Liquidity and Autocorrelations in Individual Stock Returns

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Abstract

The efficient market hypothesis has been challenged by short horizon return predictability that has been extensively documented. Previous research has claimed that contrarian trading strategies that exploit the negative autocorrelations in individual stock returns are quite profitable. This paper documents that the contrarian trading strategy profits are smaller than the likely transactions costs. The short-run reversals occur mainly in the loser stocks, especially at the monthly frequency. Extreme price changes occur in the high turnover stocks that have low liquidity. The largest reversals and the potential contrarian trading strategy profits occur in precisely these high turnover, low liquidity stocks as the price pressures caused by non-informational demands for immediacy are accommodated. However, these high turnover, low liquidity stocks face high transaction and large market impact costs.

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1 Introduction

The efficient market hypothesis is a fundamental paradigm in financial economics. The concepts of market efficiency have been defined by Fama (1970) in his seminal review as weak, semi-strong, and strong form efficiency. However, an extensive body of empirical work shows that past returns contain important information for forecasting future returns – an apparent violation of weak form market efficiency. For example, early research by Cootner (1964) and Fama (1965) documents that individual stock returns exhibit negative autocorrelation over short horizons. More recently, Lo and MacKinlay (1988, 1990) find that weekly portfolio returns have large positive autocorrelations, which they ascribe to the cross-autocorrelation patterns in stock returns, and Lehmann (1990) and Jegadeesh (1990) show that contrarian strategies that exploit the return reversals in individual stocks generate abnormal returns of over 2% per month. From a theoretical point of view, Campbell, Grossman, and Wang (1993) (henceforth CGW) explain the potentially high abnormal payoffs to short-run contrarian strategies within a rational framework.

In the CGW (1993) framework, trading volume plays an important role in identifying price changes either due to public information or due to exogenous selling pressure from non-informational trades. The notion is that non-informational trading causes price movements that, when absorbed by liquidity suppliers, revert prices. Such non-informed trading is accompanied with high trading volume, whereas informed trading is accompanied with little trading volume. Thus, price changes accompanied with high trading volume should revert, whereas those accompanied with low trading volume should not revert. Empirical support for the CGW model has been provided by Conrad, Hameed, and Niden (1994) based on a sample of NASDAQ stocks. Cooper (1999), on the other hand, finds evidence to the contrary based on a sample of large NYSE-AMEX stocks. Cooper argues that his results support the asymmetric information model of Wang (1994) in which price continuations are accompanied by high trading volumes when informed investors condition their trades on private information.

This paper incorporates the dimension of illiquidity into the investigation of the serial correlation patterns of individual stock returns. The CGW (1993) framework implicitly assumes that the demand curves for stocks are not perfectly elastic; otherwise, there would be no impact of trades on prices and subsequent price reversals would not occur. With downward sloping demand curves, however, price reversals should follow non-informational trading. We conjecture that the price pressures caused by

demands for immediacy from liquidity traders lead to, or at least enhance, price reversals. Therefore, controlling for trading volume, liquidity or rather the lack of it should have an impact on autocorrelations of stock returns. While liquidity is an elusive concept, most market participants agree that liquidity generally denotes an ability to buy or sell sufficient quantities, quickly, at low cost and without impacting the market price too much. Following Amihud (2002), we measure weekly or monthly illiquidity as the average of the daily price impacts of the order flow, i.e., the daily absolute price change per dollar of daily trading volume.

In a sample of NYSE-AMEX stocks over the period 1962-2002, we find that there are reversals in weekly and monthly stock returns but they are mainly confined to the loser stocks – stocks that had negative returns in the past week or month – especially at the monthly frequency. At the weekly frequency, high turnover stocks exhibit higher negative serial correlations than low turnover stocks. The empirical evidence supports the predictions of CGW (1993) and is consistent with the findings of Conrad, Hameed, and Niden (1994). However, this result is at odds with that of Cooper (1999) possibly because Cooper implements filter rules based on the largest stocks. The fact that our results are also apparently at odds with the predictions of Wang (1994) suggests that the degree of information asymmetry may not be large enough to have an impact on individual stock return autocorrelations. Indeed, when the degree of asymmetric information is low, Wang model reduces to that of CGW (1993).

Next, we show that liquidity has a robust effect on stock return autocorrelations. After controlling for turnover, there is more reversal in stocks with low liquidity than in highly liquid stocks. Moreover, the high turnover, low liquidity stocks have the highest negative serial correlations and the stongest potential contrarian strategy trading profits. The high turnover stocks with low liquidity exhibit the largest initial price changes that are subsequently reversed as the demand for immediacy is accommodated by liquidity suppliers. These stocks reverse the most not only because they have the largest initial price change but also because they have the most negative return autocorrelations.

We find the impact of liquidity on autocorrelations to be similar at the weekly and monthly frequencies. In contrast, at the monthly frequency the impact of turnover on autocorrelations reverses relative to that based on the weekly frequency; low turnover stocks exhibit more reversals than high turnover stocks. This evidence suggests that while the non-informational trades represent a demand for liquidity at a weekly frequency, these demands are easily accommodated and may in fact even enhance liquidity at the monthly frequency. Overall, our findings are consistent with the CGW (1993)

hypothesis that non-informational demands for liquidity cause price pressures that are subsequently reversed as liquidity suppliers react to profit from prices that move away from fundamentals.

We contribute to the literature by showing that the return reversals are more prominent in the less liquid stocks when the demand for liquidity is high. Thus, the predictability in short horizon returns occurs because of stresses in the market for liquidity. We also provide evidence that a high frequency trading strategy that attempts to profit from the negative serial correlations generates high transactions costs and substantial price impact. Consequently, while the presence of negative autocorrelations in individual security returns is undeniable, it is not possible to profit from this short-run predictability. This lack of profitability and the fact that the overall findings are consistent with the rational paradigm of CGW (1993) suggest that the violation of the efficient market hypothesis due to short term reversals is not so egregious after all.

The rest of the paper is organized as follows. Section 2 presents the summary statistics of the data. Section 3 presents the results and Section 4 concludes.

2 Data

We obtain the return and trading volume data from CRSP for the universe of NYSE-AMEX stocks over the sample period 1962 through 2002. The average number of stocks in the sample is 2070. The Amihud (2002) illiquidity measure is the average daily price impact of order flow and is computed as the absolute price change per dollar of daily trading volume:[1]

$$ILLIQ_{it} = \frac{1}{D_{it}} \sum_{t=1}^{D_{it}} \frac{|R_{itd}|}{DVOL_{itd}}, \tag{1}$$

where R_{itd} is the return, $DVOL_{itd}$ is the dollar trading volume of stock i on day d in week t, and D_{it} is the number of days in week t for which data is available for stock i. We need at least two days (or 10 days for a monthly measure of illiquidity) with return and trading volume data each week. In order to avoid the extremely illiquid stocks from

[1]Hasbrouck (2003) compares effective and price impact measures estimated from daily data to those from high frequency data and finds that the Amihud (2002) measure is the most highly correlated with trade-based measures.

the sample, penny stocks have been eliminated.[2] Summary statistics of the data are presented in Table 1.

Panel A of Table 1 documents the time-series averages of the cross-sectional statistics. The mean (median) cross-sectional return is 0.17% (–0.14%) per week and the mean (median) weekly turnover is 0.23% (0.14%). The mean (median) cross-sectional illiquidity measure is 3.13 (0.25); i.e., the mean absolute daily return for one million dollar trading volume is 3.13. Panel C presents the cross-sectional averages of the time series statistics of the individual stocks. The mean (median) return of an individual stock over the sample period is 0.14% (–0.16%) per week and the turnover is 0.27% (0.17%). The mean (median) illiquidity measure for an individual stock is 4.39 (1.75).

Panel B of Table 1 presents the cross-sectional correlations of returns, turnover, and the illiquidity measure. The correlation between returns and turnover is positive at 0.13. The correlation between returns and illiquidity is negative at –0.02. Since turnover has often been used as a measure of liquidity[3] one may expect the illiquidity measure to be related to turnover. However, the cross-sectional correlation between turnover and liquidity is only –0.08. The information in the Amihud illiquidity measure is not subsumed by that in turnover, thus, allowing us to separately study the impact of turnover as well as of illiquidity on the serial correlation pattern of weekly and monthly stock returns.

3 Results

CGW (1993) argue that price reversals occur as risk averse market makers absorb order flow from uninformed or liquidity traders. In their model, a decline (increase) in stock prices could occur due to public information or due to liquidity driven selling (buying) pressure. When the price change is due to informational reasons, price reversals are unlikely. However, suppliers of liquidity who accommodate the non-informational sell orders demand higher expected returns and must be compensated for bearing portfolio risk when buying shares that they would otherwise not trade. In fact, liquidity suppliers are attracted by prices that move away from fundamentals in response to the liquidity driven buying or selling pressure. We do not expect price changes after the public

[2]In the context of long-term contrarian investment strategies, Ball, Kothari, and Shanken (1995) show that microstructure issues can create severe biases amongst low-priced stocks.

[3]See, e.g., Brennan, Chordia, and Subrahmanyam (1998) and Chordia, Subrahmanyam, and Anshuman (2001).

information has been incorporated into prices. On the other hand, price reversals are to be expected following liquidity driven trading. Of course, if demand curves were perfectly elastic, price reversals would not obtain. Given downward sloping demand curves, price reversals should follow liquidity or non-informational trading. The CGW model, therefore, suggests that liquidity or the lack of it should have an impact on price reversals. Also, CGW use trading volume to distinguish between information and liquidity based trading activity. Trading activity accompanied with high trading volume is likely to be liquidity driven while trading activity accompanied by low trading volume is likely to be information driven. Thus, both trading volume and illiquidity should influence reversals in returns.

Lehmann (1990) and Jegadeesh (1990) document negative serial correlation in the cross-section of weekly and monthly stock returns, respectively. This economically significant predictability conflicts with weak-form market efficiency. Prices should follow a martingale process over short time intervals since systematic short-run changes in fundamental values should be negligible in efficient markets with a random information arrival process.

We conjecture that a lack of liquidity around large price changes causes deviations from the so-called martingale process and price reversals arise as the price pressure in response to a demand for liquidity from uninformed investors abates.

3.1 One-Way Sorts

Table 2 provides the initial evidence. Each week, we sort stocks into quartiles based on Wednesday to Tuesday close returns in week $t-1$. Following Lehmann (1990) and Jegadeesh (1990), we skip a day at the end of each week (or month) in order to avoid the negative serial correlation that is induced by the bid-ask bounce.[4] We next further sort negative and positive return portfolios into the extreme and non-extreme portfolios. Thus, we have four portfolios: the first portfolio is the extreme negative return portfolio with an average equally weighted return of –5.69% per week; the second portfolio is the medium negative return portfolio; the third portfolio is the medium positive return portfolio; and the fourth portfolio is the extreme positive return portfolio with an average return of 6.11% per week. Trading volume and illiquidity are both higher for the extreme portfolios. The average equally weighted turnover for portfolios one and four is 0.23%

[4]We will follow this skip-day methodology throughout the rest of the paper.

and 0.29% respectively, whereas it is only 0.16% for portfolios two and three. The average illiquidity measure in portfolio two is 0.8, whereas it is almost four times as high in portfolio one at 3.1. In the case of the positive return portfolios, illiquidity is 1.4 and 2.0.

The same pattern obtains for turnover and illiquidity in week t. The illiquidity and turnover of the extreme portfolios are larger than those of the non-extreme portfolios, and the gap in the illiquidity measure between extreme and non-extreme portfolios is much larger among the loser portfolios. Note that there is reversal in both of the negative return portfolios. The returns in week t for portfolios one and two are 0.47% and 0.14%, respectively. The average return of portfolio three in week t is 0.17% and, thus, does not reverse. The extreme winner portfolio has a time-series average return that is statistically indistinguishable from zero in week t. Overall, the results of the one-way sort suggest that much of the negative serial correlation in individual stock returns is driven by the two loser portfolios with negative returns in week $t-1$. Also, the higher average illiquidity of the extreme loser portfolio suggests a link between illiquidity and reversals.

3.2 Two-Way Sorts

Table 3 presents evidence from two-way simultaneous sorts based on returns and either turnover or illiquidity in week $t-1$. As before, the return portfolios one and four are the extreme loser and winner portfolios. In the case of sorts based on turnover or illiquidity, portfolio one (four) has the lowest (highest) turnover or illiquidity. We sort on turnover and not changes in the number of transactions[5] as done by Conrad, Hameed, and Niden (1994) or changes in turnover as done by Cooper (1999). We elect to sort on turnover because the model of CGW (1993) relates the serial correlation patterns in returns to the level and not changes in turnover (see equation (16) in CGW). Also, the empirical analysis in CGW uses the detrended level of turnover and not changes in turnover.

Table 3 presents the means and standard deviations of the post-formation week t equally weighted returns. Sorting on returns and turnover provides results that are generally consistent with CGW (1993). Focusing on return portfolio one, we find that

[5]Conrad, Hameed, and Niden (1994) note that their results are unchanged when sorting on changes in trading volume instead of changes in the number of transactions. Sorting on changes in turnover we find that amongst the loser stocks low change in turnover securities revert more (a return of 0.64% in week t) than high change in turnover securities (a return of 0.25%).

the average return for the lowest turnover portfolio is 0.21%, while the average return of the highest turnover portfolio is 0.64%. Thus, the highest turnover portfolio exhibits more reversal than does the lowest counterpart. The return differential between the highest and lowest turnover portfolios is statistically and economically significant at 0.43% per week. For return portfolio two, the return differential between the highest and lowest turnover portfolios is 0.29% per week. Reversal also obtains for the highest return portfolio four, with the difference in returns between the highest and lowest turnover portfolios being -0.07%. Only return portfolio three generates patterns that are inconsistent with CGW, in that the return differential between the highest and lowest turnover portfolios is a positive (instead of being negative) 0.22%. Also, the standard deviation of returns is highest for the extreme return portfolios resulting in a U-shaped pattern within each turnover quartile. Moreover, return volatility increases monotonically with turnover for each of the four return portfolios pointing to the possible presence of non-informational traders in the high turnover portfolios as suggested by CGW.

In the case of the two way sorts based on illiquidity and returns we find reversals for only the extreme return portfolios. For instance, in return portfolio one, the average return for the lowest illiquidity portfolio is 0.42%, while the average return of the highest illiquidity portfolio is 0.51%. The difference in returns between the highest and lowest illiquidity portfolios is 0.09% per week suggesting that there is more reversal in the highest illiquidity portfolio. While the return volatility shows a U-shaped pattern across the return portfolios, there is no consistent pattern across the illiquidity portfolios.

Overall, in the extreme return portfolios, both turnover and illiquidity sorts exhibit more reversal for the higher turnover and illiquidity portfolios. These findings could attest that there are liquidity stresses in high turnover and high illiquidity portfolios. In addition, the high volatility of the extreme return portfolios and the high turnover portfolios suggests that non-informational trades generate the price movements in these portfolios.

Next, we consider the formation period returns, i.e., in week $t-1$, to document the demands for liquidity in three-way sorted portfolios.

3.3 Three-Way Sorts

We base the three way sorts on returns, turnover, and illiquidity. Our attempt here is to test the hypothesis that it is the price pressure that causes the initial large returns in period $t-1$, which are then reversed in period t. The price pressure should be the largest in the least liquid stocks and in stocks with high turnover where the demand is the strongest. We first demonstrate the price impact in period $t-1$ and then we document the degree of reversal in period t.

Table 4 presents the average equally weighted returns in week $t-1$ for portfolios formed by independent sorts of the week $t-1$ returns, turnover, and liquidity. Recall that return portfolio one (four) has the lowest (highest) returns in week $t-1$. Also, turnover and illiquidity portfolio one (four) has the lowest (highest) turnover and illiquidity, respectively. Focusing on return portfolio one, we note that for any illiquidity portfolio the week $t-1$ equally weighted average return decreases with turnover, and for any turnover portfolio the return decreases with illiquidity. For any illiquidity portfolio, the return difference between turnover portfolio four and portfolio one is negative and this difference becomes monotonically more negative as illiquidity increases. Similarly, for any turnover portfolio, the return difference between illiquidity portfolio four and portfolio one is negative and this difference becomes monotonically more negative as turnover increases. Also, the standard deviation of the weekly returns increases with turnover and illiquidity.

More specifically, the average weekly return difference between illiquidity portfolio four and portfolio one decreases monotonically from –1.7% for turnover portfolio one to –3.7% for turnover portfolio four. Similarly, the average weekly return difference between turnover portfolio four and portfolio one decreases monotonically from –1.7% for illiquidity portfolio one to –3.6% for illiquidity portfolio four. Moreover, the volatility of the difference in returns for the turnover portfolios increases monotonically with illiquidity (from 1.09% to 2.69% per week) and the volatility of the difference in returns for the illiquidity portfolios increases monotonically with turnover (from 0.95% to 2.80% per week). Thus, within return portfolio one, the week $t-1$ returns become more negative and their volatility increases with turnover and illiquidity.

A similar pattern obtains for extreme winner portfolio four. The week $t-1$ returns become more positive and their volatility increases with turnover and illiquidity. The average weekly return difference between illiquidity (turnover) portfolios four and one increases monotonically from 1.97% (2.41%) for the turnover (illiquidity) portfolio one

to 7.75% (7.99%) for turnover (illiquidity) portfolio four. The volatility of the difference in returns for the turnover portfolios increases monotonically with illiquidity (from 1.23% to 4.92% per week) and the volatility of the difference in returns for the illiquidity portfolios increases monotonically with turnover (from 1.21% to 5.15% per week). These return patterns are depicted in Figure 1. In contrast, the (absolute) returns and volatilities of return portfolios two and three are orders of magnitude smaller than those of the counterpart extreme return portfolios, suggesting that the extreme returns and volatilities exist when there are large price changes.

Table 5 presents the equally weighted average returns in week t of the three-way sorted portfolios. Focusing on return portfolio one, we note that the returns of each of the portfolios is positive, consistent with a reversal in returns. Except for illiquidity portfolio one, the return difference between the turnover portfolio four and portfolio one is positive and significant. This return difference increases monotonically across the illiquidity portfolios from an insignificant 0.07% to 0.86% per week, suggesting that reversals increase with turnover and are much more pronounced when illiquidity is higher. Similarly, the return difference between illiquidity portfolios four and one increase across the turnover portfolios from an insignificant –0.09% to 0.65%. Once again, reversals increase with illiquidity and are more pronounced when turnover is higher. Also, in most cases, the return volatility is higher for the higher illiquidity and the higher turnover portfolios.

In regard to return portfolio four, 15 of the 16 returns are negative albeit significantly so in only four cases. Also, the reversal increases with illiquidity only for the highest turnover portfolio and with turnover only for the two high illiquidity portfolios. There is no reversal in return portfolio three. Return portfolio two does have reversals and the reversals increase with turnover across the illiquidity portfolios but the reversals do not increase with illiquidity across the turnover portfolios. We illustrate these reversals in Figure 2.

In sum, the large price changes occur in the high turnover portfolios and in portfolios with high illiquidity. CGW (1993) have suggested that non-informational or liquidity trades cause high turnover. Thus, the demand for liquidity from the non-informational trades combined with illiquidity causes large price changes. We conjecture that these large price changes in week $t-1$ should be reversed in week t as liquidity suppliers step in to profit from prices that temporarily deviate from fundamentals. We now check for reversals amongst the high turnover and the high illiquidity stocks in week t. The evidence in Table 5 supports our conjecture. Also, the reversal is weaker for the

winner portfolios than for the loser portfolios. While there is clear evidence of reversals increasing with turnover and illiquidity in the extreme loser portfolio, this evidence is weaker for the extreme winner portfolio. Overall, the reversals are consistent with liquidity stresses and this evidence is stronger for the loser portfolios.

3.3.1 Number of stocks and non-synchronous trading

Next, we must ensure that our results are robust to the following two important considerations:

1. Number of stocks in each portfolio.
2. Non-synchronous trading.

Since we are following a strategy of independently sorting stocks into return-turnover-illiquidity portfolios, it is possible that some of these portfolios may end up with a few or no stocks. Recall that we need a stock to trade for at least two days each week before it is included in the 2,111-week sample. Not all stocks have trades on at least two days each week. This lack of trading along with independent sorting can result in some portfolios with no stocks during some weeks. We find that the most problematic portfolio in Table 5 is the loser portfolio with the lowest turnover and the lowest illiquidity. For this portfolio, out of the possible 2,111 weeks, 764 weeks have no stocks. The other problematic portfolio is the winner portfolio with the lowest turnover and the lowest illiquidity. For this portfolio, 553 weeks have no stocks. Given that most of the reversal takes place in the high turnover, high illiquidity portfolios, these missing weeks are not problematic for our reversal results. The high turnover, high illiquidity loser portfolio has only three weeks with no stocks and the high turnover, high illiquidity winner portfolio has only four weeks without stocks. We will also confirm our results using the relative strength strategies that do not have any missing weeks.

Next, non-synchronous trading can lead to erroneous results for two reasons. The first is attributable to misclassification of stocks due to non-trading during the formation week $t-1$ and the second is attributable to mismeasurement in the week t. Consider the misclassification error first and imagine a situation in which the market declines strongly in the first two days of week $t-1$ and then rises strongly over the rest of the week. If a stock (with a positive beta) traded only during the first two days of the week and had large negative returns it would be classified as a loser stock even though had it

traded later in the week it would have had positive returns. Even if the market return is zero over week t the stock's return will be strongly positive if it trades during week t. This situation would result in a reversal. Thus, non-synchronous trading can lead to misclassification errors and stock returns could erroneously exhibit negative serial correlations.

Turning to measurement period returns in period t, consider a situation in which the market return is negative in week $t-1$; the return is positive during the first two days of week t but becomes negative over the rest of week t so that the overall return in week t is negative. If a stock trades on all days of week $t-1$ and only on the first two days of week t then it will be correctly classified as a loser stock in week $t-1$. This stock will exhibit negative serial correlation even if it would not have exhibited a reversal in returns had it traded on the other days of week t. Thus, non-synchronous trading could erroneously result in reversals.

To ensure that our results are not being contaminated by non-synchronous trading, we reran our entire analysis using only stocks that traded on each and every day of the week. A stock that did not trade on any day of a given week was dropped from the sample for that week and the next week to ensure that there would be no misclassification or mismeasurement errors. The unreported results remain essentially unchanged. For instance, amongst the loser stocks in the highest illiquidity portfolio the difference in returns between the high turnover and the low turnover stocks is 1.16% compared to 1.08% in Table 5 and amongst the winner stocks in the highest illiquidity portfolio the difference in returns between the high turnover and the low turnover stocks is –0.17% compared to –0.26% in Table 5

In sum, non-synchronous trading is not the source of return reversals in individual stocks at the weekly frequency. This conclusion is consistent with Foerster and Keim (2000) who report that the likelihood of a NYSE-AMEX stock going without trading for two consecutive days is 2.24%. Of course, it is possible that non-trading within the day could lead to misclassification and mismeasurement errors, but we do not expect these high frequency intra-day non-trading issues to be severe enough to impact serial correlations at the weekly or monthly frequency.

We also checked for the presence of seasonalities in the serial correlation patterns of returns. Upon replicating Table 5, with all weeks in January eliminated, we find that there is more reversal in the winner portfolios. Except for the lowest turnover winner portfolio, low liquidity stocks reverse more than high liquidity stocks and amongst the

two highest illiquidity portfolios, high turnover stocks reverse more than low turnover stocks. For instance, in the highest illiquidity portfolio the difference in returns between the high turnover and the low turnover stocks is –0.42% compared to –0.26% in Table 5. Therefore, reversals for the extreme winner portfolio returns are stronger for the February through December months. The results (while still significant) are weaker for the loser stocks. For instance, in the highest illiquidity portfolio the difference in returns between the high turnover and the low turnover stocks is 0.83% compared to 1.08% in Table 5.

3.3.2 Are the high turnover, low liquidity stocks really different?

Tables 4 and 5 as well as Figures 1 and 2 show that stocks facing the most price pressure in week $t-1$ reverse the most in week t. However, from only this evidence it is not clear whether we learn anything more than that individual stocks have negative serial correlations at the weekly frequency. Given the negative serial correlation, it may not be surprising that stocks that have higher (lower) returns in week $t-1$ will, on average, have lower (higher) returns in week t. Are the high turnover, highly illiquid stocks really different? Do these stocks reverse more than the low turnover, more liquid stocks?

To address these questions, we estimate cross-sectional regressions similar to those in Jegadeesh (1990). We estimate the following equation for various turnover or/and liquidity groups at the weekly frequency:

$$R_{it} = \alpha_t + \beta_t \; R_{it-1} + \epsilon_{it} \; . \tag{2}$$

If the various turnover/liquidity groups are not different then the slope coefficient β in the above equation will be similar across the groups.

Table 6 presents the Fama-Macbeth coefficients from the cross-sectional regressions. The time-series average of β based on all stocks in the sample is –0.049 confirming the fact that in the cross-section stocks with higher (lower) returns in week $t-1$ have lower (higher) returns in week t. Panel B (C) presents the coefficients for stocks sorted by turnover (illiquidity). The average β for the lowest turnover (illiquidity) stocks is –0.031 (–0.042), while for the highest turnover (illiquidity) stocks it is –0.052 (–0.057). Thus, high turnover, less liquid stocks are more negatively autocorrelated than the low turnover, more liquid stocks. The same pattern is observed in Panel D when simultaneously sorting on turnover and illiquidity. Consider the highest turnover stocks. The

average beta from equation 2 increases monotonically from –0.036 to –0.073 with illiquidity. A similar increase with turnover is observed for the most illiquid stocks.

We conclude that high turnover, low liquidity stocks are indeed different from low turnover, high liquidity stocks in their reversal patterns – they are more negatively autocorrelated. Thus, the reversals in Table 5 do not simply represent one uniform negative serial correlation. The reversals result from the fact that the high turnover, low liquidity stocks face the most price pressure in week $t-1$ *and* also have the most negative serial correlations.

If the negative serial correlation patterns in individual stocks are more pronounced for stocks with higher turnover and higher illiquidity then we should observe higher reversals with strategies that overweight the high turnover and the high illiquidity stocks. Next, we study the so-called relative strength strategies.

3.4 Relative Strength Strategies

Thus far, we have calculated equally weighted average returns for each of our portfolios. We now follow the relative strength strategy of Lehmann (1990), Lo and MacKinlay (1990), and Conrad, Hameed, and Niden (1994), which puts heavier weights on stocks with the extreme returns, turnover, and illiquidity.

We start with a return-based weighting strategy by which the winner and the loser portfolios are formed by assigning the following weights to stock i in week t:

$$w_{pit} = \frac{R_{it-1}}{\sum_{i=1}^{N_p} R_{it-1}}, \quad p = W, L, \tag{3}$$

where N_p represents the number of stocks in the winner (W) or loser (L) portfolio. A stock is a winner (loser) if its return in week $t-1$ was positive (negative). The weights are all positive and sum to one for each portfolio. This relative strength strategy is designed to put more weight on the extreme winner and loser stocks in week $t-1$.

Panel A of Table 7 presents the returns in week t from the one-way return based sorts in week $t-1$. The winner (loser) portfolio has a return of –0.25% (0.56%) with a standard deviation of 2.15% (2.42%). Clearly, there is reversal in weekly returns for both the winner and the loser portfolio. A zero investment strategy that is long in the loser portfolio and is short in the winner portfolio yields a statistically and economically significant 0.82% per week. Observe in Table 2 that the equally weighted strategy yields

trading profits (not accounting for transactions costs) that are far lower. In fact, there is no reversal in the equally weighted winner portfolio, which suggest that the reversal occurs in stocks with the extreme returns.

We now turn to two-way sorts based on returns and either turnover or illiquidity. The portfolios are classified as winners and losers based on returns and as high and low based on either turnover or illiquidity. The weight on stock i in week t for each of the four portfolios is as follows:

$$w_{pit} = \frac{R_{it-1}S_{it-1}}{\sum_{i=1}^{N_p} R_{it-1}S_{it-1}}, \quad p = WH, WL, LH, LL, \tag{4}$$

where S_{it-1} represents either the illiquidity or the turnover of stock i in week $t-1$ less the corresponding cross-sectional median of illiquidity or turnover in week $t-1$. N_p is the number of stocks in each of the four portfolios formed by the two-way sort between winners (W) and losers (L), and high (H) and low (L) turnover or illiquidity. High and low turnover or illiquidity is defined as being higher or lower than the cross-sectional median in week $t-1$.

Panel B of Table 7 presents the results for the two-way sorts with weighting criteria based on returns alone as in equation (3) or based on returns and turnover or returns and illiquidity as in equation (4). First consider the two-way sorts of returns and turnover when the weighting criterion is based on returns alone. The high (low) turnover winner portfolio has a return in week t of –0.32% (–0.11%). Thus, both the high and the low turnover winner portfolios exhibit reversals, but the reversal is larger for the higher turnover portfolio as suggested by CGW (1993). A zero investment portfolio that is long (short) the low (high) turnover winner portfolio has a weekly return of –0.21%. In the case of the loser portfolio, the zero investment strategy yields 0.34% with the high turnover portfolio exhibiting higher reversals. The reversals are stronger (–0.29% for the winner portfolio and 0.47% for the loser portfolio) when the weighting criterion is both return and turnover, suggesting that turnover has an impact on reversals in excess of that of return. Observe from Table 3 that equal weighting produces weaker reversals.

The results are remarkably similar when sorting on returns and illiquidity. In fact, the results are stronger for the two-way sorts based on returns and illiquidity than those for returns and turnover. There is more reversal for the high illiquidity portfolios. When the weighting criterion is returns alone, the winner (loser) portfolio has a zero investment return of –0.29% (0.27%). These payoffs are –0.36% (0.50%) when the weighting criterion is based on returns and illiquidity as shown in equation (4), once again suggesting that

illiquidity has an important impact on the serial correlation pattern of individual stock returns.

We now turn to three-way sorts based on returns, turnover, and illiquidity. The weight on stock i in week t for each of the eight portfolios is as follows:

$$\begin{aligned} w_{pit} &= \frac{R_{it-1}T_{it-1}L_{it-1}}{\sum_{i=1}^{N_p} R_{it-1}T_{it-1}L_{it-1}}, \\ p &= WHH, WHL, WLH, WLL, LHH, LHL, LLH, LLL, \end{aligned} \tag{5}$$

where T_{it-1} (L_{it-1}) represents the turnover (illiquidity) of stock i in week $t-1$ less the corresponding cross-sectional median of turnover (illiquidity) in week $t-1$. N_p represents the number of stocks in each of the eight portfolios formed by the three-way sort between winners and losers, and high and low turnover and illiquidity. The results are presented in Panel C of Table 7 for different weighting criteria.

Consider the first set of results for winner stocks with high turnover. For these stocks, high illiquidity results in considerable reversal of returns regardless of the weighting criterion. For instance, the week t return is –0.95% when the weighting criterion is based on returns, turnover, and illiquidity as in equation (5). The return for the low illiquidity portfolio is insignificantly different from zero for the same weighting criterion. A zero investment winner and high turnover portfolio that is long stocks with low illiquidity and short stocks with high illiquidity shows significant reversals. Weighting by all three characteristics results in a zero investment portfolio return of –0.86% per week. The different weighting criteria reveal that both illiquidity and turnover considerably contribute to the reversal in returns with a larger impact of illiquidity. While the return of the zero investment portfolio with weighting based on equation (5) is the largest, the return volatility as measured by the standard deviation of weekly returns is also the largest.

The reversal for the low turnover winner stocks is lower than that for the high turnover winners. For the low turnover winners, a zero investment portfolio that is long the low illiquidity stocks and short the high illiquidity stocks results in an average weekly return of only 0.16% with a standard deviation of 2.62%. Liquidity is also an important driver of reversals for the winner portfolio. A zero investment portfolio of high illiquidity winners that is long the low turnover stocks and short the high turnover stocks has a week t return that ranges from 0.38% to 0.76% when the weighting criterion is based on equations (3) and (5), respectively. The comparable returns for the low illiquidity

stocks are a marginally significant 0.05% and a statistically insignificant 0.06%.

The lower half of Panel C of Table 7 presents the week t returns for the loser stocks as of week $t-1$. The reversals for the loser stocks are all statistically significant and are larger than those for the winner stocks under each and every scenario. High turnover loser stocks have higher reversals than the low turnover loser stocks. With the weighting criterion as in equation (5), the zero investment portfolio composed of high (low) turnover loser stocks, that is long on the high illiquidity and short on the low illiquidity stocks has a week t return of 1.39% (0.25%) with a standard deviation of 6.21% (2.38%). High illiquidity loser stocks also have higher reversals than the low illiquidity loser stocks. With the weighting criterion as in equation (5), the zero investment portfolio composed of high (low) illiquidity loser stocks, that is long on the high turnover and short on the low turnover stocks has a week t return of 1.29% (0.14%) with a standard deviation of 6.13% (2.11%).

A final point to note in Panel C of Table 7 is that the reversal patterns are in general weaker when the week t stock returns are equally weighted. In fact, there is no reversal in the winner portfolios and, though present in the loser portfolios, the reversal patterns are weaker than those based on the other weighting schemes. Also the return volatilities with an equal weighting scheme are substantially smaller. Observe that the results from the relative strength strategies are stronger than those presented in Table 5 when the portfolios are formed by equally weighting the stocks within the various portfolios. These findings support our argument that the return reversals are stronger for stocks with extreme returns, trading volumes, and illiquidity values.

The relative strength strategies yield profits as high as 1.76% per week in the case of a high turnover, high illiquidity, loser portfolio with a weighting scheme as in equation (5). Since this return obtains when there are extreme price movements due to stresses in the market for liquidity, a profitable trading strategy is likely to incur high market impact costs. Also, the return volatility of the above strategy is 6.43%. In other words, while the profits seem high the risk as measured by volatility is also high and the transaction costs are likely to be high due to weekly rebalancing and due to the overweighting of the highly illiquid stocks.

3.5 Return Reversals at the Monthly Frequency

We have confined all our analysis thus far to weekly returns. Jegadeesh (1990) also documents negative serial correlations in the cross-section of monthly returns; we now focus on the monthly frequency to check whether the impact of turnover and illiquidity continues to hold. The results are presented in Table 8, which is the monthly equivalent of Table 7.[6]

Panel A reports the week t returns from one-way sorts using returns in week $t-1$ as per equation (3). While the winner portfolio continues to have positive, albeit statistically insignificant, returns in week t, the loser portfolio exhibits an average monthly return of 1.18%. A portfolio that is long the loser stocks and short the winner stocks returns 0.95% with a standard deviation of 3.43%. When an equally weighted weighting criterion is used, the zero investment portfolio has a lower return of 0.49% with a lower standard deviation of 2.07%. Also, with the equally weighted criterion, the winner portfolios continue to perform well and have a monthly return of 0.65%. Thus, the reversal at the monthly frequency is observed for the loser stocks alone and this reversal in the loser stocks is large enough so that individual stock returns exhibit negative autocorrelations in the cross-section.

Turning now to the two-way sorts based on returns and turnover or returns and illiquidity as in equation (4), we note that the high or low turnover winner portfolios exhibit no reversal; in fact, stocks in both these portfolios exhibit continuation when equally weighted. The loser portfolios when sorted on turnover do exhibit reversals, but, contrary to CGW (1993), the reversal is larger in the low turnover portfolio than in the high turnover portfolio. These results are the opposite of those at the weekly frequency. On the other hand, except for the continuation in the case of the low illiquidity winners, the results when sorting on returns and illiquidity are consistent across the two different frequencies – weekly and monthly.

Panel C of Table 8 presents the results for the three-way sorts based on returns, turnover, and illiquidity. There is reversal in the high turnover winners with high illiquidity but only when the weighting criterion includes illiquidity. The high turnover, low illiquidity winners exhibit continuations regardless of the weighting criterion. The same result obtains in the case of the low turnover winners. With the weighting criterion based on returns and illiquidity as per equation (4), a zero investment high (low) turnover,

[6]To conserve space we present only the relative strength strategy results at the monthly frequency.

winner portfolio that is long on low illiquidity stocks and short on high illiquidity stocks has an average monthly return of 1.79% (1.64%) with a standard deviation of 7.70% (6.40%). Moreover, there is no reversal in the zero investment high (low) liquidity winner portfolio that is long on high turnover stocks and short on low turnover stocks. At the monthly frequency, turnover does not contribute to the negative serial correlation in the winner portfolios.

Turning to the loser portfolios, we observe reversals. However, the differences in the reversals between the high and low illiquidity portfolios are confined to the high turnover losers. For instance, with the weighting criterion as in equation (5), the zero investment high turnover, loser portfolio that is long the high illiquidity stocks and short the low illiquidity stocks has a return of 2.49% with a standard deviation of 9.83%. Finally, the high turnover stocks exhibit more reversals (continuations) than the low turnover stocks for the high (low) illiquidity losers.

Overall, at the monthly frequency the negative serial correlation results are weaker for sorts based on turnover, suggesting that the liquidity demands of the non-informational traders are accommodated at the monthly frequency. Recall that at the weekly frequency these non-informational demands lead to reversals, as suggested by CGW (1993). These two results suggest that high turnover represents a demand for liquidity from uninformed traders at only the weekly frequency. At the monthly frequency, high turnover does not seem to reflect demands for liquidity.

Contrary to the results for turnover, the impact of liquidity on the serial correlation patterns of individual stock returns continues to be strong at the monthly frequency. This result is consistent with the conjecture that stresses in the market for liquidity lead to large price movements that are subsequently reversed as liquidity suppliers step in to profit from prices that diverge from fundamental values.

3.6 Transaction Costs

Table 5 shows that the potential profits from a short-run contrarian strategy can be large. For instance in the case of the extreme loser portfolio with high turnover and high illiquidity, the equally weighted contrarian strategy return is 1.08% per week. However, this portfolio has the highest volatility (4.15% per week) and, since this is the highest illiquidity portfolio, we suspect that transaction costs may render any trading strategy unprofitable. We now examine transaction costs.

Table 9 presents descriptive statistics about the various three-way sorted portfolios in Table 5.[7] Upon holding turnover constant, the weekly dollar trading volume decreases monotonically with illiquidity. The dollar trading volume for the lowest illiquidity portfolio is orders of magnitude larger than that of the highest illiquidity portfolio. For instance, for the extreme loser portfolio with the highest turnover, the dollar trading volume for the lowest (highest) illiquidity portfolio is \$4.24 million (\$0.04 million) per week. Consequently, the illiquidity measure in the lowest quartile is 0.01 and that for the highest quartile is 4.18, which is about four hundred times higher. The differences in turnover are not as stark, especially for the higher turnover portfolios. In sum, the high illiquidity portfolios have liquidity that is, in general, orders of magnitude smaller than that of the low illiquidity portfolios. The high illiquidity portfolios have low average weekly trading volumes and have stocks in the lowest size quintiles, as opposed to the low illiquidity portfolios that have high trading volumes and stocks in the fourth or fifth highest size quintiles as per NYSE breakpoints.[8]

Table 10 presents the bid-ask spread and the depths of the various three-way sorted portfolios. We obtained the data as daily averages of transaction prices and quotes from ISSM and TAQ for NYSE stocks over the period 1988 through 2002.[9] The sample selection, quote and trade matching, and filtering rules are the same as in Chordia, Roll, and Subrahmanyam (2001). Focusing once again on the extreme loser portfolios with the highest turnover, we note that the proportional effective spread increases from 0.39% for the lowest illiquidity portfolio to 3.18% for the highest illiquidity portfolio. The quoted depth also declines from 8,670 to 5,820 shares. Except for the lowest illiquidity portfolio, the effective spread is larger than the potential trading profits from a contrarian strategy. For instance, the potential profit of 1.08% for the loser portfolio with the highest turnover and illiquidity seems to be swamped by the proportional effective spread of 3.18%. However, institutional investors carefully watch transactions costs. They choose trade size and spread out their trades over days so as to minimize trading costs. Therefore, the proportional spread of 3.18% may be an overstatement. To obtain more precise estimates of institutional trading costs, we turn to Keim and Madhavan (1997) (henceforth KM).

[7]These descriptive statistics are for the post-formation week. At least part of the round-trip trading costs are incurred in the formation week and it is perhaps more relevant to check the descriptive statistics in the formation period. However, by design, the differences in the high and low turnover or high and low liquidity are even more stark in the formation periods and, as such, we are being conservative in our estimates of the transaction costs by basing them on the statistics from the post-formation week.

[8]NYSE breakpoints were obtained from the data library at Ken French's website. See http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/.

[9]This data sample is not the same sample as in the rest of the paper, but is indicative of the relative transaction costs.

KM (1997) provide estimates of market impact as well as commission costs for buy and sell trades for NYSE-AMEX stocks (as well as NASDAQ stocks) traded by 21 large institutions during 1991 to 1993. Their transaction cost data is categorized by trade size as well as by firm size. We will focus on the smallest trade sizes to minimize trading costs. We will also use the various size classifications from Table 9. Once again, we focus on the extreme loser portfolio because the potential profits are the highest for these portfolios. Consider the lowest turnover, lowest illiquidity portfolio that has a contrarian trading profit of 0.37% per week. The stocks in this portfolio belong to the largest size quintile. According to KM, the cost of a small buy trade in the largest size quintile is 0.31%, and the cost of a small sell trade in the same size quintile is 0.21% for a total round-trip cost of 0.52%. This cost is larger than the potential profit of 0.37%. Since most of the potential trading profits in the low illiquidity portfolios are lower than 0.52%, we now turn to the high illiquidity, high turnover portfolio. The average size quintile corresponding to this portfolio is 1.18. Interpolating between the two lowest size quintiles we find that cost of a small buy trade is 0.39%, and the cost of a small sell trade is 0.76% for a total round-trip cost of 1.15%. This cost once again is larger than the potential profit of 1.08%.

The above transaction costs may actually be understated because KM (1997) use data for trades that were actually consummated. If some trades were abandoned due to high transactions costs then the KM trading costs would be biased downwards. The other reason why the above costs for the high illiquidity, high turnover stocks may be understated is because we considered only the smallest trade sizes. KM show that institutional traders infrequently trade the smallest sizes. When considering the next larger trade sizes the round-trip transaction cost for the high illiquidity, high turnover stocks becomes 2.45%. This transaction cost is comparable to the potential profits from a trading strategy that exploits the serial correlation patterns in individual stock returns at the monthly frequency. Jegadeesh (1990) documents potential profits from a trading strategy at the monthly frequency to be 2.49% per month.

The overall conclusion from an analysis of bid-ask spreads, depths, and institutional transactions costs is that the potential contrarian trading profits are not attainable after accounting for transactions costs. The main reason is that the largest potential profits are obtained in the highly illiquid stocks that have high trading costs.

4 Conclusions

Stock returns can be predictable at low frequencies due to time variation in expected returns that is consistent with rational pricing. However, predictability at high frequencies, such as stock return reversals, presents a serious challenge to the efficient market hypothesis, because stock prices are likely to follow a martingale process over short horizons. Short-run changes in fundamental values should be negligible in efficient markets with random information arrival. High frequency price reversals have been explained within a rational paradigm by CGW (1993). In their model, trading volume plays an important role in identifying price changes due to public information or due to exogenous selling pressure by non-informational trades. Non-informational trading causes price movements that revert prices when absorbed by liquidity suppliers. Such non-informed trading is accompanied with high trading volume, whereas informed trading, which does not lead to reversals, is accompanied with little trading volume. Thus, price changes accompanied with high trading volume should revert, whereas those accompanied with low trading volume should not revert. Empirical support for this model has been provided by Conrad, Hameed, and Niden (1994) based on a sample of NASDAQ stocks. However, based on a sample of large NYSE-AMEX stocks Cooper (1999) finds evidence contrary to the predictions of this model.

This paper incorporates the dimension of illiquidity into the investigation of the serial correlation patterns of individual stock returns. This is motivated by the CGW (1993) paradigm which implicitly assumes downward sloping demand curves for stocks. If demand curves were perfectly elastic, there would be no impact of trades on prices and subsequent price reversals would not occur. With downward sloping demand curves, however, price reversals should follow liquidity or non-informational trading. Stocks that are more illiquid should experience stronger reversals. Indeed, we show that liquidity plays an important role in understanding the autocorrelation patterns in stock returns. Here is a summary of our findings: (i) There is reversal in weekly and monthly stock returns but it is mainly confined to the loser stocks, especially at the monthly frequency; (ii) At the weekly frequency, high turnover stocks exhibit higher negative serial correlations than low turnover stocks; (iii) At the monthly frequency the impact of turnover on autocorrelations is the opposite of that at the weekly frequency – low turnover stocks exhibit more reversals than high turnover stocks; (iv) Controlling for turnover, there is more reversal in stocks with low liquidity than in the highly liquid stocks and this pattern is the same across the weekly and the monthly frequency; (v) The high turnover,

low liquidity stocks have more negative serial correlations and the potential contrarian trading strategy profits are the highest for these stocks.

These findings accord with the hypothesis that extreme price changes occur in stocks with low liquidity and in the high turnover stocks, where the demand for liquidity from uninformed traders is high. The largest price reversals occur in precisely these high volume, low liquidity stocks as the initial price changes are reversed. Thus, the high frequency negative autocorrelations are more likely to result from stresses in the market for liquidity. A high frequency trading strategy that attempts to profit from the negative serial correlations has high transactions costs and substantial price impact. Consequently, while the presence of negative autocorrelations in individual security returns is undeniable, it is not possible to profit from this short-run predictability. This lack of profitability and the fact that the overall findings are consistent with the rational paradigm of CGW (1993) suggest that the violation of the efficient market hypothesis due to short term reversals is not so egregious after all.

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Table 1: Descriptives

This table presents descriptive statistics on the sample. Returns are in percent per week, turnover is daily turnover in percent, illiquidity is computed using the Amihud measure and is expressed as daily illiquidity (multiplied by 10^6). All returns are based on skip-day methodology in which the return on the last day of the week is not used in computations. The sample period is 1962 to 2002 and the portfolios include all NYSE/AMEX stocks that have data for at least two days of the week.

Panel A: Time-series averages of cross-sectional (across stocks) statistics

	Mean	Median	StdDev
Returns	0.17	-0.14	5.31
Turnover	0.227	0.137	0.443
Amihud	3.125	0.245	14.661

Panel B: Time-series averages of cross-sectional correlations

	Returns	Turnover	Amihud
Returns	1	0.125	-0.024
Turnover	0.125	1	-0.077
Amihud	-0.024	-0.077	1

Panel C: Cross-sectional averages of time-series (for one stock) statistics

	Mean	Median	StdDev
Returns	0.14	-0.16	6.26
Turnover	0.272	0.174	0.369
Amihud	4.385	1.745	8.439

Table 2: Return-Sorted Portfolios: Descriptives

Equal-weighted portfolios are formed every week by only sorting on returns. Portfolio 1 and 2 are loser (negative return) portfolios while portfolios 3 and 4 are winner (positive return) portfolios. Breakpoints are determined by the median return for both positive and negative lagged returns. Returns are in percent per week, turnover is daily turnover in percent, illiquidity is computed using the Amihud measure and is expressed as daily illiquidity (multiplied by 10^6). All returns are based on skip-day methodology in which the return on the last day of the week is not used in computations. Stars indicate significance of means at 99%, 95%, and 90% level. The sample period is 1962 to 2002 and the portfolios include all NYSE/AMEX stocks that have data for at least two days of the week.

	Portfolio			
	1	2	3	4
Lagged Return	–5.69***	–1.42***	0.75***	6.11***
Lagged Turnover	0.225	0.162	0.162	0.292
Lagged Illiquidity	3.109	0.787	1.404	2.012
Return	0.47***	0.14***	0.17***	–0.05
Turnover	0.230	0.184	0.181	0.253
Illiquidity	2.960	0.803	1.686	1.939
Number of Stocks	485	482	550	553

Table 3: Two-Way Sorted Portfolios: Post-Formation Returns

This table presents portfolio means and standard deviations in the post-formation week. Equal-weighted portfolios are formed every week. The sorts are based on returns/turnover and returns/illiquidity. Return breakpoints are determined by the median return for both positive and negative lagged returns. Breakpoints for turnover and illiquidity are based on quartile breakpoints. Returns are in percent per week and are based on skip-day methodology in which the return on the last day of the week is not used in computations. Stars indicate significance of means at 99%, 95%, and 90% level. The sample period is 1962 to 2002 and the portfolios include all NYSE/AMEX stocks that have data for at least two days of the week.

	Return Portfolio			
	1	2	3	4
Turnover				
1	0.21***	–0.00	0.07**	–0.02
	2.00	1.45	1.44	1.69
2	0.43***	0.15***	0.15***	–0.01
	2.27	1.82	1.76	1.92
3	0.56***	0.22***	0.25***	–0.02
	2.58	2.17	2.10	2.13
4	0.64***	0.29***	0.28***	–0.09**
	2.96	2.57	2.47	2.51
4–1	0.43***	0.29***	0.22***	–0.07**
	1.73	1.53	1.48	1.53
Illiquidity				
1	0.42***	0.19***	0.11***	–0.02
	2.59	1.98	1.78	2.13
2	0.45***	0.17***	0.19***	–0.05
	2.64	2.02	1.93	2.23
3	0.47***	0.13***	0.20***	–0.07*
	2.60	1.96	1.93	2.16
4	0.51***	0.06*	0.22***	–0.07*
	2.41	1.81	1.98	2.13
4–1	0.09**	–0.13***	0.12***	–0.05*
	1.91	1.41	1.28	1.65

Table 4: Three-Way Sorted Portfolios: Lagged Returns

This table presents means and standard deviations in the formation week. Equal-weighted portfolios are formed every week. The sorts are based on returns, turnover, and illiquidity. Return breakpoints are determined by the median return for both positive and negative lagged returns. Breakpoints for turnover and illiquidity are based on quartile breakpoints. Returns are in percent per week and are based on skip-day methodology in which the return on the last day of the week is not used in computations. Stars indicate significance of means at 99%, 95%, and 90% level. The sample period is 1962 to 2002 and the portfolios include all NYSE/AMEX stocks that have data for at least two days of the week.

	Return Portfolio=1					Return Portfolio=2				
	Illiquidity					Illiquidity				
Turnover	1	2	3	4	4–1	1	2	3	4	4–1
1	–3.74***	–3.98***	–4.33***	–5.55***	–1.71***	–1.10***	–1.24***	–1.35***	–1.52***	–0.43***
	1.36	1.47	1.43	1.53	0.95	0.58	0.56	0.56	0.59	0.38
2	–3.84***	–4.23***	–4.84***	–6.32***	–2.48***	–1.23***	–1.37***	–1.51***	–1.67***	–0.43***
	1.38	1.45	1.55	1.78	1.07	0.60	0.63	0.65	0.67	0.27
3	–4.16***	–4.67***	–5.51***	–7.19***	–3.03***	–1.32***	–1.45***	–1.58***	–1.71***	–0.39***
	1.45	1.57	1.74	2.19	1.50	0.66	0.68	0.69	0.74	0.33
4	–5.45***	–6.21***	–7.32***	–9.15***	–3.70***	–1.38***	–1.51***	–1.62***	–1.78***	–0.38***
	1.80	1.97	2.37	3.35	2.80	0.67	0.69	0.70	0.84	0.43
4–1	–1.69***	–2.20***	–2.99***	–3.60***	–4.73***	–0.29***	–0.27***	–0.27***	–0.24***	–0.67***
	1.09	1.21	1.55	2.69	2.30	0.39	0.26	0.27	0.44	0.58

	Return Portfolio=3					Return Portfolio=4				
	Illiquidity					Illiquidity				
Turnover	1	2	3	4	4–1	1	2	3	4	4–1
1	0.35***	0.80***	0.80***	0.65***	0.30***	3.27***	3.53***	4.00***	5.36***	1.97***
	0.35	0.44	0.45	0.45	0.34	1.46	1.46	1.48	1.76	1.21
2	0.73***	0.86***	0.78***	0.57***	–0.16***	3.48***	3.96***	4.70***	6.71***	3.23***
	0.48	0.51	0.51	0.51	0.23	1.37	1.49	1.67	2.38	1.70
3	0.82***	0.87***	0.75***	0.54***	–0.28***	3.90***	4.56***	5.67***	8.39***	4.49***
	0.53	0.54	0.54	0.53	0.29	1.51	1.63	2.01	3.21	2.50
4	0.88***	0.87***	0.75***	0.53***	–0.34***	5.59***	6.95***	9.10***	13.35***	7.75***
	0.53	0.54	0.58	0.60	0.40	1.87	2.16	3.01	5.73	5.15
4–1	0.52***	0.07***	–0.04***	–0.12***	0.17***	2.41***	3.42***	5.11***	7.99***	9.25***
	0.41	0.24	0.27	0.40	0.49	1.23	1.38	2.15	4.92	4.34

Table 5: Three-Way Sorted Portfolios: Post-Formation Returns

This table presents means and standard deviations in the post-formation week. Equal-weighted portfolios are formed every week. The sorts are based on returns, turnover, and illiquidity. Return breakpoints are determined by the median return for both positive and negative lagged returns. Breakpoints for turnover and illiquidity are based on quartile breakpoints. Returns are in percent per week and are based on skip-day methodology in which the return on the last day of the week is not used in computations. Stars indicate significance of means at 99%, 95%, and 90% level. The sample period is 1962 to 2002 and the portfolios include all NYSE/AMEX stocks that have data for at least two days of the week.

	Return Portfolio=1					Return Portfolio=2				
	Illiquidity					Illiquidity				
Turnover	1	2	3	4	4–1	1	2	3	4	4–1
1	0.37***	0.22***	0.17***	0.22***	–0.09	0.06*	0.07**	0.03	–0.05*	–0.12***
	2.76	2.48	2.19	2.21	2.80	1.98	1.63	1.61	1.64	1.85
2	0.38***	0.38***	0.37***	0.52***	0.14**	0.14***	0.16***	0.15***	0.19***	0.05
	2.53	2.40	2.49	2.63	2.57	1.87	1.94	2.11	2.40	2.08
3	0.43***	0.44***	0.52***	0.78***	0.34***	0.22***	0.21***	0.22***	0.22***	–0.01
	2.58	2.73	2.91	3.23	2.78	2.14	2.34	2.63	3.49	3.12
4	0.44***	0.55***	0.73***	1.08***	0.65***	0.28***	0.29***	0.34***	0.38***	0.08
	3.02	3.16	3.49	4.15	3.77	2.54	2.89	3.36	5.62	5.35
4–1	0.07	0.31***	0.56***	0.86***	0.68***	0.22***	0.22***	0.31***	0.46***	0.24**
	2.85	2.40	2.43	3.41	3.91	1.99	1.97	2.53	5.25	5.19

	Return Portfolio=3					Return Portfolio=4				
	Illiquidity					Illiquidity				
Turnover	1	2	3	4	4–1	1	2	3	4	4–1
1	–0.03	0.10***	0.11***	0.08**	0.11***	–0.10**	–0.07**	–0.04	–0.02	0.05
	1.73	1.54	1.56	1.75	1.49	2.38	1.94	1.81	2.01	2.45
2	0.10**	0.14***	0.16***	0.26***	0.16***	–0.05	–0.06	–0.03	0.00	0.05
	1.78	1.81	2.00	2.44	1.98	1.96	2.06	2.15	2.43	2.15
3	0.16***	0.27***	0.31***	0.44***	0.28***	–0.03	–0.05	–0.02	–0.02	0.01
	2.00	2.26	2.55	3.34	2.81	2.09	2.27	2.43	2.87	2.42
4	0.20***	0.30***	0.37***	0.70***	0.49***	–0.02	–0.04	–0.15**	–0.26***	–0.24***
	2.41	2.78	3.24	5.10	4.81	2.53	2.74	2.76	3.40	3.00
4–1	0.23***	0.20***	0.26***	0.61***	0.73***	0.05	0.02	–0.11**	–0.23***	–0.24***
	1.97	1.92	2.51	4.69	4.83	2.34	2.14	1.96	2.83	3.30

Table 6: Cross-Sectional Regressions

This table presents the average β in the following weekly cross-sectional Fama-Macbeth type regressions:

$$R_{it} = \alpha_t + \beta_t \, R_{it-1} + \epsilon_{it}.$$

t-statistics are given in parenthesis below the average coefficient. Separate regressions are run for different categories of stocks. Panel A is for all stocks; Panel B groups stocks by turnover, Panel C groups stocks by illiquidity, and Panel D groups stocks by turnover and illiquidity. Illiquidity is computed using the Amihud measure. All returns are based on skip-day methodology in which the return on the last day of the week is not used in computations. The sample period is 1962 to 2002 and all NYSE/AMEX stocks that have data for at least two days of the week are included.

Panel A: All

-0.049
(-31.39)

Panel B: Turnover		Panel C: Illiquidity	
1	-0.031	1	-0.042
	(-13.16)		(-14.88)
2	-0.047	2	-0.044
	(-21.41)		(-19.28)
3	-0.057	3	-0.052
	(-27.16)		(-25.50)
4	-0.052	4	-0.057
	(-29.19)		(-33.30)

Panel D: Turnover and Illiquidity

	Illiquidity			
Turnover	1	2	3	4
1	-0.027	-0.042	-0.027	-0.034
	(-0.89)	(-8.02)	(-7.91)	(-11.64)
2	-0.055	-0.055	-0.052	-0.052
	(-12.62)	(-16.56)	(-16.87)	(-17.23)
3	-0.066	-0.057	-0.058	-0.068
	(-18.70)	(-18.66)	(-20.13)	(-20.46)
4	-0.036	-0.044	-0.060	-0.073
	(-12.04)	(-17.32)	(-22.79)	(-23.10)

Table 7: Three-Way Sorted Portfolios: Relative Strength Strategies

This table presents portfolio returns in the post-formation week. Portfolios are formed every week. The sorts are based on returns, turnover, and illiquidity. Return breakpoints are determined by the median return for both positive and negative lagged returns. Breakpoints for turnover and illiquidity are based on quartile breakpoints. Weights on stock i in week t are based on

$$\begin{aligned} w_{pit} &= \frac{R_{it-1}T_{it-1}L_{it-1}}{\sum_{i=1}^{N_p} R_{it-1}T_{it-1}L_{it-1}}, \\ p &= WHH, WHL, WLH, WLL, LHH, LHL, LLH, LLL, \end{aligned}$$

where T_{it-1} (L_{it-1}) represents the turnover (illiquidity) of stock i in week $t-1$ and N_p is the number of stocks in each of the eight portfolios formed by the three-way sort between winners (W) and losers (L) and high (H) and low (L) turnover and illiquidity. The results are presented for different weighting criteria. Returns are in percent per week and are based on skip-day methodology in which the return on the last day of the week is not used in computations. Stars indicate significance of means at 99%, 95%, and 90% level. The sample period is 1962 to 2002 and the portfolios include all NYSE/AMEX stocks that have data for at least two days of the week.

Sorting Criterion			Weighting Criterion				
Return	Turnover	Illiquidity	Return	Return Turnover	Return Illiquidity	Return Turnover Illiquidity	Equal weight
Panel A: One-way sort							
W			-0.25**				0.06
			2.15				1.89
L			0.56**				0.31**
			2.42				2.11
L—W			0.82**				0.25**
			1.18				0.63
Panel B: Two-way sort							
W	H		-0.32**	-0.38**			0.06
			2.45	2.90			2.24
W	L		-0.11**	-0.09**			0.05
			1.83	1.77			1.61
W	H—L		-0.21**	-0.29**			0.01
			1.39	2.15			0.94
L	H		0.71**	0.77**			0.45**
			2.82	3.49			2.52
L	L		0.38**	0.30**			0.18**
			2.05	1.96			1.77
L	H—L		0.34**	0.47**			0.27**
			1.40	2.48			1.03
W		H	-0.37**		-0.43**		0.05
			2.26		3.07		1.96
W		L	-0.08*		-0.07		0.06
			2.22		2.19		1.93
W		H—L	-0.29**		-0.36**		-0.01
			1.41		2.70		0.90
L		H	0.66**		0.87**		0.34**
			2.50		2.90		2.16
L		L	0.39**		0.37**		0.28**
			2.49		2.47		2.18
L		H—L	0.27**		0.50**		0.06**
			1.38		2.48		1.03

Sorting Criterion			Weighting Criterion				
Return	Turnover	Illiquidity	Return	Return Turnover	Return Illiquidity	Return Turnover Illiquidity	Equal weight
			Panel C: Three-way sort				
W	H	H	-0.51**	-0.68**	-0.71**	-0.95**	0.05
			2.73	3.60	4.80	5.91	2.41
W	H	L	-0.10*	-0.11*	-0.08	-0.10	0.07
			2.44	2.83	2.40	2.80	2.23
W	H	H—L	-0.42**	-0.58**	-0.63**	-0.86**	-0.02
			1.84	3.08	4.45	5.73	1.14
W	L	H	-0.13**	-0.11**	-0.20**	-0.20**	0.06*
			1.99	1.91	2.99	2.91	1.74
W	L	L	-0.04	-0.04	-0.04	-0.04	0.03
			1.74	1.65	1.74	1.65	1.58
W	L	H—L	-0.09**	-0.07**	-0.16**	-0.16**	0.03
			1.33	1.33	2.68	2.62	0.87
W	H—L	H	-0.38**	-0.57**	-0.51**	-0.76**	-0.01
			1.80	3.03	4.74	5.98	1.08
W	H—L	L	-0.05*	-0.06	-0.05*	-0.06	0.04*
			1.31	1.98	1.29	1.96	0.98
L	H	H	0.96**	1.22**	1.52**	1.76**	0.60**
			3.17	4.85	4.73	6.43	2.73
L	H	L	0.45**	0.42**	0.42**	0.36**	0.36**
			2.74	3.23	2.71	3.19	2.49
L	H	H—L	0.51**	0.80**	1.10**	1.39**	0.24**
			1.92	4.16	4.28	6.21	1.27
L	L	H	0.41**	0.32**	0.62**	0.47**	0.20**
			2.19	2.08	2.83	2.73	1.89
L	L	L	0.26**	0.22**	0.26**	0.22**	0.17**
			1.96	1.86	1.94	1.84	1.78
L	L	H—L	0.15**	0.11**	0.36**	0.25**	0.02
			1.34	1.33	2.46	2.38	1.02
L	H—L	H	0.54**	0.90**	0.89**	1.29**	0.40**
			1.87	4.10	4.30	6.13	1.21
L	H—L	L	0.19**	0.20**	0.15**	0.14**	0.18**
			1.31	2.12	1.32	2.11	1.07

Table 8: Three-Way Sorted Portfolios: Relative Strength Strategies (Monthly Frequency)

This table presents portfolio returns in the post-formation month. Portfolios are formed every month. The sorts are based on returns, turnover, and illiquidity. Return breakpoints are determined by the median return for both positive and negative lagged returns. Breakpoints for turnover and illiquidity are based on quartile breakpoints. Weights on stock i in week t are based on

$$\begin{aligned} w_{pit} &= \frac{R_{it-1}T_{it-1}L_{it-1}}{\sum_{i=1}^{N_p} R_{it-1}T_{it-1}L_{it-1}}, \\ p &= WHH, WHL, WLH, WLL, LHH, LHL, LLH, LLL, \end{aligned}$$

where T_{it-1} (L_{it-1}) represents the turnover (illiquidity) of stock i in week $t-1$ and N_p is the number of stocks in each of the eight portfolios formed by the three-way sort between winners (W) and losers (L) and high (H) and low (L) turnover and illiquidity. The results are presented for different weighting criteria. Returns are in percent per month and are based on skip-day methodology in which the return on the last day of the month is not used in computations. Stars indicate significance of means at 99%, 95%, and 90% level. The sample period is 1962 to 2002 and the portfolios include all NYSE/AMEX stocks that have data for at least ten days of the month.

Sorting Criterion			Weighting Criterion				
Return	Turnover	Illiquidity	Return	Return Turnover	Return Illiquidity	Return Turnover Illiquidity	Equal weight
Panel A: One-way sort							
W			0.23				0.65**
			5.60				5.20
L			1.18**				1.14**
			7.00				6.10
L—W			0.95**				0.49**
			3.43				2.07
Panel B: Two-way sort							
W	H		0.38	0.56*			0.73**
			6.09	6.81			5.88
W	L		-0.05	-0.04			0.55**
			4.90	4.81			4.57
W	H—L		0.42**	0.60**			0.18*
			2.81	4.28			2.24
L	H		1.16**	0.70*			1.18**
			7.79	8.47			7.01
L	L		1.21**	1.08**			1.10**
			6.33	6.10			5.45
L	H—L		-0.06	-0.39*			0.08
			3.21	4.69			2.63
W		H	-0.12		-1.27**		0.49*
			6.22		7.58		5.93
W		L	0.62**		0.64**		0.80**
			5.35		5.17		4.90
W		H—L	-0.74**		-1.90**		-0.31**
			3.37		5.90		2.92
L		H	1.25**		1.45**		1.15**
			7.55		8.63		6.73
L		L	0.92**		0.91**		1.05**
			6.48		6.32		5.65
L		H—L	0.34*		0.54*		0.10
			3.94		6.47		3.28

Sorting Criterion			Weighting Criterion				
Return	Turnover	Illiquidity	Return	Return Turnover	Return Illiquidity	Return Turnover Illiquidity	Equal weight
			Panel C: Three-way sort				
W	H	H	-0.00	0.37	-1.07**	-0.66	0.52
			7.01	8.19	9.11	11.07	6.97
W	H	L	0.69**	0.63**	0.72**	0.68**	0.88**
			5.83	6.73	5.63	6.49	5.53
W	H	H—L	-0.69**	-0.27	-1.79**	-1.34**	-0.36**
			4.14	5.96	7.70	9.81	3.56
W	L	H	-0.26	-0.23	-1.19**	-1.06**	0.50**
			5.56	5.43	7.56	7.55	5.29
W	L	L	0.45**	0.45**	0.44**	0.42**	0.70**
			4.27	4.15	4.22	4.12	4.09
W	L	H—L	-0.71**	-0.67**	-1.64**	-1.49**	-0.19
			3.49	3.47	6.40	6.43	3.01
W	H—L	H	0.26	0.59**	0.12	0.40	0.01
			3.69	5.80	7.30	9.63	2.94
W	H—L	L	0.24*	0.19	0.28**	0.25	0.18
			3.04	4.65	2.94	4.53	2.42
L	H	H	1.36**	1.04**	2.63**	2.86**	1.26**
			8.78	9.71	10.86	12.01	8.06
L	H	L	0.81**	0.42	0.80**	0.37	1.01**
			7.15	8.27	6.95	8.04	6.49
L	H	H—L	0.55**	0.62**	1.83**	2.49**	0.25
			4.40	5.85	8.57	9.83	3.68
L	L	H	1.20**	1.08**	1.21**	1.09**	1.09**
			6.92	6.61	8.57	8.64	6.13
L	L	L	1.20**	1.12**	1.19**	1.13**	1.12**
			5.06	4.89	4.95	4.82	4.58
L	L	H—L	0.00	-0.04	0.02	-0.04	-0.02
			4.31	4.28	6.89	7.14	3.61
L	H—L	H	0.16	-0.04	1.42**	1.77**	0.16
			3.81	5.72	7.43	9.07	3.08
L	H—L	L	-0.39**	-0.70**	-0.39**	-0.77**	-0.11
			3.38	5.15	3.43	5.21	2.87

Table 9: Three-Way Sorted Portfolios: Descriptives

This table presents portfolio characteristics in the post-formation week. Equal-weighted portfolios are formed every week. The sorts are based on returns, turnover, and illiquidity. Return breakpoints are determined by the median return for both positive and negative lagged returns. Breakpoints for turnover and illiquidity are based on quartile breakpoints. Returns are in percent per week, turnover is daily turnover in percent, volume is dollar volume in millions of dollars, illiquidity is computed using the Amihud measure and is expressed as daily illiquidity (multiplied by 10^6). The sample period is 1962 to 2002 and the portfolios include all NYSE/AMEX stocks that have data for at least two days of the week.

		Return Portfolio=1				Return Portfolio=2			
		Illiquidity				Illiquidity			
Turnover		1	2	3	4	1	2	3	4
1	Sz Rank	5.00	4.50	3.27	1.63	4.92	4.13	3.06	1.81
	Turnover	0.050	0.070	0.076	0.076	0.064	0.073	0.072	0.069
	Volume	1.035	0.434	0.139	0.023	1.434	0.363	0.110	0.026
	Illiquidity	0.023	0.073	0.384	10.005	0.026	0.124	0.465	3.405
2	Sz Rank	5.00	4.08	2.74	1.43	4.85	3.81	2.60	1.48
	Turnover	0.123	0.139	0.142	0.125	0.128	0.134	0.133	0.117
	Volume	2.836	0.584	0.140	0.028	3.093	0.470	0.124	0.027
	Illiquidity	0.011	0.068	0.435	6.513	0.015	0.101	0.483	2.846
3	Sz Rank	4.89	3.73	2.43	1.30	4.76	3.55	2.35	1.33
	Turnover	0.207	0.230	0.220	0.180	0.204	0.218	0.198	0.155
	Volume	3.463	0.650	0.152	0.031	3.600	0.518	0.134	0.028
	Illiquidity	0.011	0.074	0.432	5.262	0.015	0.099	0.448	2.485
4	Sz Rank	4.55	3.30	2.13	1.18	4.48	3.21	2.09	1.18
	Turnover	0.516	0.458	0.379	0.266	0.439	0.391	0.311	0.200
	Volume	4.240	0.681	0.158	0.035	3.983	0.553	0.144	0.026
	Illiquidity	0.012	0.084	0.437	4.183	0.017	0.099	0.429	1.888

		Return Portfolio=3				Return Portfolio=4			
		Illiquidity				Illiquidity			
Turnover		1	2	3	4	1	2	3	4
1	Sz Rank	2.93	4.11	3.09	1.76	5.00	4.41	3.25	1.67
	Turnover	0.067	0.071	0.069	0.071	0.049	0.066	0.068	0.069
	Volume	0.550	0.323	0.102	0.025	1.109	0.416	0.126	0.024
	Illiquidity	4.756	0.114	0.416	4.942	0.022	0.079	0.386	7.981
2	Sz Rank	4.33	3.82	2.63	1.45	4.97	4.07	2.76	1.44
	Turnover	0.127	0.131	0.131	0.124	0.116	0.123	0.122	0.118
	Volume	2.218	0.439	0.117	0.028	3.043	0.568	0.133	0.027
	Illiquidity	0.663	0.098	0.433	4.312	0.011	0.071	0.429	5.744
3	Sz Rank	4.47	3.53	2.34	1.30	4.87	3.73	2.46	1.32
	Turnover	0.201	0.212	0.205	0.170	0.189	0.201	0.193	0.168
	Volume	2.992	0.521	0.128	0.030	3.800	0.631	0.147	0.031
	Illiquidity	0.201	0.101	0.455	3.876	0.011	0.078	0.437	4.677
4	Sz Rank	4.27	3.17	2.06	1.18	4.51	3.22	2.06	1.18
	Turnover	0.432	0.395	0.330	0.233	0.521	0.473	0.393	0.289
	Volume	3.643	0.552	0.142	0.031	4.869	0.677	0.182	0.042
	Illiquidity	0.074	0.099	0.427	2.959	0.013	0.084	0.413	3.716

Table 10: Three-Way Sorted Portfolios: Descriptives (ISSM & TAQ Sample)

This table presents portfolio characteristics in the post-formation week. Equal-weighted portfolios are formed every week. The sorts are based on returns, turnover, and illiquidity. Return breakpoints are determined by the median return for both positive and negative lagged returns. Breakpoints for turnover and illiquidity are based on quartile breakpoints. Depth is in thousands. Proportional spreads are in percent. The sample period is 1988 to 2002 and the portfolios include all NYSE stocks that have data for at least two days of the week.

		Return Portfolio=1				Return Portfolio=2			
		Illiquidity				Illiquidity			
Turnover		1	2	3	4	1	2	3	4
1	Depth	4.93	2.61	2.31	2.96	4.52	2.48	1.92	1.79
	PQSPR	0.420	0.759	1.398	3.579	0.482	0.756	1.246	2.205
	PESPR	0.263	0.484	0.902	2.428	0.327	0.489	0.795	1.439
2	Depth	5.81	3.65	3.61	4.19	6.41	3.40	2.56	2.27
	PQSPR	0.441	0.822	1.634	3.931	0.457	0.781	1.356	2.354
	PESPR	0.293	0.536	1.092	2.663	0.306	0.510	0.879	1.543
3	Depth	6.79	5.31	4.99	4.85	6.72	4.24	3.11	2.44
	PQSPR	0.490	0.923	1.935	4.211	0.477	0.840	1.475	2.365
	PESPR	0.323	0.612	1.307	2.939	0.316	0.555	0.973	1.564
4	Depth	8.67	7.21	6.89	5.82	7.83	5.19	3.61	2.13
	PQSPR	0.584	1.091	2.217	4.598	0.541	0.964	1.603	2.310
	PESPR	0.385	0.741	1.531	3.181	0.357	0.643	1.066	1.539

		Return Portfolio=3				Return Portfolio=4			
		Illiquidity				Illiquidity			
Turnover		1	2	3	4	1	2	3	4
1	Depth	4.90	2.64	2.06	2.80	4.67	2.52	2.01	2.58
	PQSPR	2.009	0.753	1.247	2.814	0.421	0.724	1.286	3.180
	PESPR	1.348	0.490	0.797	1.868	0.275	0.463	0.832	2.105
2	Depth	7.47	3.55	3.16	4.42	6.01	3.34	2.96	3.58
	PQSPR	0.621	0.796	1.462	3.513	0.421	0.768	1.473	3.496
	PESPR	0.431	0.520	0.969	2.388	0.278	0.500	0.978	2.371
3	Depth	7.54	4.63	4.65	5.37	6.72	4.46	3.96	4.15
	PQSPR	0.550	0.868	1.698	4.151	0.453	0.852	1.675	3.760
	PESPR	0.367	0.575	1.125	2.893	0.294	0.564	1.115	2.559
4	Depth	8.63	6.17	5.21	5.16	8.13	6.49	5.86	4.86
	PQSPR	0.585	0.997	1.931	4.214	0.539	0.990	1.945	4.086
	PESPR	0.390	0.676	1.310	2.892	0.361	0.674	1.328	2.800

Figure 1: Three-Way Sorted Portfolios: Lagged Returns

This figure shows portfolio returns in the formation week. Equal-weighted portfolios are formed every week. The sorts are based on returns, turnover, and illiquidity. Return breakpoints are determined by the median return for both positive and negative lagged returns. Breakpoints for turnover and illiquidity are based on quartile breakpoints. Returns are in percent per week and are based on skip-day methodology in which the return on the last day of the week is not used in computations. The sample period is 1962 to 2002 and the portfolios include all NYSE/AMEX stocks that have data for at least two days of the week.

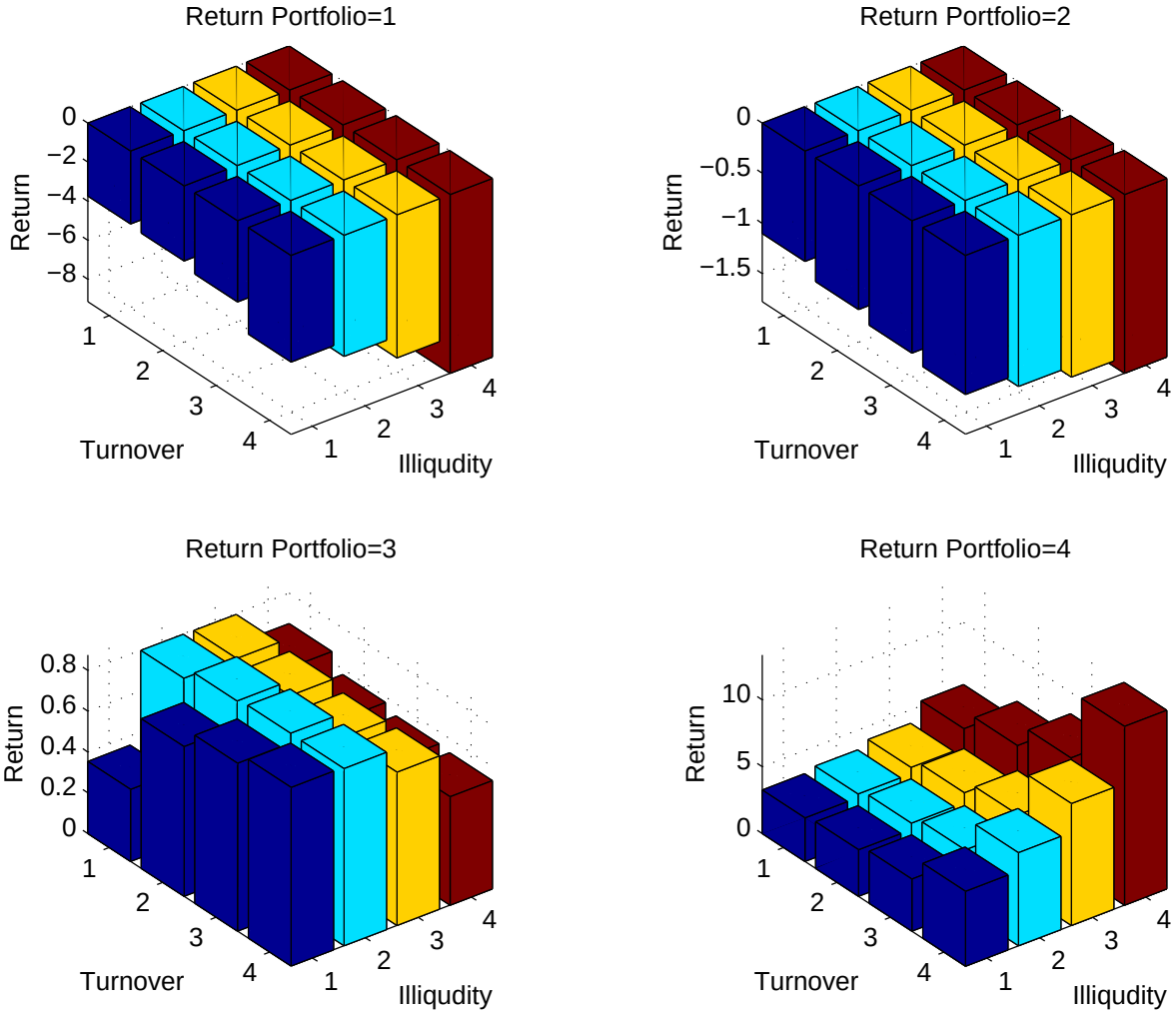

Figure 2: Three-Way Sorted Portfolios: Post-Formation Returns

This figure shows portfolio returns in the post-formation week. Equal-weighted portfolios are formed every week. The sorts are based on returns, turnover, and illiquidity. Return breakpoints are determined by the median return for both positive and negative lagged returns. Breakpoints for turnover and illiquidity are based on quartile breakpoints. Returns are in percent per week and are based on skip-day methodology in which the return on the last day of the week is not used in computations. The sample period is 1962 to 2002 and the portfolios include all NYSE/AMEX stocks that have data for at least two days of the week.