on stocks, the existence of bid-ask spread, the unavailability of shares to be sold short, price impact are examples that prevent us from selling short all the securities on the original short list. Sub-optimal short portfolios are formed and these factors affect the actual return of the trading

strategy. With these market impediments in mind, my final objective is to examine the effect of the portfolios selection under two trading mechanisms. Two-year transaction data are used to determine the risk-adjusted return for the market neutral (long/short equity) portfolio. The comparison of the returns from bid-ask quote with the returns from the transaction trade data will shed light on the true cost of the investment.

This research is organized as follows. Chapter 2 provides a literature review on the effect of short selling and long/short equity trading; and a background discussion on various trading strategies and bid-ask spreads. Chapter 3 describes the data sources and outlines the empirical methodology. Chapter 4 compares various market neutral trading strategies. Chapter 5 examines the optimal portfolio rebalancing period and optimal number of securities in portfolios. Chapter 6 provides spread analysis on portfolios under two trading mechanisms. Chapter 7 concludes the thesis with a summary and discussion of caveats that reveal future research opportunities.

CHAPTER 2. BACKGROUND AND LITERATURE REVIEW

2.1. Background

2.1.1. Short Selling

The effects of short selling on the composition and location of the efficient sets have been considered in a variety of ways. For example, Lintner (1965) suggested that short sales be treated from the perspective of a broker-dealer where an amount of money equaled to the short proceeds must be put up as initial margin with the short seller receiving risk-free interest on both the short proceeds and the margin. Alternatively, Black (1972) and Merton (1972) assumed that the short seller not have to put up any initial margin and that the short seller actually got the use of the short proceeds. Dyle (1975) assumed that the short seller must put an initial margin that is less than the short proceeds, but received no interest on either the margin or short proceeds.

Alexander (1993) extended the Elton, Gruber, and Padberg (1978) algorithm to short sales. First, he allowed the short seller to get full use of the short proceeds upon completion of a short sale without imposition of any initial margin requirements – unrestrictive short-selling. Then he imposed a 100% initial margin requirement, but allowed the short-seller to earn interest at the risk-free lending rate on both the short proceeds and the initial margin deposit. The risk-free interest rate that was paid on the short proceeds was less than the rate paid on initial margin.

Woolridge (1994) provided strong evidence refuting the popular notion that short sellers earn abnormal profits at the expense of less informed traders. Short sellers do not appear to drive prices down through their short sales. In fact, short sellers provide market liquidity by shorting into up markets and reducing short positions in down markets.

2.1.2. Long/Short Equity

Michaud (1993) stated that a market-neutral long-short equity strategy may leverage “sell” information more efficiently than a traditional long-only strategy. Claims of the superiority of a long-short investment strategy are often based on misunderstanding of modern investment theory. The increase in active return associated with the strategy is typically accompanied by an increased in active risk. Given the level of information in most institutional stock forecasts, the implied level of portfolio risk, additional costs and available alternatives, many long-term institutional investors prefer traditional long-only strategies. Long-short investing is most appropriate as a special-situation strategy.

Brush (1997) compared the efficient frontier of absolute return and absolute volatility. He found that long-short strategies with positive expected alphas everywhere improve the efficient frontier over traditional T-bill/market alternatives. Long/short is an attractive addition to a long strategy for expanding the efficient frontier – more for risk reduction if long/short expected alpha turns out to be small but for both risk reduction and return enhancement if the long/short expected alpha is large.

Ackerman, McEnally and Ravenscraft (1999) found hedge funds (market neutral strategy) used tools designed to reduce systematic rather than total risk. Market neutral hedge funds have the expected beta (β) = 0 and the Jensen’s alpha (α) significantly positive. The market risk is greatly reduced but it is very difficult to make profit on a large diversified portfolio; hence, stock picking is critical for this strategy.

2.2. Various Trading Strategies

2.2.1. Factors (Size and Book-to-Market Equity) Strategy

Banz (1981) demonstrated how market equity, ME (a stock's price times shares outstanding), can add to the explanation of the cross-section of average returns provided by market betas. Average returns on small (low ME) stocks are too high given their beta estimates, and average returns on large stocks are too low. Fama and French (1992) documented that size and the book-to-market ratio "provide a simple and powerful characterization of the cross-section of average returns for financial firms in 1963-1990 period." Stocks with high book-to-market ratios have reliably higher returns than low book-to-market stocks of the same size. Fama and French asserted that their findings have powerful implications for portfolio formation and performance evaluations for investors. Barber and Lyon (1997) found the relation between firm size, book-to-market ratios, and security returns are similar for financial and nonfinancial firms.

Size is related to profitability in Fama and French (1993). Controlling for BE/ME, small stocks tend to have lower earnings on book equity than do big stocks. The size effect in earnings is however, largely due to the low profits of small stocks after 1980. The fact that small firms can suffer a long earnings depression that bypasses big firms suggests that size is associated with a common risk factor that might explain the negative relation between size and average return.

BE/ME is related to persistent properties of earnings in Fama and French (1995). Firms that have high BE/ME (a low stock price relative to book value) signal low earnings on book equity. High-BE/ME stocks are less profitable than low-BE/ME stocks for four years before and at least five years after ranking dates. In a nutshell, low BE/ME (a high stock price relative to book value) is typical of firms with high average returns on capital

(growth stocks), whereas high BE/ME is typical of firms that are relatively distressed.

Although the size effect has attracted more attention, book-to-market equity has a consistently stronger role in average returns. The combination of size and book-to-market equity seems to absorb the roles of leverage and Earning/Price in average stock returns. Thus, with rational pricing, size and BE/ME must proxy for sensitivity to common risk factors in returns.

2.2.2. Price Momentum (Relative Strength) Strategy

Early literature on market efficiency focused on relative strength strategies that buy past winners and sell past losers. Levy (1967) claimed that a trading rule that buys stocks with current prices that are substantially higher than their average prices over the past 27 weeks realized significant abnormal returns. Jensen and Bennington (1970) analyzed the profitability of Levy's trading rule over a long time period and found that in their sample period Levy's trading rule did not outperform a buy and hold strategy and hence attributed Levy's results to a selection bias. The success of many mutual funds in Grinbalatt and Titmans (1989) sample and the predictive power of Value Line ranking provide suggestive evidence that the relative strength strategies may generate abnormal returns. Returns of all zero-cost, winner-minus-losers portfolios are positive in Jegadeesh and Titman (1993). All these returns are statistically significant except for the 3-month/3-month that does not skip a week. Additional evidence indicates that the profitability of the relative strength strategies is due to their systematic risk, not the lead-lag effects that result from delayed stock price reactions to common factors.

2.2.3. Earning Momentum Strategy

Latane and Jones (1979), Bernard and Thomas (1989), and Bernard, Thomas, and Wahlen (1995), among others, found that firms reporting unexpectedly high earnings outperform firms reporting unexpectedly poor earnings. The superior performances persist over a period of about six months after earnings announcements. Givoly and Lakonishok (1979) reported similar sluggishness in the response of prices to revisions in analysts' forecasts of earnings. Affleck-Graves and Mendenhall (1992) examined the Value Line timeliness ranking system, and suggested that earnings surprises can account for Value Line's ability to predict future returns. Chan, Jegadeesh and Lakonishok (1996) confirmed that drifts in future returns over the subsequent six to twelve months are predictable from a stock's prior return and from prior news about earnings.

2.3. Trading Mechanisms

Amihud and Mendelson (1987) studied the effect of portfolio formation under two trading mechanisms. The clearinghouse mechanism is represented by the opening transaction, whereas the closing transaction reflected the dealership market. Behavior of Open-to-Open and Close-to-Close returns on NYSE stocks is compared and the trading mechanisms are found to have a significant effect on stock price behavior.

2.4. Transaction Costs

2.4.1. Transaction Price and Bid-Ask Spread

Atkins and Dyl (1990) stated that the reported transaction price cannot truly reflect the cost of trading since the reported transaction price data can represent either the buy or sell transaction. Investors placing market orders buying at the ask price and selling at the

bid price provide the minimum cost of transacting for an arbitrageur attempting to profit from the reversals in stock prices that they observe.

2.4.2. Bid-Ask Spread

Early articles by Harold Demsetz (1968) and Jack Treynor, writing under the pseudonym Walter Bagehot (1971), examined the importance of the bid-ask spread for investment decisions. Demsetz (1968) found that spreads (measured in dollars) are inversely related to two proxies for trading volume, the number of transactions per day, and the number of shareholders. Trading costs decline as trading activity increases. Tinic (1972) found an inverse relationship between dollar spreads and daily trading volume. Transactions costs are lower for issues that are traded heavily and continuously. Bentson and Hagerman (1974) found that the scale of trading (measured by the number of shareholders) is negatively related to spreads (again, measured in dollars). An inverse relation between spreads and trading volume is also reported in Stoll (1978).

2.4.3. Quoted Spread and Effective Spread

Roll (1984) found that using proportional quoted spread as the trading cost measurement may overstate the actual trading execution cost since most of the trades are executed within the quote. Effective spreads potentially reflect reductions in trading costs attributable to executions within the quotes. Effective bid-ask spreads potentially provide a more accurate measure than quoted bid-ask spreads of execution costs averaged for all traders because effective spreads use actual trade prices.

Chordia, Roll and Subrahmanyam (2000) stated that quoted spreads, quoted depth, and effective spreads all move together with the market-wide and industry-wide liquidity.

These common influences remain significant and material after controlling for well-known individual liquidity determinants such as volatility, volume and price.

CHAPTER 3. DATA SOURCE AND EMPIRICAL METHODOLOGY

3.1. Data Source

A comprehensive analysis of different strategies on a common set of data from 1989-2000 is provided. The analysis is restricted to firms with available returns data found in the Center for Research in Security Prices (CRSP) NYSE/AMEX/NASDAQ monthly returns files from July 1990 through June 2000, and balance sheet data on COMPUSTAT annual file from 1989 to 1999. All domestic, primary stocks listed on the New York (NYSE), American (AMEX), and NASDAQ stock markets are included. Closed-end funds, Real Estate Investment Trusts (REITs), trusts, American Depositary Receipts (ADRs), and foreign stocks are excluded from the analysis. The data for firms in this sample are supplemented with the data on analysts' forecasts of earnings from the Lynch, Jones, and Ryan Institutional Brokers Estimate System (I/B/E/S) database.

Kothari, Shanken, and Sloan (1992) argued that the COMPUSTAT data may have survivor bias. If past data are included when firms are added, returns and earnings for the COMPUSTAT sample are upward biased. KSS argued that this bias is stronger for small firms with high-BE/ME ratio because small distressed firms are more likely to die before making it to COMPUSTAT. Since survivor bias is less important for relatively large firms, the sample in this research includes the top 2000 firms with the largest market equity only.

At the beginning of every month, stocks are ranked on the basis of either size/book-to-factors, past returns or a measure of earnings news. Equally weighted portfolios will be held for 6 months based on the selected trading strategies. To be eligible, stocks must have

data available on all the variables used for ranking. This is to ensure sensible comparison of risk-adjusted return among different trading strategies.

3.2. Various Trading Strategies

3.2.1. Factors (Size and Book-to-Market Equity) Strategy

I focus on twenty-five portfolios, formed every six-months from a simple sort of firms into five groups on ME (price times shares outstanding) and then sub-sort into five groups on BE/ME. To ensure that the accounting variables are known before the returns they are used to explain, the accounting data for all fiscal yearends in calendar year $t-1$ are matched with the returns for July of year t to June of $t+1$. The six-month (minimum) gap between fiscal yearend and the return tests is conservative. Firms are indeed required to file their 10-K reports with the SEC within 90 days of their fiscal yearend, but on average 19.8% do not comply. In addition, more than 40% of December fiscal yearend firms that do comply with the 90-day rule on March 31, and their reports are not made public until April. (Alford, Jones, and Amijewski(1992).)

A firm's market equity at the end of December of year $t-1$ is used to compute its book-to-market for $t-1$. Hence, book-to-market ratio for all fiscal yearends in calendar year $t-1$ will be matched with the returns for July of year t to June of $t+1$. In addition, its market equity is used to measure its size. Market Equity in June of year t will be matched its return for June t .

In each month j , the strategy buys the smallest size/highest book-to-market ratio portfolio and sells short the largest size/lowest book-to-market portfolio, holding this position for six months. In addition, the strategy closes out the position initiated in month

$j-6$. Hence, under this trading strategy I revise the weights on 1/6 of the securities in the entire portfolio in any given month and carry over the rest from the previous month.

For instance, toward the end of month j the long (short) portfolio consists of six parts: a position carried over from an investment at the end of month $j-6$ in the smallest (largest) size/ highest (lowest) book-to-market portfolio, and five similar positions resulting from long (short) portfolio investing in the smallest (largest) size/highest (lowest) book-to-market portfolio at the end of months $j-5, j-4, j-3, j-2$ and $j-1$. At the end of month j , the first of these holdings will be liquidated and replaced with an investment in the long (short) portfolio stocks with smallest (largest) size and highest (lowest) book-to-market portfolio as of time j . Hence, only 1/6 of the portfolio is eligible for revision in each month. The returns of the above strategy were calculated for a series of long and short portfolios. In addition, risk-adjusted returns for size and book-to-market factors would be investigated in the context of the Fama and French (1996) three-factor model.

3.2.2. Price Momentum (Relative Strength) Strategy

The relative strength portfolios were constructed as in Jegadeesh and Titman (1993). Specifically, a strategy that selects stocks on the basis of returns over the past J months and holds them for K months (I will refer to this as a J -month / K -month Strategy) was constructed as follows: At the beginning of each month j , the securities were ranked in descending order on the basis of their returns in the past J months. Based on these rankings, twenty-five portfolios were formed that equally weighted the stocks contained in portfolio one, portfolio two, and so on. Portfolio one is called the “winners” portfolio and the portfolio twenty-five is called the “losers” portfolio. In each month j , the strategy bought the winner portfolio and sold short the loser portfolio, holding this position for K

months. In addition, the strategy closed out the position initiated in month $j-K$. Hence, under this trading strategy I revise the weights on $1/K$ of the securities in the entire portfolio in any given month and carry over the rest from the previous month.

For example, toward the end of month j the $J=6/K=3$ Winners portfolio consists of three parts: a position carried over from an investment at the end of month $j-3$ in the 50-stock portfolio with highest prior six-month performance as of $j-3$, and two similar positions with highest prior six-month performance at the end of months $j-2$ and $j-1$. At the end of month j , the first of these holdings is liquidated and replaced with an investment in the 50-stock portfolio with highest six-month performance as of time j . Hence, only $1/3$ of the portfolio is eligible for revision in each month.

The ranking variable used in our price momentum strategy is a stock's past compound return, extending back six months prior to portfolio formation. Both winner and loser portfolios are equally weighted and held for six months. The returns of the above strategy are calculated for a series of long and short portfolios. In addition, risk-adjusted returns for size and book-to-market factors are investigated in the context of the Fama and French (1996) three-factor model.

3.2.3. Earning Momentum Strategy

The earnings momentum strategy is given by changes in analysts' forecasts of earnings. Since analyst estimates are not necessarily revised every month, many of the monthly revisions take the value of zero. To get around this, Jegadeesh and Lakonishok (1996) defined REV6, a six-month moving average of past changes in earnings forecasts by analysts:

$$REV6_{it} = \sum_{j=0}^6 (f_{it-j} - f_{it-j-1}) / p_{it-j-1} \quad (1)$$

where f_{it} is the consensus (mean) I/B/E/S estimate in month j of firm i 's earnings for the current fiscal year (FY1). The monthly revisions in estimates were scaled by the prior month's stock price. At the beginning of every month from July 1990 to June 2000, stocks were ranked on the basis of a measure of earning news. Tracking changes in analysts' forecasts was our technique for measurement of earning news. The ranked stocks were then assigned to one of twenty-five equally weighted portfolios. Portfolio 25 (1) consists of stocks with the best positive (worst) earnings news. The breakpoints in any given month were based on all firms that had reported earnings within the prior three months. This took into account a complete cycle of earning announcements.

In each month j , the strategy buys (sells short) the portfolio with the best (worst) earnings news holding this position for six months. Hence, only 1/6 of the portfolio is eligible for revision in each month. The returns of the above strategy were calculated for a series of long and short portfolios. In addition, risk-adjusted returns for size and book-to-market factors were investigated in the context of the Fama and French (1996) three-factor model.

3.3. Methodology – 3-Factor Model in Fama and French (1996)

In the three-factor model, the expected return on a portfolio in excess of the risk-free rate, $E(R_i) - R_f$, was hypothesized to be explained by the sensitivity of its return to three factors: (i) the excess return on a broad value-weighted market portfolio ($R_m - R_f$); (ii) the difference between the return on a portfolio of small stocks and the return on a portfolio of large stocks (SMB , small minus big); and (iii), the difference between the return on a portfolio of high-book-to-market stocks and the return on a portfolio of low-book-to-

market stocks (*HML*, high minus low). Specifically, the expected excess return on portfolio *i* is,

$$E(R_i) - R_f = b_i * \{E(R_M) - R_f\} + s_i * E\{SMB\} + h_i * E\{HML\}, \quad (2)$$

where $E(R_M) - R_f$, $E\{SMB\}$, and $E\{HML\}$ are expected premiums, and the factor sensitivities or loadings, b_i , s_i , and h_i , are the slopes in the time-series regression,

$$R_i - R_f = \alpha_i + b_i * \{R_M - R_f\} + s_i * \{SMB\} + h_i * \{HML\} + \varepsilon_i. \quad (3)$$

Here book-to-market equity and slopes on HML proxy for relative distress. Weak firms with persistently low earnings tend to have high BE/ME and positive slopes on HML; strong firms with persistently high earnings have low BE/ME and negative slopes on HML. Similarly, SMB is used to explain the returns on small stocks that are not captured by CAPM.

I used the yield on the three-month Treasury bills from CRSP at the beginning of each month to approximate the risk-free rate, R_f . Following Fama and French (1996), I used the value-weighted monthly return on all stocks in the sample to represent the market return, R_m in one regression and equally-weighted monthly return on another.

The explanatory returns SMB, and HML were formed as follows. At the end of the month of each year *t* (1989-1999), NYSE, AMEX and NASDAQ stocks were allocated to two groups (small or big) based on whether that particular month's market equity (ME, stock price times shares outstanding) was below or above the median ME for all NYSE stocks. Hence, the number of firms in the small and big portfolios may differ. Most AMEX and NASDAQ stocks were smaller than NYSE median, so the small group contained more stocks.

NYSE, AMEX and NASDAQ stocks were also allocated in an independent sort to three book-to-market equity (BE/ME) groups (low, medium, or high) based on the

breakpoints for the bottom 30%, middle 40%, and top 30% of the values of BE/ME for NYSE stocks. Since, the book-to-market break-points were created using only NYSE securities, the number of firms in the high and low portfolios were usually unequal. BE is the COMPUSTAT book value of stock holders' equity, plus balance sheet deferred taxes and investment tax credit (if available), minus the book value of preferred stock. The BE/ME ratio used to form portfolios in June of year t is then book common equity for the fiscal year ending in calendar year $t-1$, divided by market equity at the end of December of $t-1$.

The final portfolios are the six intersections of the two ME and the three BE/ME groups (S/L, S/M, S/H, B/L, B/M, B/H). For example, the S/L portfolio contains the stocks in the small-ME group that are also in the low-BE/ME group, while the B/H portfolio contains the big stocks that also have high BE/ME. Monthly value-weighted stock returns for the six portfolios were calculated from July of year t to June of year $t+1$, and the portfolios were reformed in June of year $t+1$. I calculated returns beginning in July of year t to be sure that book value of equity of year $t-1$ is known.

SMB is the monthly difference between the average of the returns on the three small-stock portfolios (S/L, S/M and S/H) and the average of the returns on the three big-stock portfolios (B/L, B/M, and B/H). HML is the monthly difference between the average of the returns on the two high-BE/ME portfolios (S/H and B/H) and the average of the returns on the two low-BE/ME portfolios (S/L and B/L).

3.4. Optimal Rebalancing Period and Optimal Size of the Portfolio

I used the past six-month performance to rank the top 2000 firms with the highest market equity. I purchased (sold short) the stocks with the best (worst) six-month

performance in the long (short) portfolio. Each portfolio consists of one to two hundred stocks and it would be held for a period of one to twelve months. If a stock was delisted in any given month, this partial monthly return was used as the full monthly return and the return of the stock would be 0% until the end of the holding period. It implied that the proceeds are not reinvested for the rest of the holding period.

Returns of the portfolios were determined for each holding month. Monthly return of the market neutral (long/short equity) portfolio is the difference of the monthly return of the short portfolio and that of the long portfolio. The length of the portfolio holding period was considered similar to the J-month / K-month strategy used in Jegadeesh and Titman (1993). In the six-month / three-month strategy, the long portfolio included three separate portfolios constructed over the last three months. Only one-third of the long portfolio is replaced with the newly selected long portfolio monthly. Assume that it is currently April 2000, the January portion of the long portfolio is replaced with the portion that is newly formed (April 2000).

Four scenarios of round trip transaction costs of values 0%, 0.5%, 1.0%, and 2.0% of the stock value were considered in the calculation of return. Assume a 50-stock portfolio with the best previous six-month return was purchased and it was held for five months. This entire portfolio consists of five 50-stock portfolios. A portfolio (one-fifth of the whole portfolio) formed in last August would be replaced with a January portfolio. If I am going to replace ten out of these fifty stocks in January at a 0.5% round trip transaction cost, the net transaction cost to the whole portfolio would be $(10/50) \times 0.5\% \times 1/5 = 0.02\%$ of the August portfolio's value. The significance of the risk-adjusted return (with and without transaction cost), market factor loading, size loading and financial distress loading were examined within the context of 3-Factor model (FF 1996).

3.5. Adjustment in Short Portfolio

In the previous section, I have assumed that the short seller did not have to put up any initial margin and that the short seller actually got the full use of the short proceeds. These assumptions are being challenged in reality. In fact, two medium size hedge fund companies have confirmed that there is interest earned on the initial margin and short rebate for the short portfolio. They state that the interest rate on margin normally lies between 1.00% - 1.50% above prime rate while the short rebate lies between 0.00% - 0.75% below prime rate with the initial (maintenance) margin of 50% (35%). In the hope of having the results being reflected realistically, the short portfolio return will be adjusted using the Alexander (1993) model.

In Alexander (1993), an investor must deposit cash or securities earning the risk-free rate r_f in his or her account at a brokerage firm in order to meet an initial margin requirement for short selling a share of stock. The amount deposited must be at least equal to the proportion of m (less than 1) for the sales proceeds. The sales proceeds are deposited into the investor's account and thereafter provide the investor with interest at the risk free rate r_f . The initial margin requirement is less than 100% and the risk-free interest that is paid on the short proceeds (r_f) is less than the rate paid on the initial margin (r_f). If the firm whose shares were sold short subsequently declared a cash dividend, the short seller must pay the brokerage firm an amount equal to per share cash dividend times the number of shares sold short.

Hence, return to the short seller of firm i , r_{is} , is equal to:

$$\begin{aligned} R_{is} &= (P_{i0} - P_{i1} - D_i) / (m * P_{i0}) + (m * r_{f1} * P_{i0}) / (m * P_{i0}) + (r_{f2} * P_{i0}) / (m * P_{i0}) \\ &= R_{i1} / m + r_{f1} + r_{f2} / m \end{aligned} \quad (4)$$

Expected return from short selling a share of stock is equal to:

$$E(R_{is}) = -E(R_{il}) / m + r_1 + r_2 / m \quad (5)$$

where m = initial margin = 50%,

r_1 = interest on initial margin = prime rate plus 1.25%,

r_2 = interest on short rebate = prime rate minus 0.50%

It is worth mentioning that even if firm A has a positive expected return in the one-stock long portfolio, this firm may also have a positive expected return in the one-stock short portfolio. This will happen when both the interest earned on the initial margin and the leveraged short proceeds are large enough to offset the positive return of firm A. Due to the leverage effect on the short portfolio, I need to invest more than half of the funds in the long portfolio in order to create a market neutral portfolio. In particular, the long/short portfolio will indeed be market neutral when I invest 2/3 of the funds in the long portfolio and the rest in the short portfolio.

3.6. Spread Analysis

The initial sample consists of the top 2000 NYSE, AMEX, and NASDAQ firms with the largest market capitalization from July 1997 to June 1999. American Depositary Receipts, shares of beneficial interests, companies incorporated outside the United States, closed-end funds, and real estate investment trusts are deleted from this study. Each firm in the final sample is required to have complete returns data on the Center for Research in Securities Prices (CRSP) database and bid-ask prices from the Trade and Quote Transaction (TAQ) database.

Similar to the techniques demonstrated in Amihud and Mendelson (1987), this empirical study considers the open-to-open returns and close-to-close returns,

$$R_{oj} = (P_{oj} - P_{oj-1}) / P_{oj-1} \quad (6)$$

$$R_{c,j} = (P_{c,j} - P_{c,j-1}) / P_{c,j-1} \quad (7)$$

where $P_{o,j}$ is the opening price of the last trading day of month j , adjusted for splits and stocks dividends. $P_{c,j}$ is the closing price of the last trading day of month j similarly adjusted. Thus, a sequence of open-to-open returns $\{R_{o,j}\}$ and a sequence of close-to-close returns $\{R_{c,j}\}$, which cover the very same period of time, are obtained.

For each stock i in the sample, I find the six-month period opening return ($HPR_{o,i}$) and six-month holding period closing return ($HPR_{c,i}$) in the formation period. After that, the $HPR_{o,i}$'s and $HPR_{c,i}$'s are ranked separately and portfolios are formed. The fifty stocks with the highest (lowest) $HPR_{o,i}$ ($HPR_{c,i}$) are assigned to a winner (loser) portfolio W_o (L_o). The same procedure is performed for $HPR_{c,i}$ on stock i . In total, there are 26 winner (13 W_o and 13 W_c) and 26 loser portfolios (13 L_o and 13 L_c) each containing 50 securities.

I then proceed to purchase (short sale) the firms in the winner (loser) portfolio and hold the stocks for six months as suggested by Loughran and Ritter (1996). Two trading methods are used to enter into and exit a position. The comparison of the results from these two methods will shed light on the true cost of the investment. Under the Trade Prices Method, I enter a position at the opening transaction price of a trading day and exit a position at the closing transaction price of a trading day six months later. In contrast, I enter a long (short) position at the ask (bid) price and exit the position at the bid (ask) price under the Bid-Ask Price Method.

In reality, investors have to reasonably allow a certain time frame to have the trade executed since it is highly unlikely to have the trade successfully completed immediately. Therefore, I define the trade prices and bid/ask prices in three different ways. These three techniques are examined and compared with each other. In the first scenario, I enter into

the position at the first trade (under trade price method) or the first bid/ask price (under bid-ask price method) after 9:30a.m. I terminate the position six months later at the last trade (under the trade price method) or the last bid/ask price (under the bid-ask price method). Under the second (last) scenario, the entry price is calculated by taking the average of all trade prices or bid-ask prices in the first five (ten) minutes of the given trading day. The exit price is calculated by taking the average of all trade prices or bid-ask prices in the last five (ten) minutes of the trading day six months later.

Similar to the transaction costs measures presented in Barclay (1997), two measures of execution costs are estimated in this study. The first is the quoted relative proportional bid-ask spread. This quoted spread measures the execution cost per trade for trades that occur at the quoted bid or ask. Because transactions sometimes occur at prices other than the quoted bid or ask, I also examine the absolute effective spread. This absolute effective spread measures the execution cost that traders actually pay regardless of whether their trades occur at the quoted bid or ask.

The relative proportional bid-ask spreads computed for each firm in the winner (or loser) portfolios is an average of daily relative bid-ask spread observations k for the six-month period (either formation or performance period). The intraday data is screened to ensure that the spread of each daily observation was positive and the ask quote was greater than the bid quote. Assume that stock w (stock l) is in the winner (loser) portfolios. Daily ask (Ask_{wk}) and bid (Bid_{wk}) price for stock w with daily observations v and total daily observations Z are:

$$Ask_{wk} = \sum_{v=1}^Z Ask_{wkv} / Z \quad (8)$$

$$Bid_{wk} = \sum_{v=1}^Z Bid_{wkv} / Z \quad (9)$$

I computed the average relative bid-ask spread per six-month period T for stock w as follows:

$$\text{Spread}_{wT} = \sum_{k=1}^N [(\text{Ask}_{wk} - \text{Bid}_{wk}) / (\text{Ask}_{wk} + \text{Bid}_{wk}) / 2] / N \quad (10)$$

where N is the total number of trading days for stock w during the six-month period T .

Hence, The relative proportional average bid-ask spreads for the winner portfolio (Spread_{wT}) and loser portfolio (Spread_{LT}) per six-month period T are:

$$\text{Spread}_{wT} = [\sum_{w=1}^{50} \text{Spread}_{wT}] / 50 \quad (11)$$

$$\text{Spread}_{LT} = [\sum_{l=1}^{50} \text{Spread}_{lT}] / 50 \quad (12)$$

The absolute effective spread for stock w in each six-month period T is defined as the average absolute daily bid-ask effective spread observations k for the six-month period (either formation or performance period). The daily absolute bid-ask pair is required to match with the trade within one minute in order to determine the transaction price.

$$\text{Effective Spread}_{wT} = \left| \sum_{k=1}^N [(\text{Price}_{wk} - (\text{Ask}_{wk} + \text{Bid}_{wk})/2) / (\text{Ask}_{wk} + \text{Bid}_{wk}) / 2] / N \right| \quad (13)$$

where Price is the transaction cost. The absolute effective bid-ask spreads for the winner portfolio ($\text{Effective Spread}_{wT}$) and loser portfolio ($\text{Effective Spread}_{LT}$) per six-month period T are:

$$\text{Effective Spread}_{wT} = [\sum_{w=1}^{50} \text{Effective Spread}_{wT}] / 50 \quad (14)$$

$$\text{Effective Spread}_{LT} = [\sum_{l=1}^{50} \text{Effective Spread}_{lT}] / 50 \quad (15)$$

Four statistical tests on the spreads and spreads volatility (t-test and F test) were performed. First, I compared the proportional spread and its volatility of long and short portfolios in the same (either formation or performance) period.

Hypothesis 1: There is no difference between the average proportional spreads for the portfolios in the same period.

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Hypothesis 2: There is no difference between the dispersion of the average proportional spreads for the portfolios in the same period.

Then, I compare the effective spread and its volatility of long and short portfolios in the same (either formation or performance) period.

Hypothesis 3: There is no difference between the effective spreads for the portfolios in the same period.

Hypothesis 4: There is no difference between the dispersion of the effective spreads for the portfolios in the same period.

CHAPTER 4.

THE IMPACT OF VARIOUS TRADING STRATEGIES IN PORTFOLIOS

4.1. Factors (Size and Book-to-Market Equity) Strategy

4.1.1. Sample Statistics for the Size/ Book-to-Market Portfolios

Table 1 shows the summary statistics on the Size/Book-to-Market portfolios.

Average monthly returns on various portfolios are shown in Panel A. The portfolio with the smallest size and highest book-to-market quintiles has the highest monthly average return (1.56%). Looking down the columns of average return matrix shows that there is a negative relation between average return and size. The spread of returns across the size portfolios decrease with size. For example, the spread on the average monthly return in the smallest size quintiles (0.64%) is higher than the one in the largest size quintiles (-0.24%). Within a size quintile, returns typically increase strongly with BE/ME. For instance, the spread on the average monthly return in the highest book-to-market quintiles (0.35%) is higher than the one in the lowest book-to-market quintiles (-0.53%). Average sizes of the portfolios are given in Panel B. First of all, the market equities in the largest size quintiles range from \$7093.66 million to \$19071.85 million. In comparison, the market equities in the smallest size quintiles range only from \$247.17 million to \$250.60 million. The spread on the size of the portfolio in the largest book-to-market quintiles (\$6847.71million) is smaller than the spread in the smallest book-to-market quintiles (\$18821.25million). Furthermore, the spread on the size of the portfolio in the smallest market equity quintiles (\$3.43million) is smaller than the spread in the largest market equity quintiles (\$11977.97 million).

Table 1.
Summary Statistics on Factor (Size/Book-to-Market) Trading Strategy

Panel A: Average Monthly Return (in percent)

Size	BE/ME Quintiles					
	Low	2	3	4	High	H-L
Small	1.30	1.32	1.35	1.38	1.56	0.26
2	1.27	1.18	1.25	1.30	1.51	0.24
3	1.27	1.00	1.21	1.23	1.49	0.22
4	1.08	1.09	1.19	1.26	1.30	0.22
Big	1.05	1.06	1.08	1.19	1.21	0.16
S-B	0.25	0.26	0.27	0.19	0.35	

Panel B: Average Market Capitalization (in million)

Size	BE/ME Quintiles					
	Low	2	3	4	High	H-L
Small	250.60	250.19	250.22	250.06	247.17	-3.43
2	413.43	412.74	413.59	414.12	411.33	-2.10
3	762.38	766.41	771.18	747.85	765.36	2.98
4	1805.61	1775.66	1772.30	1760.69	1754.02	-51.59
Big	19071.85	16507.37	12020.76	13071.16	7093.88	-11977.97
S-B	-18821.25	-16257.18	-11770.54	-12821.10	-6846.71	

Panel C: Average Book-to-Market

Size	BE/ME Quintiles					
	Low	2	3	4	High	H-L
Small	0.17	0.36	0.55	0.77	19.07	18.90
2	0.16	0.34	0.52	0.72	3.39	3.23
3	0.16	0.33	0.49	0.68	2.85	2.69
4	0.16	0.33	0.51	0.71	2.85	2.69
Big	0.15	0.30	0.45	0.64	6.30	6.15
S-B	0.02	0.06	0.10	0.13	12.77	

Top 2000 firms with the highest market equity are ranked by market equity into quintiles and subsorted by book-to-market into quintiles from July 1989-June 2000.

Finally, average book-to-market ratios for various portfolios are reported in Panel C. It is worth mentioning that the book-to-market ratio for the portfolio in the smallest size and largest BE/ME quintiles (19.07) is noticeably higher than the others. The BE/ME spread in the largest book-to-market quintiles (12.77) is higher than the one in the lowest book-to-market quintiles (0.02). The above results support the notion presented in Chan and Chen (1991). They postulate that the earning prospects of firms are associated with a risk factor in returns. Firms that the market judges to have poor prospects, signaled by low stock prices and high ratios of book-to-market equity, have higher expected stock returns (they are penalized with higher costs of capital) than firms with strong prospects. Overall, I confirm that firms with low market equity are more likely to have poor prospects, resulting in low stock prices and high book-to-market equity. Conversely, large stocks are more likely to be firms with stronger prospects, higher stock prices, lower book-to-market equity, and lower average returns.

4.1.2. Returns of Size/ Book-to-Market Portfolios

Table 2 reports the summary statistics (mean, median and standard deviation) and estimates of the three-factor regression for the long portfolio, short portfolio and arbitrage portfolio. The average monthly return for the smallest size/highest book-to-market (largest size/lowest book-to-market) portfolio is 1.56% (1.45%). Median monthly return for the smallest size/ highest book-to-market (largest size/low book-to-market) portfolio is 1.89% (1.40%). Standard deviation for the first portfolio is 4.57 while the later portfolio is 5.12. Hence, the relative return /risk ratio is higher for the long portfolio ($1.56/4.57=0.34$) than the short portfolio ($1.45/5.12=0.28$). As I consider the market neutral long/short equity portfolio as an arbitrage portfolio, the average (median) monthly return is 0.11% (0.21%)

Table 2. Risk-Adjusted Portfolios Returns in Factors Trading Strategy**Panel A: Summary Statistics on Monthly Returns**

	Long Portfolio	Short Portfolio	Arbitrage Portfolio
Mean	1.56	1.45	0.11
Median	1.89	1.40	0.21
Std Dev	4.57	5.12	4.09
Return/Risk	0.34	0.28	0.03

Panel B: With Value-Weighted Rm

$$R_i - R_f = a_i + b_i * (R_m - R_f) + s_i * (SMB) + h_i * (HML) + e_i$$

	Long Portfolio	Short Portfolio	Arbitrage Portfolio
a	0.32	0.08	-0.18
t(a)	1.80	0.62	-0.83
b	0.97	0.98	0.00
t(b)	23.38	26.27	-0.07
s	0.62	0.25	0.37
t(s)	13.52	6.18	5.53
h	0.44	-0.52	0.97
t(h)	7.68	-10.15	11.64
R²	0.87	0.91	0.65
s²(e)	1.7	1.52	2.47
F	273.86	446.82	78.41

Panel C: With Equally-Weighted Rm

$$R_i - R_f = a_i + b_i * (R_m - R_f) + s_i * (SMB) + h_i * (HML) + e_i$$

	Long Portfolio	Short Portfolio	Arbitrage Portfolio
a	0.08	-0.14	-0.20
t(a)	0.48	-0.84	-0.90
b	0.99	0.98	0.01
t(b)	20.66	20.98	0.21
s	-0.18	-0.54	0.35
t(s)	-2.17	-8.17	3.99
h	0.36	-0.61	0.98
t(h)	5.85	-10.09	12.02
R²	0.84	0.88	0.65
s²(e)	1.87	1.83	2.47
F	217.66	297.21	78.45

Long (Short) Portfolio is the portfolio with the smallest (largest) and highest (lowest) book-to-market. Arbitrage Portfolio is the jumbo portfolio of long and short portfolios combined.

while the standard deviation is substantially lower than either the long or short portfolio alone. Its return/risk ratio is 0.03 (0.11/4.09). In the following section, I will test whether or not this portfolio is indeed market-neutral.

4.1.3. Risk-Adjusted Returns of Size/ Book-to-Market Portfolios

Overall, the directions of all the variables are similar regardless of using either the value-weighted or equally-weighted market portfolio as one of the independent variables in the Fama and French (1996) three-factor model. Risk-adjusted return in the regression with value-weighted market portfolio for the long (short) portfolio is 0.32% (0.08%) per month while the former return is significantly different from zero. On the other hand, the risk-adjusted return in the regression with equally-weighted market portfolio for the long (short) portfolio is 0.08% (-0.14%) per month. Hence, the combined (long/short) portfolio has the risk-adjusted return of either 0.24% (0.32%-0.08%) or 0.22% (0.08%--0.14%) per month depending on the how market portfolios are constructed. It is worth noting that most of the risk-adjusted return for the combined portfolio derives from the long (short) portfolio when value-weighted (equally-weighted) market portfolio are chosen in the regression. The cause of this difference is yet to be explored.

The long and short portfolios have very similar market risk exposures. Beta coefficients are not only close to one but also significant for both long and short portfolio in both regressions. In the regression with value-weighted market portfolio, beta is 0.97 (0.98) for the long (short) portfolio. For the regression with equally-weighted portfolio, beta is 0.99 (0.98) for the long (short) portfolio. So, I can infer the beta for both long and short portfolios in either regression are almost the same and the combined portfolio appears to be market neutral.

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The size-loading factor for long and short portfolios in the regression with value-weighted market portfolio are 0.62 and 0.25 respectively. Both portfolios load significantly on size. Conversely, it is negative significantly for both long (-0.18) and short (-0.54) portfolios in the regression with equal-weighted market portfolio. The book-to-market loading factor is significantly positive (negative) for the long (short) portfolio in either regression. Long portfolio concentrates more heavily on value stocks, and so loads positively on the book-to-market factor. At the same time, short portfolio is more oriented towards glamour stocks, so it loads negatively on the book-to-market factor.

Enormous predictive power for both regressions is found. R^2 is 0.87 (0.91) for the long (short) portfolio for regression with value-weighted market portfolio and 0.84 (0.88) for regression with equally-weighted market portfolio. I therefore claim that value-weighted market portfolio is a slightly better explanatory variable than equally-weighted market portfolio.

The result of the regressions is similar when I treat the return the long/short portfolio as one arbitrage portfolio. Beta for this arbitrage portfolio is extremely close to zero in either regression. I therefore verify that this portfolio is indeed market neutral. The size and book-to-market factor loading are positive significantly in either regression. Nevertheless, the predictive power for both regressions has fallen to 0.65.

Overall, the adjusted risk return for the long portfolio, short portfolio and arbitrage portfolio in either regression are not significantly different from zero (except the long portfolio in the regression with value-weighted market portfolio as one of the independent variable). This result is well expected. Since the present trading strategy relies only on the size and book-to-market factors of the stocks, its performance is just a manifestation of

size and book-to-market effects, then the intercept of the equation should not be significantly different from zero.

4.2. Price Momentum (Relative Strength) Strategy

4.2.1. Sample Statistics for Relative Strength Portfolio

Table 3 reports the average monthly return, average size and average book-to-market ratios for twenty-five portfolios. Overall, the return in the winner portfolios tends to yield higher returns than the loser portfolios. For instance, the return for portfolio 1 (2.66%) is greater than portfolio 2 (2.07%) which is in turn greater than portfolio 3 (1.75%). At the same token, the return for portfolio 25 (0.79%) has the lowest return among twenty-five portfolios. Average size of the portfolios range from \$1019.5 million to \$4537.62 million. Average book-to-market ratio of the portfolios ranges from 0.60 to 3.58. Loser portfolio (portfolio 25) indeed has the smallest size and high book-to-market ratio as compared with the others, whereas winner portfolio (portfolio 1) has a relatively low book-to-market ratio.

4.2.2. Returns for the Relative Strength Portfolio

Table 4 reports the summary statistics (mean, median and standard deviation) and estimates of the three-factor regression for the long portfolio, short portfolio and arbitrage portfolio. The average monthly return for the portfolio with the highest (lowest) past 6-month performance is 2.66% (0.79%) per month. Median monthly returns return for the winner (loser) portfolio is 3.52% (1.09%). Standard deviation for the winner portfolio is 10.05 while the loser portfolio is 7.69. Hence, the relative return /risk ratio is much higher for the winner portfolio ($2.66/10.05=0.26$) than the loser portfolio ($0.79/7.69=0.10$). As I

Table 3. Summary Statistics on Relative Strength Trading Strategy

Portfolio	Average Monthly Return (in %)	Average Market Capitalization (in million)	Average Book-to-Market
Winner	2.66	1722.95	0.60
2	2.07	2641.76	2.43
3	1.75	3125.95	2.72
4	1.55	3951.11	2.60
5	1.47	4096.76	1.89
6	1.41	4515.56	0.93
7	1.34	4436.58	1.94
8	1.24	4498.11	0.80
9	1.25	4537.62	1.16
10	1.15	4483.19	1.17
11	1.21	4217.64	2.02
12	1.15	4138.77	1.38
13	1.16	4016.42	0.60
14	1.11	3893.18	2.62
15	1.23	3642.82	1.57
16	1.17	3643.17	1.47
17	1.22	3360.76	1.71
18	1.13	3124.18	3.02
19	1.10	3118.06	2.14
20	1.06	2976.41	3.58
21	1.11	2537.98	1.63
22	0.98	2532.00	1.51
23	0.95	2030.41	1.60
24	0.98	1499.38	1.51
Loser	0.79	1019.15	3.60
W-L	1.87	703.80	-3.00

Top 2000 firms with the highest market capitalization are ranked by their prior 6-month return from July 1989-June 2000 into twentieth-five portfolio..

Winner (Loser) Portfolio is the portfolio with the best (Worst) past 6-month performance.

Table 4. Risk-Adjusted Portfolios Returns in Relative Strength Strategy**Panel A: Summary Statistics on Monthly Returns**

	Long Portfolio	Short Portfolio	Arbitrage Portfolio
Mean	2.66	0.79	1.87
Median	3.52	1.09	1.73
Std Dev	10.05	7.69	8.20
Return/Risk	0.26	0.10	0.23

Panel B: With Value-Weighted Rm

$$R_i - R_f = a_i + b_i * (R_m - R_f) + s_i * (SMB) + h_i * (HML) + e_i$$

	Long Portfolio	Short Portfolio	Arbitrage Portfolio
a	0.96	-0.84	1.38
t(a)	2.26	-2.31	2.00
b	1.39	1.38	0.02
t(b)	12.00	13.83	0.09
s	1.65	0.99	0.66
t(s)	12.97	9.11	3.18
h	-0.91	-0.03	-0.87
t(h)	-5.72	-0.25	-3.37
R^2	0.78	0.73	0.14
s^2(e)	4.72	4.05	7.67
F	154.09	114.09	7.16

Panel C: With Equally-Weighted Rm

$$R_i - R_f = a_i + b_i * (R_m - R_f) + s_i * (SMB) + h_i * (HML) + e_i$$

	Long Portfolio	Short Portfolio	Arbitrage Portfolio
a	0.67	-1.20	1.44
t(a)	1.45	-3.13	2.05
b	1.36	1.40	-0.04
t(b)	10.58	13.22	-0.22
s	0.55	-0.15	0.70
t(s)	3.06	-0.97	2.53
h	-1.05	-0.14	-0.90
t(h)	-6.33	-1.01	-3.58
R^2	0.76	0.71	0.14
s^2(e)	5.03	4.16	7.67
F	130.76	105.99	7.18

Long (Short) Portfolio is the portfolio with the best (worst) prior 6-month performance.

Arbitrage Portfolio is the jumbp portfolio of long and short portfolios combined.

consider the market neutral long/short equity portfolio as one arbitrage portfolio, the average (median) monthly return is 1.87% (1.73%) while the standard deviation lies between the winner and loser portfolios alone. Its relative return/risk ratio is 0.23 (1.87/8.20).

4.2.3. Risk-Adjusted Returns of Relative Strength Portfolios

Overall, the directions of all the variables are similar regardless of using either the value-weighted or equally-weighted market portfolio in the Fama and French (1996) three-factor model. Risk-adjusted return in the regression with value-weighted market portfolio for the long (short) portfolio is 0.96% (-0.84%) per month while both returns are significantly different from zero. On the other hand, the risk-adjusted return in the regression with equally-weighted market portfolio for the long (short) portfolio is 0.67% (-1.20%) per month. Hence, the combined (long/short) portfolio has the risk-adjusted return of either 1.80% (0.96%--0.84%) or 1.87% (0.67%--1.20%) per month depending on how market portfolios are constructed. It is worth noting that most of the risk-adjusted return for the combined portfolio derives from the long (short) portfolio when value-weighted (equally-weighted) market portfolio are chosen in the regression. The cause of this difference is yet to be explored.

Beta coefficients are not only close but also significant for both long and short portfolios in both regressions. In the regression with value-weighted market portfolio, beta is 1.39 (1.38) for the long (short) portfolio. For the regression with equally-weighted portfolio, beta is 1.36 (1.40) for the long (short) portfolio. So, I can infer the beta for both long and short portfolios in either regression are almost the same and the combined portfolio appears to be market neutral.

The size-loading factor for long and short portfolios in the regression with value-weighted market portfolio are 1.65 and 0.99 respectively. They are both significantly different from zero. Conversely, size-loading factor is positive significantly from zero only for long portfolio (0.55) in the regression with value-weighted market portfolio. Short portfolio in this case has the size-loading factor of -0.15.

The book-to-market loading factor is negative for both long and short portfolios regardless of the market portfolio chosen in either regression. Furthermore, it is significantly different from zero for the long portfolios in either case.

Satisfactory predictive power for the both regression are found. R^2 is 0.78 (0.73) for the long (short) portfolio for regression with value-weighted market portfolio and 0.76 (0.71) for regression with equally-weighted market portfolio. I therefore suggest that value-weighted market portfolio is a slightly better explanatory variable than equally-weighted market portfolio.

The result of the regressions is similar when I treat the long/short portfolio as one arbitrage portfolio. Risk-adjusted return is 1.38% (1.44%) per month for the regression with value-weighted (equally-weighted) market portfolio as one of the independent variables. They are both significantly different from zero. Beta for this arbitrage portfolio is quite close to zero in either regression. I therefore suggest that this portfolio is market neutral. The size factor loading is positive significantly while the book-to-market factor loading is negative in either regression. Nevertheless, the explanatory power for both regressions has fallen to 0.14. With this low predictive power, it simply implies that a better model is yet to be discovered.

The risk-adjusted returns of the long portfolio, short portfolio and arbitrage portfolio are significantly different from zero in either regression (except the long portfolio

in equally-weighted market portfolio as one of the variables in the regression). This result suggests that additional variables are needed to explain for the cause of the return.

4.3. Earning Momentum Strategy

4.3.1. Sample Statistics for REV6 Portfolios

Table 5 shows the summary statistics on the REV6 portfolios. Average monthly returns of the portfolios range from 1.01% to 1.68% per month. Average sizes of the portfolios range from \$1178.05 million to \$5521.38 million. Average book-to-market ratios for the portfolios range from 0.54 to 6.38. Portfolio with the best earning news (portfolio 25) has smallest size and the highest monthly return while portfolio with the worst earning news (portfolio 25) has the highest book-to-market ratio.

4.3.2. Returns of REV6 Portfolios

Table 6 reports the summary statistics (mean, median and standard deviation) and estimates of the three-factor regression for the long portfolio, short portfolio and arbitrage portfolio. The average monthly return for the best (worst) earnings news portfolio is 1.68% (1.43%). Median monthly return for the best (worst) earnings portfolio is 2.25 % (2.32%). Standard deviation for the first portfolio is 7.09 while the later portfolio is 5.99. Hence, the relative return /risk ratio is the same for the long portfolio ($1.68/7.09=0.24$) and the short portfolio ($1.43/5.99=0.24$). As I consider the market neutral long/short equity portfolio as an arbitrage portfolio, the average (median) monthly return is 0.25% (-0.13%) while the standard deviation is substantially lower than either the long or short portfolio alone. Its return/risk ratio is 0.08 ($0.25/3.00$) that is much lower than the best earning news

Table 5. Summary Statistics on Earning Momentum Strategy

Portfolio	Average Monthly Return (in percent)	Average Market Capitalization (in million)	Average Book-to-Market
Loser	1.43	1691.66	6.38
2	1.34	2191.39	2.82
3	1.51	2488.80	1.04
4	1.54	2854.49	1.55
5	1.54	3618.74	0.88
6	1.36	3814.81	0.54
7	1.25	3991.24	1.27
8	1.29	4197.14	1.11
9	1.13	4616.60	3.57
10	1.31	4566.61	4.51
11	1.28	4916.39	1.65
12	1.33	5521.38	0.55
13	0.98	3540.28	0.57
14	0.86	4402.63	0.60
15	1.01	4767.17	0.60
16	1.14	4104.13	0.67
17	0.99	3766.24	5.30
18	1.12	3526.46	2.57
19	1.23	3190.28	2.44
20	1.28	2849.75	0.59
21	1.25	2438.83	0.60
22	1.33	2289.49	0.68
23	1.41	1794.69	0.91
24	1.50	1442.66	2.25
Winner	1.68	1178.05	1.74
Winner-Loser	0.25	-513.60	-4.64

Top 2000 firms with the highest market capitalization are ranked by revision in analyst forecasts from July 1989-June 2000 into twenty-five portfolio.

Winner (Loser) Portfolio is the portfolio with the best (worst) earning news.

Table 6.
Risk-Adjusted Portfolios Returns in Earnings Momentum Strategy

Panel A: Summary Statistics on Monthly Returns

	Long Portfolio	Short Portfolio	Arbitrage Portfolio
Mean	1.68	1.43	0.25
Median	2.25	2.32	0.13
Std Dev	7.09	5.99	3.00
Return/Risk	0.24	0.24	0.08

Panel B: With Value-Weighted Rm

$$R_i - R_f = a_i + b_i * (R_m - R_f) + s_i * (SMB) + h_i * (HML) + e_i$$

	Long Portfolio	Short Portfolio	Arbitrage Portfolio
a	0.10	-0.12	0.65
t(a)	0.45	-0.79	2.68
b	1.34	1.28	0.05
t(b)	22.12	30.30	0.82
s	1.15	0.75	0.40
t(s)	17.35	16.20	5.51
h	0.07	0.07	0.00
t(h)	0.90	1.15	0.02
R²	0.88	0.92	0.21
s²(e)	2.47	1.72	2.69
F	316.45	481.73	11.00

Panel C: With Equally-Weighted Rm

$$R_i - R_f = a_i + b_i * (R_m - R_f) + s_i * (SMB) + h_i * (HML) + e_i$$

	Long Portfolio	Short Portfolio	Arbitrage Portfolio
a	-0.26	-0.46	0.62
t(a)	-1.13	-2.61	2.52
b	1.38	1.31	0.07
t(b)	21.51	27.00	0.98
s	0.03	-0.31	0.34
t(s)	0.29	-4.58	3.54
h	-0.02	-0.03	0.00
t(h)	-0.21	-0.45	0.05
R²	0.88	0.90	0.21
s²(e)	2.52	1.91	2.69
F	386.85	386.85	11.13

Long (Short) Portfolio is the portfolio with the best (worst) earning news forecast.
 Arbitrage Portfolio is the jumbo portfolio of long and short portfolios combined.

portfolio and the worst earning news portfolio. In the following section, I will test whether or not this portfolio is indeed market-neutral.

4.3.3. Risk-Adjusted Returns of REV6 Portfolios

Risk-adjusted return in the regression with value-weighted market portfolio for the long (short) portfolio is 0.10% (-0.12%) per month. On the other hand, the risk-adjusted return in the regression with equally-weighted market portfolio for the long (short) portfolio is -0.26% (-0.46%) per month while the former return is significantly different from zero. Hence, the combined (long/short) portfolio has the risk-adjusted return of either 0.22% (0.10%--0.12%) or 0.20% (0.26%--0.46%) per month depending on how market portfolios are constructed. It is worth noting that the risk-adjusted return for the combined portfolio derives almost equally from the long and short portfolio when value-weighted market portfolio. On the other hand, more than half of the risk-adjusted return for the combined portfolio derives from the short portfolio when equally-weighted market portfolio are chosen in the regression. The cause of this difference is yet to be explored.

Market risk exposures are higher for the long portfolio than the short portfolio in either regression. In the regression with value-weighted market portfolio as the proxy of the market performance, beta for the long (short) portfolio is 1.34 (1.28) and it is significantly different from zero. In the regression with equally-weighted market portfolio as the independent variable, beta is 1.38 (1.31) for the long (short) portfolio. Since there is a tremendous difference of betas for long and short portfolio, I seriously wonder whether the combined portfolio is market neutral.

The size-loading factor for long and short portfolios in the regression with value-weighted market portfolio are 1.15 and 0.75 respectively. They are both significantly

different from zero. Conversely, it is significant for the short (-0.31) portfolios in the regression with equal-weighted market portfolio.

The book-to-market loading factor is positive for the both long and short portfolio in the regression model with value-weighted market portfolio as one of the independent variables. It is negative for both the long and short portfolios in the other regression.

Enormous predictive power for both regressions is found. R^2 is 0.88 (0.92) for the long (short) portfolio for regression with value-weighted market portfolio and 0.88 (0.90) for regression with equally-weighted market portfolio. I therefore suggest that value-weighted and equally-weighted market portfolios are good explanatory variables for the 3-factor regression model.

The result of the regressions is quite disturbing when I treat the long/short portfolio as one arbitrage portfolio. Risk-adjusted return for the arbitrage portfolio is 0.65% (0.62%) on the regression model with value-weighted (equally-weighted) market portfolio as one of the independent variables. In both cases, the returns are significantly different from zero. Beta for this arbitrage portfolio is 0.05 (0.07) depending on the method used to select the market portfolio. The size loadings are positive significantly in either regression yet the book-to-market loading seems to have no contribution to the regression model at all. Last but not least, the predictive power for both regressions has dropped dramatically to 0.13. With this low predictive power, it simply implies that a better model is yet to be discovered.

4.4 Comparison between Factors, Price and Earning Momentum Strategies

Relative strength strategy outperforms factor (size/book-to-market) strategy and in turn factor (size/book-to-market) strategy outperforms the earning momentum strategy (see

Table 7-8). For a glance in Table 8, the arbitrage portfolio from relative strength (earning momentum) strategy has the average monthly return of 1.87% (0.25%). The superiority of returns in the relative strategies are maintained even after the monthly return are further adjusted by size, book-to-market and the market variables. Regardless of the choice of the market variables (either value-weighted or equally-weighted), the risk adjusted return of the arbitrage portfolio from the relative strength strategy is at least twice as much as the risk adjusted return from the earning momentum strategy. The risk-adjusted returns in both strategies are significantly different from zero. It is worth noting that short portfolios contribute at least half of the overall risk-adjusted returns of the arbitrage portfolio in either strategy.

It appears that there is no market risk exposure for the arbitrage portfolios in either strategy. I therefore infer the arbitrage portfolio is indeed market neutral. The arbitrage portfolios in both strategies are loaded positive in size and negative in book-to-market factors. Accordingly to Fama and French (1995), strong firms have low BE/ME and negative slopes on HML. Low Earning/Price, low cash flow/Price, and high sales growth are typical of strong firms that have negative slopes on HML. This result suggests that the arbitrage portfolios are loaded with strong firms with persistently high earnings.

It is not surprising that the returns in the relative strength strategy are higher than the earning momentum strategy. There are fundamental differences between price and earning momentum strategies. Earnings momentum strategies are based on the performance of near-term income: the innovations in quarterly earnings, or analysts' forecasts of earnings for the current fiscal year. In comparison, when a stock is selected on the basis of high or low prior returns, I isolate cases where the market has made very large revisions in its expectations of the firm's future outlook. In a similar vein, the difference

in the persistence of the two strategies has some intuitive basis. The uncertainty underlying the short-horizon measures of profitability used in the earnings momentum strategies is resolved relatively quickly. Prior returns, on the other hand, reflect a broad set of market expectations not limited to near-term profitability. On this basis, I conjecture that it may take longer for the new information to be played out in stock prices for the price momentum strategy.

Table 7.
Comparison of Various Trading Strategy on Long and Short Portfolios

Trading Strategies	Price Momentum	Earning Momentum	Factors
Average Monthly Return in Long Portfolio (in %)	2.66	1.68	1.56
Average Monthly Return in Short Portfolio (in %)	0.79	1.43	1.45
Risk-adjusted Return in Long Portfolio (in %)	0.84	0.08	0.10
Risk-adjusted Return in Short Portfolio (in %)	-1.01	-0.14	-0.14
Market Exposure in Long Portfolio - Beta	Positive	Positive	Positive
Market Exposure in Short Portfolio - Beta	Positive	Positive	Positive
Size loading in Long Portfolio - SMB	Positive	Positive	Positive
Size loading in Short Portfolio - SMB	Positive	Positive	Positive
Book-to-market loading in Long Portfolio - HML	Negative	<i>Positive</i>	Positive
Book-to-market loading in Short Portfolio - HML	<i>Negative</i>	<i>Positive</i>	Negative
Characteristics of Stocks in Long Portfolio	Small Growth	Small	Small Relative Distressed
Characteristics of Stocks in Short Portfolio	Small	Small	Small Growth

Table 8. Comparison of Various Trading Strategies on Long/Short Portfolios

Trading Strategy	Price Momentum	Earning Momentum	Factors
Average Monthly Return in Arbitrage Portfolio (in %)	1.87	0.25	0.11
Risk-adjusted Return in Arbitrage Portfolio (in %)	1.38	0.65	0.18
Return Contribution	Short	Short	Short
Market Exposure in Arbitrage Portfolio - Beta	None	None	None
Size loading in Arbitrage Portfolio - SMB	Positive	Positive	Positive
Book-to-market loading in Arbitrage Portfolio - HML	Negative	Positive	Positive
Characteristics of Stocks in the Portfolio	Small Growth	Small Relative Distressed	Small Relative Distressed

CHAPTER 5.

THE DETERMINATION OF OPTIMAL REBALANCING PERIOD AND OPTIMAL SIZE FOR PORTFOLIOS

5.1. Background

Three sets of results are presented in this section. First, I introduce the finding on the optimal rebalancing period for long, short and market neutral equity portfolios. Then, I discuss the optimal number of securities to be included in the long, short and market neutral equity portfolios. Finally, I compare optimal rebalancing period and optimal number of securities to be included in the portfolios between the no margin short (and market neutral) portfolio and the adjusted short (and market neutral) portfolios. Four different levels of round trip transaction costs (0%, 0.5%, 1% and 2% of the stock value) are used to assess its impact within each set of result.

Overall, three-factor model (FF1996) explains the continuation of better short-term returns for the best performance portfolios than the worst performance portfolios as documented by Jegadeesh and Titman (1993). Securities that have low short-term past returns tend to load positively on HML; short-term past winners load negatively on HML. Furthermore, the model has captured the size effect for both the long and short portfolios. Since only the firms with the large market capitalization (top 2000) are included in the portfolios, I have found that both the long and short portfolios load negatively on SMB. This result confirms the notion that size is negatively related to the returns. Beta in the long portfolio is significantly positive, significantly negative in the short portfolio, and insignificantly different from zero in the market neutral (long/short equity) portfolio. These observations suggest that institutional investors can construct a long and short portfolio

together in order to minimize the market risk. High Explanatory power is found in the three-factor regression model on the long and short portfolios. An alternative model may explain the return from the market neutral (long/short equity) portfolio.

5.2. Optimal Rebalancing Period

As shown in Table 9-11, regardless of the level of transaction costs, average raw returns, median raw returns and standard deviation in each holding period for the long portfolios for the ten highest risk adjusted return are higher than those from the short and market neutral portfolios. Average size of the long portfolios is larger than the size of the short portfolios. Similar results are discovered within the market neutral (long/short equity) portfolio. I find that the BE/ME ratio in the long portfolio on average is larger than the short portfolio. In addition, the long portfolio has the tighter range of BE/ME ratio than the short portfolio.

Figure 1A-C indicates that majority of the risk-adjusted returns of the long, short and market neutral (long/short equity) portfolios are unstable until at least 20 securities are included in the portfolio. Returns of the short and market neutral portfolios decline rapidly once the portfolio consists of more than 100 securities. Similar conclusion but in lesser extent is observed in long portfolio. Most of the optimal portfolios consist of 20- 80 securities. Portfolio returns are relatively stable as 80 or more securities are selected into the portfolios. The Returns decline rapidly when I further increase the number of securities from 100 or more into the portfolio. This observation implies that there is an economy of scale for including 20- 80 securities in the portfolios and diseconomy for including more than 100 securities in the portfolios.

Figure 1A.
Risk-Adjusted Long Portfolio Returns in
Optimal Holding Periods
(No Transaction Cost)

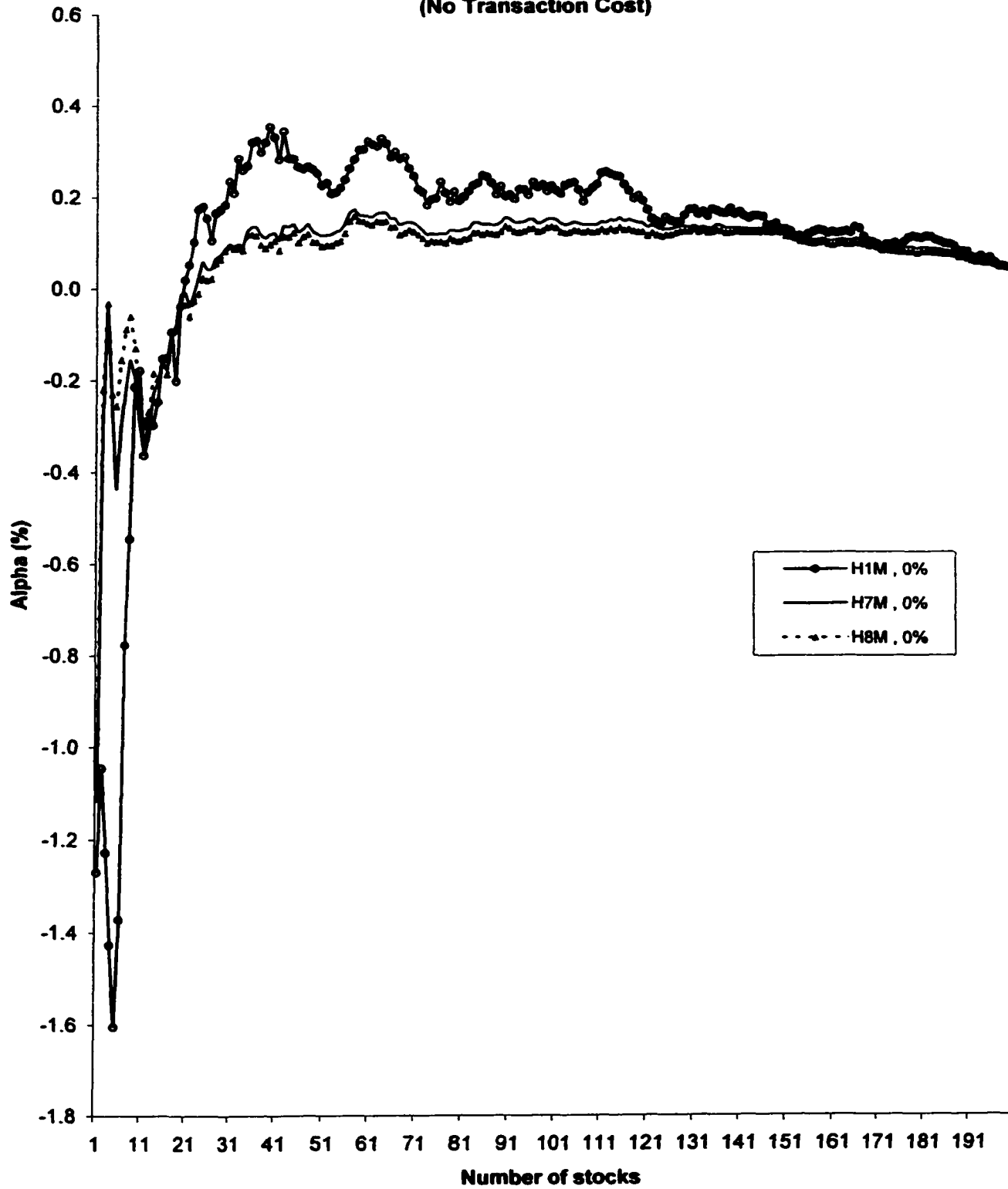


Figure 1B.
Risk-Adjusted Short Portfolio Returns in
Optimal Holding Periods
(No Transaction Cost)

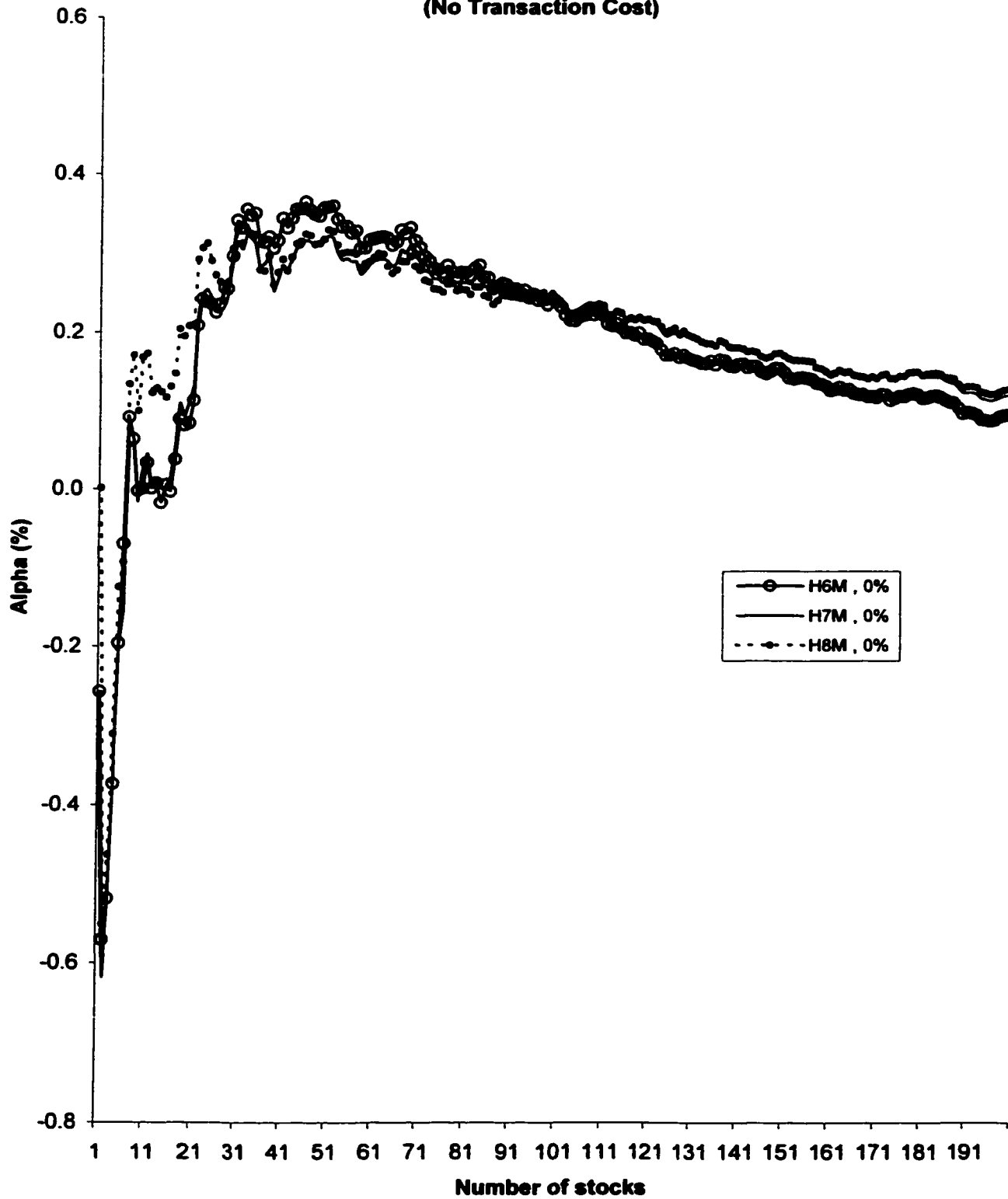
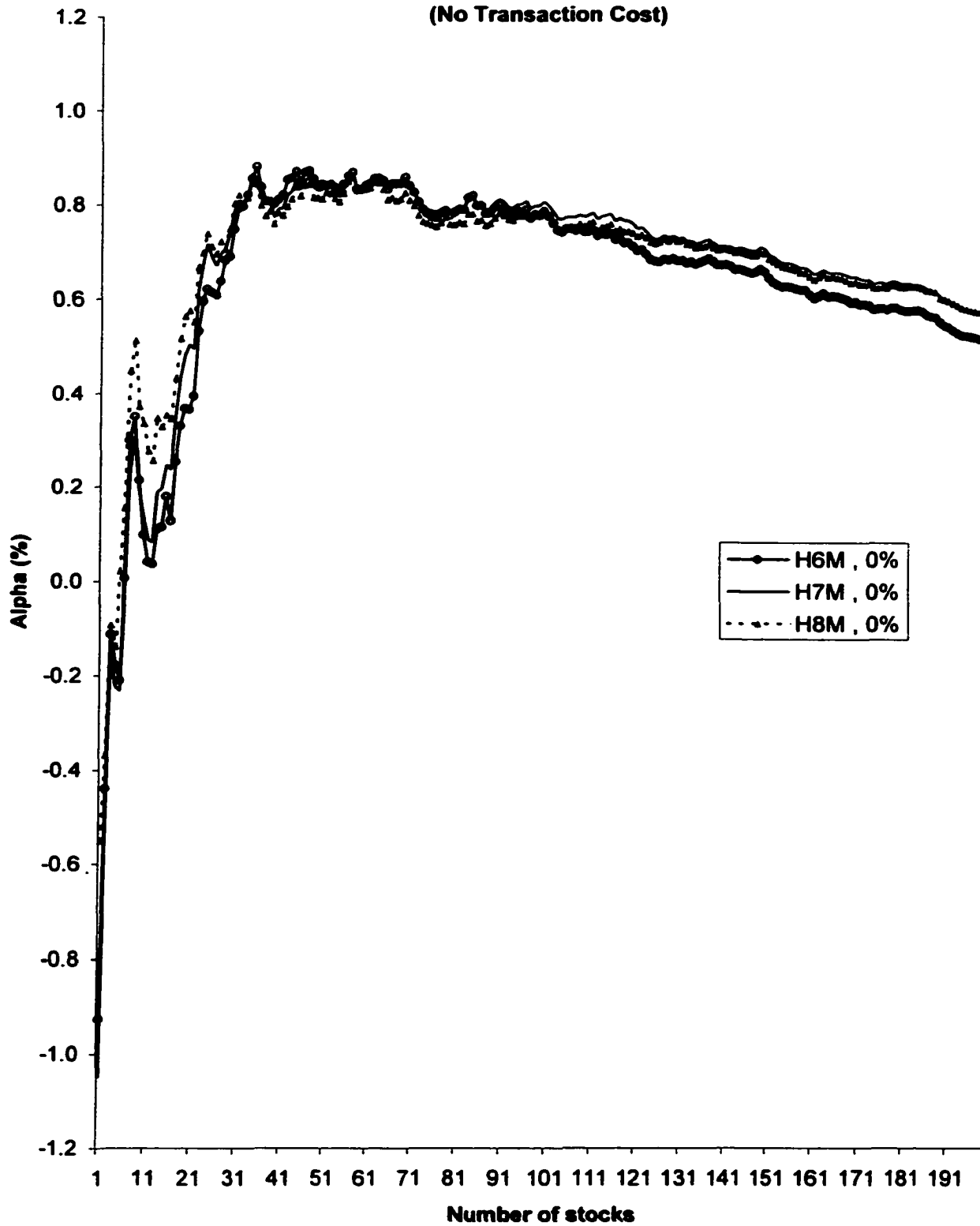


Figure 1C.
Risk-Adjusted Market Neutral Portfolio Returns in
Optimal Holding Periods
(No Transaction Cost)



5.2.1. Long Portfolios

When I test the performance of various holding period by including 1 to 200 securities in the long portfolios, 182 out of 200 portfolios in the one-month holding period have the highest risk-adjusted returns (see Table 9). The portfolios with 20-80 securities in the one-month holding period dominate the portfolios with same number of the securities in other holding periods. The highest risk-adjusted monthly return of 0.354% is found in 39-stock portfolio and it is insignificant different from zero. These results suggest that the 3-factor model may explain the cross-section returns of the portfolios.

If a round trip transaction cost of 0.50% of stock value is introduced in the portfolio, then a seven-month holding period has the highest risk-adjusted returns for 148 out of 200 portfolios. A 57-stock portfolio in the seven-month holding period has the highest risk-adjusted monthly return of 0.104%. As I further increase the round trip transaction cost to 1.00% of the stock portfolio, seven-month holding period still has the highest risk-adjusted returns for 93 out of 200 portfolios. 49 of the above portfolios come from portfolios with 20-80 securities. The optimal risk adjusted return of 0.034% per month is found on the 57-stock portfolio in seven-month holding period.

Regression results for the top ten portfolios in the top three holding periods are shown in Table 9. Beta(s) from portfolios (with no transaction costs) for ten highest risk-adjusted returns in the one-month holding period lies between 1.526 and 1.719 and they are significantly different from zero. SMB lies between -0.110 and -0.284. This result confirms the notion from Fama and French (1996) that size is negatively related to return. Also, HML lies between -0.782 and -0.876, significantly different from zero. R^2 lies between 0.620-0.698. Similar conclusion is drawn for the portfolios returns with seven-

Table 9. Long Portfolios with the Ten Highest Risk-Adjusted Return in the Top Three Holding Period

Panel A. Portfolios with No Transaction Cost

Summary Statistics								
Holding Period	Mean (%)	Median (%)	Standard Deviation	Mean/Std. Dev	Average ME (in million)	Average BE/ME	Optimal Portfolio	Replacement
1M	2.539-2.886	3.092-3.467	11.689-13.610	0.213-0.218	1517-1777	1.14-1.64	182	1
7M	2.029-2.172	2.378-3.108	8.863-9.611	0.225-0.229	1735-1871	1.14-1.22	7	1
8M	2.145-2.291	2.455-2.858	8.568-9.338	0.246-0.250	1735-1871	1.14-1.22	2	0

Regression Results					
Holding Period	Alpha (%)	Beta	SMB	HML	R-Square
1M	0.315-0.354	1.526-1.719	-0.110--0.284	-0.782--0.876	0.620-0.698
7M	0.173-0.154	1.411-1.513	-0.072--0.091	-0.747--0.830	0.787-0.810
8M	0.157-0.153	1.400-1.507	-0.056--0.066	-0.727--0.806	0.792-0.815

Panel B: Portfolios with 0.5% Round Trip Transaction Cost

Summary Statistics								
Holding Period	Mean (%)	Median (%)	Standard Deviation	Mean/Std. Dev	Average ME (in million)	Average BE/ME	Optimal Portfolio	Replacement
1M	2.313-2.669	2.852-3.248	11.691-13.615	0.196-0.200	1519-1790	1.14-1.64	13	1
7M	1.876-2.102	2.125-3.080	8.442-9.669	0.271-0.222	1735-2068	1.04-1.22	148	1
8M	2.085-2.230	2.399-2.798	8.571-9.342	0.239-0.243	1735-1871	1.14-1.22	28	0

Regression Results					
Holding Period	Alpha (%)	Beta	SMB	HML	R-Square
1M	0.119-0.083	1.526-1.721	-0.109--0.249	-0.781--0.871	0.620-0.698
7M	0.104-0.086	1.350-1.521	-0.061--0.090	-0.698--0.832	0.787-0.825
8M	0.096-0.074	1.401-1.507	-0.050--0.065	-0.727--0.807	0.791-0.815

Optimal Portfolio: Number of the portfolios with the highest risk-adjusted return among all holding period

Table 9. Long Portfolios with the Ten Highest Risk-Adjusted Return in the Top Three Holding Period

Panel C: Portfolios with 1.0% Round Trip Transaction Cost

Summary Statistics								
Holding Period	Mean (%)	Median (%)	Standard Deviation	Mean/Std. Dev	Average ME (in million)	Average BE/ME	Optimal Portfolio	Replacement
7M	1.809-2.032	2.062-3.010	8.870-9.672	0.210-0.214	1735-2068	1.04-1.22	93	1
8M	2.025-2.168	2.342-2.739	8.575-9.345	0.232-0.236	1735-1871	1.14-1.22	94	0

Regression Results					
Holding Period	Alpha (%)	Beta	SMB	HML	R-Square
7M	0.034-0.018	1.350-1.521	-0.060--0.088	-0.698--0.832	0.781-0.823
8M	0.034-0.014	1.401-1.507	-0.049--0.064	-0.728--0.807	0.791-0.815

and eight-month holding period when round-trip transaction costs are introduced in the portfolio.

5.2.2. Short Portfolios

In the absence of transaction cost, six-month holding period have the highest risk-adjusted returns for 58 out of 200 portfolios (Table 10). 46 of the above portfolios in the six-month holding period have 20-80 securities. Yet most of the optimal portfolio returns in seven- and eight-month holding period consist of more than 97 securities. The highest risk-adjusted return of 0.366% per month is observed in the 46-stock portfolio with six-month holding period and it is insignificantly different from zero. If I include a round trip transaction cost of 0.50% of stock values in the portfolio, then six-, eight- and nine-month holding period have the highest risk-adjusted returns for 35, 28 and 122 portfolios respectively. Majority of the highest portfolio returns in the eight- and nine-month holding period have 91 securities or more. By contrast, 32 out of 35 portfolios from the six-month holding period have 20-80 securities. A 46-stock portfolio in the six-month holding period has the highest risk adjusted return of 0.284% per month. As I further increase the round trip transaction cost to 1.00% of the stock value in the portfolio, nine-month holding period has the highest risk-adjusted returns on 171 portfolios. All of the portfolios with 20-80 securities in the nine-month holding period have the highest risk-adjusted return than the portfolios with the same number of securities in other holding period. The optimal risk adjusted return occurs at 34-stock portfolio of 0.221% per month. Nine- and ten-month holding period have the highest risk-adjusted returns of 139 and 59 portfolios respectively as the transaction cost reaches 2.0% of the securities value. Most of the optimal returns

between 20-80 securities portfolios are found in the ten-month holding period. The highest risk-adjusted returns of 0.113% per month is observed in portfolio with 31 stocks.

Portfolio beta(s) (with no transaction costs) for ten highest risk-adjusted returns in the six-month holding period lies between -1.353 and -1.371 and are significantly different from zero. SMB lies between -0.325 and -0.407. HML lies between 0.423 and 0.485, significantly different from zero. R^2 lies between 0.756 and 0.782. Similar conclusion is drawn in seven- and eight-month holding period. Beta is negative significantly yet SMB is negative insignificantly. HML is positive significantly. High Explanatory Power is found for the regression on the portfolios in seven- and eight- month holding period. Similar results are observed when round-trip transaction costs have been introduced to the portfolio.

5.2.3. Market Neutral Equity Portfolios

When I test the performance of various holding period by including different number of securities in the market neutral (long/short equity) portfolios, seven-month holding period has the highest risk-adjusted returns for 131 market neutral portfolios (Table 11). Most of these are in portfolios with 20-80 securities. The highest risk-adjusted return of 0.882% per month is observed in 35-stock portfolio with seven-month holding period but it is not significant different from zero. As I introduce a round trip transaction cost of 0.50% of stock value to the portfolio, eight-month holding period has the highest risk-adjusted returns for 119 portfolios. 33 of the above portfolios in the eight-month holding period are found in portfolios with 20-80 securities. The optimal portfolio returns decline slightly. A 57-stock portfolio in the eight-month holding period has the highest risk adjusted return of 0.736% per month. As I further increase the round trip transaction cost

Table 10.

Short Portfolios with the Ten Highest Risk-Adjusted Return in the Top Three Holding Period

Panel A. Portfolios with No Transaction Cost

Summary Statistics								
Holding Period	Mean (%)	Median (%)	Standard Deviation	Mean/ Std. Dev	Average ME (in million)	Average BE/ME (\$)	Optimal Portfolio	Replacement
6M	-1.410--1.459	-1.249--1.498	7.914-8.320	-0.173--0.179	851-926	0.75-2.52	58	0
7M	-1.423--1.449	-1.084--1.506	7.569-8.190	-0.174--0.189	851-1018	0.38-2.52	57	0
8M	-1.405--1.450	-1.266--1.681	7.761-8.108	-0.173--0.186	847-926	0.38-2.52	60	0

Regression Results					
Holding Period	Alpha (%)	Beta	SMB	HML	R-Square
6M	0.366-0.350	-1.353--1.371	-0.325--0.407	0.423-0.485	0.756-0.782
7M	0.325-0.311	-1.336--1.364	-0.242--0.397	0.334-0.504	0.759-0.800
8M	0.331-0.316	-1.332--1.362	-0.281--0.363	0.397-0.490	0.772-0.802

Panel B: Portfolios with 0.5% Round Trip Transaction Cost

Summary Statistics								
Holding Period	Mean (%)	Median (%)	Standard Deviation	Mean/ Std. Dev	Average ME (in million)	Average BE/ME (\$)	Optimal Portfolio	Replacement
6M	-1.491--1.542	-1.388--1.629	7.911-8.317	-0.183--0.190	851-926	0.75-2.52	35	0
8M	-1.468--1.514	-1.327--1.742	7.757-8.104	-0.181--0.194	847-926	0.38-2.52	28	0
9M	-1.525--1.559	-1.508--1.716	7.686-8.082	-0.190--0.200	841-926	0.38-2.52	122	0

Regression Results					
Holding Period	Alpha (%)	Beta	SMB	HML	R-Square
6M	0.284-0.268	-1.354--1.371	-0.319--0.406	0.423-0.485	0.756-0.779
8M	0.268-0.253	-1.332--1.362	-0.286--0.362	0.397-0.490	0.772-0.802
9M	0.278-0.260	-1.355--1.368	-0.241--0.333	0.374-0.445	0.781-0.806

Table 10.
Short Portfolios with the Ten Highest Risk-Adjusted Return in the Top Three Holding Period
Panel C: Portfolios with 1.0% Round Trip Transaction Cost

Summary Statistics								
Holding Period	Mean (%)	Median (%)	Standard Deviation	Mean/Std. Dev	Average ME (in million)	Average BE/ME (\$)	Optimal Portfolio	Replacement
8M	-1.531--1.575	-1.398--1.770	7.753-8.098	-0.189--0.202	851-926	0.38-2.52	5	0
9M	-1.583--1.615	-1.566--1.768	7.682-8.079	-0.197--0.208	841-926	0.38-2.52	171	1
10M	-1.575--1.604	-1.553--1.763	7.611-7.983	-0.197--0.209	841-926	0.38-2.52	17	0

Regression Results					
Holding Period	Alpha (%)	Beta	SMB	HML	R-Square
8M	0.205-0.190	-1.332--1.359	-0.284--0.385	0.397-0.490	0.772-0.802
9M	0.221-0.203	-1.355--1.367	-0.245--0.332	0.374-0.445	0.781-0.806
10M	0.217-0.194	-1.354--1.364	-0.226--0.326	0.356-0.427	0.789-0.813

Panel D: Portfolios with 2.0% Round Trip Transaction Cost

Summary Statistics							
Holding Period	Mean (%)	Median (%)	Standard Deviation	Mean/Std. Dev	Average ME (in million)	Average BE/ME (\$)	Optimal Portfolio
8M	-1.658--1.702	-1.508--1.924	7.747-8.094	-0.205--0.218	847-926	0.38-2.52	1
9M	-1.695--1.755	-1.673--1.869	7.676-8.073	-0.211--0.223	846-926	0.38-2.52	139
10M	-1.678--1.708	-1.650--1.859	7.604-8.030	-0.210--0.222	841-926	0.38-2.52	59

Regression Results					
Holding Period	Alpha (%)	Beta	SMB	HML	R-Square
8M	0.080-0.065	-1.349--1.359	-0.292--0.383	0.397-0.477	0.772-0.802
9M	0.107-0.091	-1.367--1.355	-0.319--0.238	0.377-0.445	0.781-0.806
10M	0.113-0.092	-1.353--1.364	-0.224--0.324	0.356-0.427	0.789-0.813

to 1.00% of the stock portfolio, eight-month holding period has the highest risk-adjusted returns for 174 out of 200 portfolios. 56 of these portfolios in the eight-month holding period are observed in portfolios with 20-80 securities. The optimal risk adjusted portfolio return is found at 57-stock portfolio of 0.612% per month. Finally, eight-month holding period has the highest risk-adjusted returns of 147 out of 200 portfolios. 30 of these portfolios in the eight-month holding period are observed in portfolios with 20-80 securities. The optimal risk adjusted portfolio return is found in 57-stock portfolio of 0.364% per month.

Portfolio Beta(s) (with no transaction costs) for ten highest risk-adjusted returns in the six-month holding period lies between 0.121 and 0.251. SMB lies between -0.352 and -0.500. HML lies between -0.436 and -0.489, significantly different from zero. R^2 lies between 0.085-0.093. This low explanatory power in the regression implies that another model may better explain the return from the market neutral trading strategy. Similar results are observed from seven- and eight-month holding period with or without transaction costs. Both Beta and SMB are insignificantly different from zero yet HML is significantly negative. Low explanatory power from the regression is found on the portfolios with seven- and eight- month holding period.

5.2.4. Interpretation

To test the assumption that portfolio returns improves when the portfolio is revised more frequently, then, one-month holding period should be the holding period for the long, short and market neutral (long/short equity) portfolios in absence of transaction cost. It turns out that this presumption is correct only for the long portfolio.

Table 11.
Market Neutral Portfolios with the Ten Highest Risk-Adjusted Return in the Top Three Holding Period

Panel A. Portfolios with NoTransaction Cost

Summary Statistics										
Holding Period	Mean (%)	Median (%)	Standard Deviation	Mean/ Std. Dev	Average ME (L)	Average ME (S)	Average BE/ME (L)	Average BE/ME (S)	Optimal Portfolio	Replacement
6M	1.40-1.67	0.72-1.26	8.66-9.91	0.162-1.700	1519-1799	858-1018	1.09-1.64	0.72-2.62	25	0
7M	1.06-1.27	1.01-1.31	7.27-8.41	0.146-0.151	1599-1782	858-1018	1.09-1.64	0.75-2.62	131	1
8M	1.20-1.38	1.16-1.75	6.84-7.90	0.174-0.176	1518-1735	847-984	1.22-1.67	0.75-2.37	29	1

Regression Results					
Holding Period	Alpha (%)	Beta	SMB	HML	R-Square
6M	0.882-0.857	0.121-0.251	-0.352--0.500	-0.436--0.489	0.085-0.093
7M	0.867-0.851	0.140-0.197	-0.314--0.478	-0.427--0.493	0.097-0.105
8M	0.860-0.837	0.132-0.257	-0.311--0.457	-0.408--0.457	0.094-0.100

Panel B: Portfolios with 0.5% Round Trip Transaction Cost

Summary Statistics										
Holding Period	Mean (%)	Median (%)	Standard Deviation	Mean/ Std. Dev	Average ME (L)	Average ME (S)	Average BE/ME (L)	Average BE/ME (S)	Optimal Portfolio	Replacement
6M	1.24-1.51	0.49-1.10	8.67-9.91	0.143-0.152	1519-1799	858-1018	1.09-1.64	0.75-2.62	4	1
7M	0.92-1.05	0.88-1.09	7.37-7.87	0.127-0.134	1599-1799	904-1018	1.09-1.41	1.57-2.62	65	0
8M	1.08-1.25	1.04-1.64	6.85-7.91	0.156-0.160	1518-1795	858-1795	1.15-1.67	0.75-2.37	119	0

Regression Results					
Holding Period	Alpha (%)	Beta	SMB	HML	R-Square
6M	0.717-0.693	0.121-0.251	-0.498--0.387	-0.489--0.443	0.094-0.105
7M	0.727-0.710	0.123-0.211	-0.396--0.351	-0.493--0.427	0.094-0.106
8M	0.736-0.713	0.132-0.257	-0.445--0.303	-0.437--0.408	0.089-0.094

Table 11.
Market Neutral Portfolios with the Ten Highest Risk-Adjusted Return in the Top Three Holding Period
Panel C: Portfolios with 1.0% Round Trip Transaction Cost

Summary Statistics										
Holding Period	Mean (%)	Median (%)	Standard Deviation	Mean/Std. Dev	Average ME (L)	Average ME (S)	Average BE/ME (L)	Average BE/ME (S)	Optimal Portfolio	Replacement
7M	0.78-0.91	0.74-0.96	7.37-7.87	0.108-0.114	1599-1782	904-1018	1.09-1.41	2.57-2.62	13	2
8M	0.96-1.13	0.93-1.52	6.85-7.92	0.138-0.144	1795-1518	847-973	1.15-1.67	0.75-2.37	174	0
9M	1.01-1.24	0.84-1.57	6.41-7.39	0.158-0.170	1518-1782	847-976	1.47-1.67	0.75-2.37	4	0

Regression Results					
Holding Period	Alpha (%)	Beta	SMB	HML	R-Square
7M	0.587-0.569	0.123-0.212	-0.394-0.310	-0.493-0.427	0.095-0.106
8M	0.612-0.589	0.133-0.257	-0.453-0.300	-0.438-0.408	0.089-0.091
9M	0.588-0.558	0.111-0.234	-0.404-0.255	-0.456-0.409	0.086-0.100

Panel D: Portfolios with 2.0% Round Trip Transaction Cost

Summary Statistics									
Holding Period	Mean (%)	Median (%)	Standard Deviation	Mean/Std. Dev	Average ME (L)	Average ME (S)	Average BE/ME (L)	Average BE/ME (S)	Optimal Portfolio
7M	0.51-0.62	0.47-0.73	7.29-7.82	0.069-0.080	1518-1795	847-984	1.09-1.35	1.57-2.62	0
8M	0.72-0.88	0.75-1.29	6.86-7.92	0.103-0.111	1518-1762	847-993	1.15-1.67	0.75-2.33	147
9M	0.79-1.01	0.64-1.35	6.42-7.39	0.123-0.139	1518-1762	847-993	1.14-1.67	0.75-2.37	39

Regression Results					
Holding Period	Alpha (%)	Beta	SMB	HML	R-Square
7M	0.307-0.289	0.124-0.198	-0.385-0.321	-0.465-0.431	0.092-0.098
8M	0.364-0.341	0.134-0.258	-0.449-0.296	-0.438-0.409	0.088-0.094
9M	0.362-0.336	0.112-0.196	-0.400-0.250	-0.456-0.415	0.085-0.099

Average ME is expressed in millions.

Transaction costs play a role in determining the optimal holding period for the portfolios. Optimal holding periods for the long, short and market neutral (long/short equity) portfolios changes as transaction costs are included. The additional returns (marginal benefit) generated from revising the portfolio has to be able to compensate the amount of transaction cost (marginal cost) involved. This chapter shows that the optimal holding period(s) ranges from six to ten months depending upon the type of portfolios being considered. Overall, returns are enhanced (reduced) as the holding period is lengthening from one to six (ten to twelve) months.

The frequency of revising the portfolio is inversely related to the level of transaction costs. This phenomenon is obvious in the short portfolio. Six-month holding period is the optimal holding period in the case of 0.0% and 0.5% transaction cost (see Table 12). However, nine-month holding period becomes the dominant one as the transaction cost is raised to 1.0% of the stock value. As the transaction cost is further increased to 2.0% of the stock value, ten-month holding period becomes the optimal holding period. There is only a minor change of the optimal holding period for the long and market neutral (long/short equity) portfolios. With no transaction cost, one-month (six-month) holding period is the optimal holding period for the long (market neutral) portfolio. Yet, seven-month (eight-month) holding period becomes the optimal ones as the transaction cost is introduced in the model.

5.3. Optimal Portfolio Size

In Table 13-15 (Table 16-18), I examine the number of securities to be included in the portfolio in each holding period that will yield the ten highest (lowest) risk-adjusted returns. Overall, portfolios with either small or large numbers of securities have the worst

Table 12. Optimal Portfolios Holding Periods with Various Transaction Cost Assumption

	Long Portfolio Transaction Cost			Short Portfolio Transaction Cost				Market-Neutral Portfolio Transaction Cost			
	0.00%	0.50%	1.00%	0.00%	0.50%	1.00%	2.00%	0.00%	0.50%	1.00%	2.00%
Optimal Holding Period	1-month	7-month	7-month	6-month	6-month	9-month	10-month	6-month	8-month	8-month	8-month
Dominance (P21-P80)	1M 60	7M 44	7M 49	6M 58	6M 32	9M 60	10M 48	6M 24	8M 33	8M 56	8M 30
Optimal Portfolio Size	P39	P57	P57	P46	P46	P34	P31	P35	P57	P57	P57
Optimal Monthly Return	0.354%	0.104%	0.034%	0.366%	0.284%	0.221%	0.113%	0.882%	0.736%	0.612%	0.364%
t(risk-adjusted return)	0.570	0.260	0.080	0.930	0.720	0.580	0.300	1.340	1.340	1.120	0.660
R-Square	0.636	0.787	0.787	0.778	0.778	0.789	0.792	0.103	0.089	0.089	0.088
Market Loading	1.685	1.513	1.513	-1.359	-1.357	-1.368	-1.353	0.251	0.143	0.144	0.145
t(beta)	9.620	13.510	13.500	-12.300	-12.310	-12.740	-12.920	1.360	0.930	0.940	0.940
Size Loading	-0.208	-0.085	-0.084	-0.345	-0.344	-0.312	-0.324	-0.500	-0.310	-0.308	-0.304
t(SMB)	-0.770	-0.490	-0.490	-2.030	-2.020	-1.950	-2.010	-1.760	-1.320	-1.300	-1.280
Financial Distress Loading	-0.818	-0.830	-0.830	0.447	0.447	0.432	0.425	-0.476	-0.429	-0.429	-0.430
t(HML)	-3.460	-5.490	-5.490	3.000	3.000	3.000	3.010	-1.920	-2.070	-2.070	-2.070
Mean (in %)	2.861	2.101	2.032	-1.425	-1.507	-1.593	-1.679	1.671	1.110	0.987	0.740
Median (in %)	3.453	2.85	2.785	-1.498	-1.579	-1.628	-1.696	1.263	1.082	0.953	0.755
Standard Deviation	13.151	9.614	9.618	9.032	8.028	8.010	7.976	9.907	7.002	7.005	7.014
Reward Ratio*	0.218	0.219	0.211	-0.177	-0.188	-0.192	-0.210	0.169	0.159	0.141	0.105
Average ME -- Long	1536	1782	1782					1519	1782	1782	1782
Average BE/ME -- Long	1.520	1.210	1.210					1.640	1.210	1.210	1.210
Average ME -- Short				918	918	851	859	858	957	957	957
Average BE/ME -- Short				1.590	1.590	0.760	0.380	0.750	2.330	2.330	2.330
Optimal Portfolio Starts From	P20	P30	P55	P20	P20	P20	P30	P20	P20	P20	P20
Optimal Portfolio Ends At	P70	P70	P70	P80	P80	P70	P70	P70	P70	P70	P70
Returns Decline From	P120	P120	P150	P120	P120	P70	P110	P100	P100	P100	P100

Average ME is expressed in millions of dollars

Reward Ratio=Mean/Std.Deviation

performance. For long and market neutral (long/short equity) portfolios, 1-21 stocks portfolios (P1-P21) have the worst performance regardless of holding period or transaction costs. Similarly, ten worst performances for the short portfolios are found among 1-21 stocks portfolios, and 190-200 stocks portfolios (P190-P200). Conversely, majority of the top 10 performance in the long (short) portfolios have been constructed with 50-69 (30-59) stocks. Top 10 performances in the market neutral (long/short equity) portfolios, on the other hand, consist of 30-69 stocks.

5.3.1. Long Portfolios

Regardless of transaction costs, there is a shift in the number of securities in the top ten performance portfolios as the holding period increases from one-month to twelve-months. For example, the optimal number of stocks to be included in the portfolios with no transaction cost for one-month holding period lies between 30-69 securities, and for eight-month holding period, between 50-99 securities. Only four of the top ten performance portfolios in the twelve-month holding period with no transaction cost have positive risk-adjusted return (P1-P4).

As the transaction cost increases from 0% to 0.5% of the portfolio value, all the portfolios in the three-, four- and twelve-month period have negative risk-adjusted return. In addition, there is only a minor change in the composition of the top ten portfolios in each holding period. For instance, there is one security replacement in the portfolios with one-, two-, four-, six-, seven-, nine-month; and no security replacement in the portfolios with three-, eight- and twelve-month holding period. Majority of the ten best performance portfolios consist of 50-69 securities.

When the round trip transaction cost is raised to 1.0% of the stock value, only the long portfolios with seven- and eight-month holding period have positive risk-adjusted return. The number of stocks in the ten highest portfolios performance range from 50-99 for the seven-month holding period and 50-119 for the eight-month holding period. It is worth noting that seventeen out of twenty portfolios have 50-69 securities each. Again, there is only a minor change in the composition of the top ten portfolios in each holding period as the transaction costs increases. For instance, there is one security replacement in the portfolios with one-, two-, five-, six-, seven-, nine-month holding period. Finally, the risk-adjusted returns for the long portfolios in all holding periods is negative when the round trip transaction cost is further raised to 2.0% of the stock value.

5.3.2. Short Portfolios

The number of stocks in the top ten performance short portfolios in any holding period is fewer than the long portfolio. For example, the optimal number of securities to be included in the short portfolios with no transaction cost for one-month holding period lies between 20-39 securities. By contrast, the optimal number of securities to be included in the long portfolio with no transaction cost for one-month holding period lies between 30-69 stocks. Most of the top ten performance portfolios consist of 30-59 stocks.

As the transaction cost increases from 0% to 0.5% of the stock value, all the portfolios in the one-month period exhibit negative risk-adjusted return. Minor change in the composition of the top ten portfolios in each holding period is found. For instance, there is one security replacement for two-month holding period, and none in the other holding periods. Most of the ten best performance portfolios have 30-59 securities.

Similar finding is attained as the round trip transaction cost is raised to 1.0% of the stock value. All the portfolios in the two-month holding period have negative risk-adjusted returns. Small modification in the composition of the top ten portfolios in each holding period is observed. For example, there is one security replacement in portfolios with five-month holding period, and none in other holding periods. When the round trip transaction cost is further raised to 2.0% of the stock value. All the portfolios in the three-, four-, five- and twelve- month holding period have negative risk-adjusted return. In addition, there is one security replacement for portfolios with six- and nine-month holding period, and none in the other holding periods. It is worth noting that seventy-nine out of eighty portfolios of the top ten performance portfolios have 30-59 securities each.

5.3.3. Market Neutral (Long/Short Equity) Portfolios

Since the return of the short portfolio is subtracted from the long portfolio to get the return of the market neutral (long/short equity) portfolio, the optimal number of the securities to be included in the market neutral portfolio can be inferred from the ones in the long and short portfolios. The optimal number of the securities to be included in the long (short) portfolio lies between 50-69 (30-59) securities while 99% of the top ten market neutral performance portfolios have 30-69 stocks. As the transaction costs increase to 0.5% of the stock value, there is at most one security replacement for the top ten market- neutral performance portfolio in each holding period. It is not until the round trip transaction cost has been raised to 1% of the stock value that all the portfolios in the one-month holding period exhibit negative returns. All portfolios in the two-, three- and four-month holding period have their returns in negative territory as the round trip transaction cost is further increased to 2.0% of the stock value.

5.3.4. Interpretation

As I have mentioned in previous section, most of the optimal portfolios are constructed with 20- 80 securities. The returns remain stable as I include 80 securities or more in the portfolios. As I further include 100 or more securities in the portfolio, the returns start to decline rapidly. This implies that the optimal efficiency occurs somewhere between 20-80 securities in the portfolios, and loss of efficiency with more than 100 securities in the portfolios. In other words, the benefit of adding more securities in the portfolio outweighs the cost at the beginning. At this point, returns are maximized while the unique risks are minimized. Then the benefits and costs of adding additional securities are break even. Most of the unique risks have been minimized at this point and the portfolios are exposed only to market risk. Finally, the costs exceed the benefits as more than 100 securities are added in the portfolios.

The composition of the portfolio is modified when I introduce the transaction cost in each holding period. The degree of modification is minor overall. By examining all of the portfolios in various holding period, I find that there is only one portfolio with two securities replacement (seven-month market neutral portfolio rebalancing) when the transaction cost is raised from one level to the other. All other portfolios have either one security or no security replacement with different level of transaction cost. This result suggests that even though transaction cost affects the performance of the portfolios, it does not necessarily change the composition of the portfolio significantly.

5.4. Adjustment in Short Portfolio Return

In Figure 2 (Figure 3), the adjusted short portfolios returns in one-month (six-month) holding periods exhibit similar graphical patterns as the ones in original short

Table 13. Number of Securities in Long Portfolios with the Ten Highest Risk-Adjusted Return**Panel A. Portfolios with No Transaction Cost**

Holding Period	P1-P9	P30-P39	P40-P49	P50-P59	P60-P69	P80-P89	P90-P99	P100-P109
1M		4	2		4			
2M				4	6			
3M						5	4	1
4M			1	4	2	3		
5M			2	4	1		1	2
6M				1	1		6	2
7M				4	5		1	
8M				4	5		1	
9M	1			3	3		2	1
12M	5			3	2			
Total	6	4	5	28	28	8	15	6

Panel B. Portfolios with 0.5% Round-Trip Transaction Cost

Holding Period	P1-P9	P30-P39	P40-P49	P50-P59	P60-P69	P80-P89	P90-P99	P100-P109
1M		3	2		5			
2M				3	6	1		
5M				3	1		4	2
6M				1			7	2
7M				4	5			1
8M				4	5		1	
9M	1			2	3		3	1
Total	1	3	2	17	25	1	15	6

Panel C. Portfolios with 1.0% Round-Trip Transaction Cost

Holding Period	P50-P59	P60-P69	P90-P99	P110-P119
7M	4	4	1	1
8M	4	5	1	
Total	8	9	2	1

Table 14. Number of Securities in Short Portfolios with the Ten Highest Risk-Adjusted Return**Panel A. Portfolios with No Transaction Cost**

Holding Period	P1-P9	P20-P29	P30-P39	P40-P49	P50-P59	P60-P69
1M		5	5			
2M		3	6		1	
3M		1	7	2		
4M	2	1	6	1		
5M	1		6	3		
6M			2	5	3	
7M			4	2	3	1
8M			4	3	3	
9M			6	2	2	
12M			4	6		
Total	3	10	50	24	12	1

Panel B. Portfolios with 0.5% Round-Trip Transaction Cost

Holding Period	P1-P9	P20-P29	P30-P39	P40-P49	P50-P59	P60-P69
2M		2	6		2	
3M		1	7		2	
4M	1	1	6	2		
5M	1		6	3		
6M			2	5	3	
7M			4	2	3	1
8M			4	3	3	
9M			6	2	2	
12M				4	6	
Total	2	4	41	21	21	1

Panel C. Portfolios with 1.0% Round-Trip Transaction Cost

Holding Period	P1-P9	P20-P29	P30-P39	P40-P49	P50-P59	P60-P69
3M		1	7	2		
4M	1	1	6	2		
5M			6	4		
6M			2	5	3	
7M			4	2	3	1
8M			4	3	3	
9M			6	2	2	
12M				4	6	
Total	1	2	35	24	17	1

Panel D. Portfolios with 2.0% Round-Trip Transaction Cost

Holding Period	P30-P39	P40-P49	P50-P59	P60-P69
6M	1	6	3	
7M	4	2	3	1
8M	4	3	3	
9M	5	2	3	
Total	14	13	12	1

Table 15.
Number of Securities in Market Neutral Portfolios with the Ten Highest Risk-Adjusted Return

Panel A. Portfolios with No Transaction Cost

Holding Period	P1-P9	P30-P39	P40-P49	P50-P59	P60-P69
1M		5		2	3
2M			1	4	5
3M		3	3		4
4M		2	6	2	
5M		3	6	1	
6M		1	4	2	3
7M		1	3	2	4
8M		2	3	2	3
9M		3	3	2	2
12M	1		1	3	5
Total	1	20	30	20	29

Panel B. Portfolios with 0.5% Round-Trip Transaction Cost

Holding Period	P1-P9	P30-P39	P40-P49	P50-P59	P60-P69	P80-P89
1M		4		2	4	
2M			1	4	5	
3M		2	3		4	1
4M		2	5	3		
5M		3	6	1		
6M		1	4	2	3	
7M			3	2	5	
8M		2	2	3	3	
9M		3	3	2	2	
12M	1			4	5	
Total	1	17	27	23	31	1

Panel C. Portfolios with 1.0% Round-Trip Transaction Cost

Holding Period	P1-P9	P30-P39	P40-P49	P50-P59	P60-P69	P80-P89
2M			1	4	5	
3M		2	2		4	2
4M		2	5	2	1	
5M		3	6	1		
6M		1	3	2	4	
7M			3	2	5	
8M		2	3	2	3	
9M		2	3	2	3	
12M	1			4	5	
Total	1	12	26	19	31	2

Panel D. Portfolios with 2.0% Round-Trip Transaction Cost

Holding Period	P1-P9	P30-P39	P40-P49	P50-P59	P60-P69
5M		1	3	2	4
6M		2	4	2	2
7M			1	2	7
8M		2	3	2	3
9M		2	3	2	3
12M	1			4	5
Total	1	7	14	14	24

Table 16.
Number of Securities in Long Portfolios with the Ten Worst Risk-Adjusted Return

Panel A. Portfolios with No Transaction Costs

Holding Period	P1	P2	P3	P4	P5	P6	P7	P8	P10	P11	P12	P13	P14	P15	P16	P17	P18	P21
1M	*	*	*	*	*	*	*	*		*		*						
2M	*	*	*	*	*	*	*		*	*		*						
3M	*	*	*	*	*	*			*	*	*	*						
4M	*	*	*	*	*	*			*	*	*	*						
5M	*	*		*	*	*	*		*	*	*	*						
6M	*	*			*	*			*	*	*	*	*	*	*			
7M	*	*		*	*	*	*		*	*	*	*						
8M	*	*		*	*				*	*	*	*	*		*			
9M	*				*				*	*	*	*	*	*	*	*		
12M									*	*	*	*	*	*	*	*	*	*
Total	9	8	4	7	9	7	4	1	9	10	8	10	4	3	4	2	1	1

Panel B. Portfolios with 0.5% Round-Trip Transaction Costs

Holding Period	P1	P2	P3	P4	P5	P6	P7	P8	P10	P11	P12	P13	P14	P15	P16	P17
1M	*	*	*	*	*	*	*	*		*		*				
2M	*	*	*	*	*	*	*		*	*		*				
5M	*	*		*	*	*	*		*	*	*	*				
6M	*	*			*	*			*	*	*	*	*		*	
7M	*	*		*	*	*	*		*	*	*	*				
8M	*	*		*	*				*	*	*	*	*		*	
9M	*				*				*	*	*	*	*	*	*	*
Total	7	6	2	5	7	5	4	1	6	7	5	7	3	1	3	1

Panel C. Portfolios with 1.0% Round-Trip Transaction Costs

Holding Period	P1	P2	P4	P5	P6	P7	P10	P11	P12	P13	P14	P16
7M	*	*	*	*	*	*	*	*	*	*		
8M	*	*	*	*		*	*	*	*	*	*	*
Total	2	2	2	2	1	1	2	2	2	2	1	1

Table 17. Number of Securities in Short Portfolios with the Ten Worst Risk-Adjusted Return**Panel A. Portfolios with No Round-Trip Transaction Costs**

HoldingPeriod	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15-P16	P194-P198
1M	*	*	*	*	*	*	*	*	*	*						
2M	*	*	*	*	*	*	*		*	*	*					
3M	*	*	*	*	*	*				*				*	*	*
4M		*		*								*	*	*	**	****
5M	*	*	*	*										*		*****
6M	*	*	*	*	*	*			*			*		*	*	
7M	*	*	*	*	*	*			*			*		*	*	
8M	*	*	*	*	*	*			*			*		*	*	*
9M		*	*	*	*	*			*	*			*	*	*	
12M		*	*	*	*	*			*			*	*	*	**	
Total	7	10	9	10	7	8	2	1	7	4	1	4	3	7	9	11

Panel B. Portfolios with 0.5% Round-Trip Transaction Costs

HoldingPeriod	P1	P2	P3	P4	P5	P6	P7	P9	P10	P11	P12	P13	P14	P15	P16	P194-P197
2M	*	*	*	*	*	*	*	*	*	*						
3M	*	*	*	*	*	*			*			*	*	*		
4M		*		*								*	*	*	*	****
5M	*	*	*	*									*		*	****
6M	*	*	*	*	*	*		*	*				*		*	
7M	*	*	*	*	*	*		*			*		*	*		
8M	*	*	*	*	*	*		*			*		*	*		
9M		*	*	*	*	*		*	*			*	*	*		
12M		*	*	*		*		*			*	*	*	*	*	
Total	6	9	8	9	6	7	1	6	4	1	3	4	8	6	4	8

Table 17. Number of Securities in Short Portfolios with the Ten Worst Risk-Adjusted Return**Panel C. Portfolios with 1.0% Round-Trip Transaction Costs**

HoldingPeriod	P1	P2	P3	P4	P5	P6	P9	P10	P12	P13	P14	P15	P16	P195	P196	P197
3M	*	*	*	*	*	*		*		*	*	*	*			
4M		*		*					*	*	*	*	*	*	*	*
5M	*	*	*	*	*					*	*	*	*		*	
6M	*	*	*	*	*	*	*	*		*		*				
7M	*	*	*	*	*	*	*		*		*	*				
8M	*	*	*	*	*	*	*		*		*	*				
9M		*	*	*	*	*	*	*		*	*	*				
12M		*	*	*		*	*		*	*	*	*	*			
Total	5	8	7	8	6	6	5	3	4	5	8	7	4	1	2	1

Panel D. Portfolios with 2.0% Round-Trip Transaction Costs

HoldingPeriod	P1	P2	P3	P4	P5	P6	P9	P10	P12	P13	P14	P15	P16
6M	*	*	*	*	*	*	*	*			*	*	*
7M	*	*	*	*	*	*	*		*		*	*	*
8M	*	*	*	*	*	*	*		*		*	*	*
9M		*	*	*	*	*	*	*		*	*	*	*
Total	3	4	4	4	4	4	4	2	2	1	4	3	1

Table 18. Number of Securities in Market Neutral Portfolios with the Ten Worst Risk-Adjusted Return

Panel A. Portfolios with No Round-Trip Transaction Cost

Holding Period	P1	P2	P3	P4	P5	P6	P7	P8	P10	P11	P12	P13	P14	P15	P16	P17	P18
1M	*	*	*	*	*	*	*	*	*	*							
2M	*	*	*	*	*	*	*		*	*	*						
3M	*	*	*	*	*	*			*	*		*	*				
4M	*	*		*	*	*			*	*	*	*	*				
5M	*	*	*	*	*	*			*	*	*	*					
6M	*	*	*	*	*	*			*	*	*	*					
7M	*	*	*	*	*	*			*	*	*	*					
8M	*	*	*	*	*	*			*	*	*		*				
9M	*	*	*	*	*	*			*	*	*		*	*			
12M	*	*							*	*	*	*	*	*	*	*	*
Total	9	10	8	9	9	9	2	1	9	10	8	6	5	2	1	1	1

Panel B. Portfolios with 0.5% Round-Trip Transaction Cost

Holding Period	P1	P2	P3	P4	P5	P6	P7	P8	P10	P11	P12	P13	P14	P15	P16	P17	P18
1M	*	*	*	*	*	*	*	*	*	*							
2M	*	*	*	*	*	*	*		*	*	*						
3M	*	*	*	*	*	*			*	*		*	*				
4M	*	*		*		*			*	*	*	*	*		*		
5M	*	*	*	*	*	*			*	*	*	*					
6M	*	*	*	*	*	*			*	*	*	*					
7M	*	*	*	*	*	*			*	*	*	*					
8M	*	*	*	*	*	*			*	*	*		*				
9M	*	*	*	*	*	*			*	*	*		*	*			
12M		*							*	*	*	*	*	*	*	*	*
Total	9	10	8	9	8	9	2	1	9	10	8	6	5	2	2	1	1

Panel C. Portfolios with 1.0% Round-Trip Transaction Cost

Holding Period	P1	P2	P3	P4	P5	P6	P7	P10	P11	P12	P13	P14	P15	P16	P17
2M	*	*	*	*	*	*	*	*	*	*					
3M	*	*	*	*	*	*		*	*		*	*			
4M	*	*		*	*	*		*	*	*	*	*			
5M	*	*	*	*	*	*		*	*	*	*				
6M	*	*	*	*	*	*		*	*	*	*				
7M	*	*	*	*	*	*		*	*	*	*				
8M	*	*	*	*	*	*		*	*	*		*			
9M	*	*	*	*	*	*		*	*		*	*			
12M		*						*	*	*	*	*	*	*	*
Total	8	9	7	8	8	8	1	8	9	8	6	5	2	2	1

Panel D. Portfolios with 2.0% Round-Trip Transaction Cost

Holding Period	P1	P2	P3	P4	P5	P6	P10	P11	P12	P13	P14	P15	P16	P17	P18
5M	*	*	*	*	*	*	*	*	*	*					
6M	*	*	*	*	*	*	*	*	*	*					
7M	*	*	*	*	*	*	*	*	*	*					
8M	*	*	*	*	*	*	*	*	*		*				
9M	*	*	*	*	*	*	*	*	*		*	*			
12M		*					*	*	*	*	*	*	*	*	*
Total	5	6	5	5	5	5	5	6	6	4	3	2	1	1	1

portfolios. However, these adjusted portfolio returns are amplified. Returns in the adjusted short portfolios increase in larger magnitude when the returns in the original short portfolios are in the positive territory than the decrease in the returns of adjusted short portfolios that are in negative territory to begin with. For instance in Table 19, 31-stock portfolio (the best performance in one-month holding period with no transaction cost) has the risk adjusted return of 0.194% in the original short portfolio and 2.778% in the adjusted short portfolio. 1-stock portfolio (the worst performance in one-month holding period with no transaction cost) has the risk adjusted return of -3.638% in the original short portfolio and -4.885% in the adjusted short portfolio. In addition, the decline of portfolio returns with identical number of stocks in the same holding period for different transaction costs is greater when the returns are in negative territory. Again, the return for the 60-stock (10-stock) original portfolio in the six-month holding period declines from 0.236% to 0.155% (-0.084% to -0.170%) when the transaction costs has increased from 0.50% to 1.0% of the securities value. The decline in return of 0.081% (0.085%) is also observed in the 60-stock (10-stock) adjusted portfolio.

When the new market neutral (long/short equity) portfolios with identical securities are compared with the original market neutral portfolios in the same holding period, the former portfolios exhibit a larger increase in returns that are in negative territory than the returns in the positive territory (see Table 20). These patterns are found in Figure 4 and Figure 5. For instance, 1-stock portfolio (60-stock portfolio) with no transaction cost has a return of -4.506% (0.318%) in the original market neutral portfolio in the one-month (six-month) holding period. A difference of 2.030% is found between the original and adjusted market neutral (1-stock) portfolio in one-month holding period with no transaction cost. On the other hand, the difference of 0.775% is found between the original and adjusted

market neutral (60-stock) portfolio in six-month holding period with no transaction cost. The spread of returns on the identical portfolios but with different transaction costs is almost of same magnitude. The risk-adjusted return for 31-stock and 1-stock original (adjusted) market neutral portfolios in the six-month holding period with no transaction cost are 0.342% (1.060%) and -0.257% (-0.087%) respectively. With 0.5% transaction cost, the returns for the 31-stocks and 1-stock portfolios decline to 0.259% (0.978%) and -0.342% (-0.174%). The decline on average of 0.085% is found when the transaction costs is introduced.

Table 19.
Comparison of Short Portfolios Returns with Different Levels of Transaction Costs

Panel A. Monthly Risk-Adjusted Portfolio Return (Cash Settlement)

Holding Period	Portfolio	Transaction Cost			
		0.00%	0.50%	1.00%	2.00%
1-Month	1	-3.638%	-3.956%	-4.274%	-4.911%
	10	-1.088%	-1.357%	-1.626%	-2.163%
	31	0.194%	-0.046%	-0.286%	-0.766%
	60	0.091%	-0.138%	-0.366%	-0.822%
6-Month	1	-0.257%	-0.342%	-0.427%	-0.629%
	10	0.001%	-0.084%	-0.170%	-0.340%
	31	0.342%	0.259%	0.176%	0.009%
	60	0.318%	0.236%	0.155%	-0.007%

Panel B. Monthly Risk-Adjusted Portfolio Return with Interest on Margin and Short Rebate
(Initial Margin = 50% + Interest Earned on Margin + Short Rebate)

Holding Period	Portfolio	Transaction Cost			
		0.00%	0.50%	1.00%	2.00%
1-Month	1	-4.885%	-5.203%	-5.521%	-6.157%
	10	0.215%	-0.054%	-0.323%	-0.861%
	31	2.778%	2.538%	2.298%	1.818%
	60	2.572%	2.344%	2.116%	1.660%
6-Month	1	1.885%	1.800%	1.715%	1.544%
	10	2.400%	2.315%	2.230%	2.059%
	31	3.083%	3.000%	2.916%	2.749%
	60	3.033%	2.952%	2.871%	2.709%

Interest earned on margin = prime rate + 1.25%

Short Rebate + prime rate - 0.50%

Table 20.**Comparison of Market Neutral Portfolios Returns with Different Levels of Transaction Costs****Panel A. Monthly Risk-Adjusted Portfolio Return (Cash Settlement in Short Portfolio)**

Holding Period	Portfolio	Transaction Cost			
		0.00%	0.50%	1.00%	2.00%
1-Month	1	-4.506%	-5.183%	-5.860%	-7.215%
	10	-0.864%	-1.415%	-1.966%	-3.069%
	31	0.806%	0.327%	-0.152%	-1.110%
	60	0.815%	0.361%	-0.092%	-0.999%
6-Month	1	-0.257%	-0.342%	-0.427%	-0.629%
	10	0.001%	-0.084%	-0.170%	-0.340%
	31	0.342%	0.259%	0.176%	0.009%
	60	0.318%	0.236%	0.155%	-0.007%

**Panel B. Monthly Risk-Adjusted Portfolio Return with Interest on Margin and Short Rebate
(Initial Margin = 50% + Interest Earned on Margin + Short Rebate in Short Portfolio)**

Holding Period	Portfolio	Transaction Cost			
		0.00%	0.50%	1.00%	2.00%
1-Month	1	-2.476%	-2.821%	-3.166%	-3.857%
	10	-0.048%	-0.326%	-0.603%	-1.159%
	31	1.065%	0.826%	0.587%	0.168%
	60	1.072%	0.845%	0.619%	0.166%
6-Month	1	-0.087%	-0.174%	-0.260%	-0.434%
	10	0.597%	0.511%	0.426%	0.256%
	31	1.060%	0.978%	0.895%	0.730%
	60	1.093%	1.012%	0.931%	0.770%

Interest earned on margin = prime rate + 1.25%

Short Rebate + prime rate - 0.50%

Figure 2A.
Risk-Adjusted Short Portfolio Returns with
Various Transaction Cost Assumptions
(One-Month Holding Period)

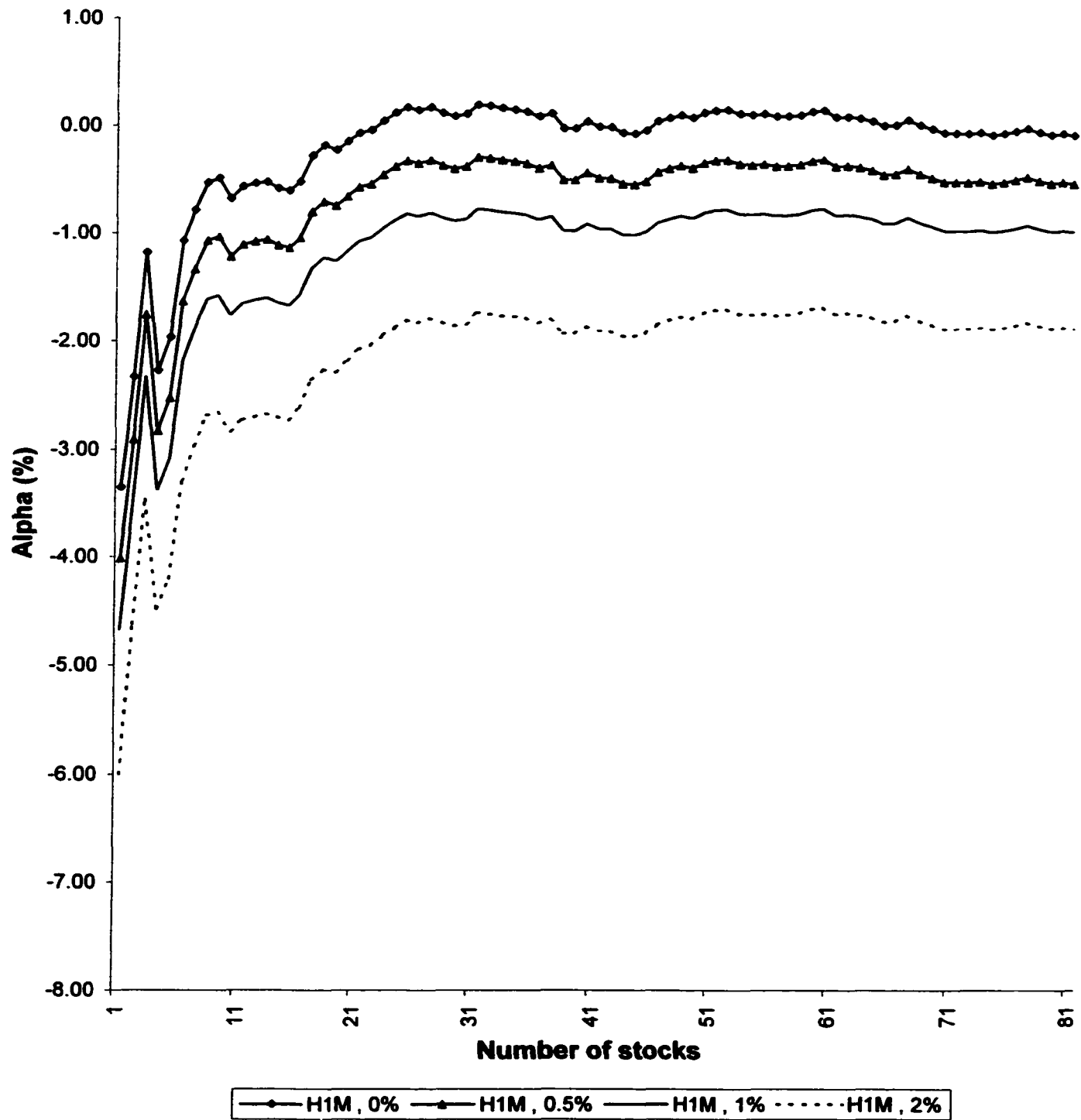


Figure 2B.
Risk-Adjusted Modified Short Portfolio Returns
with Various Transaction Cost Assumptions
(One-Month Holding Period)

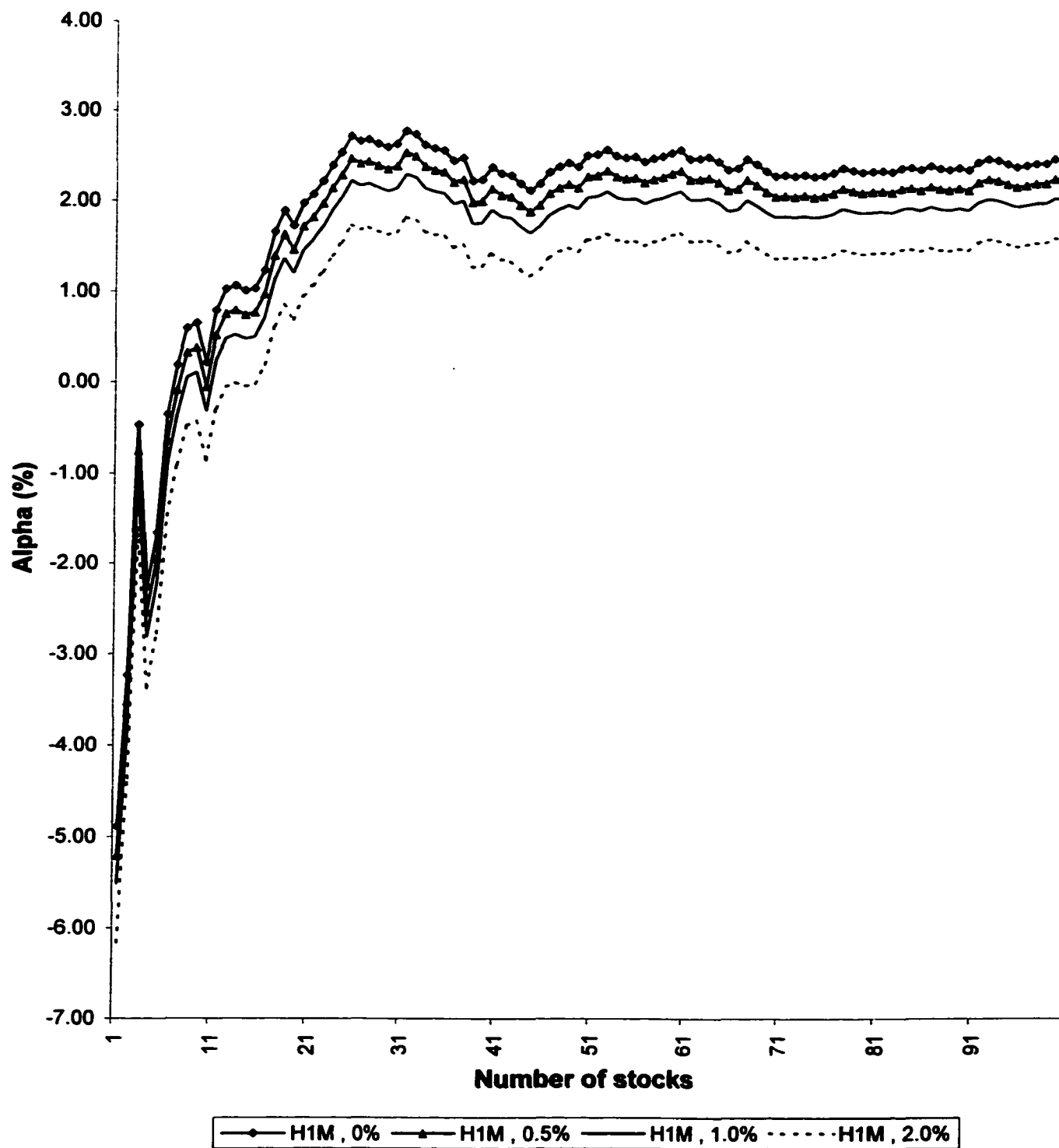


Figure 3A.
Risk-Adjusted Short Portfolio Returns with
Various Transaction Cost Assumptions
(Six-Month Holding Period)

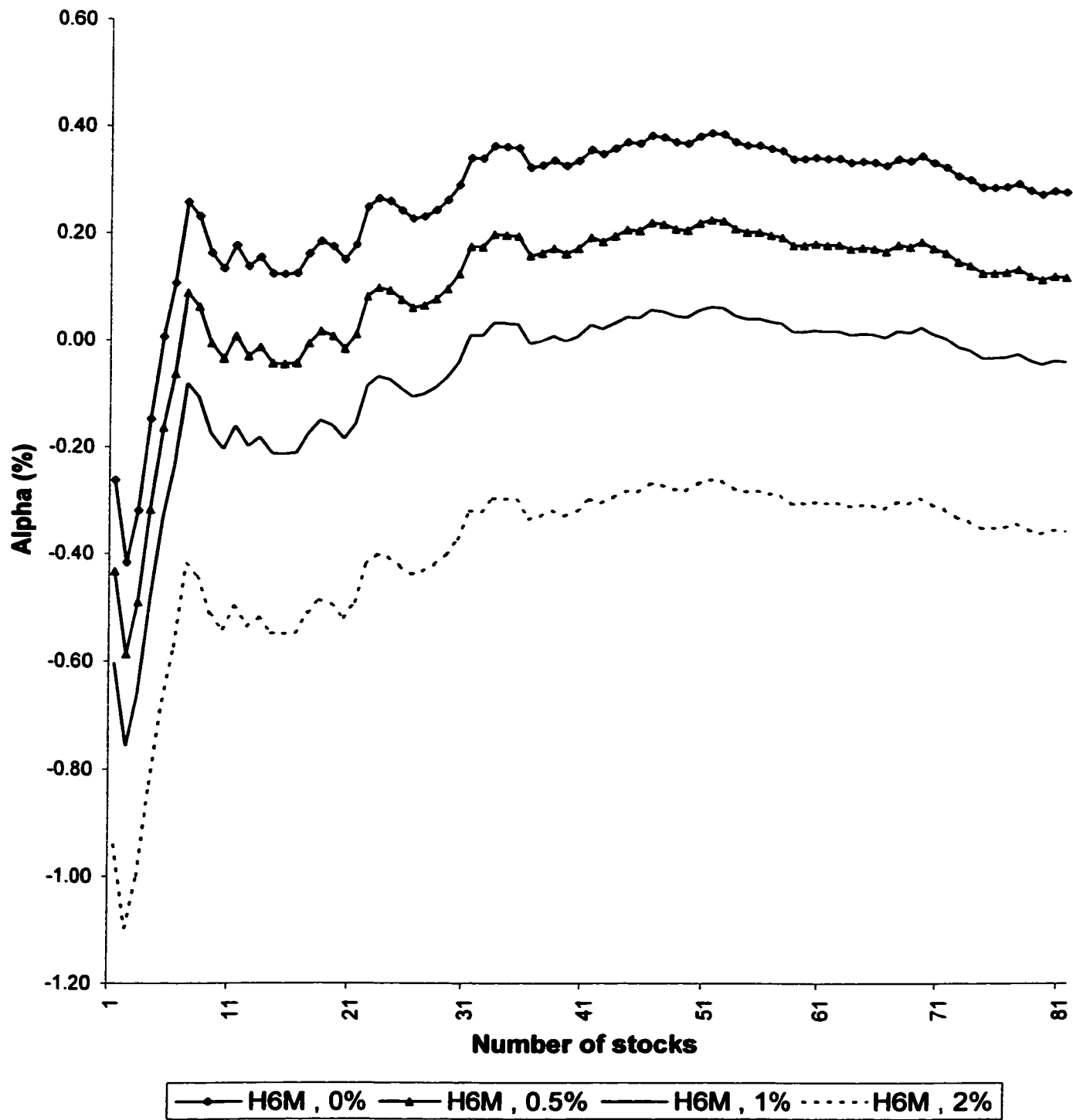


Figure 3B.
Risk-Adjusted Modified Short Portfolio Returns
with Various Transaction Cost Assumptions
(Six-Month Holding Period)

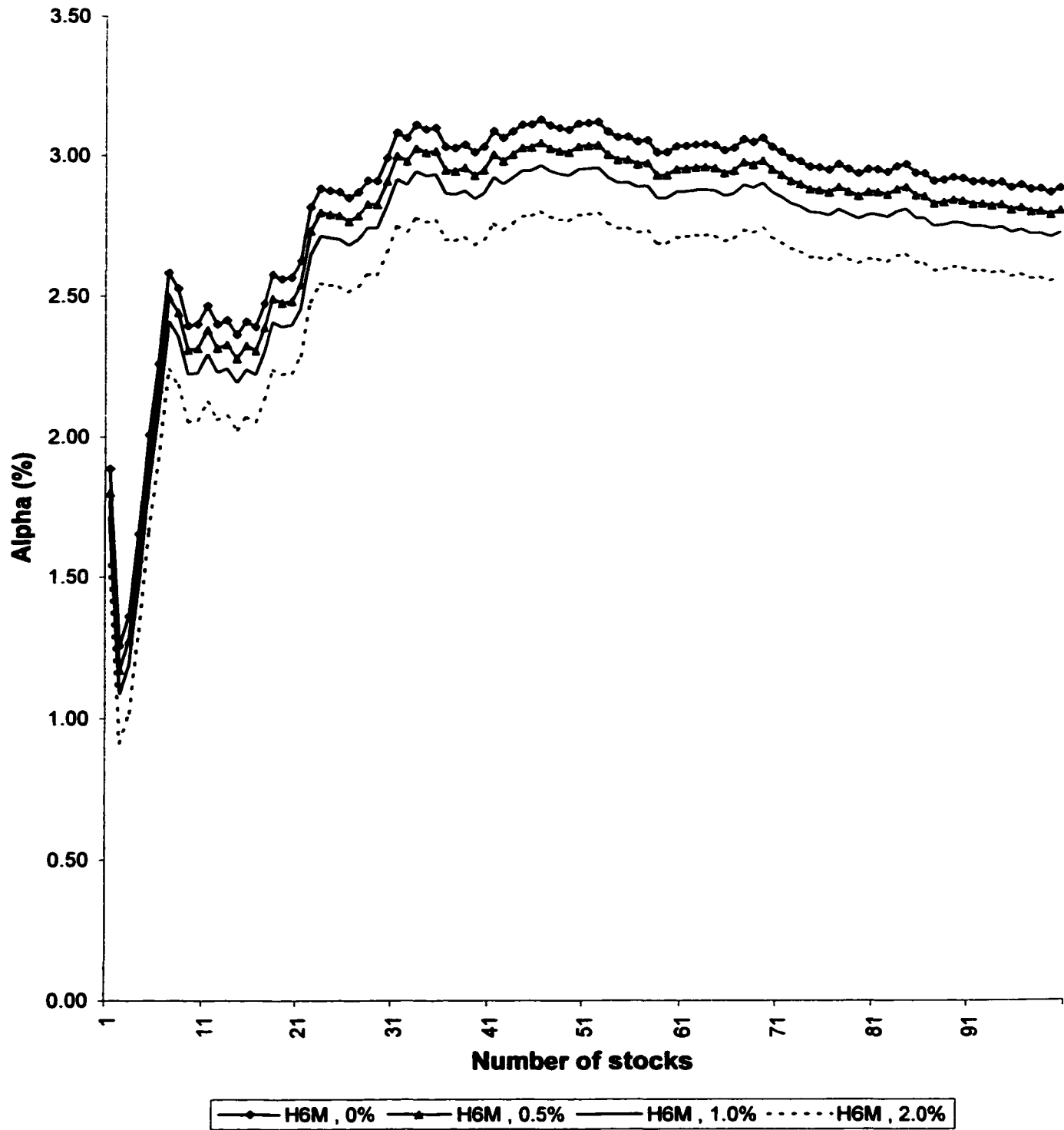


Figure 4A.
Risk-Adjusted Market Neutral Portfolio Returns with
Various Transaction Cost Assumptions
(One-Month Holding Period)

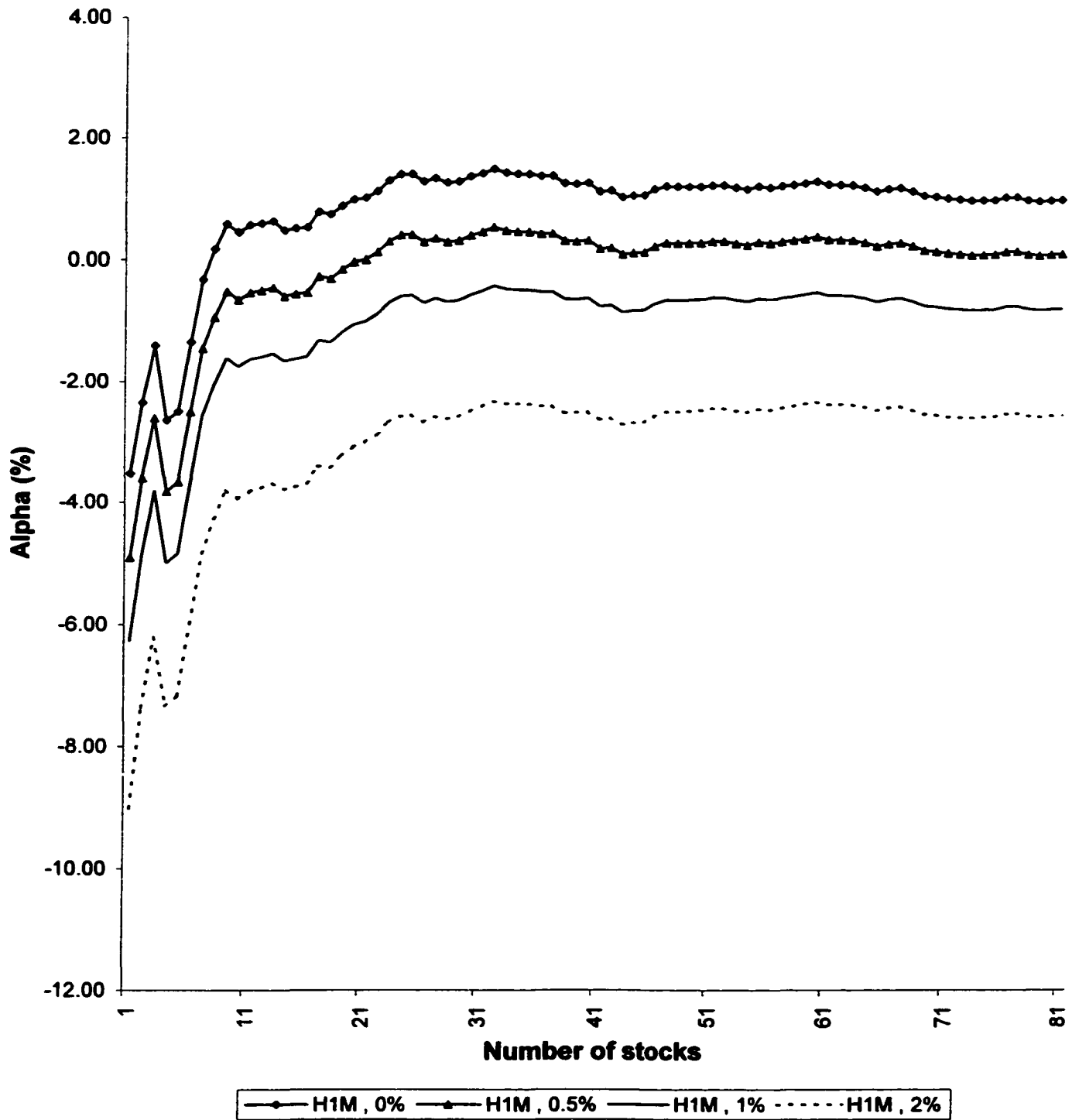


Figure 4B.
Risk-Adjusted Modified Market Neutral Portfolios Returns with Various
Transaction Cost Assumption
(One-Month Holding Period)

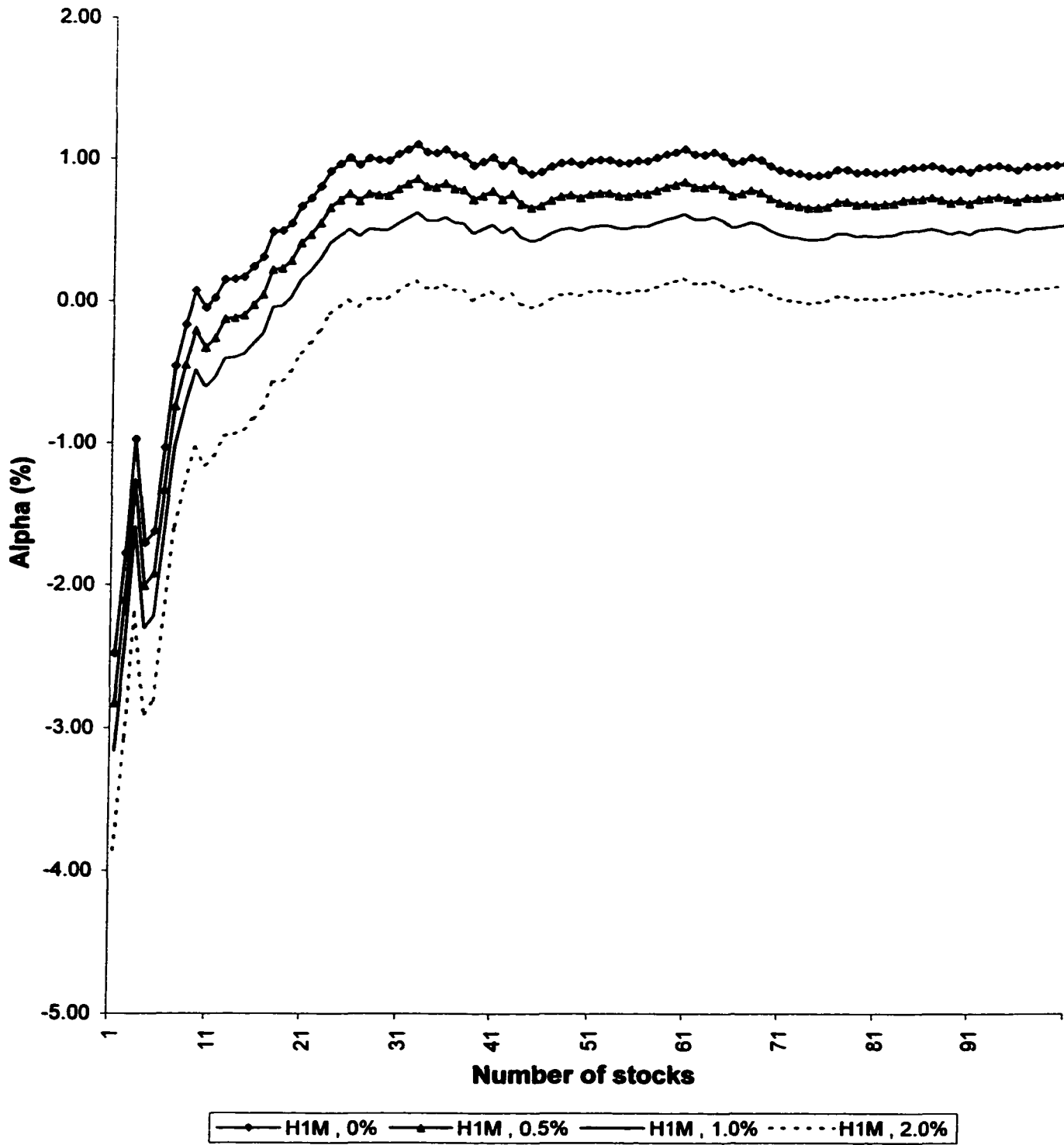


Figure 5A.
Risk-Adjusted Market Neutral Portfolio Returns with
Various Transaction Cost Assumptions
(Six-Month Holding Period)

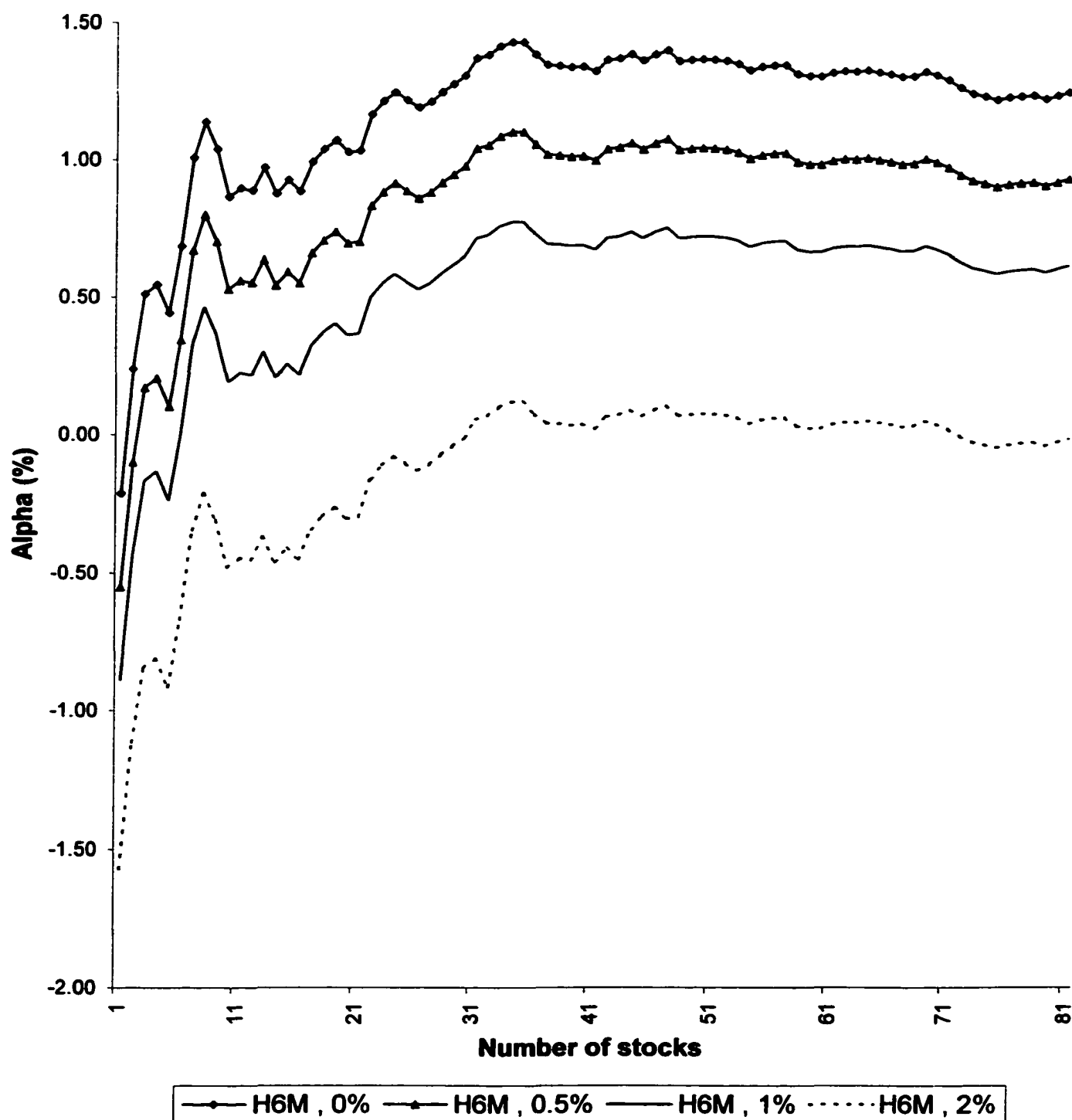
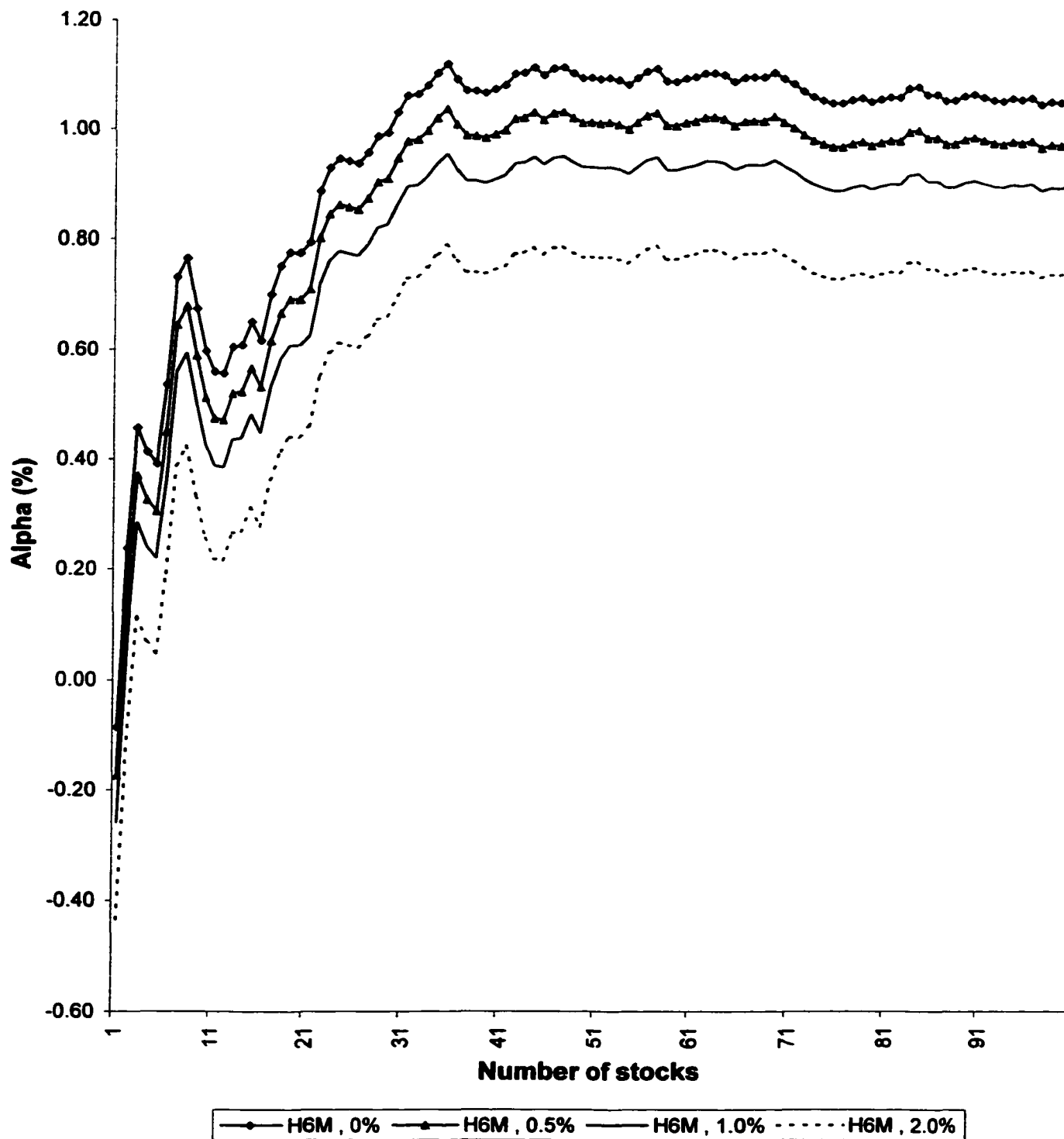


Figure 5B.
Risk-Adjusted Modified Market Neutral Portfolios Returns with Various
Transaction Cost Assumption
(Six-Month Holding Period)



CHAPTER 6.

SPREAD AND VOLATILITY ANALYSIS ON PORTFOLIOS UNDER DIFFERENT TRADING MECHANISMS

6.1. Differences of the Open-to-Open Portfolios and the Close-to-Close Portfolios

The opening transactions represent the outcome of a call trading procedure, whereas trading at the closing prices are set or affected by the exchange's market makers. The differences of the opening and closing transaction prices of the same security may be due in part to the process by which prices are set in the market, that is, to the trading mechanisms. The purpose of comparing the Open-to-Open and Close-to-Close portfolios in the formation period is to study the effects of each trading mechanism on securities price behavior and thus the portfolio formation.

Two different pricing methods are used to find the six-months performance for the top 2000 firms with the highest market capitalization values. Open-to-Open Pricing Method assumes investor enter and exit the market in the first trade of the exchange while Close-to-Close Pricing Method assumes investor enter and exit the market in the last trade of the exchange. Under each method, the six-months performances for these 2000 firms are then ranked in descending order. Forty portfolios with fifty firms each are formed. A winner (loser) portfolio is considered as the one with the highest (lowest) six-month performance. A Mismatch is defined as the number of firms that appeared in the Open-to-Open winner (or loser) portfolio but not in the Close-to-Close winner (or loser) portfolio in the formation period. For example, firm A is considered to be one mismatch if this firm is counted as one of the components in the Open-to-Open winner portfolio but not in the close-close winner portfolio. In Table 21, a total of 71(61) mismatches are found in the

winner (loser) portfolio. On average, there are more mismatches in the winner portfolio than in the loser portfolio. The degree of mismatch is more severe for the period in September 1998. These observations imply that there is indeed significant difference of two trading mechanisms.

The results in Table 22 and Table 23 confirm that all Open-to-Open portfolios with the same ranking order have greater average returns than all Close-to-Close portfolios. The Open-to-Open winner (loser) portfolio has an average return of 1.1079% (-0.5565%) per month. The winner (loser) portfolio average return is 0.0381% (0.0052%) higher than the average return of the Close-to-Close winner (loser) portfolio. Thus, the average Open-to-Open returns have greater dispersion than average Close-to-Close returns. If the strategy is set to purchase the winner portfolio and sell short of the loser portfolio, the Open-to-Open portfolio will yield an extra return of 0.033% per month over the Close-to-Close portfolio. Furthermore, the Open-to-Open portfolios has a wider range of the average market capitalization -from 945 million dollars to 9124 millions.

These findings support the notion (from Mendelson 1987) that the opening price is likely to have greater amount of information that has accumulated since the last transaction and has not yet been reflected in market prices. These findings also suggest that investors who choose to transact at the opening are usually exposed to a higher variance in prices than those who trade at the closing. Put differently, the return volatility is greater in the clearinghouse than in the dealership market.

**Table 21. Number of Mismatch in Winner and Loser Portfolios
from the period of 1998/01/01-1999/01/01**

50 Portfolio	Winner Group # Mismatched	Loser Group # Mismatched
19980101	4	5
19980201	5	5
19980301	6	3
19980401	4	5
19980501	6	5
19980601	4	3
19980701	5	6
19980801	6	5
19980901	11	7
19981001	5	5
19981101	4	4
19981201	5	3
19990101	6	5

1. Both the opening and closing price are used in the formation period to select 50 firms with the best 6-month performance and worst 6-month performance.

2. Mismatch is defined as number of firms that appeared in the winner (loser) portfolio when opening price is used in the formation period but the same firms were not included in the winner (loser) portfolio when closing price is used.

For example: If "IBM" is counted as the winner in the open-to-open portfolio but not in the close-to-close portfolio. I will then count that as 1 mismatch.

Table 22.
Summary Statistics on Open-to-Open Portfolios in Formation Period

Portfolios in Formation Period	Average Mkt Cap (million)	Median Mkt Cap (million)	Average 6-Month Return	Median 6-Month Return
Winner	3246	767	1.1079	0.9572
2	6527	1047	0.6109	0.6698
3	9124	1363	0.4771	0.5427
4	6963	1198	0.4020	0.4481
5	6492	1365	0.3486	0.3962
6	8824	1378	0.3049	0.3575
7	6722	1444	0.2684	0.3272
8	6251	1229	0.2385	0.2954
9	5344	1401	0.2127	0.2570
10	7512	1390	0.1891	0.2339
11	7125	1146	0.1677	0.2104
12	7169	1229	0.1486	0.1857
13	6009	1222	0.1306	0.1667
14	5978	1438	0.1132	0.1500
15	4093	1129	0.0968	0.1313
16	4970	1306	0.0813	0.1161
23	3730	1094	-0.0180	0.0214
24	3940	1187	-0.0317	0.0108
25	2964	931	-0.0457	-0.0005
26	3555	1085	-0.0602	-0.0135
27	3881	996	-0.0759	-0.0332
28	3543	1089	-0.0907	-0.0466
29	4030	996	-0.1074	-0.0631
30	3494	1048	-0.1248	-0.0776
31	3442	877	-0.1442	-0.0942
32	3234	858	-0.1642	-0.1147
33	2784	835	-0.1858	-0.1317
34	2512	879	-0.2106	-0.1575
35	2039	783	-0.2372	-0.1813
36	1918	777	-0.2681	-0.2124
37	1575	737	-0.3072	-0.2493
38	1575	725	-0.3558	-0.3001
39	1266	658	-0.4222	-0.3828
Loser	945	549	-0.5565	-0.4887
Winner-Loser			1.6645	1.4459

Table 23.
Summary Statistics on Close-to-Close Portfolios

Portfolios in Formation Period	Average Mkt Cap. (million)	Median Mkt Cap. (million)	Average 6-Month Return Return	Median 6-Month Return Return
Winner	3537	763	1.0698	0.9526
2	5962	1143	0.5955	0.6714
3	8415	1166	0.4668	0.5111
4	7367	1389	0.3911	0.4413
5	6154	974	0.3396	0.3961
6	8221	1311	0.2982	0.3552
7	6900	1234	0.2626	0.3019
8	6190	1435	0.2342	0.2712
9	7054	1438	0.2074	0.2388
10	6541	1247	0.1842	0.2132
11	7430	1316	0.1637	0.1944
12	6700	1252	0.1439	0.1689
13	6752	1289	0.1249	0.1499
14	5288	1281	0.1084	0.1378
15	4665	1374	0.0917	0.1229
16	4810	1437	0.0760	0.1092
17	4788	1138	0.0608	0.0954
23	3450	1005	-0.0233	0.0187
24	3152	961	-0.0372	0.0057
25	3829	975	-0.0515	-0.0097
26	3266	996	-0.0660	-0.0235
27	3128	1186	-0.0809	-0.0388
28	4600	965	-0.0969	-0.0532
29	3911	924	-0.1140	-0.0666
30	3639	917	-0.1315	-0.0833
31	3298	1017	-0.1493	-0.1032
32	3112	939	-0.1697	-0.1230
33	3030	796	-0.1917	-0.1416
34	2383	783	-0.2163	-0.1632
35	2284	762	-0.2429	-0.1922
36	1649	756	-0.2733	-0.2159
37	1624	737	-0.3131	-0.2481
38	1438	707	-0.3626	-0.3095
39	1359	642	-0.4300	-0.3804
Loser	971	559	-0.5617	-0.4994
Winner-Loser			1.6315	1.4521

6.2. Portfolios Returns in the Performance Period

6.2.1. Portfolios formed by Open Transaction Price in the Formation Period (PORT_o)

Regardless of the definition of the trading prices (TPM) or bid/ask prices (BAPM), the average returns for the long and short portfolios in the TPM are higher than those in the BAPM (see Table 24). For example, the average portfolio return for the long (short) portfolio in TPM is 0.0087% (0.119%) higher than those in BAPM in the first scenario; 0.0092% (0.0168%) in the second scenario and 0.0091% (0.0157%) in the last scenario. The differences in returns under TPM and BAPM are more pronounced for the short portfolios. In all three scenarios, the average return for the Long/Short portfolio in TPM is between 207-247 basis points higher than those in BAPM.

The portfolios under different definitions of trading prices method do not yield a significantly different average returns. For instance, the average return for the long (short) portfolio is 0.1995% (0.0740%) in the first scenario; 0.1994% (0.0745%) in the second scenario; and 0.1997% (0.0748%) in the last scenario. Similar observations obtain for the average portfolio returns for the long portfolio but not the short portfolio under various definitions of bid-ask prices method. Short portfolio has the highest average return by assuming immediate executions at the bid-ask price. Its return is 44 (30) basis points per month higher than the portfolio being executed at the bid-ask price within the five (ten) minutes.

6.2.2. Portfolios formed by Close Transaction Price in the Formation Period (PORT_c)

Again, the average returns for the long and short portfolios in the Trade Price Method are higher than those in the Bid-Ask Price Method (see Table 25). For example, the average portfolio return for the long (short) portfolio in TPM is 0.0100% (0.133%)

higher than those in BAPM in the first scenario; 0.0103% (0.0186%) in the second scenario and 0.0103% (0.0172%) in the last scenario. The differences in returns under TPM and BAPM are more pronounced for the short portfolios. In all three scenarios, the average return for the Long/Short portfolio in TPM is between 233-288 basis points higher than those in BAPM.

The portfolios under different definitions of trading pricing method do not yield a significantly different average returns. For instance, the average return for the long (short) portfolio is 0.1888% (0.0714%) in the first scenario; 0.1885% (0.0719%) in the second scenario and 0.1891% (0.0721%) in the last scenario. Similar conclusion is drawn for the average portfolio returns for the long portfolio but not for the short portfolio under various bid-ask prices definitions. Short portfolio has the highest average return by assuming immediate executions at the bid-ask price. Its return is 48 basis points per month higher than the portfolio being executed at the bid-ask price within the five minutes, and 32 basis points higher if execution is within ten minutes.

6.2.3. Interpretation

The results in Table 24-25 confirm the findings in previous empirical studies (such as Roll 1984, Atkins and Dyl (1990)). Using transaction price in the determination of returns may not truly reflect the cost of an investment since this price has been settled either at the buy or sell trade. For instance, the average return for the long (short) portfolio will be overstated if investor enter into the position at the transaction bid (ask) price and exit the position six month later at the transaction ask (bid) price. Therefore, using Bid-Ask Price Trading Method enable investors to capture the trading cost more accurately. Firms in the loser portfolios have a wider spread. Also, the average size of the loser portfolio is

smaller than the average size of the winner portfolio. Copeland, Thomas and Dan Galai, (1983) have documented that there exists more asymmetric information among small firms than large firms. Thus the specialists require a higher compensation to carry the small-stock inventory. This wider spread also supports Harold Demsetz (1968)'s claim that the specialists require a higher compensation to carry the risky inventory (holding risk). The longer the time needed to have the trade executed, the higher the holding risk the specialists perceived in accepting the trade, hence the higher will be the spread for the short portfolio.

6.2.4. Comparison between the $PORT_o$ and $PORT_c$

Negative average returns for the long $PORT_o$ and long $PORT_c$ are found when these portfolios are formed on March 1998, April 1998 and May 1998. The degree of negativity in returns is stronger in long $PORT_c$. Similarly, negative average returns for the short $PORT_o$ and short $PORT_c$ are found when these portfolios are formed on September 1998, October 1998, November 1998, December 1998, and January 1999. It is worth mentioning that the unprofitable investment on the short $PORT_c$ actually begins a month earlier than the short $PORT_o$.

Overall, the average return for $PORT_o$ in Table 24 is higher than those for $PORT_c$ in Table 25. Under the various definitions of trading prices in TPM, the return for the long (short) $PORT_o$ on average is 107 (26) basis points higher than the long (short) $PORT_c$. Hence, the difference between the average returns for long $PORT_o$ and long $PORT_c$ is almost four times greater than that for the short $PORT_o$ and short $PORT_c$. Similar conclusion is drawn for the three cases of bid-ask prices in BAPM. Under BAPM, the return for the long (short) $PORT_o$ on average is 120 (42) basis points higher than the long

(short) $PORT_c$. Hence, the spread between the average returns for long $PORT_o$ and long $PORT_c$ is only three times greater than those for the short $PORT_o$ and short $PORT_c$.

The above observations provide additional evidence for Chordia, Roll and Subrahmanyam (2000)'s finding that the dynamic change in the macro-environment has a huge impact on the entire financial markets and this impact can be minimized but not eliminated simply by adjusting the timing of the portfolio formation. On the other hand, the results also show that the choice of the portfolio formation (or of the trading mechanisms) will affect the returns of the portfolios. According to Amihud and Mendelson (1987), closing price represents the outcome of the competitive market clearing while the opening price represents the outcome of the trading process from multiple dealers or traders. Therefore, the returns generated from the Close-to-Close portfolio should be lower than those of the Open-to-Open portfolio.

6.3. Spread Comparison Analysis and Volatility Analysis

6.3.1 Proportional Spread and Spread Volatility

Regardless of the choice of the trading mechanism (Open-to-Open or Close-to-Close transaction) in the formation period, the range and the standard deviation of the quoted proportional spread for the short portfolios is wider than those for the long portfolios within the same period. These dispersions are more pronounced in the performance period. In addition, I find that the average quoted spread for the short portfolios is greater than the quoted spread for the long portfolio. For instance in Table 26, the average proportional quoted spread for the Close-to-Close long (short) portfolio in the formation period lies between 0.0066% and 0.0118% (0.0084% and 0.0206%) per month while the standard deviation of the quoted spread for the Close-to-Close long (short)

**Table 24. 6-month Portfolio Return in the Performance Period
(Selected by Opening Prices in Formation Period)**

Portfolio Date	Using Trade Prices*			Using Bid/Ask Prices**		
	LONG	SHORT	Portfolio	LONG	SHORT	Portfolio

Panel A: Use First and Last Trade/Ask/Bid Prices

980101	0.3586	0.0179	0.3765	0.3494	0.0079	0.3573
980201	0.1883	0.0829	0.2711	0.1803	0.0690	0.2494
980301	-0.1251	0.4311	0.3060	-0.1328	0.4217	0.2889
980401	-0.1963	0.4204	0.2240	-0.2023	0.4137	0.2114
980501	-0.1079	0.3658	0.2579	-0.1158	0.3523	0.2366
980601	0.0465	0.2461	0.2925	0.0402	0.2271	0.2673
980701	0.1019	0.1822	0.2840	0.0978	0.1732	0.2710
980801	0.5261	0.0276	0.5537	0.5140	0.0216	0.5357
980901	0.8139	-0.1426	0.6713	0.8007	-0.1646	0.6362
981001	0.3908	-0.1502	0.2406	0.3799	-0.1505	0.2294
981101	0.2180	-0.0590	0.1590	0.2128	-0.0711	0.1417
981201	0.1653	-0.1769	-0.0116	0.1568	-0.1925	-0.0358
990101	0.2140	-0.2830	-0.0690	0.1996	-0.3009	-0.1013
Average	0.1995	0.0740	0.2736	0.1908	0.0621	0.2529

Panel B: Use First and Last five minutes' Trade/Ask/Bid Prices

980101	0.3596	0.0186	0.3782	0.3497	0.0068	0.3564
980201	0.1884	0.0829	0.2713	0.1785	0.0672	0.2456
980301	-0.1249	0.4318	0.3069	-0.1331	0.4213	0.2881
980401	-0.1967	0.4199	0.2232	-0.2046	0.4124	0.2079
980501	-0.1096	0.3657	0.2560	-0.1174	0.3483	0.2309
980601	0.0483	0.2452	0.2935	0.0407	0.2249	0.2656
980701	0.1020	0.1827	0.2846	0.0962	0.1685	0.2646
980801	0.5276	0.0272	0.5548	0.5154	0.0164	0.5318
980901	0.8143	-0.1398	0.6745	0.8007	-0.1640	0.6367
981001	0.3899	-0.1522	0.2377	0.3767	-0.1655	0.2112
981101	0.2166	-0.0548	0.1619	0.2094	-0.0803	0.1291
981201	0.1657	-0.1777	-0.0120	0.1569	-0.2058	-0.0488
990101	0.2114	-0.2807	-0.0693	0.2038	-0.3007	-0.0969
Average	0.1994	0.0745	0.2740	0.1902	0.0577	0.2479

Panel C: Use First and Last 10 minutes' Trade/Ask/Bid Prices

980101	0.3616	0.0199	0.3815	0.3509	0.0093	0.3602
980201	0.1870	0.0838	0.2708	0.1772	0.0668	0.2440
980301	-0.1239	0.4317	0.3079	-0.1313	0.4212	0.2899
980401	-0.1976	0.4205	0.2229	-0.2053	0.4132	0.2079
980501	-0.1098	0.3661	0.2563	-0.1172	0.3487	0.2315
980601	0.0474	0.2443	0.2918	0.0402	0.2249	0.2651
980701	0.1025	0.1820	0.2845	0.0961	0.1690	0.2651
980801	0.5305	0.0263	0.5568	0.5199	0.0173	0.5372
980901	0.8158	-0.1386	0.6772	0.8015	-0.1634	0.6381
981001	0.3893	-0.1545	0.2348	0.3762	-0.1617	0.2145
981101	0.2163	-0.0521	0.1641	0.2087	-0.0744	0.1343
981201	0.1663	-0.1783	-0.0119	0.1583	-0.2026	-0.0444
990101	0.2103	-0.2795	-0.0692	0.2031	-0.3000	-0.0969
Average	0.1997	0.0748	0.2744	0.1906	0.0591	0.2497

* We enter a position at the beginning of a trading day and exit it at the end of the trading day 6 months later.

** We enter a LONG (SHORT) position at Ask (Bid) and exit it at Bid (Ask) 6 months later.

**Table 25. 6-month Portfolio Return in the Performance Period
(Selected by Closing Prices in Formation Period)**

Portfolio Date	Using Trade Prices*			Using Bid/Ask Prices**		
	LONG	SHORT	Portfolio	LONG	SHORT	Portfolio

Panel A. Use First and Last Trade/Ask/Bid Prices

980101	0.3443	-0.0065	0.3377	0.3351	-0.0175	0.3176
980201	0.1987	0.0614	0.2600	0.1907	0.0431	0.2338
980301	-0.1393	0.4238	0.2846	-0.1468	0.4139	0.2672
980401	-0.2497	0.4127	0.1630	-0.2551	0.4056	0.1505
980501	-0.1401	0.3751	0.2350	-0.1478	0.3614	0.2136
980601	0.0941	0.2337	0.3278	0.0878	0.2150	0.3029
980701	0.0934	0.2525	0.3460	0.0898	0.2368	0.3266
980801	0.6176	-0.0079	0.6097	0.6050	-0.0219	0.5831
980901	0.4908	-0.0526	0.4383	0.4771	-0.0709	0.4062
981001	0.3425	-0.1908	0.1516	0.3324	-0.1907	0.1417
981101	0.2104	-0.1218	0.0885	0.1868	-0.1355	0.0513
981201	0.3223	-0.1548	0.1675	0.3156	-0.1708	0.1448
990101	0.2693	-0.2968	-0.0276	0.2534	-0.3130	-0.0596
Average	0.1888	0.0714	0.2602	0.1788	0.0581	0.2369

Panel B. Use First and Last five minutes' Trade/Ask/Bid Prices

980101	0.3451	-0.0060	0.3391	0.3349	-0.0187	0.3162
980201	0.1986	0.0610	0.2596	0.1887	0.0414	0.2301
980301	-0.1392	0.4248	0.2856	-0.1468	0.4137	0.2669
980401	-0.2495	0.4122	0.1627	-0.2569	0.4043	0.1474
980501	-0.1419	0.3749	0.2330	-0.1493	0.3574	0.2081
980601	0.0962	0.2330	0.3292	0.0886	0.2115	0.3001
980701	0.0936	0.2530	0.3466	0.0882	0.2324	0.3206
980801	0.6196	-0.0080	0.6116	0.6080	-0.0280	0.5800
980901	0.4879	-0.0497	0.4382	0.4758	-0.0712	0.4046
981001	0.3409	-0.1915	0.1494	0.3287	-0.2057	0.1230
981101	0.2089	-0.1182	0.0908	0.1833	-0.1447	0.0386
981201	0.3249	-0.1568	0.1681	0.3167	-0.1847	0.1320
990101	0.2659	-0.2945	-0.0286	0.2574	-0.3146	-0.0572
Average	0.1885	0.0719	0.2604	0.1782	0.0533	0.2316

Panel C. Use First and Last 10 minutes' Trade/Ask/Bid Prices

980101	0.3469	-0.0047	0.3423	0.3359	-0.0161	0.3198
980201	0.1972	0.0613	0.2585	0.1871	0.0411	0.2282
980301	-0.1379	0.4247	0.2868	-0.1449	0.4137	0.2688
980401	-0.2504	0.4125	0.1622	-0.2576	0.4050	0.1474
980501	-0.1414	0.3754	0.2340	-0.1488	0.3579	0.2091
980601	0.0961	0.2319	0.3280	0.0890	0.2114	0.3004
980701	0.0939	0.2527	0.3466	0.0882	0.2334	0.3215
980801	0.6257	-0.0088	0.6170	0.6148	-0.0273	0.5875
980901	0.4883	-0.0487	0.4396	0.4752	-0.0706	0.4046
981001	0.3401	-0.1928	0.1472	0.3280	-0.2012	0.1268
981101	0.2088	-0.1151	0.0937	0.1828	-0.1384	0.0444
981201	0.3261	-0.1577	0.1684	0.3184	-0.1817	0.1367
990101	0.2644	-0.2933	-0.0289	0.2564	-0.3139	-0.0575
Average	0.1891	0.0721	0.2612	0.1788	0.0549	0.2337

* We enter a position at the beginning of a trading day and exit it at the end of the trading day 6 months later.

** We enter a LONG (SHORT) position at Ask (Bid) and exit it at Bid (Ask) 6 months later.

portfolio in the formation period lies between 0.0035% and 0.0096% (0.0031% and 0.0100%) per month. By contrast, the average proportional quoted spread for the Close-to-Close long (short) portfolio in the performance period (see Table 27) lies between 0.0071% and 0.0148% (0.0118% and 0.0273%) per month while standard deviation of the quoted spread for the Close-to-Close long (short) portfolio in the performance period lies between 0.0044% and 0.0109% (0.0070% and 0.0269%) per month.

Disregarding the choice of the trading mechanisms (Open-to-Open or Close-to-Close transaction in the formation period), I have rejected the hypothesis that average proportional quoted spread for the short portfolios and long portfolios in the performance period are the same in all thirteen cases. Similar decision is made to a weaker extent (7 out of 13 cases for the Open-to-Open portfolios and 10 out of 13 cases for the Close-to-Close portfolios) for the long portfolios and short portfolios in the formation period. On the other hand, I cannot reject the hypothesis that the volatility of the quoted spread is different between the long and short portfolios in the performance period. I am able to reject the hypothesis that the volatility of the quoted spread for the Open-to-Open (Close-to-Close) long and short portfolios are the same only 1 out of 13 cases (2 out of 13 cases).

6.3.2. Effective Spread and Spread Volatility

I find the results in Table 28-29 resemble Table 26-27. For illustrative purpose, the average effective spread for the Open-to-Open long (short) portfolio in the formation period (see Table 28) lies between 0.0025% and 0.0038% (0.0028% and 0.0060%) per month while standard deviation of the effective spread for the Open-to-Open long (short) portfolio in the formation period lies between 0.0013% and 0.0022% (0.0015% and 0.0029%) per month. In contrast, the average effective spread for the Open-to-Open long

(short) portfolio in the performance period (see Table 29) lies between 0.0027% and 0.0047% (0.0037% and 0.0084%) per month while standard deviation of the effective spread for the Open-to-Open long (short) portfolio in the performance period lies between 0.0014% and 0.0040% (0.0022% and 0.0094%) per month.

Similar to the decision rule in prior session, I have rejected the hypothesis that average effective spread for the short portfolios and long portfolios in the performance period are the same in all cases for the Open-to-Open trading mechanism (in 12 out of 13 cases for the Close-to-Close trading mechanism). This ruling is weaker for the long portfolios and short portfolios in the formation period (9 out of 13 cases for the Open-to-Open portfolios and 10 out of 13 cases for the Close-to-Close portfolios).

I cannot reject the hypothesis that the volatility of the effective spread is different between the long and short portfolios in the performance period. I am able to reject the hypothesis that the volatilities of the effective spread for the long and short portfolios for either trading mechanism in the formation period are the same in 2 cases.

6.3.3. Interpretation

Copeland, Thomas and Dan Galai (1983) stated large size firms normally release more public announcements than small size firms. The frequent review of the firms' specific information to the public allows the individual and institutional traders to provide more in-depth update analysis on the large size firms than on the small size firms. As a result, the dealers and market dealers will have similar perception of the riskiness of the large size firm. The dealers and market dealers will set comparable compensation of carrying the securities issued by the large size firm. Firms in the long portfolios are shown

to have larger size on average than the firms in the short portfolios. The range of the average spreads for the long portfolio is thus tighter.

I am advancing three explanations to support the notion that the average proportional quoted spreads, average effective spreads and their spreads' volatility are smaller for the long portfolios. First, firms in the short portfolios are known to have smaller size on average than the firms in the large portfolios. Since the larger companies have more stockholders and more dealers who are interested in making a market in the stock, the spread for the large companies will keep down to the competitive level. Second, Bagehot (1971) has shown that the trading volume of the larger companies is generally heavier than that of the smaller companies. As trading volume increases, the amount of inventory that the dealers must be held per transaction is lowered. Hence, the spread for the large companies should be lower than the spread for the small companies. On the other hand, Tinic (1972) has suggested that the inventory carrying costs per unit are positively related to the riskiness of holding the inventory. Risk-averse dealers consider carrying securities issued by the small size firms risky since they are unable to eliminate the risk by portfolio diversification. Hence, various dealers or market makers will require a higher compensation such as a greater spread for carrying these securities. As a result, the average spreads are greater for the short portfolios.

Table 26.**Comparison of Portfolios' Proportional Spread and Spread Volatility
in Formation Period****Panel A. Opening Price**

Date	Long Portfolio		Short Portfolio		Statistical Tests			
	Average	Std. Dev.	Average	Std. Dev.	t-statistic	***	F-statistic	***
980101	0.0105	0.0071	0.0118	0.0064	0.9829		1.2518	
980201	0.0110	0.0076	0.0108	0.0070	0.0971		1.1892	
980301	0.0079	0.0063	0.0099	0.0068	1.5103		0.8655	
980401	0.0089	0.0059	0.0086	0.0030	0.3381		3.7412	*
980501	0.0078	0.0036	0.0113	0.0080	2.8528	*	0.2090	
980601	0.0079	0.0054	0.0118	0.0065	3.3305	*	0.6848	
980701	0.0078	0.0036	0.0109	0.0055	3.3677	*	0.4280	
980801	0.0083	0.0045	0.0131	0.0068	4.0753	*	0.4459	
980901	0.0081	0.0043	0.0186	0.0101	6.7346	*	0.1759	
981001	0.0101	0.0055	0.0164	0.0070	5.0407	*	0.6216	
981101	0.0087	0.0046	0.0203	0.0086	8.3694	*	0.2842	
981201	0.0066	0.0054	0.0167	0.0083	7.1795	*	0.4250	
990101	0.0084	0.0063	0.0157	0.0077	5.2009	*	0.6695	

Panel B. Closing Price

Date	Long Portfolio		Short Portfolio		Statistical Tests			
	Average	Std. Dev.	Average	Std. Dev.	t-statistic	***	F-statistic	***
980101	0.0118	0.0096	0.0122	0.0064	0.2635		2.2521	*
980201	0.0107	0.0076	0.0114	0.0076	0.4376		1.0121	
980301	0.0075	0.0060	0.0101	0.0068	2.0475	**	0.7850	
980401	0.0092	0.0062	0.0084	0.0031	0.8528		4.0346	*
980501	0.0082	0.0047	0.0117	0.0079	2.6793	*	0.3505	
980601	0.0076	0.0037	0.0121	0.0073	3.8947	*	0.2569	
980701	0.0075	0.0035	0.0108	0.0057	3.4363	*	0.3843	
980801	0.0083	0.0045	0.0125	0.0070	3.6118	*	0.4207	
980901	0.0081	0.0044	0.0175	0.0100	6.0978	*	0.1965	
981001	0.0095	0.0057	0.0165	0.0070	5.4993	*	0.6680	
981101	0.0085	0.0046	0.0206	0.0085	8.8082	*	0.3021	
981201	0.0066	0.0054	0.0165	0.0084	7.0149	*	0.4212	
990101	0.0081	0.0063	0.0162	0.0080	5.6756	*	0.6173	

note:

- * - 1% statistically significant
- ** - 5% statistically significant
- *** - 10% statistically significant

Table 27.**Comparison of Portfolios' Proportional Spread and Spread Volatility
in Performance Period****Panel A. Opening Price**

Date	Long Portfolio		Short Portfolio		Statistical Tests			
	Average	Std. Dev.	Average	Std. Dev.	t-statistic	***	F-statistic	***
980101	0.0078	0.0068	0.0117	0.0069	2.8623	*	0.9740	
980201	0.0092	0.0074	0.0121	0.0081	1.9126	***	0.8315	
980301	0.0094	0.0070	0.0160	0.0099	3.8685	*	0.4902	
980401	0.0138	0.0100	0.0201	0.0131	2.7123	*	0.5867	*
980501	0.0115	0.0067	0.0268	0.0184	5.5076	*	0.1337	
980601	0.0095	0.0077	0.0220	0.0156	5.0860	*	0.2409	
980701	0.0078	0.0044	0.0223	0.0265	3.8314	*	0.0275	
980801	0.0077	0.0059	0.0207	0.0205	4.2787	*	0.0842	
980901	0.0075	0.0109	0.0253	0.0271	4.2902	*	0.1609	
981001	0.0073	0.0048	0.0203	0.0225	4.0079	*	0.0459	
981101	0.0073	0.0044	0.0203	0.0209	4.3179	*	0.0448	
981201	0.0081	0.0110	0.0213	0.0237	3.5622	*	0.2149	
990101	0.0072	0.0058	0.0160	0.0190	3.1210	*	0.0933	

Panel B. Closing Price

Date	Long Portfolio		Short Portfolio		Statistical Tests			
	Average	Std. Dev.	Average	Std. Dev.	t-statistic	***	F-statistic	***
980101	0.0080	0.0068	0.0118	0.0070	2.7667	*	0.9514	*
980201	0.0088	0.0074	0.0124	0.0083	2.3235	**	0.7929	
980301	0.0093	0.0068	0.0161	0.0099	4.0505	*	0.4644	
980401	0.0148	0.0108	0.0197	0.0132	2.0215	**	0.6771	*
980501	0.0122	0.0071	0.0273	0.0181	5.4627	*	0.1560	
980601	0.0093	0.0066	0.0210	0.0137	5.4381	*	0.2330	
980701	0.0077	0.0044	0.0234	0.0268	4.0799	*	0.0267	
980801	0.0077	0.0059	0.0199	0.0206	3.9997	*	0.0819	
980901	0.0080	0.0113	0.0250	0.0269	4.1366	*	0.1750	
981001	0.0071	0.0049	0.0200	0.0226	3.9182	*	0.0468	
981101	0.0089	0.0119	0.0199	0.0209	3.2593	*	0.3213	
981201	0.0076	0.0110	0.0214	0.0238	3.7387	*	0.2124	
990101	0.0071	0.0058	0.0161	0.0188	3.2569	*	0.0943	

note:

- * - 1% statisitcally significant
- ** - 5% statisitcally significant
- *** - 10% statisitcally significant

Table 28.**Comparison of Portfolios' Effective Spread and Spread Volatility
in Formation Period****Panel A. Opening Price**

Date	Long Portfolio		Short Portfolio		Statistical Tests			
	Average	Std. Dev.	Average	Std. Dev.	t-statistic	***	F-statistic	***
980101	0.0038	0.0022	0.0036	0.0018	0.3213		1.5218	***
980201	0.0039	0.0022	0.0036	0.0021	0.6142		1.0375	
980301	0.0029	0.0019	0.0034	0.0021	1.1764		0.8543	
980401	0.0032	0.0018	0.0028	0.0007	1.3350		5.8095	*
980501	0.0029	0.0014	0.0036	0.0022	1.9160	***	0.4273	
980601	0.0029	0.0019	0.0038	0.0019	2.4978	**	0.9629	
980701	0.0029	0.0013	0.0034	0.0017	1.8437	***	0.6351	
980801	0.0031	0.0016	0.0040	0.0021	2.4974	**	0.5433	
980901	0.0030	0.0017	0.0056	0.0029	5.5191	*	0.3183	
981001	0.0036	0.0021	0.0048	0.0020	2.9712	*	1.0231	
981101	0.0030	0.0016	0.0060	0.0024	7.4081	*	0.4501	
981201	0.0025	0.0014	0.0049	0.0019	6.8704	*	0.5318	
990101	0.0032	0.0016	0.0048	0.0015	5.2227	*	1.2015	

Panel B. Closing Price

Date	Long Portfolio		Short Portfolio		Statistical Tests			
	Average	Std. Dev.	Average	Std. Dev.	t-statistic	***	F-statistic	***
980101	0.0043	0.0032	0.0037	0.0019	1.0746		2.8875	*
980201	0.0038	0.0022	0.0039	0.0025	0.0500		0.8106	
980301	0.0028	0.0019	0.0035	0.0021	1.7533	***	0.8057	
980401	0.0033	0.0019	0.0028	0.0007	1.8982	***	7.8473	*
980501	0.0030	0.0018	0.0037	0.0022	1.7421	***	0.6455	
980601	0.0028	0.0014	0.0039	0.0020	3.1605	*	0.4837	
980701	0.0028	0.0013	0.0033	0.0017	1.4717		0.6214	
980801	0.0031	0.0016	0.0039	0.0020	2.1261	**	0.5984	
980901	0.0027	0.0016	0.0053	0.0029	5.4622	*	0.2890	
981001	0.0034	0.0021	0.0049	0.0020	3.4209	*	1.0545	
981101	0.0030	0.0016	0.0062	0.0023	8.1124	*	0.4782	
981201	0.0026	0.0014	0.0047	0.0020	6.3558	*	0.5440	
990101	0.0032	0.0016	0.0050	0.0016	5.6210	*	1.0403	

note:

- * - 1% statistically significant
- ** - 5% statistically significant
- *** - 10% statistically significant

Table 29.
Comparison of Portfolios' Effective Spread and Spread Volatility
in Performance Period

Panel A. Opening Price

Date	Long Portfolio		Short Portfolio		Statistical Tests			
	Average	Std. Dev.	Average	Std. Dev.	t-statistic	***	F-statistic	***
980101	0.0027	0.0020	0.0037	0.0022	2.4289	**	0.8209	
980201	0.0033	0.0021	0.0041	0.0027	1.6715	***	0.5797	
980301	0.0032	0.0020	0.0051	0.0032	3.5314	*	0.3803	
980401	0.0047	0.0029	0.0063	0.0038	2.2988	**	0.5767	
980501	0.0040	0.0021	0.0084	0.0060	4.8958	*	0.1219	
980601	0.0034	0.0024	0.0069	0.0043	4.9037	*	0.3123	
980701	0.0031	0.0015	0.0069	0.0076	3.4497	*	0.0394	
980801	0.0034	0.0019	0.0072	0.0073	3.5778	*	0.0661	
980901	0.0029	0.0040	0.0083	0.0094	3.7319	*	0.1868	
981001	0.0028	0.0019	0.0064	0.0078	3.1802	*	0.0582	
981101	0.0027	0.0015	0.0067	0.0081	3.4285	*	0.0334	
981201	0.0030	0.0036	0.0069	0.0088	2.9009	*	0.1673	
990101	0.0027	0.0014	0.0052	0.0063	2.7395	*	0.0504	

Panel B. Closing Price

Date	Long Portfolio		Short Portfolio		Statistical Tests			
	Average	Std. Dev.	Average	Std. Dev.	t-statistic	***	F-statistic	***
980101	0.0028	0.0020	0.0038	0.0022	2.2042	**	0.8074	
980201	0.0031	0.0021	0.0042	0.0029	2.1714	**	0.5341	
980301	0.0032	0.0020	0.0052	0.0032	3.7578	*	0.3701	
980401	0.0050	0.0032	0.0061	0.0037	1.5327		0.7585	
980501	0.0042	0.0023	0.0086	0.0059	4.9561	*	0.1439	
980601	0.0034	0.0022	0.0065	0.0035	5.2426	*	0.3959	
980701	0.0031	0.0016	0.0070	0.0077	3.4707	*	0.0412	
980801	0.0034	0.0019	0.0069	0.0073	3.2563	*	0.0665	
980901	0.0030	0.0042	0.0083	0.0093	3.6971	*	0.2020	
981001	0.0028	0.0019	0.0063	0.0078	3.0850	*	0.0582	
981101	0.0033	0.0041	0.0067	0.0081	2.6257	**	0.2552	
981201	0.0028	0.0036	0.0069	0.0088	3.0182	*	0.1649	
990101	0.0026	0.0014	0.0052	0.0063	2.8527	*	0.0510	

note:

- * - 1% statistically significant
- ** - 5% statistically significant
- *** - 10% statistically significant

CHAPTER 7. CONCLUSION

The first part of the research uses contemporary data (CRSP and COMPUSTAT data from 1989-2000) to test the validity of the 3-factor model as presented in Fama-French (1996). The performances of three different market-neutral (long/short equity) trading strategies are examined. I investigate whether the behavior of returns on factors, price momentum and earnings momentum portfolios can be explained by factors related to size and book-to-market. This is done in the context of the Fama-French (1996) 3-factor model. If the 3-factor model describes expected returns, alpha (α) should be close to 0.0. Any estimated intercept different from zero should indicate that the model leaves a large negative or positive unexplained return for a certain portfolio even though R^2 is high.

In the second study, the trading strategy that provides the best performance is chosen to determine the optimal portfolio rebalancing period and the optimal portfolio size. In this case, further tests on the market-neutral (long/short equity) portfolio in the relative strength strategy are performed. Following the techniques expressed in Fama-French (1992, 1993, 1996), long/short portfolios are formed periodically. In addition to the transaction cost for institutional ownership, return on the short-sale portfolio is further adjusted by using the technique expressed in Alexander (1993).

In reality, it may be difficult to purchase or sell short all of the securities derived from the strategy in this paper. Short sale restriction on stocks, the existence of a bid-ask spread, and the unavailability of shares to be sold short are examples that prevent us from selling short all the securities on the original short list. A sub-optimal short portfolio is formed and these factors affect the actual return of the trading strategy. With these market impediments in mind, 2-year transaction data from July 1997 to June 1999 are used in the

final study. This study examines the effects of prevalent trading mechanisms (the periodic clearing house and the continuous dealership market) on the behavior of stocks returns. In short, this study compares the effects of the trading mechanism on the selection of the winner and loser portfolios in the formation period.

Two trading methods (trading price method and bid-ask price method) are used to enter into and exit a position in the performance period. Three different assumptions of the timing of a trade execution (immediate, within five and ten minutes) are made. This comparison of the average returns between the winner and loser portfolios among various methods and assumptions will improve understanding of the true cost of investing.

Two measures of execution costs (the quoted proportional bid-ask spread and the absolute effective spread) are estimated in this study. The former spread measures the execution cost per trade for trades that occur at the quoted bid or ask while the later measures the execution cost that traders actually pay regardless of whether their trades occur at the quoted bid or ask. The analysis on spread and its volatility among the winner and loser portfolios within the same period will shed light on the components of the bid-ask spread.

Overall, the adjusted risk returns for the long portfolio, short portfolio and market neutral portfolio from the factor trading strategy are not significantly different from zero (except the long portfolio in the regression with value-weighted market portfolio as one of the independent variable). This result is well expected. Since the present trading strategy relies only on the size and book-to-market factors of the stocks, its performance is just a manifestation of size and book-to-market effects, and then the intercept of the equation should not be significantly different from zero. On the other hand, the adjusted risk returns

for the market neutral portfolios from relative strength strategy and earnings momentum strategy are significantly different from zero.

Risk-adjusted return of the market neutral portfolio in the relative strength strategy outperforms the ones in the earning momentum strategy and factors trading strategy. Here, both the long and short portfolios are settled in cash accounts. Difference in the persistence of the two strategies has some intuitive basis. The uncertainty underlying the short-horizon measures of profitability used in the earnings momentum strategies is resolved relatively quickly. Prior returns, on the other hand, reflect a broad set of market expectations not limited to near-term profitability. On this basis, I conjecture that it may take longer for the new information to be played out in stock prices for the price momentum strategy.

Evidence is hereby provided that the frequency to revise the portfolio is inversely related to the level of transaction costs. The optimal holding period(s) ranges from six to nine months depending upon the type of portfolios and the level of transaction costs being considered. Economy (diseconomy) of scale for constructing a portfolio with 20- 80 (more than 100) securities is observed. Furthermore, it is found that the returns on the short portfolios (market neutral portfolios) and adjusted short portfolios (adjusted market neutral portfolios) exhibit similar graphical patterns. Adjustments to the short portfolio by introducing the interest earned on margin and short rebate simply magnify the returns. The spread on the short (and market neutral) portfolios' returns on the identical number of stocks with different transaction costs is almost the same in magnitude.

Taken as a whole, the evidence in the final study suggests that Open-to-Open portfolios have higher average returns, greater dispersion of average returns and smaller average market capitalization than the Close-to-Close portfolios. It is found that the market

neutral portfolios' return under the Trade Price Method is between 200-300 basis points higher than the portfolio' return under the Bid-Ask Price Method; but the timing of the trade execution does not affect the average monthly portfolio returns significantly.

The above results confirm the findings in previous empirical studies (such as Roll 1984, Atkins and Dyl (1990)). Using transaction price in the determination of returns may not truly reflect the cost of an investment since this price has been settled either at the buy or sell trade. For instance, the average return for the long (short) portfolio will be overstated if investors enter into the position at the transaction bid (ask) price and exit the position six months later at the transaction ask (bid) price. Therefore, using Bid-Ask Price Trading Method enables investors to capture the trading cost more accurately.

Firms in the loser portfolios have a wider spread. Also, the average size of the loser portfolio is smaller than the average size of the winner portfolio. Furthermore, it is found that the average quote spreads and the average effective spreads are greater (smaller) for the loser (winner) portfolio. The range of the average quote spreads and that of the effective spreads are wider for the loser portfolio. These results can be interpreted as being consistent with early literature. Copeland, Thomas and Dan Galai, (1983) documented that there exists more asymmetric information among small firms than large firms. Thus, the specialists require a higher compensation to carry small-stock inventory. This wider spread also supports the notion from Harold Demsetz (1968) that the specialists require a higher compensation to carry the risky inventory (holding risk).

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