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ABSTRACT

This paper intends to study the intermediate-term momentum and long-term reversal of stock prices by investigating the informational role of unusual trading volume for winner and loser stocks. I argue that unusual trading volume has different implications for winner and loser stocks. Specifically, high trading volume for losers is driven by purchases made by informed investors; while high trade volume for winners could be driven by either information or representativeness bias or both. The arguments are tested in the paper by showing that in the short run, losers/winners with high abnormal trading volume outperform losers/winners with low abnormal trading volume; while in the long run, the high-volume premium will be eliminated. Finally, I show that momentum profit is higher and more persistent among stocks with low abnormal trading since the loser with low volume bounces back slowly but winners with high volume fall faster and with greater magnitude.

TABLE OF CONTENTS

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I. Introduction

A large body of finance literature documents that the cross-section stock returns are predictable based on past returns. For example, DeBondt and Thaler (1985, 1987) document long-term price reversals in which the past losers outperform past winners over the subsequent three to five years. Similarly, Jegadeesh (1990) and Lehmann (1990) report price reversals at monthly and weekly intervals. More puzzlingly, Jegadeesh and Titman (1993, 2001) report the return continuations in the intermediate horizon. They show that past winners on average continue to outperform past losers over the next three to twelve months.

The objective of this paper is to study intermediate-term price momentum and long-term price reversal by investigating the role of unusual trading activity in terms of the information it contains about future return evolution. More precisely, I am interested in the different implications of unusual trading volume for predicting the evolution of future price movements for losers and winners. This paper shows that stocks whose trading activity is unusually large over periods of a month tend to experience larger returns than the stocks with less trading activity over the subsequent 1~2 months. Although we can observe high-volume premium for both losers and winners, I postulate that high trading volume for losers is driven by the purchases made by informed investors; and high trade volume for winners could be driven by either information or the representativeness bias of momentum chasers.

It is motivated by Hong and Stein (1999) to define two types of trading activities. In their paper, they define two types of investors: news watchers and momentum traders.

The news watchers trade only on private information about fundamentals, whereas the momentum traders trade only on past price movements. Both are quasi-rational in the sense that they ignore all other information.

Representativeness bias was first documented by Tversky and Kahneman (1974). This psychological phenomenon describes the tendency of experimental subjects to view events as typical or representative of some specific class and to ignore the laws of probability in the process. In the securities market, for instance, investors might classify some stocks as growth stocks based on a history of consistent earnings growth or good performance, ignoring the likelihood that there are very few stocks that just keep appreciating. Barberis, Shleifer and Vishny (1998) build a behavior model based on conservatism bias and representativeness bias, and argue that conservatism bias causes investors to update their priors insufficiently when they observes new public information about a firm. This leads to an initial market underreaction. However, representativeness bias makes investors overreact to the good (bad) news when they receive a long sequence of good (bad) news. As a result, firms experiencing prolonged periods of increasing earnings tend to become overvalued, and those experiencing long periods of declining earnings tend to become undervalued. The prices of these stocks ultimately undergo reversals as realized earnings fail to meet expectations.

This paper further explores the implications of representativeness bias. According to the Barberis, Shleifer and Vishny (1998), representativeness bias implies that investors tend to not buy loser stocks since short sale is constrained, which in turn implies low trading volume. So we expect to see a low trading volume for a loser stock if there is no information. As long as we observe a loser stocks with unusually high trading volume, it

must be because some informed investors are buying the stocks, e.g., a rationally managed firm may tend to buy back more of its stock when managers believe their stock is undervalued by the market. Their purchase attracts the attention of more investors, who then pull the losers back to fair value in 1~2 months and then retain normal prices afterwards. I presume the trading is driven by private information and not public information because we do not expect a high trading volume if the information is publicly available (Campbell, Grossman and Wang (1993)). While for losers with unusually low trading volume (no information traders), they will continue the path of lower returns which is suggested by intermediate-term momentum.

On the other hand, representativeness bias also implies that investors tend to buy winner stocks, which further implies high trading volume. Further more, the stronger the upward trend is, the more momentum chasers will buy the stocks, which pull the prices up more. Thus, I conjecture that the winner stocks with unusually high trading volume are the winners with stronger upward trend, which attracts more momentum traders. While for winners with weaker upward trend, the representativeness bias is weaker, which implies relatively low trading volume. But high trading for winners could also be driven by information.

Since DeBondt and Thaler (1985, 1987) find long-term price reversal and Jegadeesh and Titman (1993, 2001) find intermediate-term price momentum, several behavioral models have attempted to provide a framework for integrating the two empirical phenomena (e.g., Daniel , Hirshleifer and Subrahmanyam (1998), Barberis, Shleifer and Vishny (1998), Hong and Stein (1999), Lee and Swaminathan (2000) and Hou, Peng and Xiong (2006), etc.).

Daniel, Hirshleifer and Subrahmanyam (1998) propose a behavior model based on two psychological biases: investor overconfidence about the precision of private information; and biased self-attribution, which causes asymmetric shifts in investors' confidence. They show that overconfidence implies negative long-lag autocorrelations (reversal), while biased self-attribution adds positive short-lag autocorrelations (momentum). Thus, intermediate-term momentum is a result of continuing overreaction, and long-term reversal is the following correction.

Hong and Stein (1999) show that if firm-specific information diffuses gradually across news watchers, there will be an initial underreaction. This underreaction in turn allows momentum traders to make money by trend chasing. As more and more momentum traders arrive, the initial underreaction turns into overreaction at longer horizons. This paper argues that both private information and momentum chase could eventually cause stock purchases, which implicitly implies high trading volume for those stocks with information or momentum trend.

Lee and Swaminathan (2000) propose a theory of momentum life cycle (MLC) using trading volume as a proxy for investor favoritism and neglect. They argue that high volume winners (low volume losers) are more likely to reverse in the near future because they tend to be overvalued (undervalued) much. Conversely low volume winners (high volume losers) are at the early stage of momentum, in the sense that their momentum are more likely to persistent in the near future.

Hou, Peng and Xiong (2006) also use trading volume as a proxy for attention to study price momentum and reversal phenomena. They argue that attention could aggravate investors' behavioral biases, such as extrapolative expectations and overconfidence, and

finally lead to price overreaction to information. So they conjecture that price momentum is caused by investors' overreaction, which will be more severe with higher attention, i.e. high trading volume.

This paper contributes to the literature on price momentum in two ways. First, I reconcile the intermediate-term momentum and long-term reversal by studying the future evolution process of past losers and winners. Second, I show that abnormal trading volume provides important information to predict both the magnitude and the persistence of price momentum. Specifically, losers with high abnormal trading volume reverse faster; and winners with high abnormal trading volume reverse stronger in the long run. Conditional on abnormal trading volume, we can create Jegadeesh and Titman-type momentum portfolios (winners minus losers) that either exhibit faster and stronger return reversal or slower and weaker returns reversal.

This paper also extends the literature on high-volume return premium. Previous studies (e.g., Gervais, Kaniel and Mingelgrin (2001) and Ying (1966)) shows that stocks experiencing unusually high (low) trading volume over a day or a week tend to appreciate (depreciate) over the course of the following month, and argue that investor attention by the unusually high trading volume explain the appreciation. I show that the high-volume return premium still exists when using monthly measurement of abnormal trading volume, and further show that the premium is driven by different reasons for past losers and past winners.

The remainder of the paper is organized as follows. In Section II, I develop my hypothesis, and then describe the data and methodology used in this paper. In Section III,

I present the empirical results, and further explore the economic significance and implications of the results. Finally, I conclude in Section IV.

II. Sample and Methodology

A. *Main Hypothesis*

The main objective of this paper is to investigate the informational role of unusual trading activities in predicting the evolution process of stock returns. In particular, I am interested in studying that how the trading activity in an individual stock is related to the future price evolution of the stocks.

As documented above, high trading volume could be driven by information trading or momentum chasing (representativeness bias). Trading activities based on private information leads to high trading volume and price increase for both losers and winners. Then the purchase attracts more investors to buy the stocks until the stock price embrace all the information, which implies price increase in the short run. Since the trade is information-based, we don't expect to see price reversal in the long run. However, trading activities based on momentum chasing have very different implications for losers and winners. For loser stocks, representativeness bias implies that stock prices continue to go down. But we don't expect to see high trading volume with the price decrease since most of the investors will just avoid buying those loser stocks, but not short-sell them because of the short-selling constraints. While for winner stocks, representativeness bias implies that stock prices continue to go up as well as high trading volume because of the purchase by momentum chasers. Since the behavioral bias will be corrected finally, we expect to see price reversal in the long run.

According to the analysis above, we know that high trading volume for loser stocks is only driven by information trading. So we expect to see the price of losers with high trading volume goes up to a fair level in the short run. Losers with low trading volume go back to fair value gradually so that the cumulative return difference between losers with high and low volume will be eliminated in the long run. While for winner stocks, high trading volume could be driven by two kinds of trade: information trading and momentum chasing. For those information-traded winners, the price evolution is similar to those information-traded losers. For those momentum-traded winners, we still see short-term price increase because of representativeness bias, but we also expect to see a long-term price reversal because momentum chasing tend to push the stock price too high. Taking both effect into consideration, we expect to a price increase in the short run for winners with high trading volume, and in the long run, those winners with high trading volume will reverse more than those with low trading volume.

Therefore, we have the following testable hypothesis that:

In the short run, losers/winners with high abnormal trading volume outperform losers/winners with low abnormal trading volume. In the long run, the high-volume premium will be eliminated.

B. Data description

To test the above hypothesis, I examine all NYSE/AMEX listed securities on the Center for Research in Security Prices (CRSP) monthly data files with share codes 10 or 11 (e.g. excluding ADRs, closed-end funds, REITs) from January 1970 to December 2006. I exclude NASDAQ firms from my sample for three reasons. First, the reported volume for NASDAQ firms includes inter-dealer trades which make the volume

incomparable with NYSE/AMEX volume. Second, the volume information is not available for NASDAQ firms on the CRSP tapes until after 1981. Third, NASDAQ firms tend to be smaller and more difficult to trade in momentum strategies.

Abnormal trading volume is the key ranking variable in this paper. However, unusual trading activity could be driven by the liquidity demand (Campbell, Grossman and Wang (1993)) or information based trades by a few large investors (Barber and Odean (2003)) or trading made by momentum chasers (Hong and Stein (1999)). This is especially ambiguous for small capitalization stocks with low average trading volume. I use standardized abnormal trading volume (SATV) as the proxy for abnormal trading. The SATV for stock *i* in month *t* is defined as

$$SATV_{i,t} = \frac{Turnover_{i,t} - \frac{1}{12}\sum_{t=-13}^{-1} Turnover_{i,t}}{\sigma_{i,t}}$$

Where $Turnover_{i,t}$ is turnover of stock *i* in month *t,* which is defined as the number of shares traded in the month divided by the number of shares outstanding at the end of the month. I use average monthly turnover over the previous twelve months as the benchmark for normal trading volume in order to eliminate seasonal effects from volume data. So the numerator represents the deviation of monthly turnover from normal levels. $\sigma_{i,t}$ is the standard deviation of the numerator over the last twelve months, which lessens the concern that the abnormal trading is driven by liquidity demand from small stocks.

In addition, size is CRSP market capitalization at the end of December of year *t-1*. Book equity is COMPUSTAT stockholder's equity plus the balance sheet deferred tax and investment tax credit less the book value of preferred stock. Book-to-market ratio is

then calculated by dividing the most recently available quarterly book equity by CRSP market capitalization in every month.

C. Empirical Methodology

To examine the predictability of price evolution using abnormal trading volume, I form portfolios double-sorted by SATV and past returns. At the beginning of each month *t*, I rank all eligible NYSE/AMEX stocks in my sample into quintiles based on their SATV in the last month. Then I sort stocks into quintiles independently based on their cumulative return over the past *J* months (skipping the most recent month to avoid market microstructure effects, *J*=6, 12). The intersections by the two independent rankings give rise to 25 SATV-based price momentum portfolios.

In order to test the hypothesis, at the beginning of every month I construct zero-investment portfolios by buying the losers/winners stocks with high SATV, and simultaneously short selling the losers/winners stocks with low SATV. First, I focus attention on the returns of the zero-investment portfolios in the following month after portfolio formation to test the short-term price evolution. To further explore the determinations of the high volume return premium, I run a Fama-MacBeth regression of monthly returns on a set of firm-specific regressors: previous one month return, prior-year return after skipping the previous one month, market capitalization, book-to-market ratio at the end of previous month, SATV in the previous month and average monthly turnover during the past twelve months. Specifically, I run the cross-section regression of monthly returns on these regressors in every month, and then calculate the mean coefficients over the time horizon.

To test the long-term price evolution, I study the cumulative returns of these zero-investment portfolios in the following 36 months. I also analyze the characteristic-adjusted returns of the zero-investment portfolios. I follow the characteristics-matching procedure in Daniel and Titman (1997) to account for the return premium associated with size and book-to-market equity. In particular, I sort stocks first into size deciles, and then within each size decile further sort them into book-to-market deciles. Stocks are equal-weighted within each of these 100 portfolios to form a set of 100 benchmark portfolios. Then I subtract the return of the equal-weighted benchmark portfolio to which that stock belongs from the return of that stock. The expected value of this excess return is zero if size and book-to-market ratio completely accounts for the return premium.

Finally, I examine the implication of the finding for momentum strategies. First, I study the evolution process of momentum returns conditional on SATV. Then I follow Jegadeesh and Titman (1993) to construct an applicable strategy to check the economic significance of the finding. In particular, the monthly return for a *K*-month holding period is based on an equal-weighted average of portfolio returns from strategies implemented in the current month and the previous *K*-1 months. Specifically, I revise the weights of *1/K* of the securities in the entire portfolio in any given month and carry over the rest from the previous month. Hence, the strategy closes out the position initiated in month *t-K*. The return spread between the winner and loser portfolios (past return quintiles 5 and 1 within each SATV quintile) constitutes the profit from the price momentum strategy.

III. Empirical Results

In this section, I discuss the empirical results for testing my hypothesis. In section A, I study the high-volume premium in short term and examine the predictive power of SATV for cross-sectional returns. In section B, I analyze the long-term performance of the zero-investment portfolios (SATV5-SATV1). In section C, I further analyze the implications of the results for momentum strategies, and then check the economic significance of the finding.

Table I reports descriptive characteristics for the double-sorted portfolios. Looking across each row, we see that losers are generally smaller firms with lower prices. This is not surprising given that losses they recently sustained. Looking down each column, we see that losers with high or low abnormal trading volume do not differ significantly in terms of their past twelve month returns and mean price. This observation is consistent with the intuition that abnormal trading volume for losers is not driven by the past performance, but by information-traders. We can also see that winners with high abnormal trading volume outperform winners with low abnormal trading in the previous year. For example, in panel A (*j=6)*, high SATV winners outperform low SATV winners by 18% in the previous year. It is also consistent with the intuition that momentum chasers tend to buy winners with stronger upward trends. Interestingly, we can see in every past-return quintile that average monthly turnover in the previous twelve months (Volume) is negatively correlated to SATV, i.e. Volume monotonically decreases across SATV quintiles. I will show later that it does not mean the finding in this paper is only another manifestation of the volume story documented by Lee and Swaminathan (2000) and Hou, Peng and Xiong (2006).

A. High-Volume Premium (short-term analysis)

Table II reports average monthly raw returns and Fama-French adjusted returns as well as the returns spread in the first month after portfolio formation. Firstly, conditional on past returns, stocks with high SATV generally outperform stocks with low SATV in the following month. This is seen in the consistently positive returns to the SATV5-SATV1 portfolio. Secondly, the high-volume premium are most pronounced in losers' quintile. For example, with a six-month portfolio formation period (J=6), high SATV losers outperform low SATV losers by 1.71 percent per month, whereas high SATV winners only outperform low SATV winners by 0.53 percent per month. The difference of 1.19 percent per month is significant economically and statistically. The two observations are consistent with the finding in Gervais, Kaniel and Mingelgrin (2001). In their paper, they argue that abnormal trading attracts the attention of investors towards a given stock and then results in a subsequent price increase, and it is especially true for past losers since they are more likely to have fallen off the investor's radar.[1]

In order to further explore the determinations of the high volume return premium, I run Fama-MacBeth regression (see Fama and MacBeth (1973)) of monthly returns on a set of firm-specific regressors. Table III reports the coefficients of various model specifications. Model 1 is a benchmark test, which shows that monthly return is negatively related to the past one-month return (short-term price reversal, see Jegadeesh (1990) and Lehmann (1990) etc), and positively related to the previous one-year return (intermediate-term price momentum, see Jegadeesh and Titman (1993, 2001)). Also, the size effect is marginally significant and the value effect (book-to-market) is strongly

[1] Notice that they use daily and weekly abnormal trading volume in their paper, and study the effect in the following one month.

significant. In model 2, we see that the SATV in the previous month is significantly positively related to monthly return, which shows that this result is robust after controlling several firm-specific variables. Model 3 shows that average monthly turnover over the previous twelve months is significantly negatively related to monthly return, which is consistent with the previous studies by Lee and Swaminathan (2000) and Hou, Peng and Xiong (2006). However, model 4 shows that our result is not another manifestation of the volume story documented by Lee and Swaminathan (2000) and Hou, Peng and Xiong (2006) because SATV still has explanatory power after controlling for past trading volume. Finally, model 5 and 6 shows that SATV is significantly positively related to returns of both winner and loser stocks.

The results in Table II and III verify the hypothesis that Losers/winners with high abnormal trading volume will outperform losers/winners with low abnormal trading volume in the short run.

B. Long-Horizon Analysis

Table IV reports long-term (event time) cumulative returns of the zero-investment portfolios (SATV5-SATV1) in the 36 months after the formation date.[2] For sake of parsimony, these results are only based on the six-month portfolio formation period (*j=6*). Panel A presents both raw returns and characteristic-adjusted returns of zero-investment portfolios for loser stocks. Consistent with the analysis for Table II, we see the cumulative raw return in month 1 is significantly positive. Then we find the cumulative return declines gradually and becomes not significantly different from zero

[2] Since overlapping returns are used to calculate the cumulative returns in event time, the autocorrelation-consistent Newey-West standard errors are used to compute the t-statistics for the cumulative returns (see Newey, Whitney K., and Kenneth D. West, 1987, A Simple, Positive Semi-Definite, Heteroskedasticity and Autocorrelation Consistent Covariance Matrix, *Econometrica* 55, 703-708.)

after nine months. We can see similar result when we use characteristic adjusted returns. The observation verifies the hypothesis that the high-volume premium for losers will be eliminated in the long run.

Panel B presents both raw returns and characteristic-adjusted returns of zero-investment portfolios for winner stocks. From the analysis for Table II, we see the cumulative raw return in month 1 is significantly positive. Then the return goes down gradually and becomes significantly negative after fourteen months. But surprisingly, the characteristic adjusted return goes down faster and is not significant from zero even in month 1, which may mean the portfolio characteristics do explain the high-volume premium for winner stocks. And the characteristic adjusted return becomes significantly negative only after three months. The observation also verifies the hypothesis that the high-volume premium for winners will be eliminated in the long run. Actually, we find the returns for winner with high SATV decrease so much that the cumulative returns for them are significantly less than winners with low SATV. It may be because the previous stronger behavioral bias for high SATV winners causes overcorrection for them eventually.

Figure 1 and 2 provide graphical representations of these zero-investment returns. Figure 1 reports the cumulative raw returns and Figure 2 reports the characteristic-adjusted returns. Both graphs show that the zero-investment return is higher and more persistent among losers.

C. Implication for Momentum Strategies: SATV-Based Price Momentum

Table V reports the cumulative returns of a simple momentum strategy (R5-R1) and two SATV-based momentum strategies (R5-R1|SATV=1 and R5-R1|SATV=5) in event

time over the 36 months after portfolio formation. As documented by Jegadeesh and Titman (1993), momentum profits are significant for about twelve months and then start to reverse. The simple momentum strategy earns, significantly, about a 5.5% profit in the first year, and then declines to not significantly different from zero. For the two SATV-based momentum strategies, we can see the magnitude and persistence of the momentum profits are quite different from them. Conditional on low SATV stocks, the momentum profit is, significantly, about 6.2% in the first year, and still marginally significant after two years. While conditional on high SATV stocks, the momentum profit is about 5.0% in the first year, and then reverses to an insignificant level after 18 months. Figure III shows the evolution of cumulative returns of the three momentum strategies. We can see the momentum profit is higher and more persistent conditional on low SATV stocks. It is not surprising given that the returns of winners with high SATV drop so much in the long run.

In order to show the profit difference is economically significant, I calculate the monthly returns of all the portfolios for different holding period. Table VI shows that conditional on past returns, high SATV stocks generally outperform low SATV stocks over the next 6 months. This is seen in the consistently positive returns to the SATV5-ATV1 portfolio. It is consistent with the hypothesis. Secondly, the high-volume premium is most pronounced in the losers' quintile, which is conjectured to be driven by increasing purchases following information-traders. Conditional on SATV, momentum profits (R5-R1) are higher among low SATV stocks, and the difference is statistically and economically significant. For example, for the case of six-month formation period and

three-month holding period (*J=6, K=3*), momentum profit for low SATV stocks is 0.43% per month greater than high SATV stocks.

Table VII reports two robustness tests for the above strategies. Panel A reports the Fama-French adjusted monthly returns, and show that our result is not driven by the factors documented by Fama and French (1993). Panel B reports the monthly returns outside January to show that our result is still robust after eliminating the January effect documented by Thaler (1987).

IV. Conclusion

This paper studies different informational roles of unusual trading volume (SATV) on loser stocks and winner stocks. I find high abnormal trading volume is following by high return in the next 1~2 month. It holds for both loser stocks and winner stocks.

I further show that in the long run, the price of loser stocks with low abnormal trading volume will increase later. Finally the cumulative returns of losers with high volume and low volume have no difference. I argue that high trading volume for losers is driven by the purchase made by informed investors. This high volume attracts other investors' attention so that the stock price goes up to a fair level, which generates the high-volume premium for loser stocks. In the long run, all the loser stocks will go back to their fair value. So the premium are eliminated, which explain no return difference between loser stocks with high volume and low volume in the long run

On the other hand, I show that the high-volume premium for winners is eliminated in the long run. Actually, the returns for winner with high SATV decrease so much that the cumulative returns for them are significantly less than winners with low SATV. I argue that the high trade volume for winners could be driven by either information or

representativeness bias or both. Investors buy winner stocks with strong upward trends, and push their price to overpriced level. In the long run, winner stocks will revert to their fair value, so the premium is eliminated.

Finally, I study the implication of the finding on momentum strategies, and show that momentum profit is higher and more persistent among low SATV stocks since the loser with low volume bounces back slowly but winners with high volume fall faster and with greater magnitude.

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Appendix

Table I Characteristics of Portfolios Based on Price Momentum and Abnormal Trading Volume (SATV)

This table presents portfolio characteristics for portfolios based on price momentum and abnormal trading volume (SATV). At the beginning of each month, all available stocks in NYSE/AMEX are ranked independently by SATV and returns over the past *J* month (skipping the most recent month, *J*=6, 12). *R1* represents the *loser* portfolio, and *R5* represents the *winner* portfolios; S*ATV1* represents portfolios with the *lowest* abnormal trading volume, and S*ATV5* represents portfolios with the *highest* abnormal trading volume. Return refers to the cumulative return in pervious twelve month; Volume is the average monthly turnover in previous twelve month; Price is the time-series average of the mean price of the portfolio in formation month and Size is the time-series average of the mean market capitalization of the portfolio in formation month. Panel A reports the statistics of portfolios based on past six month returns (*J*=6) and SATV; Panel B reports the statistics of portfolios based on past twelve month returns (*J*=12) and SATV.

Panel A: Portfolios based on past six month returns (*J*=6) and SATV

Portfolio	R1 (Losers)				R3				R5 (Winners)			
	Return	Volume	Price	Size	Return	Volume	Price	Size	Return	Volume	Price	Size
SATV1	-0.22	0.74	13.1	783	0.10	0.52	54.2	2532	0.51	0.70	29.9	2049
SATV3	-0.22	0.65	14.2	927	0.12	0.48	48.0	2672	0.61	0.63	33.4	1884
SATV5	-0.25	0.55	14.7	1216	0.11	0.43	32.5	2501	0.69	0.58	42.3	1724

Panel B: Portfolios based on past twelve month returns (*J*=12) and SATV

Portfolio	R1 (Losers)				R3				R5 (Winners)			
	Return	Volume	Price	Size	Return	Volume	Price	Size	Return	Volume	Price	Size
SATV1	-0.35	0.72	11.2	724	0.09	0.51	42.8	2491	0.75	0.75	44.9	2456
SATV3	-0.35	0.62	10.8	829	0.09	0.47	58.8	2669	0.81	0.68	32.7	1991
SATV5	-0.35	0.52	12.1	947	0.09	0.43	39.3	2526	0.85	0.62	47.6	1893

Table II Abnormal Trading Volume and Price-Momentum Profits

The equal-weighted monthly raw returns and Fama-French adjusted returns of the SATV and past return sorted portfolios are reported over the period from January 1970 to December 2006. At the beginning of each month, all stocks on NYSE/AMEX are ranked by SATV (standardized abnormal trading volume) in prior month and placed into quintiles. Within each ATV quintile, stocks are further sorted into quintiles based on return over past *J* month (skipping the most recent month, *J*=6, 12). *R1* represents the *loser* portfolio, and *R5* represents the *winner* portfolios; S*ATV1* represents portfolios with the *lowest* abnormal trading volume, and S*ATV5* represents portfolios with the *highest* abnormal trading volume.

		Raw Returns				Fama-French Adjusted Returns			
J	Portfolio	R1	R3	R5	R5-R1	R1	R3	R5	R5-R1
6	SATV1	0.0018	0.0104	0.0112	0.0094	-0.0137	-0.0031	-0.0020	0.0117
		0.48	*4.19*	*4.14*	*3.77*	*-6.79*	*-3.29*	*-1.63*	*4.84*
	SATV3	0.0076	0.0133	0.0145	0.0069	-0.0085	-0.0006	0.0011	0.0096
		2.04	*5.34*	*5.29*	*2.71*	*-4.09*	*-0.61*	*0.96*	*3.75*
	SATV5	0.0190	0.0174	0.0165	-0.0025	0.0023	0.0031	0.0037	0.0014
		4.75	*6.86*	*5.87*	*-0.83*	*0.95*	*2.89*	*2.80*	*0.47*
	SATV5-SATV1	0.0171	0.0071	0.0053	-0.0119	0.0160	0.0062	0.0057	-0.0103
		8.19	*6.41*	*3.81*	*-5.18*	*7.37*	*5.52*	*3.96*	*-4.39*
12	SATV1	0.0001	0.0097	0.0143	0.0142	-0.0083	-0.0012	0.0021	0.0104
		0.03	*3.97*	*5.16*	*5.72*	*-4.21*	*-1.38*	*2.42*	*5.04*
	SATV3	0.0067	0.0131	0.0172	0.0104	-0.0074	0.0000	0.0023	0.0097
		1.81	*5.25*	*6.02*	*4.01*	*-3.93*	*-0.06*	*2.54*	*4.73*
	SATV5	0.0183	0.0169	0.0182	0.0000	-0.0058	0.0002	0.0030	0.0088
		4.48	*6.76*	*6.30*	*-0.01*	*-3.37*	*0.29*	*2.93*	*4.07*
	SATV5-SATV1	0.0182	0.0072	0.0039	-0.0142	0.0025	0.0014	0.0009	-0.0016
		8.31	*7.08*	*2.96*	*-6.01*	*2.32*	*2.43*	*1.04*	*-1.36*

Table III Return Determination by Fama-MacBeth Regression 1971-2005

This table reports coefficients from Fama-MacBeth regression of monthly returns on a set of firm-specific regressors. $Ret_{(-1,0)}$ is the pervious one month return for controlling microstructure effect, $Ret_{(-13,-1)}$ is the prior-year return after skipping the previous one month, $Size_{(-1,0)}$ is the log of market capitalization in December last year, $b\text{-}t\text{-}m_{(-1,0)}$ is the book-market-ratio at the end of previous month, $SATV_{(-1,0)}$ refers to the standardized abnormal trading volume in the previous month and $TV_{(-12,0)}$ represents the average monthly turnover over the previous twelve months. I run cross-sectional regressions of monthly return on these variables every month, and then calculate the time-series mean values of all the coefficients (see Fama and MacBeth (1973)).

		Model 1	Model 2	Model 3	Model 4	Model 5 (winners)	Model 6 (losers)
Const.	parameter	0.0085	-0.0257	0.0099	-0.0259	-0.0299	-0.0309
	t-stat	*2.06*	*-7.40*	*2.53*	*-8.00*	*-7.50*	*-6.69*
$Ret_{(-1,0)}$	parameter	-0.0628	-0.0904	-0.0635	-0.0913	-0.1001	-0.1184
	t-stat	*-13.21*	*-17.56*	*-13.99*	*-18.42*	*-17.65*	*-17.29*
$Ret_{(-13,-1)}$	parameter	0.0089	0.0067	0.0096	0.0067		
	t-stat	*5.43*	*3.99*	*6.07*	*4.10*		
$Size_{(-1,0)}$	parameter	-0.0006	-0.0001	-0.0005	-0.0001	0.0004	-0.0016
	t-stat	*-1.20*	*-0.17*	*-1.06*	*-0.31*	*1.05*	*-2.28*
$b\text{-}t\text{-}m_{(-1,0)}$	parameter	0.0069	0.0059	0.0068	0.0060	0.0059	0.0076
	t-stat	*15.18*	*13.43*	*15.76*	*14.16*	*5.78*	*11.36*
$SATV_{(-1,0)}$	parameter		0.0299		0.0297	0.0384	0.0324
	t-stat		*30.61*		*29.81*	*29.15*	*17.94*
$TV_{(-12,0)}$	parameter			-0.0048	0.0017		
	t-stat			*-2.70*	*0.91*		

Table IV Cumulative Returns for the Zero-investment Portfolios (SATV5-SATV1)

At the beginning of each month, stocks are ranked independently by SATV and past six month returns (skipping the most recent month, *J*=6). The zero-investment portfolios are formed by buying the loser/winner stocks with high SATV, and selling the loser/winner stocks with low SATV. t is the month after portfolio formation. The sample period is January 1970 to December 2006. Panel A reports the average cumulative raw returns and characteristic adjusted returns of the zero-investment, buy minus sell, portfolios for loser stocks in each month following formation period. Panel B reports the average cumulative raw returns and characteristic adjusted returns of the zero-investment portfolios for winner stocks in each month following formation period. The t-statistics (in *italics*) are computed using autocorrelation-consistent Newyer-West standard errors (see Newyer and West (1987)).

Panel A Cumulative Returns of zero-investment portfolios for loser stocks

Raw Returns						Characteristic Adjusted Returns					
t	Cumulative Return	t	Cumulative Return	t	Cumulative Return	t	Cumulative Return	t	Cumulative Return	t	Cumulative Return
1	0.0171	13	0.0094	25	0.0139	1	0.0138	13	0.0117	25	0.0013
	8.19		*0.91*		*0.91*		*7.48*		*1.34*		*0.10*
2	0.0201	14	0.0114	26	0.0197	2	0.0149	14	0.0116	26	0.0044
	6.16		*1.03*		*1.31*		*5.00*		*1.31*		*0.34*
3	0.0209	15	0.0075	27	0.0176	3	0.0152	15	0.0078	27	0.0038
	5.14		*0.69*		*1.13*		*3.92*		*0.88*		*0.28*
4	0.0192	16	0.0077	28	0.0160	4	0.0145	16	0.0088	28	-0.0003
	3.85		*0.70*		*1.10*		*3.04*		*0.97*		*-0.02*
5	0.0180	17	0.0084	29	0.0124	5	0.0130	17	0.0083	29	-0.0031
	2.91		*0.72*		*0.82*		*2.30*		*0.84*		*-0.22*
6	0.0187	18	0.0104	30	0.0117	6	0.0137	18	0.0092	30	-0.0027
	2.62		*0.84*		*0.76*		*2.14*		*0.87*		*-0.18*
7	0.0194	19	0.0107	31	0.0109	7	0.0135	19	0.0088	31	-0.0043
	2.42		*0.82*		*0.67*		*1.97*		*0.80*		*-0.29*
8	0.0176	20	0.0071	32	0.0121	8	0.0124	20	0.0048	32	-0.0045
	1.99		*0.52*		*0.70*		*1.73*		*0.43*		*-0.29*
9	0.0194	21	0.0095	33	0.0119	9	0.0142	21	0.0052	33	-0.0046
	1.98		*0.66*		*0.66*		*1.92*		*0.46*		*-0.28*
10	0.0165	22	0.0050	34	0.0106	10	0.0136	22	0.0023	34	-0.0075
	1.59		*0.34*		*0.56*		*1.73*		*0.20*		*-0.45*
11	0.0129	23	0.0046	35	0.0086	11	0.0121	23	0.0026	35	-0.0109
	1.25		*0.30*		*0.43*		*1.53*		*0.22*		*-0.67*
12	0.0056	24	0.0066	36	0.0048	12	0.0112	24	0.0022	36	-0.0136
	0.55		*0.43*		*0.22*		*1.35*		*0.18*		*-0.87*

Panel B Cumulative Returns of zero-investment portfolios for winner stocks

Raw Returns						Characteristic Adjusted Returns					
t	Cumulative Return	t	Cumulative Return	t	Cumulative Return	t	Cumulative Return	t	Cumulative Return	t	Cumulative Return
1	0.0053	13	-0.0085	25	-0.0375	1	0.0007	13	-0.0198	25	-0.0351
	3.81		*-1.00*		*-2.86*		*0.47*		*-3.10*		*-3.05*
2	0.0063	14	-0.0106	26	-0.0395	2	-0.0014	14	-0.0208	26	-0.0356
	2.80		*-1.20*		*-2.96*		*-0.68*		*-3.06*		*-2.92*
3	0.0072	15	-0.0159	27	-0.0440	3	-0.0027	15	-0.0230	27	-0.0364
	2.36		*-1.69*		*-3.06*		*-1.02*		*-3.12*		*-2.77*
4	0.0065	16	-0.0183	28	-0.0467	4	-0.0059	16	-0.0239	28	-0.0377
	1.74		*-1.85*		*-3.21*		*-1.91*		*-3.11*		*-2.78*
5	0.0059	17	-0.0220	29	-0.0488	5	-0.0071	17	-0.0264	29	-0.0374
	1.39		*-2.07*		*-3.22*		*-1.89*		*-3.10*		*-2.65*
6	0.0040	18	-0.0236	30	-0.0496	6	-0.0081	18	-0.0282	30	-0.0371
	0.79		*-2.18*		*-3.26*		*-1.98*		*-3.26*		*-2.61*
7	-0.0003	19	-0.0274	31	-0.0496	7	-0.0112	19	-0.0304	31	-0.0384
	-0.06		*-2.37*		*-3.11*		*-2.54*		*-3.40*		*-2.51*
8	-0.0030	20	-0.0295	32	-0.0519	8	-0.0155	20	-0.0336	32	-0.0393
	-0.54		*-2.48*		*-3.12*		*-3.32*		*-3.48*		*-2.50*
9	-0.0028	21	-0.0313	33	-0.0509	9	-0.0163	21	-0.0335	33	-0.0356
	-0.44		*-2.54*		*-2.95*		*-3.19*		*-3.31*		*-2.30*
10	-0.0046	22	-0.0349	34	-0.0521	10	-0.0172	22	-0.0343	34	-0.0375
	-0.68		*-2.84*		*-2.96*		*-3.18*		*-3.33*		*-2.37*
11	-0.0061	23	-0.0369	35	-0.0535	11	-0.0175	23	-0.0363	35	-0.0370
	-0.84		*-3.03*		*-3.06*		*-3.10*		*-3.21*		*-2.26*
12	-0.0071	24	-0.0361	36	-0.0536	12	-0.0190	24	-0.0341	36	-0.0362
	-0.94		*-2.81*		*-2.79*		*-3.23*		*-2.97*		*-2.09*

Table V Cumulative Momentum Profits for Three Momentum Strategies

The average cumulative raw returns of the three momentum portfolios in each month following formation period are reported. At the beginning of each month, stocks are ranked independently by SATV and past six month returns (skipping the most recent month, *J*=6). The simple momentum portfolio is formed by buying the loser, and selling the winner. The high/low SATV momentum portfolio is formed by buying the loser with high/low SATV, and selling the winner high/low SATV. t is the month after portfolio formation. The sample period is January 1970 to December 2006. The t-statistics (in *italics*) are computed using autocorrelation-consistent Newyer-West standard errors (see Newyer and West (1987)).

Portfolios	t+1	t+1:t+6	t+1:t+12	t+1:t+18	t+1:t+24	t+1:t+30	t+1:t+36
Low SATV	0.0094	0.0477	0.0623	0.0508	0.0602	0.0563	0.0482
(R5-R1|SATV=1)	*3.77*	*5.00*	*3.35*	*1.86*	*1.75*	*1.26*	*0.82*
High SATV	-0.0025	0.0330	0.0496	0.0169	0.0175	-0.0050	-0.0101
(R5-R1|SATV=5)	*-0.83*	*2.78*	*2.12*	*0.57*	*0.52*	*-0.12*	*-0.17*
Simple Momentum	0.0055	0.0445	0.0551	0.0288	0.0275	0.0096	-0.0010
	2.22	*4.64*	*2.69*	*1.01*	*0.79*	*0.21*	*-0.02*

Table VI Monthly Returns for Portfolios Based on Abnormal Trading Volume and Price Momentum

Average monthly returns on portfolios sorted by SATV and past returns are reported over the period from January 1970 to December 2006 for various holding periods. At the beginning of each month, all available stocks in NYSE/AMEX are ranked independently by ATV and returns over the past *J* month (skipping the most recent month, *J*=6, 12). The equal-weighted monthly returns on these double-sorted portfolios are computed for three holding periods: *K*=one, three, or six months. *R1* represents the *loser* portfolio, and *R5* represents the *winner* portfolios; *ATV1* represents portfolios with the *lowest* abnormal trading volume, and *ATV5* represents portfolios with the *highest* abnormal trading volume.

		K=1				*K*=3				*K*=6			
J	Portfolio	R1	R3	R5	R5-R1	R1	R3	R5	R5-R1	R1	R3	R5	R5-R1
6	SATV1	0.0018	0.0104	0.0112	0.0094	0.0063	0.0121	0.0138	0.0075	0.0084	0.0132	0.0164	0.0080
		0.48	*4.19*	*4.14*	*3.77*	*1.67*	*4.91*	*5.19*	*3.10*	*2.27*	*5.41*	*6.19*	*3.68*
	SATV3	0.0076	0.0133	0.0145	0.0069	0.0083	0.0133	0.0149	0.0066	0.0095	0.0143	0.0167	0.0073
		2.04	*5.34*	*5.29*	*2.71*	*2.24*	*5.45*	*5.44*	*2.77*	*2.64*	*5.92*	*6.11*	*3.48*
	SATV5	0.0190	0.0174	0.0165	-0.0025	0.0128	0.0150	0.0160	0.0032	0.0110	0.0144	0.0169	0.0058
		4.75	*6.86*	*5.87*	*-0.83*	*3.52*	*6.24*	*5.71*	*1.30*	*3.19*	*6.11*	*6.11*	*2.68*
	5-1	0.0171	0.0071	0.0053	-0.0119	0.0064	0.0029	0.0022	-0.0043	0.0026	0.0012	0.0005	-0.0021
		8.19	*6.41*	*3.81*	*-5.18*	*5.05*	*4.26*	*2.08*	*-2.85*	*2.45*	*2.23*	*0.59*	*-1.76*
12	SATV1	0.0001	0.0097	0.0143	0.0142	0.0056	0.0122	0.0155	0.0098	0.0094	0.0135	0.0157	0.0063
		0.03	*3.97*	*5.16*	*5.72*	*1.50*	*5.02*	*5.79*	*3.98*	*2.48*	*5.68*	*5.97*	*2.60*
	SATV3	0.0067	0.0131	0.0172	0.0104	0.0083	0.0130	0.0163	0.0079	0.0106	0.0141	0.0165	0.0060
		1.81	*5.25*	*6.02*	*4.01*	*2.23*	*5.30*	*5.78*	*3.27*	*2.82*	*5.86*	*5.99*	*2.53*
	SATV5	0.0183	0.0169	0.0182	0.0000	0.0127	0.0147	0.0165	0.0038	0.0120	0.0144	0.0163	0.0043
		4.48	*6.76*	*6.30*	*-0.01*	*3.37*	*6.21*	*5.78*	*1.45*	*3.30*	*6.23*	*5.81*	*1.75*
	5-1	0.0182	0.0072	0.0039	-0.0142	0.0070	0.0025	0.0010	-0.0060	0.0026	0.0010	0.0006	-0.0020
		8.31	*7.08*	*2.96*	*-6.01*	*5.43*	*3.66*	*1.00*	*-4.05*	*2.46*	*1.71*	*0.72*	*-1.64*

Table VII Monthly Returns for Portfolios Based on Abnormal Trading Volume and Price Momentum: Robustness Tests

This table presents results for robustness tests on portfolios sorted by SATV and past returns are reported over the period from January 1970 to December 2006 for various holding periods. At the beginning of each month, all available stocks in NYSE/AMEX are ranked independently by ATV and returns over the past *J* month (skipping the most recent month, *J*=6, 12). The equal-weighted monthly returns on these double-sorted portfolios are computed for three holding periods: *K*=one, three, or six months. *R1* represents the *loser* portfolio, and *R5* represents the *winner* portfolios; *ATV1* represents portfolios with the *lowest* abnormal trading volume, and *ATV5* represents portfolios with the *highest* abnormal trading volume. Panel A reports Fama-French three factor adjusted returns. Panel B reports the returns after eliminating the January effect.

Panel A: Fama-French Three Factor Adjusted Monthly Returns

		K=1				*K*=3				*K*=6			
J	Portfolio	R1	R3	R5	R5-R1	R1	R3	R5	R5-R1	R1	R3	R5	R5-R1
6	SATV1	-0.0137	-0.0031	-0.0020	0.0117	-0.0096	-0.0017	0.0004	0.0101	-0.0083	-0.0012	0.0021	0.0104
		-6.79	*-3.29*	*-1.63*	*4.84*	*-4.69*	*-1.89*	*0.44*	*4.34*	*-4.21*	*-1.38*	*2.42*	*5.04*
	SATV3	-0.0085	-0.0006	0.0011	0.0096	-0.0080	-0.0004	0.0015	0.0095	-0.0074	0.0000	0.0023	0.0097
		-4.09	*-0.61*	*0.96*	*3.75*	*-4.05*	*-0.54*	*1.54*	*4.04*	*-3.93*	*-0.06*	*2.54*	*4.73*
	SATV5	0.0023	0.0031	0.0037	0.0014	-0.0033	0.0014	0.0030	0.0063	-0.0058	0.0002	0.0030	0.0088
		0.95	*2.89*	*2.80*	*0.47*	*-1.75*	*1.75*	*2.63*	*2.57*	*-3.37*	*0.29*	*2.93*	*4.07*
	5-1	0.0160	0.0062	0.0057	-0.0103	0.0063	0.0031	0.0026	-0.0038	0.0025	0.0014	0.0009	-0.0016
		7.37	*5.52*	*3.96*	*-4.39*	*4.83*	*4.34*	*2.40*	*-2.49*	*2.32*	*2.43*	*1.04*	*-1.36*
12	SATV1	-0.0083	-0.0012	0.0021	0.0104	-0.0107	-0.0013	0.0027	0.0134	-0.0081	-0.0006	0.0025	0.0106
		-4.21	*-1.38*	*2.42*	*5.04*	*-5.26*	*-1.49*	*2.63*	*5.75*	*-4.03*	*-0.76*	*2.67*	*4.79*
	SATV3	-0.0074	0.0000	0.0023	0.0097	-0.0083	-0.0008	0.0032	0.0115	-0.0072	-0.0003	0.0028	0.0100
		-3.93	*-0.06*	*2.54*	*4.73*	*-4.22*	*-0.97*	*2.96*	*4.92*	*-3.60*	*-0.38*	*2.76*	*4.49*
	SATV5	-0.0058	0.0002	0.0030	0.0088	-0.0039	0.0012	0.0038	0.0076	-0.0056	0.0004	0.0028	0.0084
		-3.37	*0.29*	*2.93*	*4.07*	*-1.97*	*1.55*	*3.21*	*3.00*	*-3.05*	*0.53*	*2.55*	*3.60*
	5-1	0.0025	0.0014	0.0009	-0.0016	0.0068	0.0026	0.0011	-0.0057	0.0025	0.0010	0.0003	-0.0022
		2.32	*2.43*	*1.04*	*-1.36*	*5.06*	*3.66*	*1.06*	*-3.75*	*2.29*	*1.77*	*0.35*	*-1.79*

Panel B: Monthly Returns outside January

		K=1				*K*=3				*K*=6			
J	Portfolio	R1	R3	R5	R5-R1	R1	R3	R5	R5-R1	R1	R3	R5	R5-R1
6	SATV1	-0.0041	0.0083	0.0094	0.0135	-0.0015	0.0093	0.0113	0.0128	0.0003	0.0102	0.0134	0.0130
		-1.14	*3.36*	*3.34*	*5.89*	*-0.45*	*3.88*	*4.16*	*6.29*	*0.10*	*4.34*	*5.06*	*7.21*
	SATV3	-0.0001	0.0098	0.0118	0.0119	0.0001	0.0101	0.0121	0.0121	0.0012	0.0110	0.0135	0.0122
		-0.02	*4.07*	*4.20*	*5.19*	*0.02*	*4.26*	*4.34*	*6.19*	*0.39*	*4.72*	*4.92*	*7.14*
	SATV5	0.0092	0.0138	0.0140	0.0049	0.0053	0.0122	0.0138	0.0085	0.0046	0.0117	0.0145	0.0099
		2.66	*5.79*	*4.86*	*2.02*	*1.58*	*5.13*	*4.79*	*4.05*	*1.41*	*5.04*	*5.12*	*5.15*
	5-1	0.0133	0.0054	0.0047	-0.0086	0.0068	0.0029	0.0026	-0.0042	0.0042	0.0015	0.0011	-0.0031
		6.86	*5.24*	*3.24*	*-3.83*	*5.24*	*4.11*	*2.43*	*-2.76*	*4.09*	*2.79*	*1.30*	*-2.60*
12	SATV1	-0.0053	0.0075	0.0126	0.0179	-0.0022	0.0093	0.0132	0.0154	0.0008	0.0107	0.0135	0.0127
		-1.50	*3.04*	*4.43*	*7.55*	*-0.65*	*3.94*	*4.85*	*7.10*	*0.23*	*4.66*	*5.05*	*6.28*
	SATV3	-0.0014	0.0097	0.0145	0.0159	-0.0002	0.0097	0.0135	0.0137	0.0015	0.0109	0.0138	0.0123
		-0.40	*4.02*	*5.06*	*7.14*	*-0.06*	*4.09*	*4.71*	*6.73*	*0.45*	*4.71*	*4.95*	*6.36*
	SATV5	0.0085	0.0135	0.0161	0.0075	0.0048	0.0120	0.0145	0.0097	0.0046	0.0120	0.0143	0.0097
		2.38	*5.59*	*5.42*	*2.78*	*1.38*	*5.10*	*4.93*	*4.24*	*1.37*	*5.21*	*4.97*	*4.47*
	5-1	0.0138	0.0060	0.0035	-0.0103	0.0070	0.0027	0.0013	-0.0057	0.0038	0.0013	0.0009	-0.0030
		6.68	*5.99*	*2.52*	*-4.51*	*5.30*	*3.94*	*1.35*	*-3.93*	*3.72*	*2.43*	*1.01*	*-2.51*

Figure I: Cumulative Raw Returns for the Zero-investment Portfolios (SATV5-SATV1)

This figure shows event-time cumulative raw returns for the zero-investment, buy minus sell, portfolios. At the beginning of each month, stocks are ranked independently by SATV and past six month returns (skipping the most recent month, *J*=6). The zero-investment portfolios are formed by buying the loser/winner stocks with high SATV, and selling the loser/winner stocks with low SATV. t is the month after portfolio formation. The sample period is January 1970 to December 2006.

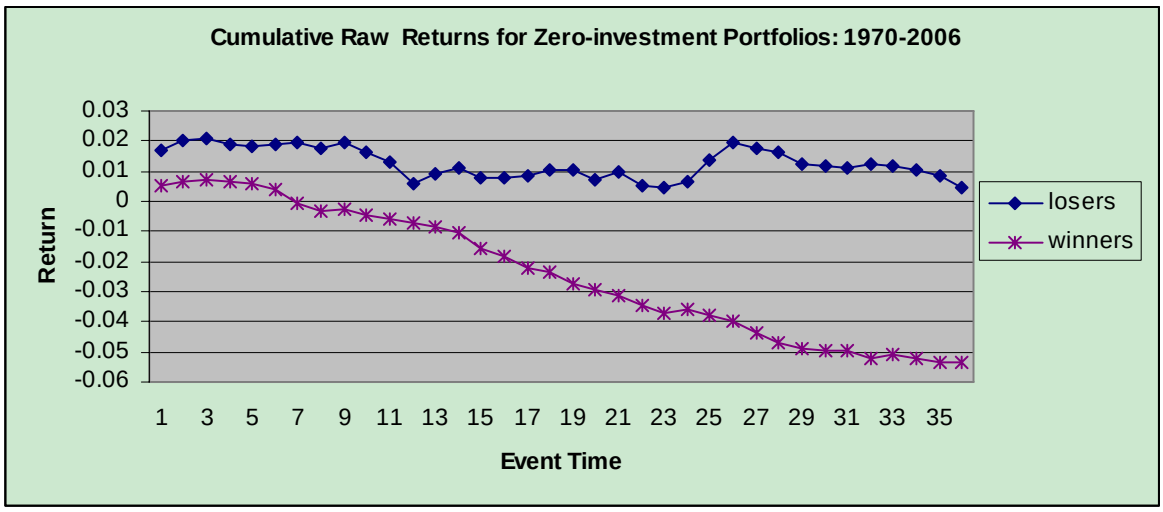

Figure II: Characteristic-adjusted Returns for the Zero-investment Portfolios (SATV5-SATV1)

This figure shows event-time cumulative characteristic-adjusted returns for the zero-investment, buy minus sell, portfolios. At the beginning of each month, stocks are ranked independently by SATV and past six month returns (skipping the most recent month, *J*=6). The zero-investment portfolios are formed by buying the loser/winner stocks with high SATV, and selling the loser/winner stocks with low SATV. The adjustment employ a characteristic-based matching procedure which accounts for the return premium associated with size and book-to-market following Daniel, Grinblatt, Titman, and Wermers (1997). t is the month after portfolio formation. The sample period is January 1970 to December 2006.

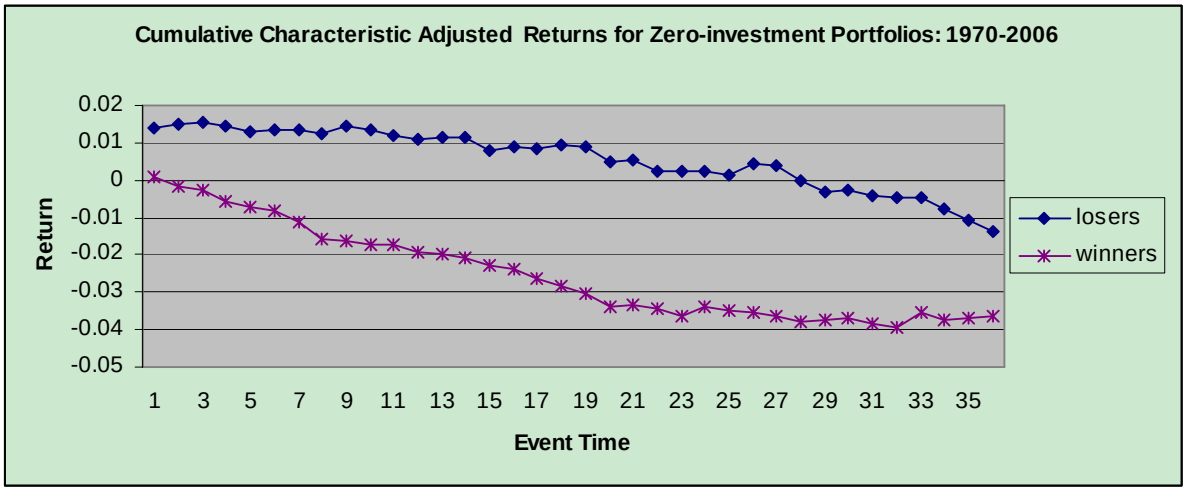

Figure III: Momentum Profits for Three Momentum Strategies

This figure shows event-time cumulative returns for three momentum strategies. At the beginning of each month, stocks are ranked independently by SATV and past six month returns (skipping the most recent month, *J*=6). The simple momentum portfolio is formed by buying the loser, and selling the winner. The high/low SATV momentum portfolio is formed by buying the loser with high/low SATV, and selling the winner high/low SATV. t is the month after portfolio formation. The sample period is January 1970 to December 2006.