# Profitable Momentum Trading Strategies for Individual Investors

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**Abstract**

For nearly three decades, scientific studies have explored momentum investing strategies and observed stable excess returns in various financial markets. However, the trading strategies typically analyzed in such research are not accessible to individual investors due to short selling constraints, nor are they profitable due to high trading costs. Incorporating these constraints, we explore a simplified momentum trading strategy that only exploits excess returns from topside momentum for a small number of individual stocks. Building on US data from the New York Stock Exchange from July 1991 to December 2010, we analyze whether such a simplified momentum strategy outperforms the benchmark after factoring in realistic transaction costs and risks. We find that the strategy can indeed work for individual investors with initial investment amounts of at least $5,000. In further attempts to improve this practical trading strategy, we analyze an overlapping momentum trading strategy consisting of a more frequent trading of a smaller number of "winner" stocks. We find that increasing the trading frequency initially increases the risk-adjusted returns of these portfolios up to an optimal point, after which excessive transaction costs begin to dominate the scene. In a calibration study, we find that, depending on the initial investment amount of the portfolio, the optimal momentum trading frequency ranges from bi-yearly to monthly.

**JEL Classifications:** G11, G12, G14

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## 1. Introduction

Researchers have been writing about momentum trading since the 1990s. In their original work, Jegadeesh and Titman (1993) found that buying (shorting) the 10% best (worst) performing stocks from the previous 3, 6, 9, and 12 months can result in abnormal profits of approximately 1% per month after holding each portfolio for 3, 6, 9, or 12 months. Other empirical research finds the same results in various markets around the world with Rouwenhorst (1998) finding profits in 12 European countries, profits in emerging markets (Cakici, Fabozzi, & Tan, 2013; Rouwenhorst, 1999), and positive returns in 31 of 39 international markets (Griffin, Ji, & Martin, 2003). Asness, Moskowitz, and Pedersen (2013) evaluate momentum jointly across eight various markets and find consistent momentum return premia across all evaluated markets. Fama and French's three-factor model (1993) cannot sufficiently explain the continuation of short-term returns found in the United States (Jegadeesh & Titman, 1993; 2001). They later describe the abnormal returns yielded by momentum strategies as the "premiere anomaly" of their three-factor model (Fama & French, 2008). Unfortunately for individual investors, momentum investing, as originally outlined by Jegadeesh and Titman (1993), assumes a zero-cost trading strategy, which omits various market frictions, such as transaction costs, bid-ask spreads, and short-selling constraints. Carhart (1997) concludes that momentum trading, as proposed by Jegadeesh and Titman (1993), becomes unprofitable after factoring in such trading costs.

Although the theory of momentum investing is well documented in literature, the body of applied research as it pertains to individual investors is relatively small. Rey and Schmid (2007) use Swiss data to show that investors could earn profits up to 44% annually by buying the top performer in the SMI and selling short the worst performer in the same formation period. In the US market, Ammann, Moellenbeck, and Schmid (2011) find significant abnormal monthly returns of 1.16% to 2.05% by buying the single best performing stock in

the S&P 100 and shorting the index. Additionally, Siganos (2010) concedes that it would be too costly for retail investors "to buy/sell short hundreds of stocks" and employs U.K. data for the top and bottom 1-50 best and worst performers. Siganos concludes that after accounting for transaction costs and risk that small investors (with portfolios ranging from £5,000 to £1,000,000) can exploit the momentum effect with only a limited number of stocks. Furthermore, this work finds evidence that momentum profits increase as the number of stocks in the portfolio decreases (Siganos, 2007).

These works lay an encouraging foundation for small investors and a solid framework for our analysis. However, these papers imply that private investors have the capability to short stocks in their portfolio.[1] Momentum trading, as proposed by previous literature, exposes investors to unlimited downside risk by short selling uncovered positions in their portfolios. Moreover, private investors would have to contend with additional "hard to borrow" fees.[2] Margin risk is also something that accompanies short selling and should be only engaged by very knowledgeable investors who understand the risks involved.[3] Thus, this paper examines the feasibility of private investors profiting from buying long only the "winner" portfolio.[4]

Individual investors do not have many opportunities to consistently outperform the benchmark. Research shows that in the nearly $12 trillion mutual fund industry, only 0.6% of all mutual funds outperformed the benchmark after accounting for risks, expenses, and management fees (Wermers, Barras, & Scaillet, 2010). Even if mutual funds that beat the benchmark exist, the question remains: How would an individual investor choose the correct

[1] Although it is unclear how many investors have the option to short stocks in their account, Barber and Odean (2009) show that only 0.29% of all individual investors took short positions in their portfolio.
[2] If a customer has shorted a stock, the clearing firm has to borrow it in order to deliver it to the buyer. When there is a huge demand to short a stock and there is a shortage of shares to borrow, holders of long stock can charge potentially very high rates to borrow stock.
[3] Margin requirements for small and microcap stocks are often much higher than the standard 30-50% margin requirement.
[4] According to Jegadeesh and Titman's (1993) and Grinblatt and Moskowitz's (2004) findings, the abnormal performance of momentum trading is mainly due to the winner portfolio rather than the loser portfolio.

over performing mutual fund? Answering this question is far beyond most individual investor's capacity.

Recently, a handful of mutual funds based on the momentum effect have become available to individual investors. The most notable mutual fund family that uses stock price momentum is AQR Capital Management. The Momentum Fund (Symbol AMOMX), started in 2009, is the largest AQR fund, with assets of nearly $1 billion. According to the fund's website, the portfolio is rebalanced at least quarterly (AQR Funds, 2011) and management always buys the top one-third of the best performing stocks on the Russell 1000 Index (which also incorporates the "buying the winners only" strategy), based on the returns of the previous 12 months. Unfortunately, this fund currently has a high entry barrier for individual investors, seeing that it requires a minimum initial investment of $5,000,000.

The good news for individual investors about momentum trading is that the strategy requires very little knowledge of investing (Siganos, 2010) and only a small time commitment to research the previous winners, which can easily be done on the Internet. According to Goetzmann and Kumar (2008), 79.99% of all the households in their analysis traded individual stocks at least once. Moreover, today's trading environment allows investors to trade stocks in their accounts for less cost.[5] Investors can now choose which type of buy (market orders, on the open, on the close) and sell orders (stop loss, trailing stop loss) they would like at the beginning and end of each holding period.[6] Finally, all investors have the option to "reinvest all dividends" at no additional cost when they buy stocks, eliminating the cost of holding cash earned on dividends. The details on how and when individuals can easily execute this strategy at the beginning and end of each holding period are outlined in the data and methodology section.

[5] As of June 16, 2011 the costs of trading a stock averaged $8.77 per trade at five of the largest US discount brokers (Fidelity $7.95, Schwab $8.95, Scott Trade $7, E-Trade $9.95, TD Ameritrade $9.99).
[6] On the first day of the holding period, investors can place "good 'til canceled" stop loss or trailing stop orders for an amount or percentage loss that remain open up to 120 days.

The remainder of this paper analyzes the momentum returns of the top performing 1-50 stocks traded on the New York Stock Exchange from July 1, 1991 to December 31, 2010 and finds numerous opportunities for individual investors, with initial investments ranging from $5,000 to $1,000,000, to outperform the benchmark after accounting for transaction costs and risk. This is not the first paper to investigate the profit potential of momentum trading for individual investors after factoring in costs and risks. However, after investigating the initial gross momentum returns, we notice higher returns in the smaller portfolios, that is, those with fewer than 10 stocks, coupled with higher portfolio volatility. Based on this finding, this paper adds to the current body of literature by introducing increased momentum trading frequencies in order to reduce the volatility of the portfolio returns while capturing the higher average returns possible in the portfolios consisting of a small number of "winner" stocks. The trade-off between the reduced volatility of these returns and the reduced portfolio performance due to the higher transaction costs is evaluated. We find evidence that buying the smaller overlapping portfolios consisting of the top five to eight best performers of the six-month formation period on a bi-yearly to monthly basis results in larger risk-adjusted returns compared to buying a larger portfolio consisting of 20-50 stocks one time per year. We conclude that each initial investment amount has a different optimal trading frequency, the point yielding the highest Sharpe ratio against the benchmark, at which the trade-off is the greatest, ranging from bi-yearly to monthly trading.

## 2. Data and Methodology

For this analysis, all equities traded on the New York Stock Exchange (NYSE) as of November 23, 2011 were included in the original data set. All stock information was collected from July 1, 1991 to December 31, 2010 using Thomson Reuters Datastream. Both delisted and active NYSE stocks were included in this sample to avoid any survivorship bias. The total number of stocks in our original sample ranged from 1,786 to 3,121 with an average of 2,286

stocks each month. All stocks were included in the initial analysis, even those that traded for less than $5. However, for the analysis highlighted in this paper, we eliminated all stocks with a market capitalization (*MV* in Datastream) less than $20 million on the first day of the holding period. This filter primarily eliminates the potentially illiquid stocks that have extremely high bid and ask spreads. It also prevents an individual with a million dollar portfolio from potentially owning over 5% of all outstanding shares, thus avoiding the need to file Schedule 13D with the Securities and Exchange Commission (SEC).[7] Adding this filter slightly decreases the overall gross returns of each portfolio, though it does not have a significant impact on the overall results. After applying the market capitalization filter, the size of the data set is an average of 2,102 stocks per month, with a range of 1,722 to 2,589.

For the analysis, a six-month formation period (-5 to 0 months) is implemented, using the daily closing prices of each stock on the first trading day in the formation period and the last trading day of the formation period. For example, the formation period starting in February would run from the closing stock prices on February 1 to the closing prices on July 31, providing both were valid trading days. Each stock would be ranked by its formation period (six-month) performance, from best to worst.[8] The total return (*RI* in Datastream) for each stock was used in order to fully reflect dividends.[9] After ranking each stock, equally weighted portfolios were formed that contained the best (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20, 30, 40, 50) performing stocks in the formation period.

We established a 12-month holding period and bought each stock at the closing price on the first trading day of the period. At the end of the 12-month holding period, all stocks were sold

[7] When a person or group of persons acquires beneficial ownership of more than 5% of a voting class of a company's equity securities registered under Section 12 of the Securities Exchange Act of 1934, they are required to file a Schedule 13D with the SEC. Viewed on 08.04.2014. http://www.sec.gov/answers/sched13.htm

[8] Companies that become delisted during the formation period were assigned a return of 0%, which is consistent with Agyei-Ampomah (2007) and Siganos (2010). However, no delisted stocks made it into any of the winner portfolios during the analyzed period.

[9] As previously mentioned, investors can opt to fully reinvest dividends when buying each stock. This is a free service at most discount brokers in the United States.

at the closing price on the last trading day of the period. For example, the holding period would begin at the closing price on August 1 and all stocks would be held until the closing price on July 31 the following year (given that both are valid trading days). The intuition behind this is that individuals realistically would be able to turnover their portfolio in one sitting. For instance, an investor could place "sell at the close" orders on the last day of the holding period, calculate previous returns of the formation period after the market closes, and set up his or her trades using the proceeds from the sales to place "buy at the close" orders on the next trading day.[10] Proceeds from sold stocks are immediately available to purchase new stocks at most discount brokers, thus avoiding the otherwise T+3 settlement days for funds to become available.

The overall return of each time period was calculated by averaging the performance of all stocks in each portfolio. Over multiple time periods, the average annual total return (geometric mean) of each portfolio was calculated in order to reach the gross returns, as prescribed by the SEC for all U.S. mutual funds.[11] Later in our analysis, these returns and their respective trading costs were applied to nine different portfolio sizes with initial investments ranging from $5,000 to $1,000,000. The returns after all applicable transaction costs are applied are shown in the risk analysis section.

## 3. Empirical Findings

### *3.1 Gross Returns*

For gross returns unadjusted for costs, we calculate the overall performance of each portfolio from holding periods starting in January 1992 and lasting until December 2010.

[10] Investors in the United States can set up "buy at the close" and "sell at the close" orders for no additional charge.

[11] SEC website viewed 08.02.2012 http://www.sec.gov/rules/final/33-7512f.htm#E12E2

**Table 1: Gross Momentum Returns, Unadjusted for Costs (% per Month)**

| **Portfolio Size** | **SP500** | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
|---|---|---|---|---|---|---|---|---|
| Jan 1992-Dec 2010 | 0.63 | 1.15 | 2.68*** | 2.94*** | 2.95*** | 3.04*** | 3.04*** | 3.07*** |
| Max | 5.23 | 135.09 | 77.43 | 55.05 | 41.10 | 33.62 | 28.57 | 25.60 |
| Min | -3.83 | -7.14 | -6.84 | -6.55 | -6.50 | -6.41 | -6.20 | -6.33 |
| Median | 0.99 | 0.78 | 2.45 | 3.37 | 3.03 | 3.48 | 3.49 | 3.55 |
| Monthly St Dev. | 0.06 | 0.70 | 0.44 | 0.34 | 0.29 | 0.24 | 0.22 | 0.20 |
| Correlation | NA | 0.20 | 0.26 | 0.29 | 0.33 | 0.38 | 0.40 | 0.40 |
| Outperform SP500 | NA | 49% | 64% | 64% | 68% | 73% | 73% | 74% |
| Sub-periods | | | | | | | | |
| 1992-2000 | 1.24 | 1.53 | 3.14 | 3.04 | 3.06 | 3.41 | 3.46 | 3.30 |
| 2001-2009 | 0.06 | 0.79 | 2.23 | 2.84 | 2.83 | 2.69 | 2.64 | 2.84 |
| 2007-2008 | -1.58 | -4.32 | -4.31 | -3.83 | -3.60 | -3.42 | -3.22 | -3.01 |
| 1992-2006; 09-10 | 0.95 | 2.23 | 4.16 | 4.31 | 4.24 | 4.30 | 4.24 | 4.20 |

| **Portfolio Size** | **8** | **9** | **10** | **15** | **20** | **30** | **40** | **50** |
|---|---|---|---|---|---|---|---|---|
| Jan 1992-Dec 2010 | 3.06*** | 2.91*** | 2.82*** | 2.54*** | 2.36*** | 2.28*** | 2.20*** | 2.13*** |
| Max | 23.50 | 23.72 | 21.27 | 16.80 | 13.94 | 11.13 | 10.41 | 9.70 |
| Min | -6.20 | -5.94 | -5.83 | -5.73 | -5.53 | -5.07 | -5.18 | -4.85 |
| Median | 3.40 | 3.53 | 3.32 | 3.08 | 3.04 | 2.85 | 2.76 | 2.76 |
| Monthly St Dev. | 0.19 | 0.18 | 0.17 | 0.14 | 0.12 | 0.11 | 0.10 | 0.10 |
| Correlation | 0.43 | 0.45 | 0.46 | 0.51 | 0.55 | 0.62 | 0.64 | 0.65 |
| Outperform SP500 | 74% | 74% | 75% | 73% | 76% | 78% | 78% | 77% |
| Sub-periods | | | | | | | | |
| 1992-2000 | 3.36 | 3.20 | 3.08 | 2.72 | 2.52 | 2.60 | 2.54 | 2.53 |
| 2001-2009 | 2.77 | 2.64 | 2.57 | 2.36 | 2.21 | 1.97 | 1.88 | 1.74 |
| 2007-2008 | -2.81 | -2.70 | -2.71 | -2.42 | -2.17 | -2.06 | -2.12 | -2.12 |
| 1992-2006; 09-10 | 4.14 | 3.93 | 3.81 | 3.40 | 3.12 | 3.00 | 2.92 | 2.83 |

Note: For the analysis, a six-month formation period (-5 to 0 months) is implemented, ranking each stock by its formation period (six-month) performance, from best to worst. After ranking each stock, equally weighted portfolios were formed that contained the best (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20, 30, 40, 50) performing stocks in the formation period. We established a 12-month holding period and the overall return of each time period was calculated by averaging the performance of all stocks in each portfolio. Over multiple time periods, the average annual total return (geometric mean) of each portfolio was calculated in order to reach the monthly gross returns. Correlation is between each portfolio and the S&P 500. "Outperform S&P 500" means the percentage of months where each portfolio outperforms the S&P 500 benchmark. Statistical significance of the overall returns is given by two sample parametric t-tests comparing the returns of each portfolio with the S&P 500.
* Significant at the 10% level, ** significant at the 5% level, *** significant at the 1% level.

The results in Table 1 show that all portfolios, on average, outperform the S&P 500 benchmark by 0.52%-2.44% per month.[12] Consistent with Siganos (2007), larger momentum profits were primarily seen in the smaller portfolios. However, the portfolio containing the

[12] The S&P 500 was used as the benchmark in this analysis as it the most commonly used benchmark for U.S. stocks. We also ran the risk analysis against the Willshire 5000 Index, arguably a more comparable benchmark, and found similar results.

best performing stock performed the worst out of all portfolios (1.15%), which is inconsistent with the findings of Ammann, Moellenback, and Schmid (2011) and with those of Rey and Schmid (2007). Overall portfolio performance gradually increases until it reaches the highest performance, 3.07% per month, in the top seven stock portfolio. The returns then decrease as the portfolio holds more stocks. Regardless, the top 50 stock portfolio still outperformed the S&P 500 by 1.50% per month in the overall sample period.

Gross returns were divided into two equal sub-periods, January 1992 to December 2000 and January 2001 to December 2009. Each sub-period appears to consistently outperform the S&P 500 in both categories. However, momentum trading clearly struggled during the financial crisis of 2007 and 2008, incurring heavy losses and faring much worse than the S&P 500. In this period, all portfolios underperformed the S&P 500 by 0.54% in the top 50 portfolio, and by as much as 2.74% per month in the one stock portfolio. These findings are consistent with Andrikopoulos, Clunie, and Siganos (2013), who find no evidence of momentum returns during a similar period, February 2007 to February 2010, in the U.K. market. In hindsight, it would have been more profitable to either stay in cash or seek an alternative trading strategy.[13] We hope that these findings inspire further research into whether it is possible to capture reliable ex-ante cues from the formation period data that can inform investors as to whether they should continue with the momentum strategy or opt for an alternative trading strategy for those holding periods.

### *3.2 Transaction Costs*

To more accurately analyze the true profitability of momentum trading, all applicable transaction costs are applied to each portfolio. At the beginning and end of each holding period, a flat $10 commission per trade was factored in for each buy and sell order.

[13] Daniel and Moskowitz (2013) find that in extreme market environments, the loser portfolio provides a high premium, while the winner portfolio returns are minimal following large market declines.

The bid and ask spreads were also taken into account for each stock. The actual bid and ask spreads for the stocks were available only from April 2006 to December 2010. Therefore, we implemented averaged bid and ask spreads based on the market capitalization of each stock, using the bid/ask spread averages from small, mid, and large cap stocks listed on the NYSE in 1998 (Bessimbinder, 2003). Specifically, for all stocks with a market capitalization under $215.6 million we assume a 0.750% half spread on both the buy and sell order each period. A half spread of 0.497% was used for stocks with market capitalization between $215.7 and $11,365.8 million. All stocks with a market capitalization greater than $11,365.8 million were given a half spread of 0.212%.[14] For the top 50 performers over the 18-year sample period, 31% of the stocks were classified as small capitalization, 65% were mid-capitalization, and 4% were large capitalization. Although the lack of actual bid and ask data was not ideal, the current market is so heavily traded that every stock ranked in the top 10 best performing stocks for all 12 formation periods in 2010 had an average bid and ask spread of $.01, providing a more favorable trading environment for investors seeking to implement this strategy in the future.

Finally, a nominal "Securities and Exchange Commission (SEC) Fee" for every sale of a stock was included at its rate, prior to December 28, 2001, 0.003333% of the total amount sold.[15]

[14] These assumptions are supported by the available bid/ask spread data from April 2006 to December 2010. During this time span, the average actual small cap stock posted a half bid/ask spread of 0.65%, which is slightly less than our assumed average. The mid cap and large cap stocks posted significantly lower actual bid/ask half spreads, 0.19% and 0.10%, respectively. As a robustness check, we ran the analysis with the actual spreads of the relevant stocks for this period and found no systematic difference from the results in our base scenario with fixed spreads for small, mid, and large caps.

[15] Section 31 of the Securities Exchange Act of 1934 states that, "self-regulatory organizations (SROs) such as the Financial Industry Regulatory Authority (FINRA) and all of the national securities exchanges (including the New York Stock Exchange) must pay transaction fees to the SEC based on the volume of securities sold on their markets. These fees recover the costs incurred by the government, including the SEC, for supervising and regulating the securities markets and securities professionals." Viewed on 05.03.2014 on at http://www.sec.gov/answers/sec31.htm.

To maintain an equally weighted portfolio at the beginning of each holding period, all portfolios were rebalanced at the end of the previous holding period. Therefore, at the end of the holding period, the full $10 commission for each stock, the other half bid/ask spread, and the SEC selling fee were added to the full amount of the sell order of each stock. In summary, the overall costs, *o*, to implement a 12-month momentum strategy are:

$$o = (2 * c) + (2 * 0.5s) + f \quad (1)$$

Where *c* is the sales commission, *s* is the bid/ask spread, and *f* is the SEC sales fee.

These transaction costs are applied to nine different initial investment amounts ranging from $5,000 up to $1,000,000 in order to reflect the feasibility and effects on performance.

Table 2 shows the net monthly returns after applying transaction costs. With a trading frequency of only once per year, all (except one) portfolios continued to outperform the S&P 500.[16] Yearly traded portfolios containing the top five to eight stocks continue to generate the highest gross returns, ranging from 2.66% to 2.96% per month. No expenses were added to the S&P 500 benchmark in this section, which further strengthens the results.

[16] The top 50 stock portfolio with an initial amount of $5,000 underperformed the S&P 500 by 0.39% per month.

**Table 2: Net Monthly Momentum Returns After Adding Transaction Costs (%)** Full Turnover; Yearly Trading Frequency

**S&P 500 Return: 0.63**

| Initial $/# Stocks | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 15 | 20 | 30 | 40 | 50 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $ 5,000 | 1.07 | 2.52*** | 2.71*** | 2.67*** | 2.74*** | 2.70*** | 2.69*** | 2.66*** | 2.47*** | 2.34*** | 1.89*** | 1.54*** | 1.11* | 0.67 | 0.24 |
| $ 10,000 | 1.09 | 2.57*** | 2.77*** | 2.76*** | 2.84*** | 2.82*** | 2.83*** | 2.81*** | 2.65*** | 2.53*** | 2.16*** | 1.91*** | 1.65*** | 1.40*** | 1.15** |
| $ 15,000 | 1.10 | 2.58*** | 2.79*** | 2.78*** | 2.87*** | 2.86*** | 2.87*** | 2.86*** | 2.70*** | 2.60*** | 2.26*** | 2.03*** | 1.83*** | 1.64*** | 1.44*** |
| $ 30,000 | 1.11 | 2.60*** | 2.81*** | 2.81*** | 2.91*** | 2.90*** | 2.92*** | 2.91*** | 2.76*** | 2.66*** | 2.35*** | 2.15*** | 2.01*** | 1.87*** | 1.74*** |
| $ 50,000 | 1.11 | 2.60*** | 2.82*** | 2.82*** | 2.92*** | 2.91*** | 2.94*** | 2.93*** | 2.78*** | 2.68*** | 2.38*** | 2.20*** | 2.08*** | 1.97*** | 1.86*** |
| $ 100,000 | 1.11 | 2.61*** | 2.83*** | 2.83*** | 2.93*** | 2.92*** | 2.95*** | 2.95*** | 2.80*** | 2.70*** | 2.41*** | 2.23*** | 2.13*** | 2.04*** | 1.95*** |
| $ 250,000 | 1.12 | 2.61*** | 2.83*** | 2.83*** | 2.94*** | 2.93*** | 2.96*** | 2.96*** | 2.81*** | 2.71*** | 2.43*** | 2.25*** | 2.16*** | 2.08*** | 2.00*** |
| $ 500,000 | 1.12 | 2.61*** | 2.83*** | 2.84*** | 2.94*** | 2.93*** | 2.96*** | 2.96*** | 2.81*** | 2.72*** | 2.43*** | 2.26*** | 2.17*** | 2.09*** | 2.02*** |
| $ 1,000,000 | 1.12 | 2.61*** | 2.83*** | 2.84*** | 2.94*** | 2.93*** | 2.96*** | 2.96*** | 2.81*** | 2.72*** | 2.44*** | 2.26*** | 2.18*** | 2.10*** | 2.02*** |

Note: Full turnover applies the commission ($10 per stock) and half bid/ask spread at the beginning of each holding period. At the end of the holding period, the full turnover applies the full commission for each stock, the other half bid/ask spread and the SEC selling fee on the full amount of the sell order of each stock. Statistical significance is given by two sample parametric t-tests comparing the returns of each portfolio with the S&P 500.

* Significant at the 10% level, ** significant at the 5% level, *** significant at the 1% level.

### *3.3 Real Turnover*

It is possible that, when turning over the portfolio from one holding period to the next, an individual stock could remain in the portfolio. In this case, the overall portfolio would still need to be rebalanced, requiring a buy or sell order for a fraction of this stock position, in order to maintain an equally weighted portfolio at the beginning of each holding period. Thus, one $10 commission would still be applied for each stock. However, the second commission of $10 is saved in this instance as only one transaction is needed for the adjustment. Moreover, as only a fraction of the stock position would be bought or sold for rebalancing purposes, the negative consequences of the bid/ask spread are mostly waived, thereby further reducing the overall transaction fees. We make these adjustments so as to reflect the real-world situation as accurately as possible, even though comparing Table 3 (real turnover) with Table 2 (full turnover) shows that the performance effect is negligible. Nevertheless, we consider the real turnover in all analyses that follow.

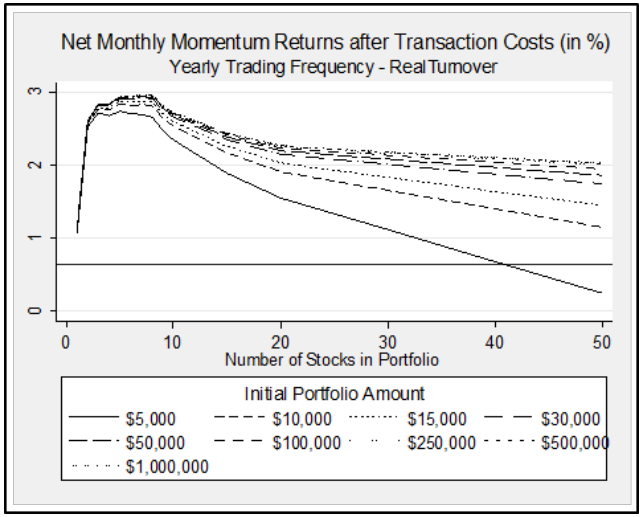
**Table 3: Net Monthly Momentum Returns After Adding Transaction Costs (%)** Real Turnover; Yearly Trading Frequency

**S&P 500 Return: 0.63**

| Initial $/# Stocks | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 15 | 20 | 30 | 40 | 50 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $5,000 | 1.07 | 2.52*** | 2.71*** | 2.68*** | 2.74*** | 2.70*** | 2.69*** | 2.66*** | 2.48*** | 2.35*** | 1.89*** | 1.55*** | 1.11* | 0.68 | 0.25 |
| $10,000 | 1.10 | 2.57*** | 2.77*** | 2.76*** | 2.84*** | 2.82*** | 2.83*** | 2.81*** | 2.65*** | 2.53*** | 2.17*** | 1.91*** | 1.65*** | 1.40*** | 1.15** |
| $15,000 | 1.10 | 2.58*** | 2.80*** | 2.79*** | 2.88*** | 2.86*** | 2.88*** | 2.86*** | 2.71*** | 2.60*** | 2.26*** | 2.03*** | 1.83*** | 1.64*** | 1.45*** |
| $30,000 | 1.11 | 2.60*** | 2.82*** | 2.81*** | 2.91*** | 2.90*** | 2.92*** | 2.91*** | 2.76*** | 2.66*** | 2.35*** | 2.15*** | 2.01*** | 1.88*** | 1.74*** |
| $50,000 | 1.11 | 2.60*** | 2.82*** | 2.82*** | 2.92*** | 2.92*** | 2.94*** | 2.94*** | 2.78*** | 2.69*** | 2.39*** | 2.20*** | 2.08*** | 1.97*** | 1.86*** |
| $100,000 | 1.12 | 2.61*** | 2.83*** | 2.83*** | 2.93*** | 2.93*** | 2.95*** | 2.95*** | 2.80*** | 2.70*** | 2.41*** | 2.23*** | 2.14*** | 2.04*** | 1.95*** |
| $250,000 | 1.12 | 2.61*** | 2.84*** | 2.84*** | 2.94*** | 2.93*** | 2.96*** | 2.96*** | 2.81*** | 2.72*** | 2.43*** | 2.26*** | 2.17*** | 2.08*** | 2.00*** |
| $500,000 | 1.12 | 2.61*** | 2.84*** | 2.84*** | 2.94*** | 2.94*** | 2.96*** | 2.96*** | 2.82*** | 2.72*** | 2.44*** | 2.26*** | 2.18*** | 2.10*** | 2.02*** |
| $1,000,000 | 1.12 | 2.61*** | 2.84*** | 2.84*** | 2.94*** | 2.94*** | 2.97*** | 2.96*** | 2.82*** | 2.72*** | 2.44*** | 2.27*** | 2.18*** | 2.11*** | 2.03*** |

Note: Net monthly momentum returns, reflecting the real portfolio returns for those stocks remaining in each portfolio from one holding period to the next. Thus, a commission of $10 is saved in this instance as a new stock is not required to be purchased for the next holding period. Moreover, as only a fraction of the stock holding would be sold for rebalancing purposes, the negative consequences of the bid/ask spread would be waived, thereby further reducing the overall transaction fees. Statistical significance is given by two sample parametric t-tests comparing the returns of each portfolio with the S&P 500.

* Significant at the 10% level, ** significant at the 5% level, *** significant at the 1% level.



### *3.4 Risk Factors*

This section applies the net monthly results from the previous section to various risk factors in order to determine if these returns continue to outperform the benchmark after factoring in risk. The capital asset pricing model (Sharpe, 1964) and the Fama-French three factor model (1993) are applied to the net monthly returns of each portfolio in order to test against systematic risk.

For the capital asset pricing model (CAPM), overlapping data were used in the sample set. A majority of recent finance literature employs overlapping data (Harri & Brorsen, 2009), although there is no consensus on which type of data are less biased. To control for the autocorrelation of the overlapping data, the Newey-West (1987) estimator with an 11-month lag was applied. For our estimation, we use the following equation:

$$Nr \; - \; R_f \; = \; \beta \, ( \, K_m \; - \; R_f \, ) \; + \; \alpha \qquad (2)$$

where "$R_f$" is the risk free rate from French's Data Library, "$Nr$" is the net monthly return, and "$K_m$" is the performance of the S&P 500.

For the Fama-French three factor model, we use the following regression:

$$Nr - R_f = \beta\left(K_m - R_f\right) + b_s * SMB + \; b_v * HML + \; \alpha \qquad (3)$$

where "$R_f$" is the yearly risk free rate. The high minus low book to market ratio (HML) and small minus big (SMB) data are from Kenneth French's Data Library.

Tables 4 and 5 show the results for the monthly alpha for each portfolio traded one time per year. In the CAPM and Fama-French models, all one-stock portfolios have a zero and slightly negative alpha, respectively. Additionally, the $5,000 portfolios consisting of 40 and 50

stocks post a negative alpha. All other portfolios alphas indicate a statistically significant abnormal profit after factoring in risk using the capital asset pricing model and the Fama-French three-factor model. The highest statistically significant alphas in the yearly traded capital asset pricing and the Fama-French three-factor model were observed in the top five to eight stock portfolios.

**Table 4: Capital Asset Pricing Model - Monthly Alpha "α" (in %)**

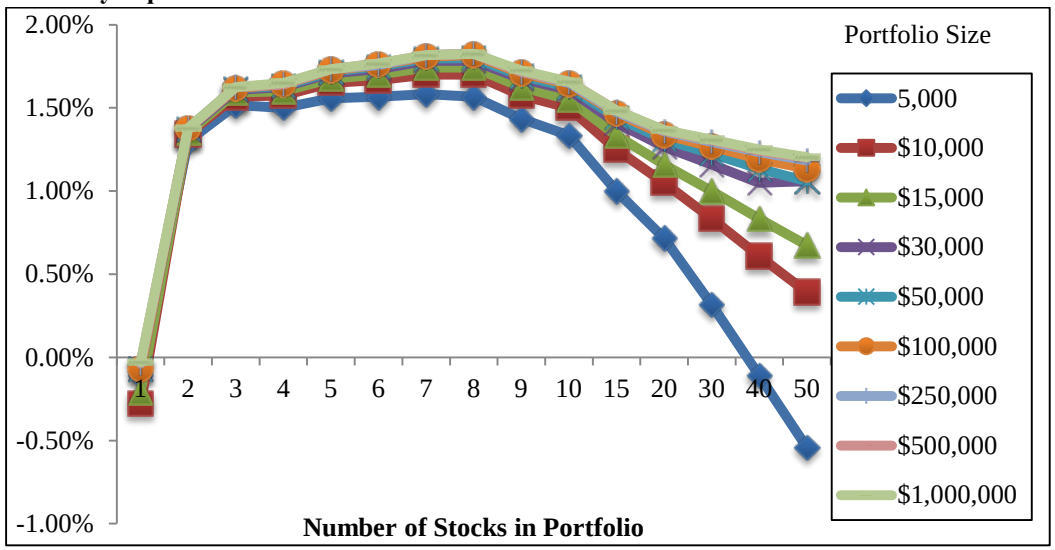
| 1X Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 15 | 20 | 30 | 40 | 50 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **$5,000** | -0.06 | 1.30*** | 1.52*** | 1.50*** | 1.56*** | 1.56*** | 1.58*** | 1.57*** | 1.43*** | 1.33*** | 1.00*** | 0.72*** | 0.32** | -0.11 | -0.54*** |
| **$10,000** | -0.03 | 1.34*** | 1.57*** | 1.58*** | 1.65*** | 1.67*** | 1.70*** | 1.70*** | 1.58*** | 1.50*** | 1.25*** | 1.05*** | 0.83*** | 0.61*** | 0.39*** |
| **$15,000** | -0.02 | 1.35*** | 1.58*** | 1.60*** | 1.68*** | 1.70*** | 1.74*** | 1.74*** | 1.63*** | 1.55*** | 1.33*** | 1.16*** | 1.00*** | 0.83*** | 0.68*** |
| **$30,000** | -0.02 | 1.37*** | 1.61*** | 1.63*** | 1.71*** | 1.73*** | 1.78*** | 1.78*** | 1.68*** | 1.61*** | 1.41*** | 1.27*** | 1.16*** | 1.05*** | 1.06*** |
| **$50,000** | -0.01 | 1.38*** | 1.62*** | 1.63*** | 1.72*** | 1.75*** | 1.80*** | 1.80*** | 1.69*** | 1.63*** | 1.44*** | 1.31*** | 1.23*** | 1.13*** | 1.06*** |
| **$100,000** | -0.01 | 1.38*** | 1.62*** | 1.64*** | 1.73*** | 1.76*** | 1.81*** | 1.82*** | 1.71*** | 1.64*** | 1.47*** | 1.34*** | 1.27*** | 1.19*** | 1.13*** |
| **$250,000** | 0.00 | 1.38*** | 1.63*** | 1.64*** | 1.73*** | 1.76*** | 1.82*** | 1.82*** | 1.72*** | 1.65*** | 1.48*** | 1.36*** | 1.30*** | 1.23*** | 1.18*** |
| **$500,000** | 0.00 | 1.38*** | 1.63*** | 1.64*** | 1.73*** | 1.76*** | 1.82*** | 1.83*** | 1.72*** | 1.66*** | 1.48*** | 1.36*** | 1.31*** | 1.24*** | 1.20*** |
| **$1,000,000** | 0.00 | 1.38*** | 1.63*** | 1.65*** | 1.73*** | 1.77*** | 1.82*** | 1.83*** | 1.73*** | 1.66*** | 1.48*** | 1.37*** | 1.31*** | 1.25*** | 1.20*** |

* 10% statistical significance, ** 5% statistical significance, *** 1% statistical significance

To control for the autocorrelation of the overlapping data, the Newey-West (1987) estimator with an 11-month lag was applied.

We use: Nr - Rf = β(Km - Rf) + α, where "Rf" is the risk free rate from French's Data Library, "Nr" is the net monthly real turnover portfolio returns, and "Km" is the performance of the S&P 500.

**Monthly Alpha "α"**




**Statistical Significance (Newey-West Estimator, 11-Month Lag)**

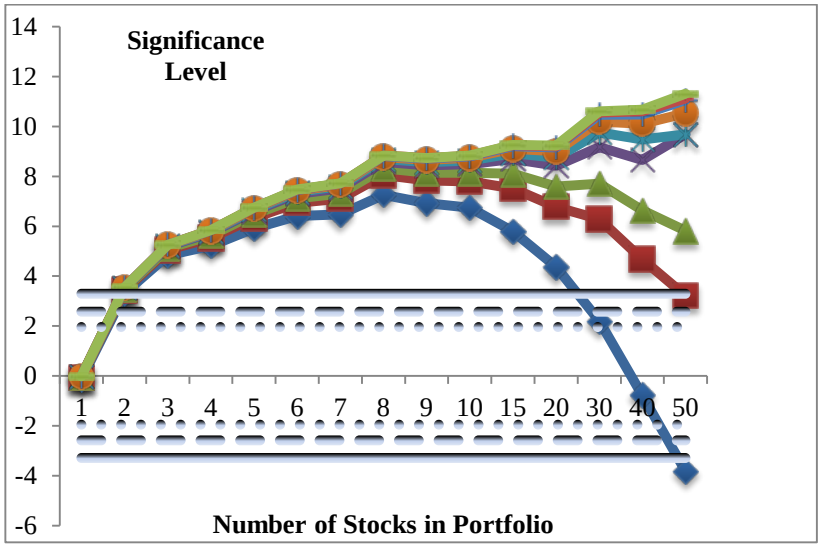


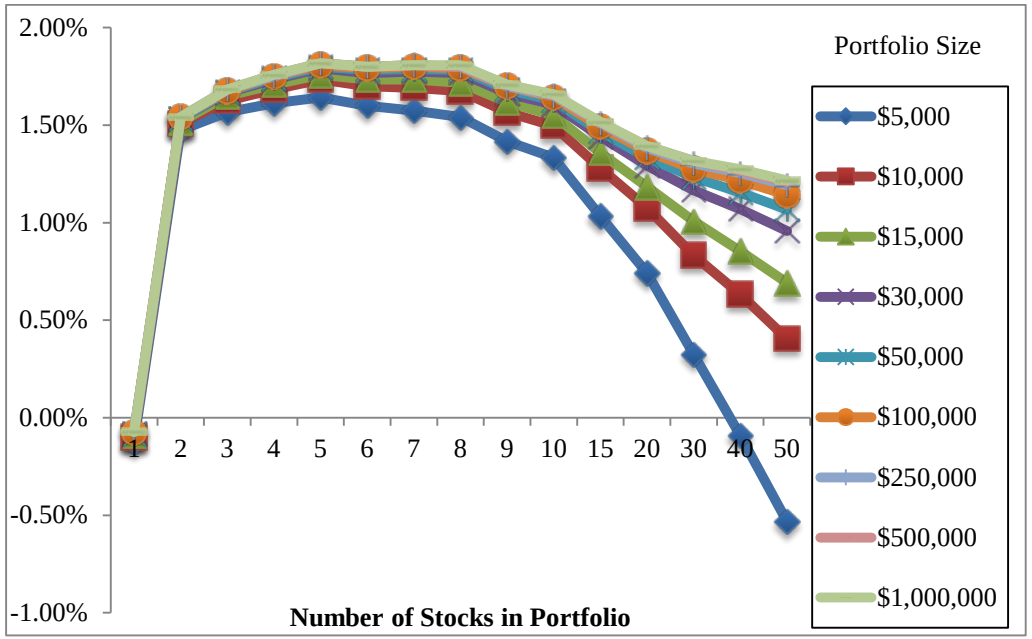
**Table 5: Fama French Three Factor Model - Monthly Alpha "α" (in %)**

| 1X Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 15 | 20 | 30 | 40 | 50 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **$5,000** | -0.13 | 1.48*** | 1.57*** | 1.61*** | 1.64*** | 1.60*** | 1.58*** | 1.54*** | 1.42*** | 1.33*** | 1.03*** | 0.74*** | 0.33* | -0.09 | -0.53*** |
| **$10,000** | -0.10 | 1.51*** | 1.63*** | 1.68*** | 1.73*** | 1.70*** | 1.69*** | 1.68*** | 1.57*** | 1.50*** | 1.28*** | 1.08*** | 0.83*** | 0.63*** | 0.41*** |
| **$15,000** | -0.09 | 1.52*** | 1.65*** | 1.71*** | 1.76*** | 1.73*** | 1.73*** | 1.72*** | 1.62*** | 1.55*** | 1.36*** | 1.18*** | 1.01*** | 0.85*** | 0.69*** |
| **$30,000** | -0.08 | 1.53*** | 1.67*** | 1.73*** | 1.79*** | 1.77*** | 1.78*** | 1.77*** | 1.66*** | 1.60*** | 1.44*** | 1.29*** | 1.17*** | 1.07*** | 0.96*** |
| **$50,000** | -0.08 | 1.53*** | 1.67*** | 1.74*** | 1.80*** | 1.78*** | 1.79*** | 1.78*** | 1.6(*** | 1.63*** | 1.47*** | 1.33*** | 1.23*** | 1.15*** | 1.07*** |
| **$100,000** | -0.08 | 1.54*** | 1.68*** | 1.75*** | 1.81*** | 1.79*** | 1.80*** | 1.79*** | 1.70*** | 1.64*** | 1.49*** | 1.37*** | 1.28*** | 1.22*** | 1.14*** |
| **$250,000** | -0.07 | 1.54*** | 1.68*** | 1.75*** | 1.82*** | 1.80*** | 1.81*** | 1.80*** | 1.70*** | 1.65*** | 1.51*** | 1.38*** | 1.30*** | 1.25*** | 1.19*** |
| **$500,000** | -0.07 | 1.54*** | 1.68*** | 1.76*** | 1.82*** | 1.80*** | 1.81*** | 1.80*** | 1.71*** | 1.65*** | 1.51*** | 1.39*** | 1.32*** | 1.27*** | 1.21*** |
| **$1,000,000** | -0.07 | 1.54*** | 1.68*** | 1.76*** | 1.82*** | 1.80*** | 1.81*** | 1.81*** | 1.71*** | 1.66*** | 1.52*** | 1.39*** | 1.32*** | 1.28*** | 1.22*** |

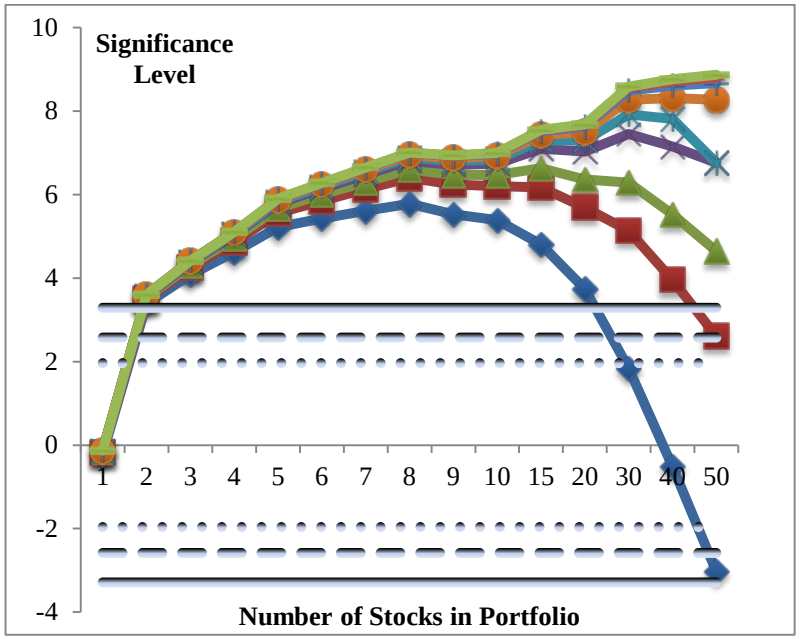
* 10% statistical significance, ** 5% statistical significance, *** 1% statistical significance

For the Fama-French three factor model, the following regression was used: Nr-Rf= β(Km-Rf )+bs*SMB+ bv*HML+ α, where "Rf" is the yearly risk-free rate, high minus low book to market ratio (HML) and small minus big (SMB) data are from Kenneth French's Data Library. Similar to the capital asset pricing model, we use "Nr" to signify the net monthly real turnover portfolio returns and "Km" to signify the performance of the S&P 500.

**Monthly Alpha "α"**




**Statistical Significance (Newey-West Estimator, 11-Month Lag)**



## 4. Overlapping Momentum Trading Strategies

Tables 1 to 3 show that noticeably higher average returns were observed in the smaller portfolios consisting of the top two to ten stocks, compared to the portfolios with 15 to 50 stocks. However, these increased returns coincide with a higher variance of returns. To reduce the volatility of the portfolio returns, the remainder of the analysis applies six different trading frequencies for each portfolio, varying from once per year up to monthly. This strategy was implemented in order to investigate whether the additional trading frequencies could decrease the volatility of the portfolio returns, while maintaining the larger returns seen in the smaller portfolios after factoring in transaction costs. In addition to the once per year strategy, we explore bi-yearly, tri-yearly, quarterly, bi-monthly, and monthly trading frequencies in order to observe the effects of each trading frequency on their respective portfolios.

An investor trying to decide how much he should buy of each stock when using an overlapping strategy would first need to equally divide his initial investment by the number of times he wants to trade each year, that is, his trading frequency. Then, he would equally divide that amount by the number of stocks he would like in his portfolio. The equation of buying power, *BP*, for each stock in dollars, is:

$$BP = (A/t) / k \tag{4}$$

Where $A$ is the initial investment amount, $k$ is the number of stocks in the portfolio, and $t$ is the trading frequency per year.

For example, if an investor with an initial investment amount of $50,000 would like to buy the top five stocks on a quarterly frequency, he would have a buying power of $2,500 for each stock in the portfolio. Hypothetically, this investor would initially buy $12,500 ($2,500 of each of the top five performing stocks of the previous six months) on January 1 and hold these

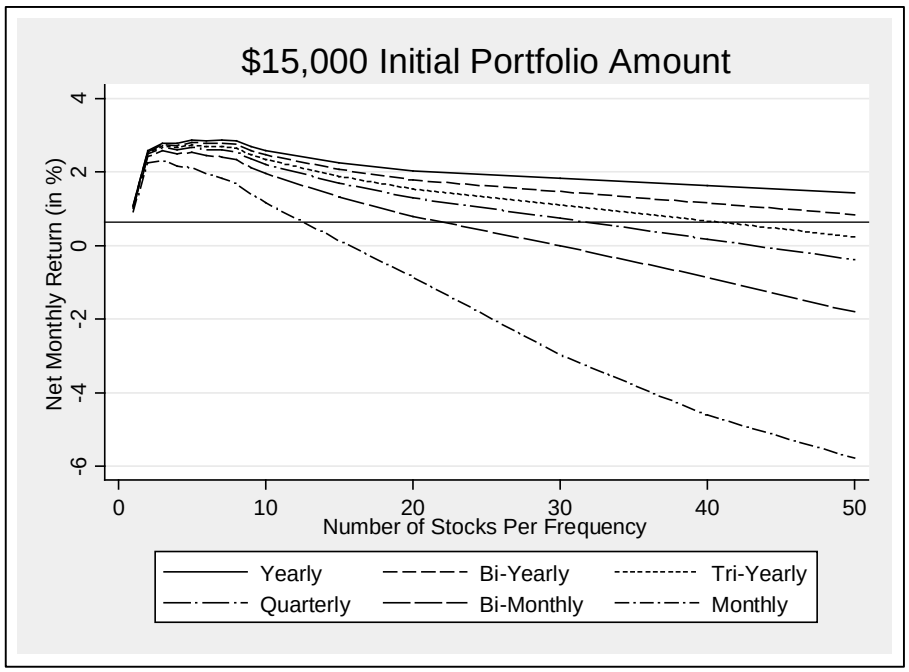
stocks until December 31. He would repeat the process on April 1, July 1, and October 1 and hold the respective portfolios for 12 months (thus selling on March 31, June 30, and September 30, respectively). In the following year, he would sell each portfolio at the end of each quarter and use the proceeds to buy the new portfolio. Once the strategy is fully established, this individual will have up to 20 different stocks in his portfolio at any given time.[17]

This increase in stock holdings reduces the volatility of the overall portfolio returns while enabling the investor to continue to enjoy the higher returns generated by the top five performing stock portfolio.[18] On the other hand, the increased trading frequency dramatically increases trading costs. In the following sections, we analyze whether the benefits of decreased volatility, particularly in the smaller portfolios, outweigh the negative effects of these increased trading costs.

The effects of trading frequency on net monthly performance of the portfolio largely depends on the initial amount in the portfolio. Unsurprisingly, portfolios with a $5,000 initial investment were affected the most by the increased trading frequency, while the million dollar portfolios were barely affected, decreasing from 2.96% per month traded yearly to 2.95% traded monthly. As the trading frequency increases, the best performing portfolios remain in the top five to eight stocks for all portfolios with an initial amount of $100,000 or more. The smaller portfolios, which are more affected by the extra trading costs, post the highest performance in the smaller (top two to five) stock portfolios as frequency increases. Figure 1 shows an example of the effects of various frequencies on net returns in a portfolio with an initial investment of $15,000. The effects for all portfolios can be found in Appendix 1.

[17] On the other hand, the investor could theoretically have a minimum of five different stocks in the portfolio at any given time, if the same top performers remain in the "winner portfolio" each quarter.
[18] This strategy would be compared to buying the top 20 performing stocks once a year.

**Figure 1: Net Monthly Momentum Returns After Transaction Costs (%)** Real Turnover Returns Based on Various Trading Frequencies. This figure shows the returns of a portfolio with an initial value of $15,000. The remaining initial portfolio amounts can be found in Appendix 1.




Next, we again apply the CAPM and Fama-French three-factor model to all trading frequencies in order to examine the effects on the monthly alphas. Appendices 2 and 3 show the monthly alphas in the CAPM and the Fama-French three-factor model for each trading frequency. There are some slight decreases in alpha as the trading frequency increases. However, most of these strategies maintain a statistically significant positive alpha.

Up to this point in the analysis, we have observed that excess returns exist in many of these portfolios after factoring in costs and systematic risk. However, most individual investors are less concerned with beta risk than they are with volatility risk. We maintain that increasing trading frequencies will decrease the volatility of the returns as well as the idiosyncratic risk of the portfolio. Therefore, this section determines the optimal trading frequency for each initial investment amount based on the highest abnormal Sharpe ratio compared to the benchmark.

To analyze idiosyncratic risks, Sharpe ratios for each portfolio were computed and compared against the benchmark's Sharpe ratio in order to determine the optimal trading frequency for each initial portfolio amount. The Sharpe ratio equation is:

$$Sharpe_i = \frac{Nr_i - R_f}{\sigma_i} \quad (5)$$

using the aforementioned net monthly real turnover returns "*Nr*", "*Rf*" as the risk free rate, and "σ" as the standard deviation of the portfolio returns.

**Figure 2: Abnormal Monthly Sharpe Ratios** Compared to the S&P 500 Benchmark. This figure shows the abnormal ratios of a portfolio with an initial value of $30,000 for different trading frequencies.

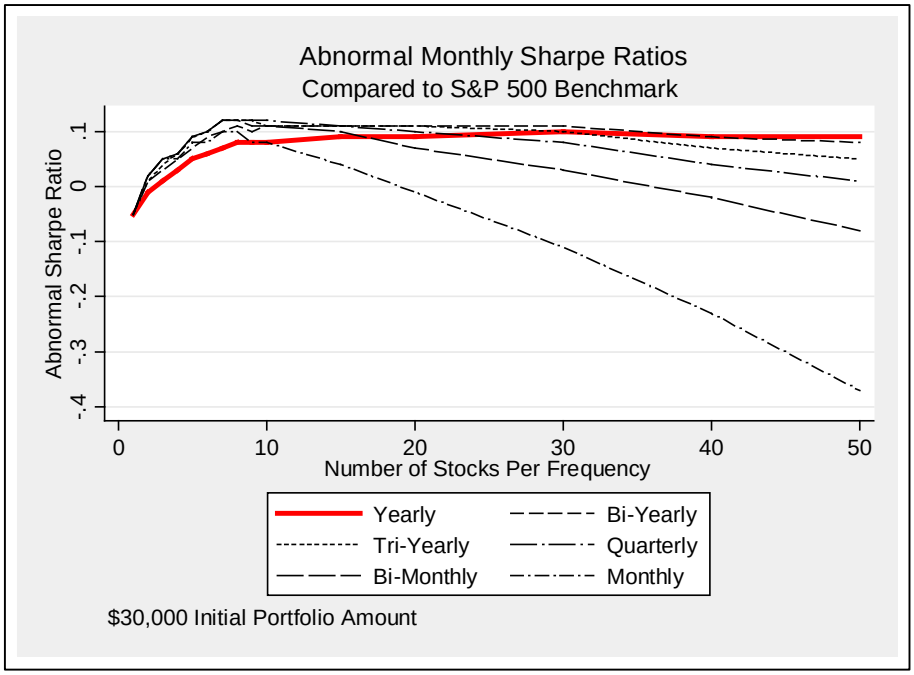



Figure 2 displays the abnormal monthly Sharpe ratios for each trading frequency compared to the S&P 500 benchmark for a portfolio with an initial value of $30,000.[19] The results indicate that for all initial investment amounts with portfolios containing the top four to ten best performing stocks, the abnormal Sharpe ratio increases as the trading frequency increases (statistically significantly) from yearly to bi-yearly.[20] This provides some initial evidence that

[19] Again, replacing the S&P 500 with the Willshire 5000 as the benchmark makes no qualitative difference in the analysis.
[20] Abnormal Sharpe ratios for all portfolios are displayed in Appendix 4.

as trading frequency increases, portfolio volatility decreases at a faster pace than performance. At this point, the abnormal Sharpe ratios reach a peak and then begin to fall as the higher transaction costs reduce performance at a faster rate than the rate of volatility reduction. Therefore, the optimal trading frequency is largely dependent on the initial investment amount. For example, abnormal Sharpe ratios for smaller initial investments of $10,000 and $15,000 begin to decrease more quickly (between tri-yearly and quarterly trading), while abnormal Sharpe ratios continue to increase up to monthly trading for the larger initial investments of $250,000, $500,000, and $1,000,000. In robustness tests, we find similar patterns in both sub-periods for all initial investment amounts.[21]

Table 6 outlines the optimal trading frequency for each initial investment amount based on the highest statistically significant abnormal Sharpe ratios for the top five to eight performing stock portfolio. It is worth noting that all portfolios have a positive and statistically significant monthly alpha in the CAPM and Fama-French three-factor model. With the exception of only a small overlap of CAPM and Fama-French alphas in the $5,000 portfolio, we find evidence in all other portfolios analyzed that overlapping portfolios provide higher net returns and alphas compared to non-overlapping strategies with a similar number of stocks in the portfolio.

[21] These results are not shown, but are available on request.

**Table 6: Comparing Overlapping Portfolios to the Yearly Trading Strategy, by Initial Portfolio Amount.** The frequencies for each portfolio are based on the highest statistically significant abnormal Sharpe ratios of the top five to eight performing stocks.

| | | Overlapping Portfolios | | | Yearly Strategy | | | |
|---|---|---|---|---|---|---|---|---|
| **Amount** | **Frequency** | **Net Return** | **CAPM α** | **FF3F α** | **Max # Stocks** | **Net Return** | **CAPM α** | **FF3F α** |
| $5,000 | Bi-Yearly | 2.35%-2.54% | 1.29-1.38 | 1.26-1.46 | 10-16 (10-15) | 1.89%-2.35% | 1.00-1.33 | 1.03-1.33 |
| $10,000 | Tri-Yearly | 2.50%-2.64% | 1.43-1.47 | 1.41-1.56 | 15-24 (15-30) | 1.65%-2.17% | 0.83-1.25 | 0.83-1.28 |
| $15,000 | Tri-Yearly | 2.66%-2.74% | 1.56-1.58 | 1.54-1.64 | 15-24 (15-30) | 1.83%-2.26% | 1.00-1.33 | 1.01-1.36 |
| $30,000 | Quarterly | 2.76%-2.81% | 1.62-1.67 | 1.63-1.70 | 20-32 (20-30) | 2.01%-2.15% | 1.16-1.27 | 1.17-1.29 |
| $50,000 | Quarterly | 2.84%-2.86% | 1.67-1.73 | 1.70-1.75 | 20-32 (20-30) | 2.08%-2.20% | 1.23-1.31 | 1.23-1.33 |
| $100,000 | Bi-Monthly | 2.87%-2.88% | 1.68-1.75 | 1.73-1.77 | 30-48 (30-50) | 1.95%-2.14% | 1.13-1.27 | 1.14-1.28 |
| $250,000 | Monthly | 2.89%-2.90% | 1.69-1.77 | 1.74-1.78 | 60-96 (50) | 2.00% | 1.18 | 1.19 |
| $500,000 | Monthly | 2.92%-2.93% | 1.72-1.80 | 1.78-1.80 | 60-96 (50) | 2.02% | 1.20 | 1.21 |
| $1,000,000 | Monthly | 2.92%-2.95% | 1.73-1.81 | 1.79-1.81 | 60-96 (50) | 2.03% | 1.20 | 1.22 |

* Maximum number of stocks at any given time in a portfolio. The numbers in parentheses are the available portfolio sizes used in this analysis to compare the results of the yearly trading frequency. Net monthly returns of the real turnover portfolios are provided.
Note: All CAPM and FF3F α's in this table are significant at the 99% confidence level

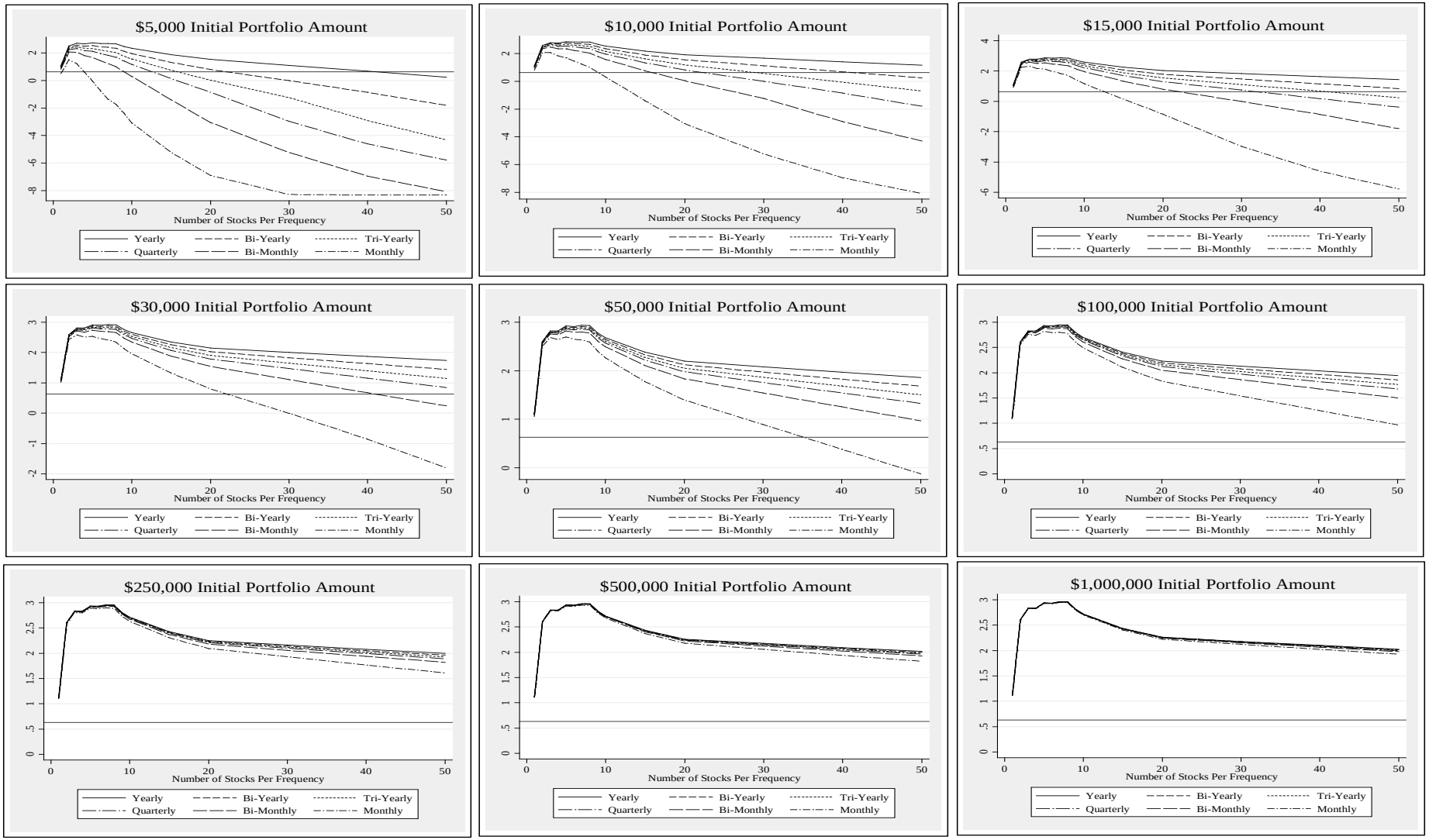
## 5. Conclusion

This paper offers a simplified trading strategy for earning excess returns from top-side momentum (i.e., buying only previously top performing stocks). Consistent with the U.K. data employed by Siganos (2010), we find that it is indeed possible for individuals with initial investment amounts of at least $5,000 to achieve profitability. After factoring in transaction costs and risks, the highest returns and monthly alphas are obtained by buying the top five to eight of the top performing stocks of the previous six-month holding period. Furthermore, we find evidence that volatility decreases at a greater rate than performance as the trading frequency increases. We conclude that, depending on the initial investment of the portfolio, the optimal momentum trading frequency ranges from bi-yearly to monthly.

These findings provide a practical solution for individual investors looking for simple trading strategies that generate excess returns. Moreover, we believe that more work can be done on this topic, particularly in regard to effective "exit" trading strategies, such as stop losses and

trailing stop losses, to achieve higher performance and less volatility, or by combining the momentum portfolios mentioned in this paper with index funds in order to more optimally diversify while still benefiting from the abnormal returns and positive alpha of the small "winner" portfolios.

**Appendix 1: Net Monthly Momentum Returns After Transaction Costs (%)** Real Turnover Returns Based on Various Trading Frequencies and Initial Portfolio Amounts.



**Appendix 2: Capital Asset Pricing Model - Monthly Alpha "α" (in %) by Trading Frequency**

| 1X Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 15 | 20 | 30 | 40 | 50 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **$5,000** | -0.06 | 1.30*** | 1.52*** | 1.50*** | 1.56*** | 1.56*** | 1.58*** | 1.57*** | 1.43*** | 1.33*** | 1.00*** | 0.72*** | 0.32* | -0.11 | -0.54*** |
| **$10,000** | -0.03 | 1.34*** | 1.57*** | 1.58*** | 1.65*** | 1.67*** | 1.70*** | 1.7*** | 1.58*** | 1.50*** | 1.25*** | 1.05*** | 0.83*** | 0.61*** | 0.39** |
| **$15,000** | -0.02 | 1.35*** | 1.58*** | 1.60*** | 1.68*** | 1.70*** | 1.74*** | 1.74*** | 1.63*** | 1.55*** | 1.33*** | 1.16*** | 1.00*** | 0.83*** | 0.68*** |
| **$30,000** | -0.02 | 1.37*** | 1.61*** | 1.63*** | 1.71*** | 1.73*** | 1.78*** | 1.78*** | 1.68*** | 1.61*** | 1.41*** | 1.27*** | 1.16*** | 1.05*** | 1.06*** |
| **$50,000** | -0.01 | 1.38*** | 1.62*** | 1.63*** | 1.72*** | 1.75*** | 1.80*** | 1.80*** | 1.69*** | 1.63*** | 1.44*** | 1.31*** | 1.23*** | 1.13*** | 1.06*** |
| **$100,000** | -0.01 | 1.38*** | 1.62*** | 1.64*** | 1.73*** | 1.76*** | 1.81*** | 1.82*** | 1.71*** | 1.64*** | 1.47*** | 1.34*** | 1.27*** | 1.19*** | 1.13*** |
| **$250,000** | 0.00 | 1.38*** | 1.63*** | 1.64*** | 1.73*** | 1.76*** | 1.82*** | 1.82*** | 1.72*** | 1.65*** | 1.48*** | 1.36*** | 1.30*** | 1.23*** | 1.18*** |
| **$500,000** | 0.00 | 1.38*** | 1.63*** | 1.64*** | 1.69*** | 1.76*** | 1.82*** | 1.83*** | 1.72*** | 1.66*** | 1.48*** | 1.36*** | 1.31*** | 1.24*** | 1.20*** |
| **$1,000,000** | 0.00 | 1.38*** | 1.63*** | 1.65*** | 1.73*** | 1.77*** | 1.82*** | 1.83*** | 1.73*** | 1.66*** | 1.48*** | 1.37*** | 1.31*** | 1.25*** | 1.20*** |

* 10% statistical significance, ** 5% statistical significance, *** 1% statistical significance.
To control for the autocorrelation of the overlapping data, the Newey-West (1987) estimator with an 11-month lag was applied.

We use: Nr - Rf = β(Km - Rf) + α, where "Rf" is the risk-free rate from French's Data Library, "Nr" is the net monthly real turnover portfolio returns, and "Km" is the performance of the S&P 500.

| 2X Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 15 | 20 | 30 | 40 | 50 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **$5,000** | -0.11 | 1.23*** | 1.40*** | 1.35*** | 1.38*** | 1.35*** | 1.34*** | 1.29*** | 1.12*** | 0.98*** | 0.47** | -0.02 | -0.88*** | -1.94*** | -4.61*** |
| **$10,000** | -0.06 | 1.30*** | 1.52*** | 1.50*** | 1.56*** | 1.57*** | 1.58*** | 1.57*** | 1.43*** | 1.33*** | 1.00*** | 0.72*** | 0.32** | -0.11*** | -0.54** |
| **$15,000** | -0.04 | 1.33*** | 1.55*** | 1.55*** | 1.62*** | 1.63*** | 1.67*** | 1.66*** | 1.53*** | 1.44*** | 1.17*** | 0.94*** | 0.67*** | 0.38*** | 0.10 |
| **$30,000** | -0.03 | 1.35*** | 1.59*** | 1.60*** | 1.68*** | 1.70*** | 1.74*** | 1.74*** | 1.63*** | 1.55*** | 1.33*** | 1.16*** | 1.00*** | 0.83*** | 0.90*** |
| **$50,000** | -0.02 | 1.37*** | 1.60*** | 1.62*** | 1.70*** | 1.73*** | 1.78*** | 1.78*** | 1.67*** | 1.59*** | 1.39*** | 1.24*** | 1.13*** | 1.01*** | 0.90*** |
| **$100,000** | -0.01 | 1.38*** | 1.62*** | 1.63*** | 1.72*** | 1.75*** | 1.80*** | 1.80*** | 1.69*** | 1.63*** | 1.44*** | 1.31*** | 1.23*** | 1.13*** | 1.06*** |
| **$250,000** | -0.01 | 1.38*** | 1.62*** | 1.64*** | 1.73*** | 1.76*** | 1.81*** | 1.82*** | 1.71*** | 1.65*** | 1.47*** | 1.34*** | 1.28*** | 1.21*** | 1.15*** |
| **$500,000** | -0.01 | 1.38*** | 1.63*** | 1.64*** | 1.73*** | 1.76*** | 1.82*** | 1.83*** | 1.72*** | 1.65*** | 1.48*** | 1.36*** | 1.30*** | 1.23*** | 1.18*** |
| **$1,000,000** | 0.00 | 1.38*** | 1.63*** | 1.64*** | 1.73*** | 1.77*** | 1.82*** | 1.83*** | 1.72*** | 1.66*** | 1.48*** | 1.36*** | 1.31*** | 1.24*** | 1.20*** |
| **3X Year** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **15** | **20** | **30** | **40** | **50** |
| **$5,000** | -0.16 | 1.14*** | 1.28*** | 1.20*** | 1.19*** | 1.13*** | 1.08*** | 0.99*** | 0.79*** | 0.61*** | -0.13 | -0.88*** | -2.58*** | -3.07*** | -3.58*** |
| **$10,000** | -0.08 | 1.26*** | 1.46*** | 1.43*** | 1.47*** | 1.46*** | 1.47*** | 1.43*** | 1.28*** | 1.16*** | 0.74*** | 0.36*** | -0.24 | -0.93*** | -1.68*** |
| **$15,000** | -0.06 | 1.30*** | 1.52*** | 1.50*** | 1.56*** | 1.57*** | 1.58*** | 1.57*** | 1.43*** | 1.33*** | 1.00*** | 0.72*** | 0.32** | -0.11 | -0.54*** |
| **$30,000** | -0.03 | 1.34*** | 1.57*** | 1.58*** | 1.65*** | 1.67*** | 1.70*** | 1.70*** | 1.58*** | 1.50*** | 1.25*** | 1.05*** | 0.83*** | 0.61*** | 0.40*** |
| **$50,000** | -0.02 | 1.36*** | 1.59*** | 1.61*** | 1.68*** | 1.71*** | 1.75*** | 1.75*** | 1.63*** | 1.57*** | 1.34*** | 1.18*** | 1.03*** | 0.88*** | 0.73*** |
| **$100,000** | -0.01 | 1.37*** | 1.61*** | 1.63*** | 1.71*** | 1.73*** | 1.78*** | 1.79*** | 1.68*** | 1.61*** | 1.42*** | 1.28*** | 1.18*** | 1.07*** | 0.98*** |
| **$250,000** | -0.01 | 1.38*** | 1.62*** | 1.64*** | 1.73*** | 1.76*** | 1.81*** | 1.81*** | 1.71*** | 1.64*** | 1.46*** | 1.33*** | 1.26*** | 1.18*** | 1.12*** |
| **$500,000** | -0.01 | 1.38*** | 1.63*** | 1.64*** | 1.73*** | 1.76*** | 1.81*** | 1.82*** | 1.72*** | 1.65*** | 1.48*** | 1.35*** | 1.28*** | 1.22*** | 1.17*** |
| **$1,000,000** | 0.00 | 1.38*** | 1.63*** | 1.64*** | 1.73*** | 1.77*** | 1.82*** | 1.83*** | 1.72*** | 1.65*** | 1.48*** | 1.36*** | 1.30*** | 1.24*** | 1.19*** |
| **4X Year** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **15** | **20** | **30** | **40** | **50** |
| **$5,000** | -0.22 | 1.06*** | 1.17*** | 1.03*** | 0.99*** | 0.89*** | 0.80*** | 0.68*** | 0.43** | 0.21 | -0.82*** | -1.74*** | -3.13*** | -4.26*** | -4.73*** |
| **$10,000** | -0.11 | 1.23*** | 1.40*** | 1.35*** | 1.38*** | 1.35*** | 1.34*** | 1.29*** | 1.12*** | 0.98*** | 0.47** | -0.02 | -0.87*** | -1.93*** | -2.83** |
| **$15,000** | -0.07 | 1.28*** | 1.48*** | 1.45*** | 1.50*** | 1.49*** | 1.51*** | 1.48*** | 1.33*** | 1.22*** | 0.83*** | 0.48*** | -0.04 | -0.64*** | -1.27*** |
| **$30,000** | -0.04 | 1.33*** | 1.55*** | 1.55*** | 1.62*** | 1.63*** | 1.67*** | 1.66*** | 1.53*** | 1.44*** | 1.17*** | 0.94*** | 0.67*** | 0.38*** | 0.08 |
| **$50,000** | -0.02 | 1.35*** | 1.58*** | 1.59*** | 1.67*** | 1.68*** | 1.73*** | 1.73*** | 1.61*** | 1.53*** | 1.30*** | 1.12*** | 0.93*** | 0.74*** | 0.57*** |
| **$100,000** | -0.01 | 1.37*** | 1.60*** | 1.62*** | 1.70*** | 1.73*** | 1.78*** | 1.78*** | 1.67*** | 1.59*** | 1.39*** | 1.24*** | 1.13*** | 1.01*** | 0.90*** |
| **$250,000** | -0.01 | 1.38*** | 1.62*** | 1.63*** | 1.73*** | 1.75*** | 1.80*** | 1.81*** | 1.70*** | 1.63*** | 1.45*** | 1.32*** | 1.24*** | 1.16*** | 1.09*** |
| **$500,000** | -0.01 | 1.38*** | 1.63*** | 1.64*** | 1.73*** | 1.76*** | 1.82*** | 1.82*** | 1.71*** | 1.65*** | 1.47*** | 1.34*** | 1.28*** | 1.21*** | 1.15*** |
| **$1,000,000** | 0.00 | 1.38*** | 1.63*** | 1.64*** | 1.73*** | 1.77*** | 1.82*** | 1.83*** | 1.72*** | 1.65*** | 1.48*** | 1.36*** | 1.30*** | 1.23*** | 1.18*** |
| **6X Year** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **15** | **20** | **30** | **40** | **50** |
| **$5,000** | -0.33 | 0.88** | 0.92** | 0.69** | 0.55* | 0.36 | 0.14 | -0.09 | -0.43 | -0.79*** | -2.64*** | -2.74*** | -4.68*** | -6.50*** | -8.06*** |
| **$10,000** | -0.16 | 1.14*** | 1.28*** | 1.20*** | 1.19*** | 1.13*** | 1.08*** | 0.99*** | 0.79*** | 0.61** | -0.13 | -0.88*** | -2.58*** | -3.07*** | -3.55*** |
| **$15,000** | -0.11 | 1.22*** | 1.40*** | 1.35*** | 1.38*** | 1.35*** | 1.34*** | 1.29*** | 1.12*** | 0.98*** | 0.47*** | 0.14 | -0.02 | -0.87*** | -1.94*** |
| **$30,000** | -0.06 | 1.30*** | 1.52*** | 1.50*** | 1.56*** | 1.57*** | 1.58*** | 1.57*** | 1.43*** | 1.33*** | 1.00*** | 0.71*** | 0.32** | -0.11 | -0.90*** |
| **$50,000** | -0.03 | 1.33*** | 1.56*** | 1.56*** | 1.63*** | 1.64*** | 1.68*** | 1.68*** | 1.55*** | 1.47*** | 1.20*** | 0.98*** | 0.73*** | 0.47*** | 0.22* |
| **$100,000** | -0.02 | 1.36*** | 1.59*** | 1.61*** | 1.68*** | 1.71*** | 1.75*** | 1.75*** | 1.63*** | 1.57*** | 1.34*** | 1.18*** | 1.03*** | 0.88*** | 0.73*** |
| **$250,000** | -0.01 | 1.37*** | 1.61*** | 1.63*** | 1.72*** | 1.74*** | 1.79*** | 1.80*** | 1.69*** | 1.62*** | 1.43*** | 1.29*** | 1.20*** | 1.11*** | 1.03*** |
| **$500,000** | -0.01 | 1.38*** | 1.62*** | 1.64*** | 1.73*** | 1.76*** | 1.81*** | 1.81*** | 1.71*** | 1.64*** | 1.46*** | 1.33*** | 1.26*** | 1.18*** | 1.12*** |
| **$1,000,000** | -0.01 | 1.38*** | 1.63*** | 1.64*** | 1.73*** | 1.76*** | 1.81*** | 1.82*** | 1.72*** | 1.65*** | 1.48*** | 1.35*** | 1.28*** | 1.22*** | 1.17*** |
| **12X Year** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **15** | **20** | **30** | **40** | **50** |
| **$5,000** | -0.68 | 0.32 | 0.00 | -0.68* | -1.44*** | -1.91*** | -2.16*** | -2.68*** | -3.71*** | -4.49*** | -8.41*** | -14.61*** | -31.28*** | -36.65*** | -37.31*** |
| **$10,000** | -0.33 | 0.88** | 0.92*** | 0.69** | 0.55* | 0.37 | 0.14 | -0.09 | -0.43 | -0.79*** | -2.67*** | -4.66*** | -8.66*** | -24.99*** | -28.41*** |
| **$15,000** | -0.22 | 1.06*** | 1.17*** | 1.03*** | 0.99*** | 0.89*** | 0.80*** | 0.68*** | 0.43* | 0.21 | -0.82*** | -1.91*** | -4.66*** | -7.28*** | -10.33*** |
| **$30,000** | -0.11 | 1.23*** | 1.40*** | 1.35*** | 1.38*** | 1.35*** | 1.34*** | 1.29*** | 1.12*** | 0.98*** | 0.47** | -0.02 | -0.88*** | -1.93*** | -2.88*** |
| **$50,000** | -0.07 | 1.28*** | 1.49*** | 1.48*** | 1.53*** | 1.53*** | 1.53*** | 1.51*** | 1.37*** | 1.27*** | 0.90*** | 0.58*** | 0.10 | -0.42*** | -1.00*** |
| **$100,000** | -0.03 | 1.33*** | 1.56*** | 1.56*** | 1.63*** | 1.64*** | 1.68*** | 1.68*** | 1.55*** | 1.47*** | 1.20*** | 0.98*** | 0.73*** | 0.48*** | 0.22* |
| **$250,000** | -0.02 | 1.36*** | 1.60*** | 1.62*** | 1.69*** | 1.72*** | 1.77*** | 1.77*** | 1.66*** | 1.58*** | 1.38*** | 1.22*** | 1.09*** | 0.96*** | 0.83*** |
| **$500,000** | -0.01 | 1.37*** | 1.61*** | 1.63*** | 1.72*** | 1.74*** | 1.79*** | 1.80*** | 1.69*** | 1.62*** | 1.43*** | 1.29*** | 1.20*** | 1.11*** | 1.03*** |
| **$1,000,000** | -0.01 | 1.38*** | 1.62*** | 1.64*** | 1.73*** | 1.76*** | 1.81*** | 1.81*** | 1.71*** | 1.64*** | 1.46*** | 1.33*** | 1.26*** | 1.18*** | 1.12*** |

**Appendix 3: Fama French Three -Factor Model - Monthly Alpha "α" (in %)**

| 1X Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 15 | 20 | 30 | 40 | 50 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **$5,000** | -0.13 | 1.48 *** | 1.57 *** | 1.61 *** | 1.64 *** | 1.59 *** | 1.58 *** | 1.54 *** | 1.41 *** | 1.33 *** | 1.03 *** | 0.74 *** | 0.33 | -0.09 | -0.54 ** |
| **$10,000** | -0.10 | 1.50 *** | 1.63 *** | 1.68 *** | 1.73 *** | 1.70 *** | 1.69 *** | 1.68 *** | 1.57 *** | 1.49 *** | 1.28 *** | 1.08 *** | 0.83 *** | 0.63 *** | 0.40 ** |
| **$15,000** | -0.09 | 1.52 *** | 1.64 *** | 1.71 *** | 1.76 *** | 1.73 *** | 1.73 *** | 1.72 *** | 1.61 *** | 1.55 *** | 1.36 *** | 1.18 *** | 1.01 *** | 0.85 *** | 0.68 *** |
| **$30,000** | -0.08 | 1.53 *** | 1.66 *** | 1.73 *** | 1.79 *** | 1.77 *** | 1.77 *** | 1.76 *** | 1.66 *** | 1.60 *** | 1.43 *** | 1.29 *** | 1.17 *** | 1.07 *** | 0.96 *** |
| **$50,000** | -0.08 | 1.53 *** | 1.67 *** | 1.68 *** | 1.80 *** | 1.78 *** | 1.78 *** | 1.78 *** | 1.68 *** | 1.63 *** | 1.47 *** | 1.33 *** | 1.23 *** | 1.15 *** | 0.96 *** |
| **$100,000** | -0.08 | 1.54 *** | 1.68 *** | 1.75 *** | 1.81 *** | 1.79 *** | 1.80 *** | 1.79 *** | 1.69 *** | 1.64 *** | 1.49 *** | 1.36 *** | 1.28 *** | 1.22 *** | 1.14 *** |
| **$250,000** | -0.08 | 1.54 *** | 1.68 *** | 1.75 *** | 1.82 *** | 1.79 *** | 1.80 *** | 1.80 *** | 1.70 *** | 1.65 *** | 1.51 *** | 1.38 *** | 1.30 *** | 1.25 *** | 1.18 *** |
| **$500,000** | -0.08 | 1.54 *** | 1.68 *** | 1.75 *** | 1.82 *** | 1.80 *** | 1.81 *** | 1.80 *** | 1.71 *** | 1.65 *** | 1.51 *** | 1.38 *** | 1.31 *** | 1.26 *** | 1.20 *** |
| **$1,000,000** | -0.08 | 1.54 *** | 1.68 *** | 1.75 *** | 1.82 *** | 1.80 *** | 1.81 *** | 1.80 *** | 1.71 *** | 1.65 *** | 1.52 *** | 1.47 *** | 1.32 *** | 1.27 *** | 1.21 *** |

* 10% statistical significance, ** 5% statistical significance, *** 1% statistical significance

For the Fama French three-factor model, the following regression was used: Nr-Rf= β(Km-Rf )+bs*SMB+ bv*HML+ α, where "Rf" is the yearly risk.free rate. The high minus low book to market ratio (HML) and small minus big (SMB) data are from Kenneth French's Data Library. Similar to the capital asset pricing model, we use "Nr" to signify the net monthly real turnover portfolio returns and "Km" to signify the performance of the S&P 500.

**Trading Frequency**

| 2X Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 15 | 20 | 30 | 40 | 50 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **$5,000** | -0.18 | 1.38 *** | 1.46 *** | 1.47 *** | 1.46 *** | 1.38 *** | 1.33 *** | 1.26 *** | 1.11 *** | 0.98 *** | 0.50 ** | 0.02 | -0.87 *** | -1.91 *** | -2.82 *** |
| **$10,000** | -0.13 | 1.47 *** | 1.58 *** | 1.62 *** | 1.64 *** | 1.60 *** | 1.58 *** | 1.54 *** | 1.42 *** | 1.33 *** | 1.03 *** | 0.74 *** | 0.33 * | -0.08 | -0.53 *** |
| **$15,000** | -0.11 | 1.49 *** | 1.61 *** | 1.66 *** | 1.70 *** | 1.67 *** | 1.66 *** | 1.63 *** | 1.52 *** | 1.44 *** | 1.20 *** | 0.97 *** | 0.68 *** | 0.40 ** | 0.11 |
| **$30,000** | -0.09 | 1.52 *** | 1.65 *** | 1.71 *** | 1.76 *** | 1.73 *** | 1.73 *** | 1.72 *** | 1.62 *** | 1.55 *** | 1.36 *** | 1.18 *** | 1.01 *** | 0.86 *** | 0.69 *** |
| **$50,000** | -0.08 | 1.53 *** | 1.66 *** | 1.73 *** | 1.78 *** | 1.76 *** | 1.77 *** | 1.76 *** | 1.65 *** | 1.59 *** | 1.43 *** | 1.27 *** | 1.13 *** | 1.03 *** | 0.91 *** |
| **$100,000** | -0.08 | 1.53 *** | 1.68 *** | 1.74 *** | 1.80 *** | 1.78 *** | 1.79 *** | 1.78 *** | 1.68 *** | 1.63 *** | 1.47 *** | 1.33 *** | 1.23 *** | 1.15 *** | 1.07 *** |
| **$250,000** | -0.07 | 1.54 *** | 1.68 *** | 1.75 *** | 1.81 *** | 1.79 *** | 1.80 *** | 1.80 *** | 1.69 *** | 1.64 *** | 1.50 *** | 1.37 *** | 1.28 *** | 1.23 *** | 1.16 *** |
| **$500,000** | -0.07 | 1.54 *** | 1.68 *** | 1.75 *** | 1.82 *** | 1.80 *** | 1.81 *** | 1.80 *** | 1.71 *** | 1.65 *** | 1.51 *** | 1.38 *** | 1.30 *** | 1.25 *** | 1.19 *** |
| **$1,000,000** | -0.07 | 1.54 *** | 1.68 *** | 1.76 *** | 1.82 *** | 1.80 *** | 1.81 *** | 1.80 *** | 1.71 *** | 1.66 *** | 1.51 *** | 1.39 *** | 1.32 *** | 1.27 *** | 1.21 *** |
| **3X Year** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **15** | **20** | **30** | **40** | **50** |
| **$5,000** | -0.23 | 1.30 *** | 1.34 *** | 1.31 *** | 1.28 *** | 1.16 *** | 1.07 *** | 0.97 *** | 0.78 *** | 0.61 ** | -0.09 | -0.84 *** | -2.57 *** | -3.00 *** | -3.59 *** |
| **$10,000** | -0.15 | 1.43 *** | 1.52 *** | 1.54 *** | 1.56 *** | 1.49 *** | 1.46 *** | 1.41 *** | 1.27 *** | 1.16 *** | 0.77 *** | 0.39 * | -0.23 | -0.91 *** | -1.67 *** |
| **$15,000** | -0.13 | 1.47 *** | 1.58 *** | 1.62 *** | 1.64 *** | 1.60 *** | 1.58 *** | 1.54 *** | 1.42 *** | 1.33 *** | 1.03 *** | 0.74 *** | 0.33 * | -0.08 | -0.53 *** |
| **$30,000** | -0.10 | 1.51 *** | 1.63 *** | 1.68 *** | 1.73 *** | 1.70 *** | 1.69 *** | 1.68 *** | 1.57 *** | 1.50 *** | 1.28 *** | 1.08 *** | 0.84 *** | 0.63 *** | 0.41 ** |
| **$50,000** | -0.09 | 1.52 *** | 1.65 *** | 1.72 *** | 1.77 *** | 1.74 *** | 1.74 *** | 1.73 *** | 1.63 *** | 1.56 *** | 1.38 *** | 1.21 *** | 1.04 *** | 0.90 *** | 0.74 *** |
| **$100,000** | -0.08 | 1.53 *** | 1.67 *** | 1.73 *** | 1.79 *** | 1.78 *** | 1.78 *** | 1.77 *** | 1.67 *** | 1.61 *** | 1.45 *** | 1.30 *** | 1.18 *** | 1.09 *** | 0.99 *** |
| **$250,000** | -0.08 | 1.54 *** | 1.68 *** | 1.75 *** | 1.81 *** | 1.79 *** | 1.80 *** | 1.79 *** | 1.69 *** | 1.64 *** | 1.49 *** | 1.36 *** | 1.27 *** | 1.21 *** | 1.13 *** |
| **$500,000** | -0.07 | 1.54 *** | 1.68 *** | 1.75 *** | 1.82 *** | 1.79 *** | 1.81 *** | 1.80 *** | 1.70 *** | 1.65 *** | 1.50 *** | 1.38 *** | 1.29 *** | 1.24 *** | 1.18 *** |
| **$1,000,000** | -0.07 | 1.54 *** | 1.68 *** | 1.76 *** | 1.82 *** | 1.80 *** | 1.81 *** | 1.80 *** | 1.71 *** | 1.65 *** | 1.51 *** | 1.39 *** | 1.31 *** | 1.26 *** | 1.20 *** |
| **4X Year** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **15** | **20** | **30** | **40** | **50** |
| **$5,000** | -0.29 | 1.22 *** | 1.23 *** | 1.15 *** | 1.08 *** | 0.93 ** | 0.78 ** | 0.65 * | 0.41 | 0.20 | -0.78 ** | -1.75 *** | -2.94 *** | -4.16 *** | -6.28 *** |
| **$10,000** | -0.18 | 1.38 *** | 1.46 *** | 1.47 *** | 1.47 *** | 1.38 *** | 1.33 *** | 1.27 *** | 1.11 *** | 0.98 *** | 0.50 *** | 0.02 | -0.87 *** | -1.92 *** | -2.84 *** |
| **$15,000** | -0.14 | 1.44 *** | 1.53 *** | 1.57 *** | 1.58 *** | 1.53 *** | 1.49 *** | 1.45 *** | 1.32 *** | 1.22 *** | 0.86 *** | 0.51 ** | -0.04 | -0.62 *** | -1.26 *** |
| **$30,000** | -0.11 | 1.49 *** | 1.61 *** | 1.66 *** | 1.70 *** | 1.67 *** | 1.66 *** | 1.63 *** | 1.52 *** | 1.44 *** | 1.20 *** | 0.97 *** | 0.68 *** | 0.40 ** | 0.11 |
| **$50,000** | -0.08 | 1.52 *** | 1.64 *** | 1.70 *** | 1.75 *** | 1.73 *** | 1.72 *** | 1.70 *** | 1.59 *** | 1.53 *** | 1.33 *** | 1.14 *** | 0.94 *** | 0.77 *** | 0.58 *** |
| **$100,000** | -0.08 | 1.53 *** | 1.66 *** | 1.73 *** | 1.78 *** | 1.76 *** | 1.77 *** | 1.76 *** | 1.65 *** | 1.59 *** | 1.43 *** | 1.27 *** | 1.13 *** | 1.03 *** | 0.91 *** |
| **$250,000** | -0.08 | 1.54 *** | 1.68 *** | 1.74 *** | 1.81 *** | 1.78 *** | 1.79 *** | 1.78 *** | 1.68 *** | 1.63 *** | 1.48 *** | 1.35 *** | 1.25 *** | 1.18 *** | 1.10 *** |
| **$500,000** | -0.07 | 1.54 *** | 1.68 *** | 1.75 *** | 1.81 *** | 1.79 *** | 1.80 *** | 1.80 *** | 1.70 *** | 1.64 *** | 1.50 *** | 1.37 *** | 1.28 *** | 1.23 *** | 1.16 *** |
| **$1,000,000** | -0.07 | 1.54 *** | 1.68 *** | 1.75 *** | 1.82 *** | 1.80 *** | 1.81 *** | 1.80 *** | 1.71 *** | 1.65 *** | 1.51 *** | 1.38 *** | 1.31 *** | 1.25 *** | 1.19 *** |
| **6X Year** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **15** | **20** | **30** | **40** | **50** |
| **$5,000** | -0.40 | 1.05 ** | 0.98 ** | 0.80 * | 0.63 | 0.39 | 0.13 | -0.12 | -0.44 | -0.81 ** | -1.63 *** | -2.72 *** | -4.62 *** | -8.49 *** | -6.28 *** |
| **$10,000** | -0.23 | 1.30 *** | 1.34 *** | 1.31 *** | 1.28 *** | 1.16 *** | 1.07 *** | 0.97 *** | 0.78 ** | 0.61 ** | -0.09 | -0.92 *** | -2.56 *** | -3.00 *** | -3.58 *** |
| **$15,000** | -0.18 | 1.38 *** | 1.46 *** | 1.47 *** | 1.46 *** | 1.38 *** | 1.33 *** | 1.27 *** | 1.11 *** | 0.98 *** | 0.50 ** | 0.01 | -0.87 *** | -1.91 *** | -2.84 *** |
| **$30,000** | -0.13 | 1.47 *** | 1.58 *** | 1.62 *** | 1.64 *** | 1.60 *** | 1.58 *** | 1.54 *** | 1.42 *** | 1.33 *** | 1.03 *** | 0.74 *** | 0.33 * | -0.08 | -0.53 *** |
| **$50,000** | -0.10 | 1.50 *** | 1.62 *** | 1.68 *** | 1.72 *** | 1.68 *** | 1.68 *** | 1.65 *** | 1.53 *** | 1.47 *** | 1.23 *** | 1.02 *** | 0.74 *** | 0.49 *** | 0.23 *** |
| **$100,000** | -0.09 | 1.52 *** | 1.65 *** | 1.72 *** | 1.77 *** | 1.74 *** | 1.74 *** | 1.73 *** | 1.63 *** | 1.56 *** | 1.38 *** | 1.21 *** | 1.04 *** | 0.90 *** | 0.74 *** |
| **$250,000** | -0.08 | 1.53 *** | 1.67 *** | 1.74 *** | 1.80 *** | 1.78 *** | 1.78 *** | 1.78 *** | 1.67 *** | 1.62 *** | 1.46 *** | 1.32 *** | 1.21 *** | 1.13 *** | 1.03 *** |
| **$500,000** | -0.08 | 1.54 *** | 1.68 *** | 1.75 *** | 1.81 *** | 1.79 *** | 1.80 *** | 1.79 *** | 1.69 *** | 1.64 *** | 1.49 *** | 1.36 *** | 1.27 *** | 1.21 *** | 1.13 *** |
| **$1,000,000** | -0.07 | 1.54 *** | 1.68 *** | 1.75 *** | 1.82 *** | 1.79 *** | 1.81 *** | 1.80 *** | 1.70 *** | 1.65 *** | 1.50 *** | 1.38 *** | 1.29 *** | 1.24 *** | 1.18 *** |
| **12X Year** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **15** | **20** | **30** | **40** | **50** |
| **$5,000** | -0.75 | 0.48 | 0.06 | -0.57 | -1.44 ** | -1.90 *** | -2.27 *** | -2.75 *** | -3.77 *** | -4.54 *** | -8.49 *** | -14.57 *** | -31.41 *** | -36.57 *** | -37.41 *** |
| **$10,000** | -0.39 | 1.05 ** | 0.98 ** | 0.80 * | 0.63 | 0.39 | 0.13 | -0.12 | -0.42 | -0.81 ** | -2.67 *** | -4.69 *** | -8.74 *** | -15.07 *** | -24.49 *** |
| **$15,000** | -0.28 | 1.22 *** | 1.23 *** | 1.15 *** | 1.08 *** | 0.93 ** | 0.78 ** | 0.65 * | 0.42 | 0.20 | -0.78 ** | -1.92 *** | -4.65 *** | -7.29 *** | -10.41 *** |
| **$30,000** | -0.17 | 1.38 *** | 1.46 *** | 1.47 *** | 1.46 *** | 1.38 *** | 1.33 *** | 1.27 *** | 1.11 *** | 0.98 *** | 0.50 ** | 0.02 | -0.87 *** | -1.91 *** | -2.88 *** |
| **$50,000** | -0.13 | 1.45 *** | 1.55 *** | 1.58 *** | 1.61 *** | 1.56 *** | 1.53 *** | 1.49 *** | 1.36 *** | 1.27 *** | 0.93 *** | 0.61 *** | 0.11 | -0.42 ** | -0.96 *** |
| **$100,000** | -0.10 | 1.50 *** | 1.62 *** | 1.68 *** | 1.72 *** | 1.68 *** | 1.68 *** | 1.65 *** | 1.53 *** | 1.47 *** | 1.23 *** | 1.02 *** | 0.74 *** | 0.49 *** | 0.23 |
| **$250,000** | -0.08 | 1.53 *** | 1.66 *** | 1.73 *** | 1.78 *** | 1.75 *** | 1.76 *** | 1.74 *** | 1.63 *** | 1.58 *** | 1.40 *** | 1.24 *** | 1.10 *** | 0.98 *** | 0.84 *** |
| **$500,000** | -0.08 | 1.53 *** | 1.67 *** | 1.74 *** | 1.80 *** | 1.78 *** | 1.78 *** | 1.78 *** | 1.68 *** | 1.62 *** | 1.46 *** | 1.32 *** | 1.21 *** | 1.13 *** | 1.03 *** |
| **$1,000,000** | -0.07 | 1.54 *** | 1.68 *** | 1.75 *** | 1.81 *** | 1.79 *** | 1.80 *** | 1.79 *** | 1.69 *** | 1.64 *** | 1.49 *** | 1.36 *** | 1.27 *** | 1.21 *** | 1.13 *** |

**Appendix 4: Abnormal Sharpe Ratios (Compared to the S&P 500)** All Periods (1992-2010), Based on Initial Portfolio Amount and Trading Frequency.

| 5,000 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 15 | 20 | 30 | 40 | 50 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Yearly** | -0.05 | -0.01 | 0.01 | 0.02 | 0.04 | 0.05 | 0.06 | 0.06 | 0.06 | 0.06 | 0.05 | 0.04 | 0.01 | -0.02 | -0.07 |
| **Bi-Yearly** | -0.06 | 0.00 | 0.02 | 0.03 * | 0.05 * | 0.06 ** | 0.07 ** | 0.07 ** | 0.06 ** | 0.06 * | 0.03 | -0.02 | -0.10 | -0.21 ** | -0.33 *** |
| **3X Year** | -0.06 | 0.00 | 0.03 * | 0.04 ** | 0.05 ** | 0.06 ** | 0.07 *** | 0.06 ** | 0.05 ** | 0.03 ** | -0.03 | -0.10 | -0.26 *** | -0.49 *** | -0.74 *** |
| **Quarterly** | -0.06 * | 0.01 * | 0.03 ** | 0.03 ** | 0.04 *** | 0.04 *** | 0.05 *** | 0.04 ** | 0.02 ** | 0.00 * | -0.09 | -0.20 *** | -0.50 *** | -0.78 *** | -1.09 *** |
| **Bi-Monthly** | -0.06 ** | 0.00 ** | 0.02 *** | 0.01 ** | 0.02 *** | 0.01 ** | 0.00 ** | -0.02 * | -0.04 | -0.07 | -0.26 *** | -0.47 *** | -0.90 *** | -1.40 *** | -2.37 *** |
| **Monthly** | -0.07 *** | -0.02 ** | -0.02 ** | -0.06 | -0.10 | -0.15 *** | -0.21 *** | -0.25 *** | -0.31 *** | -0.39 *** | -0.75 *** | -1.21 *** | -4.49 *** | -65.74 *** | NA *** |

| 10,000 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 15 | 20 | 30 | 40 | 50 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Yearly** | -0.05 | -0.01 | 0.01 | 0.02 | 0.04 | 0.05 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.06 | 0.05 | 0.03 |
| **Bi-Yearly** | -0.05 | 0.00 | 0.03 * | 0.04 * | 0.07 ** | 0.08 ** | 0.09 ** | 0.09 ** | 0.09 ** | 0.09 ** | 0.08 ** | 0.06 * | 0.03 | -0.02 | -0.08 |
| **3X Year** | -0.05 | 0.01 * | 0.04 ** | 0.05 ** | 0.07 *** | 0.08 *** | 0.10 *** | 0.10 *** | 0.09 *** | 0.08 *** | 0.06 *** | 0.03 * | -0.04 | -0.12 | -0.21 *** |
| **Quarterly** | -0.05 * | 0.01 * | 0.04 ** | 0.05 *** | 0.07 *** | 0.08 *** | 0.09 *** | 0.09 *** | 0.08 *** | 0.07 *** | 0.04 ** | -0.01 | -0.11 | -0.23 *** | -0.37 *** |
| **Bi-Monthly** | -0.05 ** | 0.01 ** | 0.04 *** | 0.04 *** | 0.06 *** | 0.06 *** | 0.07 *** | 0.07 *** | 0.05 *** | 0.04 *** | -0.02 | -0.10 | -0.28 *** | -0.51 *** | -0.77 *** |
| **Monthly** | -0.06 *** | 0.00 *** | 0.02 *** | 0.01 *** | 0.02 *** | 0.01 *** | 0.00 *** | -0.02 ** | -0.04 | -0.07 | -0.26 | -0.48 *** | -0.91 *** | -1.41 *** | -2.37 *** |

| 15,000 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 15 | 20 | 30 | 40 | 50 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Yearly** | -0.05 | -0.01 | 0.01 | 0.02 | 0.04 | 0.05 | 0.07 | 0.07 | 0.07 | 0.07 | 0.08 * | 0.08 * | 0.08 * | 0.07 | 0.06 |
| **Bi-Yearly** | -0.05 | 0.00 | 0.03 * | 0.04 * | 0.07 ** | 0.08 ** | 0.10 ** | 0.10 ** | 0.10 ** | 0.10 ** | 0.09 *** | 0.08 ** | 0.07 ** | 0.03 * | 0.00 |
| **3X Year** | -0.05 | 0.01 * | 0.04 ** | 0.05 ** | 0.08 *** | 0.09 *** | 0.11 *** | 0.11 *** | 0.10 *** | 0.10 *** | 0.09 *** | 0.07 *** | 0.03 ** | -0.02 | -0.08 |
| **Quarterly** | -0.05 * | 0.01 * | 0.05 *** | 0.05 *** | 0.08 *** | 0.09 *** | 0.11 *** | 0.11 *** | 0.10 *** | 0.09 *** | 0.08 *** | 0.04 *** | -0.01 | -0.09 | -0.17 ** |
| **Bi-Monthly** | -0.05 ** | 0.02 ** | 0.05 *** | 0.05 *** | 0.08 *** | 0.08 *** | 0.09 *** | 0.09 *** | 0.08 *** | 0.07 *** | 0.04 *** | -0.01 * | -0.11 | -0.23 *** | -0.37 *** |
| **Monthly** | -0.06 *** | 0.01 *** | 0.04 *** | 0.03 *** | 0.05 *** | 0.05 *** | 0.05 *** | 0.04 *** | 0.02 *** | 0.00 *** | -0.09 | -0.21 *** | -0.52 *** | -0.80 *** | -1.12 *** |

| 30,000 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 15 | 20 | 30 | 40 | 50 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Yearly** | -0.05 | -0.01 | 0.01 | 0.03 | 0.05 | 0.06 | 0.07 | 0.08 | 0.08 | 0.08 | 0.09 * | 0.09 * | 0.10 * | 0.09 * | 0.09 * |
| **Bi-Yearly** | -0.05 | 0.01 | 0.03 * | 0.05 * | 0.07 ** | 0.09 ** | 0.10 ** | 0.11 *** | 0.10 *** | 0.11 *** | 0.11 *** | 0.11 *** | 0.11 *** | 0.09 ** | 0.08 ** |
| **3X Year** | -0.05 | 0.01 * | 0.04 ** | 0.06 ** | 0.09 *** | 0.10 *** | 0.12 *** | 0.12 *** | 0.12 *** | 0.11 *** | 0.12 *** | 0.11 *** | 0.10 *** | 0.07 *** | 0.05 ** |
| **Quarterly** | -0.05 * | 0.02 ** | 0.05 *** | 0.06 *** | 0.09 *** | 0.10 *** | 0.12 *** | 0.12 *** | 0.12 *** | 0.12 *** | 0.11 *** | 0.10 *** | 0.08 *** | 0.04 *** | 0.01 |
| **Bi-Monthly** | -0.05 ** | 0.02 *** | 0.05 *** | 0.06 *** | 0.09 *** | 0.10 *** | 0.12 *** | 0.12 *** | 0.11 *** | 0.11 *** | 0.10 *** | 0.07 *** | 0.03 *** | -0.02 | -0.08 |
| **Monthly** | -0.05 *** | 0.02 *** | 0.05 *** | 0.05 *** | 0.08 *** | 0.08 *** | 0.10 *** | 0.10 *** | 0.08 *** | 0.08 *** | 0.04 *** | -0.01 ** | -0.11 | -0.23 *** | -0.37 *** |

| 50,000 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 15 | 20 | 30 | 40 | 50 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Yearly** | -0.05 | -0.01 | 0.01 | 0.03 | 0.05 | 0.06 | 0.07 | 0.08 | 0.08 | 0.08 | 0.09 * | 0.09 * | 0.10 * | 0.10 * | 0.10 * |
| **Bi-Yearly** | -0.05 | 0.01 | 0.03 * | 0.05 * | 0.07 ** | 0.09 ** | 0.10 *** | 0.11 *** | 0.11 *** | 0.11 *** | 0.12 *** | 0.12 *** | 0.13 *** | 0.11 *** | 0.11 *** |
| **3X Year** | -0.05 | 0.01 * | 0.05 ** | 0.06 ** | 0.09 *** | 0.10 *** | 0.12 *** | 0.12 *** | 0.12 *** | 0.12 *** | 0.13 *** | 0.12 *** | 0.13 *** | 0.11 *** | 0.09 *** |
| **Quarterly** | -0.05 * | 0.02 ** | 0.05 *** | 0.06 *** | 0.09 *** | 0.11 *** | 0.13 *** | 0.13 *** | 0.12 *** | 0.12 *** | 0.12 *** | 0.12 *** | 0.12 *** | 0.09 *** | 0.07 *** |
| **Bi-Monthly** | -0.05 ** | 0.02 *** | 0.06 *** | 0.06 *** | 0.09 *** | 0.11 *** | 0.12 *** | 0.13 *** | 0.12 *** | 0.12 *** | 0.12 *** | 0.11 *** | 0.09 *** | 0.06 *** | 0.02 *** |
| **Monthly** | -0.05 *** | 0.02 *** | 0.05 *** | 0.06 *** | 0.09 *** | 0.10 *** | 0.11 *** | 0.12 *** | 0.11 *** | 0.10 *** | 0.09 *** | 0.06 *** | 0.01 *** | -0.06 | -0.13 ** |

| 100,000 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 15 | 20 | 30 | 40 | 50 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Yearly** | -0.05 | -0.01 | 0.01 | 0.03 | 0.05 | 0.06 | 0.07 | 0.08 | 0.08 | 0.08 * | 0.09 * | 0.10 * | 0.11 * | 0.11 * | 0.11 * |
| **Bi-Yearly** | -0.05 | 0.01 | 0.03 * | 0.05 * | 0.08 ** | 0.09 ** | 0.11 *** | 0.11 *** | 0.11 *** | 0.11 *** | 0.12 *** | 0.13 *** | 0.14 *** | 0.13 *** | 0.13 *** |
| **3X Year** | -0.05 | 0.01 * | 0.05 ** | 0.06 | 0.09 *** | 0.10 *** | 0.13 *** | 0.13 *** | 0.12 *** | 0.13 *** | 0.14 *** | 0.14 *** | 0.15 *** | 0.14 *** | 0.13 *** |
| **Quarterly** | -0.05 * | 0.02 ** | 0.05 *** | 0.06 *** | 0.09 *** | 0.11 *** | 0.13 *** | 0.13 *** | 0.13 *** | 0.13 *** | 0.14 *** | 0.14 *** | 0.15 *** | 0.13 *** | 0.12 *** |
| **Bi-Monthly** | -0.05 ** | 0.02 *** | 0.06 *** | 0.07 *** | 0.10 *** | 0.11 *** | 0.13 *** | 0.14 *** | 0.13 *** | 0.13 *** | 0.14 *** | 0.13 *** | 0.13 *** | 0.11 *** | 0.10 *** |
| **Monthly** | -0.05 *** | 0.02 *** | 0.06 *** | 0.07 *** | 0.10 *** | 0.11 *** | 0.13 *** | 0.13 *** | 0.13 *** | 0.13 *** | 0.13 *** | 0.11 *** | 0.09 *** | 0.06 *** | 0.02 *** |

| 250,000 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 15 | 20 | 30 | 40 | 50 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Yearly** | -0.05 | -0.01 | 0.01 | 0.03 | 0.05 | 0.06 | 0.07 | 0.08 | 0.08 | 0.08 * | 0.09 * | 0.10 * | 0.11 * | 0.11 * | 0.12 * |
| **Bi-Yearly** | -0.05 | 0.01 | 0.03 * | 0.05 * | 0.08 ** | 0.09 ** | 0.11 *** | 0.11 *** | 0.11 *** | 0.11 *** | 0.13 *** | 0.13 *** | 0.15 *** | 0.14 *** | 0.14 *** |
| **3X Year** | -0.05 | 0.01 * | 0.05 ** | 0.06 | 0.09 *** | 0.11 *** | 0.13 *** | 0.13 *** | 0.13 *** | 0.13 *** | 0.14 *** | 0.14 *** | 0.16 *** | 0.15 *** | 0.15 *** |
| **Quarterly** | -0.05 * | 0.02 ** | 0.05 *** | 0.07 *** | 0.10 *** | 0.11 *** | 0.13 *** | 0.14 *** | 0.13 *** | 0.14 *** | 0.15 *** | 0.15 *** | 0.16 *** | 0.15 *** | 0.15 *** |
| **Bi-Monthly** | -0.05 ** | 0.02 *** | 0.06 *** | 0.07 *** | 0.10 *** | 0.11 *** | 0.13 *** | 0.14 *** | 0.14 *** | 0.14 *** | 0.15 *** | 0.15 *** | 0.16 *** | 0.15 *** | 0.15 *** |
| **Monthly** | -0.05 *** | 0.03 *** | 0.06 *** | 0.07 *** | 0.10 *** | 0.11 *** | 0.14 *** | 0.14 *** | 0.14 *** | 0.14 *** | 0.15 *** | 0.14 *** | 0.15 *** | 0.13 *** | 0.12 *** |

| 500,000 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 15 | 20 | 30 | 40 | 50 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Yearly** | -0.05 | -0.01 | 0.01 | 0.03 | 0.05 | 0.06 | 0.07 | 0.08 | 0.08 | 0.08 * | 0.09 * | 0.10 * | 0.11 * | 0.12 * | 0.12 * |
| **Bi-Yearly** | -0.05 | 0.01 | 0.03 * | 0.05 * | 0.08 ** | 0.09 ** | 0.11 *** | 0.12 *** | 0.11 *** | 0.11 *** | 0.13 *** | 0.13 *** | 0.15 *** | 0.14 *** | 0.15 *** |
| **3X Year** | -0.05 | 0.01 * | 0.05 ** | 0.06 | 0.09 *** | 0.11 *** | 0.13 *** | 0.13 *** | 0.13 *** | 0.13 *** | 0.14 *** | 0.15 *** | 0.16 *** | 0.16 *** | 0.16 *** |
| **Quarterly** | -0.05 * | 0.02 ** | 0.05 *** | 0.07 *** | 0.10 *** | 0.11 *** | 0.13 *** | 0.14 *** | 0.13 *** | 0.14 *** | 0.15 *** | 0.15 *** | 0.17 *** | 0.16 *** | 0.16 *** |
| **Bi-Monthly** | -0.05 ** | 0.02 *** | 0.06 *** | 0.07 *** | 0.10 *** | 0.11 *** | 0.14 *** | 0.14 *** | 0.14 *** | 0.14 *** | 0.15 *** | 0.15 *** | 0.17 *** | 0.16 *** | 0.16 *** |
| **Monthly** | -0.05 *** | 0.03 *** | 0.06 *** | 0.07 *** | 0.10 *** | 0.12 *** | 0.14 *** | 0.14 *** | 0.14 *** | 0.14 *** | 0.15 *** | 0.15 *** | 0.16 *** | 0.15 *** | 0.15 *** |

| 1,000,000 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 15 | 20 | 30 | 40 | 50 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Yearly** | -0.05 | -0.01 | 0.01 | 0.03 | 0.05 | 0.06 | 0.07 | 0.08 | 0.08 | 0.08 * | 0.09 * | 0.10 * | 0.11 * | 0.12 * | 0.12 * |
| **Bi-Yearly** | -0.05 | 0.01 | 0.03 * | 0.05 * | 0.08 ** | 0.09 ** | 0.11 *** | 0.12 *** | 0.11 *** | 0.11 *** | 0.13 *** | 0.13 *** | 0.15 *** | 0.15 *** | 0.15 *** |
| **3X Year** | -0.05 | 0.01 * | 0.05 ** | 0.06 | 0.09 *** | 0.11 *** | 0.13 *** | 0.13 *** | 0.13 *** | 0.13 *** | 0.15 *** | 0.15 *** | 0.17 *** | 0.16 *** | 0.16 *** |
| **Quarterly** | -0.05 * | 0.02 ** | 0.05 *** | 0.07 *** | 0.10 *** | 0.11 *** | 0.13 *** | 0.14 *** | 0.14 *** | 0.14 *** | 0.15 *** | 0.15 *** | 0.17 *** | 0.17 *** | 0.17 *** |
| **Bi-Monthly** | -0.05 ** | 0.02 *** | 0.06 *** | 0.07 *** | 0.10 *** | 0.12 *** | 0.14 *** | 0.14 *** | 0.14 *** | 0.14 *** | 0.16 *** | 0.16 *** | 0.17 *** | 0.17 *** | 0.17 *** |
| **Monthly** | -0.05 *** | 0.03 *** | 0.06 *** | 0.07 *** | 0.10 *** | 0.12 *** | 0.14 *** | 0.15 *** | 0.14 *** | 0.14 *** | 0.16 *** | 0.16 *** | 0.17 *** | 0.16 *** | 0.16 *** |

Statistical significance (conventional parametric t-tests) * 90%; ** 95%; *** 99%

The Sharpe ratio equation is: Sharpe= (Nr -Rf) /σ. The abnormal monthly Sharpe ratio is the monthly Sharpe ratio of each portfolio minus the monthly Sharpe ratio of the S&P 500 (1992-2010).

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