Transaction Costs, Trading Volume and Momentum Strategies

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Abstract

This study considers the relationship between trading volumes, transactions costs, and the profitability of momentum strategies using data from the UK. We demonstrate that round-trip transactions costs for selling loser firms are around double those of buying winners, and in particular, the costs of selling low volume losers is more than twice as high as the cost of selling low volume winners. By contrast, there are only modest differences between the costs of buying winners and losers, irrespective of their volume levels. Yet we observe that, even in net terms, momentum strategies based on low volume stocks are more profitable than those using high volume stocks. We also note important differences between transactions costs measured using quoted versus effective spreads. Altogether, our findings should sound a word of caution for any study attempting to evaluate the impact of transactions costs on momentum profitability that such costs are very heterogeneous across firms and trade types, implying that they require careful calculation.

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1. Introduction

A number of studies document that momentum strategies can be used to predict stock returns. For example, Jegadeesh and Titman (1993, 2001) report that past winners tend to outperform past losers over the following 3 to 12 months. Chan, Jegadeesh and Lakonishok (1996) show that not only price momentum, but also earnings momentum can help to predict future stock returns. Moskowitz and Grinblatt (1999) suggest that price momentum can be explained by industry momentum. Grundy and Martin (2001) find that momentum profits are dominated by stock-specific returns. Rouwenhorst (1998) and Griffin, Ji and Martin (2003) provide evidence of price continuation in international stock markets. Most of these studies assume that transaction costs are symmetric between past winners and past losers and that they are small enough to allow investors to earn significant momentum profits.

However, the availability of opportunities for exploiting momentum profits has been questioned by Lesmond, Schill and Zhou (hereafter LSZ, 2004). They argue that the measurement of transaction costs in early momentum studies is based on the trading of large and liquid stocks. But momentum profits are mainly generated by short-selling losers and yet trading in such losers typically has higher transaction costs due to their small market value, low price and low liquidity. They conclude that positive net momentum profits cannot be earned after considering transaction costs. By contrast, Hanna and Ready (2005) show that both equally-weighted and value-weighted momentum strategies can earn significant excess returns after transaction costs. Korajczyk and Sadka (2004) also study the impact of transaction costs on momentum profits. Unlike LSZ (2004), they conclude that the abnormal performances of equally- and value-weighted momentum portfolios exceed proportional transaction costs (such as effective or quoted spreads). Yet these abnormal returns quickly decline with the price impact of trading. In effect, the profits of equally- and value-weighted momentum strategies do persist but only for relatively small scale investment (of less than $200 million and $2 billion, respectively).[1]

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[1] The alphas are less likely to be wiped out by price impact costs when stocks in the long-short portfolios are weighted according to the price impact itself. $5 billion then needs to be invested in the liquidity-weighted momentum strategy for the profits to disappear.

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The conclusion of LSZ (2004) that momentum portfolios create an illusion of profitable trading opportunities is drawn solely from the "6-6" strategy, involving portfolio formation and holding periods each of 6 months' duration. Hence it may not be representative of the profitability of all momentum rules since transaction costs may differ widely for strategies with different holding periods. For example, strategies with a 6-month holding period require the purchase of winners and the sale of losers at the end of the ranking period and the closure of the long and short positions at the end of the holding period twice a year. But strategies with a 12-month holding period only require the purchase of winners, the sale of losers and the closure of long and short positions once a year. As a result, the annual transaction costs of strategies with 6-month holding periods are likely to be almost twice as high as those of strategies with 12-month holding periods.[2] Although LSZ's conclusion is valid for strategies with 6-month holding periods, it might be invalid for strategies with holding periods over 6 months. We extend their analysis of transaction costs for momentum strategies to the UK and examine net momentum returns for 9 momentum strategies with all combinations of 3-, 6-, and 12-month ranking and holding periods. [3]

The second objective of this paper is to investigate the relation between trading volume and transaction cost. Trading volume has been identified as providing valuable information for traders (see for example, Karpoff, 1986, 1987; Blume, Easley and O'Hara, 1994; Campbell, Grossman and Wang, 1993). A better understanding of the relationship between trading volume and transaction cost is important for investors to develop their trading strategies. Surprisingly, empirical findings show an ambiguous relationship between them. Chordia, Roll and Subrahmanyam (2000, 2001) document that transaction cost and trading volume are highly correlated since transaction cost can be considered a proxy for commonality in liquidity and trading volume is a proxy of liquidity in individual stocks. Foster and

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[2] Although transactions costs will not be twice as high in practice since a reasonable proportion of stocks in the momentum portfolios are likely to remain there for the following 6-month period and thus no further costs would be incurred.
[3] Li *et al*. (2009) also provide comparative evidence on the profitability of momentum strategies in the UK when returns are measured net of transactions costs. They propose an approach to portfolio construction that explicitly allows for transactions costs. By contrast, the present study instead focuses on the relationship between the profitability of relative strength portfolios and trading volumes.

Viswanathan (1993), Huang and Stoll (1997) and Chordia, Roll and Subrahmanyam (2001) find a strong positive relationship between trading volume and quoted or effective spreads. Contrary to their findings, Karpoff (1986), Glosten and Harris (1988), Admati and Pfleiderer (1988), Foster and Viswanathan (1990), and Brennan and Subrahmanyam (1995) report a negative relationship between volume and spreads. Recent studies by Lee and Swaminathan (2000) and Johnson (2008) suggest that trading volume is weakly correlated with or unrelated to bid-ask spreads.

A difficulty with existing studies in terms of their exploration of the relationship between trading volume and transaction costs is that they employ the bid-ask spread to measure the cost incurred in a round-trip transaction. However, this ignores differences in the characteristics of trading activity driven by the direction of the trade, i.e. whether the trade is a purchase or sale. A number of studies report that the price impacts of buyer- and seller-initiated transactions are asymmetric (see, for example, Kraus and Stoll, 1972; Holthausen, Leftwich and Mayers, 1987; Chan and Lakonishok, 1993, 1995; Keim, and Madhavan, 1996). Therefore, it is perhaps not surprising that existing studies fail to explicitly identify the relationship between them.

This study splits each round-trip transaction into buyer- or seller-initiated trades and separately examines the relationship between trading volume and transaction costs between purchases and sales. The rationale for this distinction stems from a conjecture that market responses to a buy order might be different from that to a sell order. Though numerous studies have examined the relationship between trading volume and transaction costs, to our knowledge, no one has adopted this method to identify the patterns of trading volume to the costs of buyer- and seller-initiated transactions for winners and losers. The purpose of this paper is to fill this gap in the literature and to shed some light on the currently ambiguous relationship in empirical findings.

In line with the study of LSZ (2004), we show that the loser portfolios mainly consist of stocks with low market value, low price and low trading volume. Transaction costs for losers are much higher than those of winners. The average round-trip total transaction cost (including commissions, stamp duties and short selling costs) based

on the effective spread is 6.67% for losers and 3.46% for winners. However, after taking account of total transaction costs based on full turnover (assuming that momentum traders close out their entire long-short portfolios at the end of each holding period), positive and significant momentum returns still exist for strategies with 12-month holding periods, but disappear for strategies with up to 6-month holding periods. When we estimate transaction costs based on actual turnover (assuming that momentum traders only close out the positions if stocks no longer remain in the same portfolio in the following period), 6 out of 9 momentum strategies generate significant net momentum profits at the 5% level. This paper therefore questions the conclusion of LSZ (2004), which may only valid for strategies with a holding period of up to 6 months in the US market.

We also add evidence to the literature on the link between trading volume and momentum. Consistent with the high volume return premium reported by Gervais, Kaniel and Mingelgrin (2001),[4] we find that both winner and loser portfolios with high trading volume generate higher returns than those with low trading volume. But overall, momentum strategies with low trading volume yield the highest momentum profits. We also provide evidence that the high momentum profits for low volume momentum strategies are mainly driven by higher returns on short selling low volume losers.

The results on the relationship between trading volume and transaction costs are intriguing. We find a positive relationship between trading volume and the costs of buying winners and losers and a negative relationship between trading volume and the costs of selling winners and losers. These results help to clarify the currently ambiguous relationship between trading volume and transaction costs in previous studies. Additionally, we find that the costs of buying losers are only slightly higher than the costs of buying winners, but the costs of selling losers are much higher than the costs of selling winners, particular for low volume stocks. On average, the costs of selling losers with low trading volume are almost 3 times as much as the costs of

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[4] Gervais, Kaniel and Mingelgrin (2001) report a high volume return premium for NYSE stocks, whereby stocks with unusually large (small) trading volume tend to generate large (small) returns over the following month.

selling winners with low trading volume. Our results therefore suggest that the relatively expensive transaction costs of losers are mainly driven by the higher costs involved in selling illiquid stocks.

The rest of the study is organised as follows. Section 2 describes the data and the methodology. Section 3 presents our results on an extension of the LSZ (2004) to the UK. Section 4 examines the relationship between trading volume, momentum returns, and transaction costs. Section 5 analyses the results and finally, section 6 presents some concluding remarks.

2. Data and Methodology

2.1. Data Description

We first create a list of all the UK companies in the London Share Price Database (LSPD) over the period of 31 December 1985 – 31 December 2005. Financial companies are excluded from our sample to avoid double counting of the companies in which the financial institutions invest. We also exclude the lowest 5% of shares by market capitalisation in any given year and companies with mid-prices less than 5p. This is to address the concern that the momentum profits may be solely driven by these extremely small and illiquid stocks. The treatment of dead stocks follows Li, Miffre, Brooks and O'Sullivan (2008): delisted stocks are assigned a return of -100% for death types 7, 14, 16, 20 and 21[5] according to the LSPD and a return of 0 for other death types such as acquisitions, takeovers, mergers, etc. This results in a total of 3,520 companies. We obtain all data from Primark Datastream, including monthly total return indices; the highest (ask) and lowest (bid) intraday prices at the end of each month; closing prices adjusted for capital actions at the end of each month; monthly market values; and trading volumes – that is, the number of shares that were traded on the final day of the month.

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[5] These death types represent: liquidation, quotation cancelled for reason unknown, receiver appointed/liquidation, in administration/administrative receivership, and cancelled and assumed valueless.

2.2. Estimation of Transaction Costs

We measure total transaction costs as the bid-ask spread estimated based on quoted spreads and on effective spreads plus commissions, stamp duty and short-selling costs for losers. The quoted bid-ask spread is defined as the difference between the quoted ask price and the quoted bid price. Following Chordia, Roll and Subrahmanyam (2000), the proportional quoted spread is calculated as:

$$Quoted\ Spread = 100 \times (A_{it} - B_{it})/(2 \times M_{it})$$

where A_{it} is the ask price, B_{it} is the bid price and M_{it} is the bid-ask midpoint for asset i on the last trading day of month t. The quoted spread measures the cost of a round-trip transaction. In order to mitigate the problem that estimates of transaction costs may be severely affected by a few winner or loser stocks with extremely high or low spreads (e.g., due to data errors), we filter out and remove stocks with negative quoted spreads and those with quoted spreads larger than 100%.

Lee and Ready (1991) argue that quoted spreads may provide misleading estimates of actual transaction costs because trades are often executed within the bid and ask quotes. Alternatively, investors may also face trading prices that are outside the spread for orders larger than normal market size. Therefore, several studies use the effective bid-ask spread to measure the "true" transaction costs (see for example, Roll, 1984; George, Kaul and Nimalendran, 1991 and Bessembinder, 1999). The effective spread is the difference between the transaction price and the bid-ask midpoint. The proportional half effective spread is calculated as

$$Half\ Effective\ Spread = 100 \times (P_{it} - M_{it})/M_{it}$$

where P_{it} is the transaction price for asset i on the last trading day of month t. The half effective spread measures the cost of a one-way transaction. Following Lee and Ready (1991), we classify a transaction as seller-initiated when the transaction price is less than the bid-ask midpoint and as buyer-initiated when the transaction price is larger than the bid-ask midpoint. A round-trip effective spread is calculated as the absolute half effective spread for a buyer-initiated transaction plus the absolute half effective spread for a seller-initiated transaction.

Commission charged by brokers is another major component of total transaction costs. It is calculated as a percentage of the total value of the trade. Commission normally increases but at a declining rate as the total value of the trade increases. We compute commission for each stock based on the following commission charges schedule, which was obtained from Barclays Stockbrokers[6] for company dealing accounts: transaction value £0-£10,000, commission is 1.75% of trade value; £10,001-£20,000: 1.125%; £20,001-£40,000: 0.5%; £40,001-£100,000: 0.4%; £100,001+: 0.3%; (minimum £100). Stamp duty (payable on all UK equity purchases at the rate of 0.5%) and short-selling costs are also included in the estimates of total transaction costs. These are particularly important for momentum strategies since many studies suggest that the momentum profits are mainly produced by the short position.[7] In accordance with the cost levied by Barclays Stockbrokers, we assume a short-selling cost of 1.5% per year.

3. Net Momentum Returns

In this section, we estimate the magnitude of transaction costs for winners and losers and examine the net momentum profits after total transaction costs for 9 momentum strategies in the UK. We first calculate monthly returns for momentum strategies and compare the characteristics of the winners, such as share price, market capitalisation and trading volume, to those of the losers. Second, we estimate transaction costs for the winner, loser and momentum portfolios based on full and actual turnover, and then relate the gross momentum profits to the total transaction costs incurred in executing the relative strength strategies.

3.1. Momentum Strategies

Winner and loser portfolios are constructed by equally weighting the 10% of all stocks that performed the best and the worst respectively in terms of the past *J*-month cumulative returns (*J* = 3, 6, 12 months). The return on the momentum portfolio is measured as the difference in returns between the winner and loser portfolios over the next *K* months (*K* = 3, 6, 12 months). The procedure is repeated throughout the whole

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[6] http://www.stockbrokers.barclays.co.uk/?category=whatweoffer&usecase=landing48
[7] See for example Moskowitz and Grinblatt (1999), Hong, Lim and Stein (2000) and LSZ (2004).

sample to produce non-overlapped return series for the winner, loser and momentum portfolios. The resulting momentum strategy taking a long position in the winner portfolio and a short position in the loser portfolio is called the *J-K* strategy.

Table 1 presents monthly mean returns for the winner, loser and momentum portfolios. The rows represent the ranking periods (J = 3, 6 and 12 months) and the columns represent the holding periods (K = 3, 6 and 12 months). Without exception, the winners significantly outperform the losers at the 1% level. Across strategies, the momentum portfolios earn an average return of 1.9% per month, ranging from a low of 1.62% for the 3-3 strategy to a high of 2.22% for the 12-3 strategy. Consistent with Moskowitz and Grinblatt (1999), Hong, Lim and Stein (2000) and LSZ (2004), we find that the momentum profits are mainly produced by the short positions. On average, the losers generate a return of -1.58% per month and the winners yield a return of 0.32% per month. The results also strongly reject the criticism that the momentum effect is only produced by extremely small and illiquid stocks: these stocks were excluded from our sample and yet the momentum strategies are still able to generate sizable positive average returns.

In line with LSZ (2004), Table 1 also extends to the UK the evidence that the loser portfolios are made of stocks with relatively smaller price, smaller size and lower trading volume than the winner portfolios. Across the 9 strategies, the losers have an average median share price of £1.20 and the winners have a median price of £2.13; the losers have an average median market capitalisation of £59.17 million, while that of the winners is £248.05 million; the losers have an average median trading volume of 11.32 million and the winners of 20.13 million. Table 1 therefore suggests that assuming symmetry of transaction costs between losers and winners would be inaccurate because several US studies (Chan and Lakonishok, 1995, 1997; Bessembinder and Kaufman, 1997; Keim and Madhavan, 1997) report market capitalisation as one of the most important factors that affect transaction costs; other things being equal, stocks with small capitalisation have high transaction costs.

3.2. Transaction Costs for Momentum Strategies

Implementing a momentum strategy requires fairly frequent trading as investors have to buy winner stocks and short sell loser stocks at the end of the ranking period and close out their long-short positions at the end of the holding period. Transaction costs therefore become an important factor in assessing the profitability of momentum strategies. Table 2 reports estimates of round-trip costs for the winner, loser and momentum portfolios based on full turnover, which assumes that investors close out the long-short portfolios entirely at the end of each holding period. A round-trip total transaction costs estimate includes a round-trip quoted or effective spread, commission, a 0.5% stamp duty for stock purchases and an annual 1.5% cost on short selling. Table 2 shows that the average round-trip effective spread is 1.90% for the winners and 3.72% for the losers. The average round-trip commission is 1.06% for the winners and 1.58% for the losers. Once commissions, stamp duties and short selling costs are added to the effective spreads, the average round-trip total transaction costs rise to 3.46% for the winners and 6.67% for the losers.

A comparison of the costs between the winners and the losers in Table 2 suggests that the estimates of the quoted spread, effective spread and commission associated with the losers are systematically higher than those of the winners. Across the 9 strategies, the average round-trip quoted spread and effective spread for the losers are 3.76% and 3.72% respectively, which are 71% and 96% higher than those of the winners (2.21% and 1.90% respectively). When the stamp duty on purchases and the costs of short-selling the losers are added, the average round-trip total trading costs based on quoted spread across the 9 strategies is 6.71% for the losers versus 3.77% for the winners. Based on effective spread, the losers (with an average round-trip total cost of 6.67%) are on average 93% more expensive to trade than the winners (which cost 3.46% on average per round-trip). In conclusion, the transaction costs of winners and losers are asymmetric and total transaction costs for momentum strategies are much higher than previously thought.[8]

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[8] Early studies on momentum strategies, such as Jegadeesh and Titman (1993), Rouwenhorst (1998), Moskowitz and Grinblatt (1999) and Liu, Strong and Xu (1999), assume a round-trip cost of up to 2% for both winners and losers.

In fact, some stocks with extreme performance are likely to stay in the same portfolios from one holding period to the next. Accordingly, momentum traders do not need to close out their entire positions at the end of each holding period. If stocks remain in the winner or loser portfolios in the following period, transaction costs are not actually incurred. Table 3 reports the proportions of winner (loser) stocks that have remained in the winner (loser) portfolio in the following holding period. We find that the 12-3 strategy has the highest proportion of positions retained, while the 6-12 strategy has the lowest proportion of positions retained. On average, 22.8% of the winners and 28.2% of the losers remain in the same portfolio in the following period across the 9 strategies, suggesting that momentum traders only need to close an average 77.2% of their long positions and 71.1% of their short positions at the end of each holding period.

Table 3 also reports estimates of the round-trip total trading costs based on actual turnover, which assumes that momentum traders only close out their positions if stocks no longer remain in the same portfolio in the following period. Relative to Table 2, naturally, total transaction costs are considerably reduced when actual turnover is taken into account. The decrease in transaction costs is particularly strong for the strategies with high proportions of winner and loser stocks that are retained in the same portfolio in the following holding period. For example, the round-trip total trading costs of the 12-3 strategy based on quoted spread estimates drop from 9.6% for full turnover in Table 2 to 4.14% for actual turnover in Table 3; similarly, the average total trading costs based on effective spread estimates drop from 9.32% to 4.01%.

Table 4 reports monthly net momentum profits after controlling for total transaction costs based on full and actual turnovers. We find that once total transaction costs are taken into account, based on full turnover, momentum strategies with a 3-month holding period even produce significantly negative average net returns at the 5% level. The strategies with a 6-month holding period yield positive but insignificant average net returns. Interestingly, the strategies with a 12-month holding period still can generate positive and significant net profits at the 5% level. The average net momentum return is 0.75% per month when total transaction costs are estimated by

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quoted spread and is 0.78% per month when total transaction costs are measured by effective spreads. These results are consistent with the finding of Agyei-Ampomah (2007) that momentum profits net of transaction costs do exist for strategies with a 12-month holding period but disappear for strategies with 3- and 6-month holding periods in the UK. The conclusion of LSZ (2004) ignores the fact that transaction costs are lower for those strategies with longer horizons and high for those strategies with shorter horizons and is consequently not supported for strategies with a 12-month holding period in the UK. When we adopt a more practical measure of transaction costs based on actual turnover, 6 out of 9 momentum strategies (the exceptions are the 3-3, 3-6 and 6-3 strategies) yield positive and significant net returns at the 5% level.

4. The Relationship of Trading Volumes with Portfolio Returns and Transaction Costs

4.1. Trading Volume and Portfolio Returns

Several studies investigate the relationship between trading volume and stock returns. Blume, Easley and O'Hara (1994) show that traders who use trading volume information in their technical analysis can improve their performance. Campbell, Grossman and Wang (1993) suggest that stock returns tend to be reversed on large trading volume days. Conrad, Hameed and Niden (1994) and Chan, Hameed and Tong (2000) report that high volume losers outperform low volume losers within 4 weeks after formation. Gervais, Kaniel and Mingelgrin (2001) find a high volume return premium for NYSE stocks – namely, that stocks with unusually large (small) trading volume tend to generate large (small) returns over the following month. By contrast, Brennan, Chordia and Subrahmanyam (1998) and Datar, Naik and Radcliffe (1998) report a negative relationship between trading volume and returns. Lee and Swaminathan (2000) also show that high (low) volume stocks earn lower (higher) future returns after portfolio formation but yield higher (lower) past returns before portfolio formation.

In this section, we attempt to add evidence to the literature on trading volume and momentum strategies, and we examine the returns of the winner, loser and momentum

portfolios at different levels of trading volume. Following Lee and Swaminathan's (2000) approach, we first rank all stocks into decile portfolios based on their past returns. We then further rank winner (the best past performance) and loser (the worst past performance) stocks based on their trading volume at the end of the ranking period, using 30-70 break points to classify winner and loser stocks into three sub-portfolios with low, middle and high levels of trading volume.[9]

Table 5 presents monthly returns for the winner, loser and momentum portfolios at the three levels of trading volume. The results show that, with only a few exceptions for the winners (the 6-12, the 12-6 and the 12-12 winners), the high volume winners and losers uniformly outperform the low volume winners and losers. On average, high volume winners yield monthly returns of 0.36% and low volume winners earn monthly returns of 0.2%; while the high and low volume losers generate monthly returns of -1.46% and -2.26%, respectively. These appear to support the finding of Gervais, Kaniel and Mingelgrin (2001) regarding the high volume return premium. We also find that momentum strategies with low trading volume always earn higher gross returns than strategies with high trading volume, with an average of 2.46% per month for low volume strategies and 1.82% per month for high volume strategies. These results indicate that momentum profits are mainly produced by short losers and high momentum profits for low volume strategies are driven by high returns on short selling low volume losers.

4.2. Trading Volume and Transaction Cost

Kraus and Stoll (1972), Holthausen, Leftwich and Mayers (1987), Chan and Lakonishok (1993, 1995) and Keim, and Madhavan (1996) find that price impacts are different between buyer- and seller-initiated transactions. Therefore, we conjecture that the relationship between trading volume and the cost of purchases may also be different to the relationship between trading volume and the cost of sales. In this section, we decompose each round-trip trade into buyer-initiated and seller-initiated

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[9] In common with Gervais *et al.* (2001), we define volume as the total number of shares traded during the day.

transactions and we investigate the costs of purchases and sales for the winner, loser and momentum portfolios at the three levels of trading volume.

The mean one-way effective spreads of buyer-initiated transactions are presented in Table 6. Clearly, a positive relationship between trading volume and purchase cost can be found for both winner and loser portfolios, suggesting that to buy a winner or loser stock with high trading volume is more expensive than to buy a stock with low trading volume. In effect, buying high volume stocks on average costs 0.93% for winners and 1.37% for losers, which is much larger than the cost of buying low volume stocks (0.68% for winners and 0.75% for losers). These results are consistent with the study of Chan and Lakonishok (1995), who find that price appreciation for buyer-initiated transactions mainly follows large trading blocks.

Table 7 reports the mean one-way effective spreads of seller-initiated transactions at the three levels of trading volume for the winner, loser and momentum portfolios. Unlike the positive relationship that was observed between trading volume and the cost of buyer-initiated transactions, we find a negative relationship between trading volume and the cost of seller-initiated transactions for both winners and losers (except for the 12-6, 3-12, 6-12 and 12-12 winners). Selling low volume stocks has the highest transaction cost and selling high volume stocks has the lowest transaction cost among the three levels of trading activity. For instance, the cost of selling low volume losers (3.31% on average) is 57% higher than the cost of selling high volume losers (2.10%). A short position in a winner stock with low trading volume costs on average 1.12%; selling a winner with middle or high trading volume costs less (0.97% and 0.90%, respectively).

A comparison of the costs between purchases and sales in Tables 6 and 7 shows that the costs of seller-initiated transactions are much higher than those of buyer-initiated transactions, particularly for losers, with an average cost of 2.68% for seller-initiated transactions and 1.05% for buyer-initiated transactions across the three levels of trading volume. For winners, it costs an average of 1.00% for seller-initiated transactions and 0.81% for buyer-initiated transactions. Additionally, Tables 6 and 7 suggest that selling low volume loser stocks is the most expensive trading activity,

which costs 4.4 times as much as buying low volume loser stocks (0.75% for buying low volume losers and 3.31% for selling low volume losers). Comparing the costs between winners and losers, Tables 6 and 7 also show that the costs of buyer-initiated transactions for losers are slightly higher than those for winners, with an average of 1.05% for losers and 0.81% for winners. But the costs of seller-initiated transactions are very different between losers and winners, particularly for low volume stocks. On average, selling low volume loser stocks costs almost 3 times as much as selling low volume winners (1.12% for selling low volume winners and 3.31% for selling low volume losers).

Net monthly returns for each of the winner, loser and momentum portfolios by trading volume class are presented in Table 8. The returns are calculated based on an assumption of full turnover, and are based on effective rather than quoted spreads.[10] Evidently, transactions costs have reduced returns by around 1.2% per month typically compared with the corresponding gross return figures in Table 5. It is also clear, as was seen above, that transactions costs are of the order 0.3-0.4% per month higher for the low volume portfolios than those in the highest volume tricile. However, interestingly the reduction in costs as we move towards firms with more liquidity is insufficient to offset the reduction in momentum profitability. As a result, in net terms, low volume momentum portfolios are considerably more profitable for any momentum strategies with holding periods of 6 months or longer. For example, for formation and holding periods of 12 months, the highest and lowest volume tricile net momentum returns are 0.19% and 1.77% respectively, with the majority of this difference arising from the additional profits of the short position in the loser stocks.

To summarise, this section attempts to examine the relationship between trading volume and transaction costs by relating the cost of buyer- and seller-initiated transactions to the trading volume of winners and losers. We find that trading volume is positively related to the costs of buying winners and losers and is negatively related

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[10] When two-way sorts are performed by momentum and volume, the constituents of the extreme decile portfolios are considerably less stable, so that the difference in costs between full and actual turnover is minimal. Nonetheless our results concerning the net profitability of the strategies in Table 8 can be considered conservative.

to the costs of selling winners and losers. Additionally, selling costs are much higher than buying costs for both winners and losers. As a result, losers with low trading volume are expensive to sell. Our results indicate that the relatively expensive transaction costs of losers are mainly due to higher selling costs for illiquid stocks. Yet short positions in low volume loser stocks generate such large profits that relative strength portfolios constructed on the basis of low volume stocks are more profitable than those based on high volume stocks, even after allowing for the higher trading costs of the former.

5. Analysis of Results

It has been widely recognised that trading volume is mainly determined by liquidity needs and information flows. Glosten and Harris (1988) have decomposed the bid/ask spread into a transitory component (such as monopoly profit, clearing costs, inventory carrying costs, etc.) and an adverse-selection component (due to private information). They show that trading volume depends mainly on the spread due to the adverse-selection component. Holthausen, Leftwich and Mayers (1987), Chan and Lakonishok (1993) and Keim and Madhavan (1996) compare the price impact of large block transactions between purchases and sales, and they find that the main impact on trading volume is from the transitory component (a temporary price effect) for large seller-initiated transactions, while for large buyer-initiated transactions, the main impact on trading volume is from the adverse-selection component (a permanent price effect). Their results therefore suggest that trading activities are elicited by different motivations: large buyer-initiated transactions are more informationally-motivated and large seller-initiated transactions are more liquidity-motivated.

The relationships between trading volume, transaction costs and information have also been widely documented in the finance literature. Demsetz (1968), Karpoff (1986), Glosten and Harris (1988), Admati and Pfleiderer (1988), Foster and Viswanathan (1990), and Brennan and Subrahmanyam (1995) find a negative relationship between trading volume and transaction costs, suggesting that high trading volume stocks are cheaper to trade. Karpoff (1987), Holthausen and Verrecchia (1990), Kim and Verrecchia (1991) and Bessembinder, Chan and Seguin (1996) report that trading volume is positively related to a proxy for information flow, indicating that high

trading volume is a result of increasing information flows. However, George, Kaul and Nimalendran (1994) argue that early studies modelling relationship between trading volume and information flow ignore transaction-cost elasticity. They show that including transaction costs, trading volume can be either positively or negatively related to information flows.

Our results are in accordance with several explanations offered by previous studies. The positive correlation between volume and the cost of buyer-initiated transactions could be due to information flows. Since a large block purchase of a particular stock conveys a message of good news, this drives up trading volume and widens spreads. On the other hand, the negative correlation between volume and the cost of seller-initiated transactions could be due to liquidity needs because a high level of trading volume will provide some of this required liquidity and will therefore decrease liquidity costs. Demsetz (1968) also documents that increased trading volume can reduce waiting costs in liquid markets and leads to lower spreads. For example, specialists can offer a narrower bid-ask spread to attract more orders for immediate fulfillment; on the other hand, they can also decrease trading volume to reduce losses by setting a wide spread. Alternatively, two behavioural explanations have been put forward in the literature. Chan and Lakonishok (1993), and Keim and Madhavan (1995) interpret the positive (negative) relationship between price impact and large buyer-(seller-) transactions to possibly be a result that institutions following positive (negative) feedback strategies, in which they buy stocks with rising prices and sell stocks with falling prices. Chan and Lakonishok (1995) add another conjecture that the price appreciation could be due to "herding" that arises when institutional investors respond in common to good news.

6. Conclusions

This article examines the impact of transaction costs and trading volume on momentum strategies in the UK. We find that losers have much higher transaction costs than winners. On average, round-trip total transaction costs based on effective spreads (including commissions, short selling costs and stamp duty) for losers are 1.9 times as much as that of winners (3.46% for winners and 6.67% for losers). Once total transaction costs are taken into account, we find that based on full turnover,

momentum strategies with 12-month holding periods can still generate positive and significant net profits at the 5% level, but strategies with 3- and 6-month holding period cannot create significant profit opportunities. Based on actual turnover, 6 out of 9 momentum strategies produce positive and significant net momentum profits at the 5% level. This paper therefore questions the conclusion of LSZ (2004) and argues that it may be specific to their data and the length of their portfolio formation and holding periods.

We also investigate the relationship between trading volume, stock returns and transaction costs. Our results show that high volume winners and losers produce higher returns than low volume winners and losers. But a short position in low volume losers generates much higher profits than a comparable position in high volume losers, even in net terms. This leads to the interesting result that low volume momentum strategies yield higher profits than high volume strategies. Furthermore, we find the clear pattern that trading volume is positively related to the costs of buyer-initiated transactions and is negatively related to the costs of seller-initiated transactions, indicating that high volume stocks are expensive to buy and low volume stocks are expensive to sell. These results are important for both the academic literature and investors as they shed light on the ambiguous relationship between trading volume and transaction costs in previous studies and provide valuable information for investors to make their investment decisions. Momentum fund managers who systematically exclude stocks with low trading volumes on the grounds that they will be more expensive to trade may be losing out on potentially larger profits, even after transactions costs. We also find that the costs of seller-initiated transactions are much higher than the costs of buyer-initiated transactions for both winners and losers, suggesting that the asymmetric costs between winners and losers are dominated by selling costs.

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Table 1 – Monthly Momentum Returns and Characteristics of Winner and Loser Portfolios

Winner and *loser* are equally-weighted non-overlapping portfolios containing the 10% of stocks that performed the best and worst over a given ranking period respectively. *Momentum* is a portfolio that buys winners and short sells losers. Mean return is the monthly average return of the portfolio expressed in %. Price (£) is the average share price of the constituents of the portfolio estimated at the end of the ranking period. MV (£ millions) is the average market capitalisation (share price multiplied by number of ordinary shares) at the end of the ranking period. Volume (millions) is the average trading volume (number of shares traded) at the end of the ranking period. *t*-statistics are in parentheses.

		Holding period of 3 months			Holding period of 6 months			Holding period of 12 months		
		Winner	Loser	Momentum	Winner	Loser	Momentum	Winner	Loser	Momentum
Panel A: Ranking period of 3 months										
Mean return		0.22	-1.40	1.62	0.35	-1.50	1.85	0.05	-1.70	1.75
		(0.75)	(-3.90)	(6.69)	(0.99)	(-3.75)	(6.38)	(0.11)	(-3.57)	(4.96)
Price	Mean	2.26	2.16		2.37	2.01		2.16	1.51	
	Median	1.92	1.33		2.12	1.18		2.12	1.22	
MV	Mean	285.1	110.7		302.7	98.6		284.9	106.3	
	Median	205.6	66.2		240.1	76.1		266.3	92.1	
Volume	Mean	22.2	17.0		22.5	18.4		26.7	17.8	
	Median	17.8	12.1		17.9	11.1		23.8	10.9	
Number of stocks		131	131		137	137		134	134	
Panel B: Ranking period of 6 months										
Mean return		0.57	-1.61	2.18	0.51	-1.64	2.15	0.04	-1.64	1.68
		(1.93)	(-4.55)	(8.13)	(1.48)	(-4.08)	(6.93)	(0.10)	(-3.36)	(4.73)
Price	Mean	2.34	1.94		2.16	1.84		2.03	1.41	
	Median	2.08	1.23		2.08	1.26		1.96	1.15	
MV	Mean	313.7	82.8		329.2	83.3		295.0	65.4	
	Median	243.1	55.1		235.2	53.4		198.7	56.8	
Volume	Mean	24.5	17.0		27.8	18.3		34.7	19.9	
	Median	18.9	10.9		21.7	11.1		23.3	12.0	
Number of stocks		128	128		135	135		132	132	
Panel C: Ranking period of 12 months										
Mean return		0.65	-1.57	2.22	0.48	-1.54	2.02	0.02	-1.63	1.65
		(2.22)	(-4.63)	(9.31)	(1.47)	(-3.95)	(7.80)	(0.04)	(-3.40)	(5.59)
Price	Mean	2.69	2.07		2.63	1.86		2.61	1.43	
	Median	2.31	1.01		2.29	1.14		2.30	1.26	
MV	Mean	346.3	63.5		352.0	53.6		413.9	56.0	
	Median	267.0	44.5		279.5	44.5		296.8	43.7	
Volume	Mean	22.9	15.4		26.4	16.9		29.7	19.8	
	Median	16.3	9.9		17.1	11.6		24.4	12.3	
Number of stocks		123	123		127	127		126	126	

Table 2 – Estimates of Transactions Costs Based on Full Turnover

The table reports estimates of round-trip transaction costs (%) for winner and loser portfolios based on full turnover. Transaction costs are measured at the end of ranking period. The estimates of total transaction costs based on quoted spread (%) equal a round-trip quoted spread plus a round-trip commission, stamp duty on purchases (0.5% per purchase) and short selling costs for losers (1.5% per year). The estimates of total transaction costs based on effective spread (%) equal a round-trip effective spread plus a round-trip commission, stamp duty on purchases and short selling costs for losers.

	Holding period of 3 months			Holding period of 6 months			Holding period of 12 months		
	Winner	Loser	Momentum	Winner	Loser	Momentum	Winner	Loser	Momentum
Panel A: Ranking period of 3 months									
Quoted spread	2.43	3.65	6.08	2.42	3.67	6.09	2.80	3.66	6.46
Effective spread	2.13	3.54	5.67	2.07	3.59	5.66	2.55	3.64	6.20
Commission	1.10	1.58	2.68	1.05	1.53	2.58	1.03	1.63	2.66
Total transaction costs based on full turnover									
Based on quoted spread	4.03	6.11	10.13	3.97	6.45	10.43	4.33	7.29	11.62
Based on effective spread	3.73	6.00	9.72	3.62	6.37	9.99	4.09	7.27	11.36
Panel B: Ranking period of 6 months									
Quoted spread	2.21	3.73	5.94	2.12	3.86	5.97	2.52	3.87	6.40
Effective spread	1.86	3.67	5.54	1.82	3.85	5.67	2.07	3.87	5.94
Commission	1.08	1.59	2.67	1.04	1.51	2.56	1.03	1.58	2.60
Total transaction costs based on full turnover									
Based on quoted spread	3.79	6.19	9.98	3.66	6.62	10.28	4.05	7.45	11.50
Based on effective spread	3.44	6.13	9.58	3.36	6.62	9.98	3.60	7.45	11.05
Panel C: Ranking period of 12 months									
Quoted spread	1.81	3.69	5.50	1.68	3.78	5.47	1.86	3.94	5.80
Effective spread	1.56	3.66	5.22	1.46	3.79	5.25	1.53	3.90	5.43
Commission	1.10	1.62	2.72	1.08	1.56	2.64	1.04	1.58	2.62
Total transaction costs based on full turnover									
Based on quoted spread	3.41	6.19	9.60	3.26	6.60	9.86	3.40	7.52	10.92
Based on effective spread	3.16	6.15	9.32	3.04	6.60	9.64	3.07	7.48	10.55

Table 3 – Estimates of Transactions Costs Based on Actual Turnover

The table reports estimates of round-trip total transaction costs (%) for winner and loser portfolios based on actual turnover. Transaction costs are measured at the end of ranking period. "Portfolio position retained" is the mean ratio of winners and losers that remain in the respective portfolios in the following period. The estimates of total transaction costs based on quoted spread (%) equal a round-trip quoted spread plus a round-trip commission, stamp duty on purchases (0.5% per purchase) and short selling costs for losers (1.5% per year). The estimates of total transaction costs based on effective spread (%) equal a round-trip effective spread plus a round-trip commission, stamp duty on purchases and short selling costs for losers.

	Holding period of 3 months			Holding period of 6 months			Holding period of 12 months		
	Winner	Loser	Momentum	Winner	Loser	Momentum	Winner	Loser	Momentum
Panel A: Ranking period of 3 months									
Portfolio position retained (%)	12.86	21.40		13.52	19.44		13.52	15.91	
Total transaction costs based on actual turnover									
Based on quoted spread	3.51	4.80	8.31	3.44	5.20	8.64	3.75	6.13	9.88
Based on effective spread	3.25	4.71	7.96	3.13	5.13	8.26	3.53	6.11	9.65
Panel B: Ranking period of 6 months									
Portfolio position retained (%)	37.41	44.27		14.36	21.44		11.85	15.57	
Total transaction costs based on actual turnover									
Based on quoted spread	2.37	3.45	5.82	3.14	5.20	8.34	3.57	6.29	9.86
Based on effective spread	2.16	3.42	5.57	2.88	5.20	8.07	3.17	6.29	9.46
Panel C: Ranking period of 12 months									
Portfolio position retained (%)	53.83	58.60		35.20	39.58		12.61	17.60	
Total transaction costs based on actual turnover									
Based on quoted spread	1.57	2.56	4.14	2.11	3.98	6.10	2.97	6.20	9.17
Based on effective spread	1.46	2.55	4.01	1.97	3.99	5.96	2.68	6.16	8.85

Table 4 – Monthly Net Returns on Momentum Strategies

The table reports monthly net returns (%) on momentum strategies based on full and actual turnovers. The estimates of total transactions costs based on quoted spread (%) equal a round-trip quoted spread plus a round-trip commission, stamp duty on purchases (0.5% per purchase) and short selling costs for losers (1.5% per year). The estimates of total transaction costs based on effective spread (%) equal a round-trip effective spread plus commission, stamp duty on purchases and short selling costs for losers. The monthly net momentum returns are calculated as monthly momentum row returns minus monthly total transaction costs. *t*-statistics are in parentheses.

Turnover	Holding period of 3 months		Holding period of 6 months		Holding period of 12 months	
	Full	Actual	Full	Actual	Full	Actual
Panel A: Ranking period of 3 months						
Based on quoted spread	-1.76	-1.22	0.11	0.34	0.78	0.94
	(-7.33)	(-5.10)	(0.40)	(1.18)	(2.33)	(2.52)
Based on effective spread	-1.62	-1.11	0.19	0.40	0.80	0.95
	(-6.75)	(-4.61)	(0.65)	(1.41)	(2.38)	(2.58)
Panel B: Ranking period of 6 months						
Based on quoted spread	-1.15	0.07	0.43	0.67	0.73	0.87
	(-4.30)	(0.24)	(1.40)	(2.19)	(2.04)	(2.23)
Based on effective spread	-1.01	0.15	0.48	0.72	0.77	0.90
	(-3.82)	(0.58)	(1.57)	(2.34)	(2.16)	(2.34)
Panel C: Ranking period of 12 months						
Based on quoted spread	-0.98	0.61	0.38	0.85	0.74	0.88
	(-4.10)	(2.58)	(1.47)	(3.29)	(2.61)	(2.84)
Based on effective spread	-0.88	0.66	0.41	0.87	0.77	0.91
	(-3.77)	(2.81)	(1.62)	(3.41)	(2.71)	(2.94)

Table 5 – Gross Monthly Returns for Winner, Loser and Momentum Portfolios Based on Trading Volume Classes

The table reports monthly returns for winner, loser and momentum portfolios at three levels of trading volume. Winner and loser portfolios are first constructed to contain the 10% of all stocks that performed the best and worst over a given ranking period. Momentum is a portfolio that buys the winner portfolio and short sells the loser portfolio. Then, winner and loser stocks are further classified into three sub-portfolios based on their trading volume at the end of ranking period. *Low* represents portfolios comprising winner and loser stocks in the bottom 30% by trading volume; *Middle* represents portfolios comprising winner and loser stocks in the middle 40% by trading volume; *High* represents portfolios comprising winner and loser stocks in the top 30% by trading volume. *t*-statistics are in parentheses.

	Holding period of 3 months			Holding period of 6 months			Holding period of 12 months		
	Winner	Loser	Momentum	Winner	Loser	Momentum	Winner	Loser	Momentum
Panel A: Ranking period of 3 months									
Low	0.02	-2.14	2.16	0.02	-2.23	2.25	-0.72	-2.37	1.65
	(0.04)	(-5.03)	(6.22)	(0.04)	(-4.41)	(5.15)	(-1.22)	(-3.78)	(2.80)
Middle	0.33	-1.53	1.86	0.73	-1.40	2.13	0.54	-1.66	2.20
	(0.89)	(-3.10)	(4.81)	(1.74)	(-2.60)	(4.90)	(0.94)	(-2.67)	(4.08)
High	0.34	-1.31	1.65	0.54	-1.42	1.95	0.06	-1.45	1.51
	(0.96)	(-2.57)	(3.89)	(1.23)	(-2.43)	(3.94)	(0.09)	(-2.17)	(2.40)
Panel B: Ranking period of 6 months									
Low	0.48	-2.29	2.78	0.36	-2.05	2.41	-0.03	-2.45	2.42
	(1.39)	(-5.31)	(7.25)	(0.91)	(-3.97)	(5.41)	(-0.05)	(-4.16)	(4.45)
Middle	0.71	-1.52	2.24	0.77	-1.52	2.29	0.20	-1.37	1.56
	(1.92)	(-3.11)	(5.55)	(1.90)	(-2.74)	(5.08)	(0.37)	(-2.13)	(2.95)
High	0.82	-1.74	2.56	0.79	-1.73	2.51	-0.18	-1.20	1.02
	(2.31)	(-3.35)	(5.64)	(1.82)	(-2.96)	(4.86)	(-0.32)	(-1.78)	(1.61)
Panel C: Ranking period of 12 months									
Low	0.62	-2.19	2.81	0.58	-2.21	2.79	0.44	-2.42	2.87
	(1.87)	(-4.99)	(7.65)	(1.47)	(-4.49)	(6.70)	(0.87)	(-3.76)	(5.11)
Middle	1.04	-1.53	2.57	0.84	-1.52	2.37	0.33	-1.52	1.86
	(2.98)	(-3.36)	(7.65)	(2.06)	(-3.01)	(6.41)	(0.66)	(-2.38)	(3.85)
High	0.75	-1.44	2.19	0.43	-1.53	1.96	-0.30	-1.34	1.04
	(2.07)	(-2.85)	(5.00)	(1.14)	(-2.60)	(4.03)	(-0.70)	(-2.01)	(1.73)

Table 6 – One-Way Effective Spreads for Buyer-Initiated Transactions Based on Trading Volume Classes

The table reports estimates of the half effective spread (%) for buying winners and losers based on trading volume classes. Trades are defined as buyer-initiated when the transaction price is larger than the bid-ask midpoint. *Winner* and *loser* portfolios are first constructed to contain the 10% of all stocks that performed the best and worst respectively over a given ranking period. *Momentum* is a portfolio that buys the winner portfolio and short sells the loser portfolio. Then, winner and loser stocks are further classified into three sub-portfolios based on their trading volume. *Low* represents portfolios comprising winner and loser stocks in the bottom 30% by trading volume; *Middle* represents portfolios comprising winner and loser stocks in the middle 40% by trading volume; *High* represents portfolios comprising winner and loser stocks in the top 30% by trading volume.

	Holding period of 3 months			Holding period of 6 months			Holding period of 12 months		
	Winner	Loser	Momentum	Winner	Loser	Momentum	Winner	Loser	Momentum
Panel A: Ranking period of 3 months									
Low	0.94	0.71	1.65	0.75	0.76	1.51	0.46	0.79	1.25
Middle	1.00	1.02	2.03	0.87	1.05	1.92	0.60	1.16	1.77
High	1.09	1.39	2.48	1.03	1.46	2.49	0.84	1.48	2.32
Panel B: Ranking period of 6 months									
Low	0.98	0.76	1.74	0.84	0.86	1.71	0.42	0.83	1.25
Middle	1.06	1.08	2.13	0.89	1.16	2.05	0.61	1.20	1.80
High	1.07	1.50	2.56	1.00	1.56	2.56	0.84	1.59	2.43
Panel C: Ranking period of 12 months									
Low	1.11	0.84	1.95	0.79	1.00	1.79	0.47	0.90	1.37
Middle	1.26	1.18	2.44	1.12	1.19	2.32	0.72	1.25	1.97
High	1.36	1.34	2.71	1.16	1.47	2.63	0.87	1.92	2.79

Table 7 – One-Way Effective Spread for Seller-Initiated Transactions Based on Trading Volume Classes

The table reports estimates of the half effective spread (%) of selling winners and losers based on trading volume classes. Trades are defined as seller-initiated when the transaction price is smaller than the bid-ask midpoint. Winner and loser portfolios are first constructed to contain the 10% of all stocks that performed the best and worst respectively over a given ranking period. Momentum is a portfolio that buys the winner portfolio and short sells the loser portfolio. Then, winner and loser stocks are further classified into three sub-portfolios based on their trading volume. *Low* represents portfolios comprising winner and loser stocks in the bottom 30% by trading volume; *Middle* represents portfolios comprising winner and loser stocks in the middle 40% by trading volume; *High* represents portfolios comprising winner and loser stocks in the top 30% by trading volume.

	Holding period of 3 months			Holding period of 6 months			Holding period of 12 months		
	Winner	Loser	Momentum	Winner	Loser	Momentum	Winner	Loser	Momentum
Panel A: Ranking period of 3 months									
Low	1.36	3.37	4.73	1.11	3.77	4.89	1.21	3.54	4.75
Middle	1.23	2.89	4.13	0.99	2.86	3.85	0.83	2.77	3.60
High	1.07	2.30	3.37	0.97	2.35	3.32	0.90	2.27	3.17
Panel B: Ranking period of 6 months									
Low	1.52	3.42	4.93	1.19	4.13	5.32	1.18	3.68	4.85
Middle	1.41	2.98	4.39	1.02	3.03	4.05	0.87	2.90	3.77
High	1.09	2.10	3.20	1.00	2.44	3.44	0.92	2.32	3.23
Panel C: Ranking period of 12 months									
Low	1.48	3.29	4.77	1.29	4.05	5.34	0.91	3.84	4.75
Middle	1.46	3.13	4.59	1.09	3.02	4.11	0.79	2.81	3.60
High	1.16	2.12	3.28	1.11	2.51	3.62	0.81	2.63	3.44

Table 8 – Net Monthly Returns for Winner, Loser and Momentum Portfolios Based on Trading Volume Classes

The table reports the net monthly returns after total trading costs based on effective spreads and full turnover for winner, loser and momentum portfolios at three levels of trading volume. Winner and loser portfolios are first constructed to contain the 10% of all stocks that performed the best and worst over a given ranking period. Momentum is a portfolio that buys the winner portfolio and short sells the loser portfolio. Then, winner and loser stocks are further classified into three sub-portfolios based on their trading volume at the end of ranking period. *Low* represents portfolios comprising winner and loser stocks in the bottom 30% by trading volume; *Middle* represents portfolios comprising winner and loser stocks in the middle 40% by trading volume; *High* represents portfolios comprising winner and loser stocks in the top 30% by trading volume. *t*-statistics are in parentheses.

	Holding period of 3 months			Holding period of 6 months			Holding period of 12 months		
	Winner	Loser	Momentum	Winner	Loser	Momentum	Winner	Loser	Momentum
Panel A: Ranking period of 3 months									
Low	-1.57	-4.73	-2.02	-0.81	-3.60	0.04	-1.12	-3.12	0.50
	(-4.12)	(-10.95)	(-5.64)	(-1.80)	(-7.08)	(0.09)	(-1.88)	(-4.97)	(0.86)
Middle	-0.86	-3.61	-1.42	0.09	-2.53	0.37	0.20	-2.31	1.21
	(-2.30)	(-7.34)	(-3.58)	(0.22)	(-4.65)	(0.85)	(0.35)	(-3.70)	(2.25)
High	-0.76	-3.10	-1.25	-0.01	-2.36	0.47	-0.25	-1.97	0.69
	(-2.15)	(-6.02)	(-2.88)	(-0.03)	(-4.01)	(0.94)	(-0.42)	(-2.94)	(1.09)
Panel B: Ranking period of 6 months									
Low	-0.96	-5.03	-1.41	-0.39	-3.57	0.15	-0.39	-3.27	1.24
	(-2.73)	(-11.48)	(-3.55)	(-0.97)	(-6.90)	(0.33)	(-0.72)	(-5.56)	(2.28)
Middle	-0.34	-3.62	-0.91	0.23	-2.67	0.60	-0.09	-2.00	0.64
	(-0.92)	(-7.39)	(-2.24)	(0.57)	(-4.81)	(1.33)	(-0.17)	(-3.11)	(1.21)
High	-0.22	-3.57	-0.31	0.26	-2.74	0.99	-0.46	-1.76	0.17
	(-0.62)	(-6.85)	(-0.69)	(0.61)	(-4.66)	(1.91)	(-0.82)	(-2.61)	(0.27)
Panel C: Ranking period of 12 months									
Low	-0.76	-4.88	-1.26	-0.10	-3.65	0.68	0.14	-3.22	1.77
	(-2.28)	(-10.98)	(-3.39)	(-0.25)	(-7.39)	(1.63)	(0.28)	(-5.02)	(3.16)
Middle	0.13	-3.64	-0.44	0.38	-2.67	0.75	0.10	-2.15	1.00
	(0.38)	(-7.92)	(-1.30)	(0.93)	(-5.27)	(2.05)	(0.20)	(-3.35)	(2.07)
High	-0.20	-3.25	-0.58	-0.05	-2.52	0.49	-0.53	-1.95	0.19
	(-0.55)	(-6.38)	(-1.32)	(-0.13)	(-4.26)	(1.00)	(-1.25)	(-2.92)	(0.32)