Yale ICF Working Paper No. 06-32

October 27, 2006

Will the smart institutional investor always drive prices to fundamental value?

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(JEL G32, L1)

Key words: momentum, asset pricing tests, market efficiency

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We are grateful to comments from Zhiwu Chen, Roger Ibbotson, and Jon Ingersoll. Elisabeth Bui and Marcus Jordan for help in research assistance. All errors are our own.

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Abstract

We study gains to momentum trading from 1946 through 2002. Past papers assume a zero-investment strategy where short sales of losers fund the purchase of winners. In practice, the broker holds the cash from the short sale as collateral, and the investor funds long positions with his own or borrowed capital. To estimate implementation costs, we assume that the investor borrows through securing other investments, pays margin costs on the borrowings, and earns the rebate rate on the cash from the short sale. We find that the difference between the call money and rebate rates is 1.4% per year over the full sample, but in more recent years, this cost approaches 2%. This zero-investment friction and trade costs restrict arbitrage and smart-investor trades. Also trade costs change over time and allow us to look at the effects of trade cost changes and momentum returns. Congress deregulated trade commissions on May 1, 1975. Commissions fell dramatically for large stocks but did not materially change for small stocks. The commission change sets up a natural experiment to test if momentum fell after commissions fell. We find that large-stock momentum fell but standard momentum strategies, which use a substantial number of smaller stocks, did not materially change.

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1 Introduction

Traditional finance theory proposes that efficient stock prices have "full information." Smart investors make the market efficient by trading mispriced securities. Typically, these pricing models assume that smart investors short overpriced stocks and long underpriced stocks. These trades force prices to fundamental value. What makes full-information pricing attractive as a working model is the lack of opportunity for arbitrage (Friedman (1953) and Ross (1976)). The idea is that if a security is mispriced, smart traders can draw on large amounts of capital through zero-investment financing and exploit the mispricing. This type of model is quite general and allows for a variety of different types of investors. Some investors may be passive and others may be irrational. In such a pricing model, we only need a few, indeed theoretically only one, smart trader to correct mispricings.

One immediate challenge to full-information pricing is that arbitrage triggers risks for additional capital if, in the short run, prices move away from fundamental value. In theoretical papers, Basak and Croitoru (2000), Gromb and Vayanos (2002), Liu and Longstaff (2004), and Shleifer and Vishny (1997) show that investors face risks from short-term poor performance and leave some arbitrage opportunities untouched. By not trading, mispricings are slow to adjust. The pricing model is a specialized risk-based argument.

A second challenge is that trade frictions slow price changes. In this argument, smart investors will not trade if transaction costs are too high.

In this paper, we examine momentum trading, the investment strategy of buying stocks that are past winners and selling short past losers. Jegadeesh and Titman (1993) were the first to note that momentum earns economically material premia. In the momentum strategy, winners and losers are ranked from 6- or 12-month past-return performance. Papers show that momentum loses money in the U.S. pre-World War II era but earns money in the post-World War II era (Jegadeesh and Titman (1993, 2001), Fama and French (1996), and Grundy and Martin (2001)). These same papers show that the momentum premium is not priced by standard asset pricing models, such as the Capital Asset Pricing Model or the Fama and French (1993) 3-factor tests. Griffen, Ji, and Martin (2003) and Rouwenhorst (1998) find momentum in international markets. Several papers suggest specialized risk-based explanations.[1] Since standard asset pricing models find abnormal premia, these risk-based stories are not widely accepted and they are not explored here. Behavioral finance papers argue that the momentum comes from investor cognitive bias,[2] but these explanations remain controversial.

To understand how market prices change and whether and how institutions might momentum-trade, several papers explore trading patterns of pension funds and mutual funds. These papers find that institutions act as momentum traders on the buy-side but not on the sell-side (Badrinath and Wahal (2002), Cohen, Gompers, and Vuolteenaho (2002), Grinblatt, Titman, and Wermers (1995), and Wermers (1999)). They find that momentum profits on the buy-side are on the order of 1-2% per year. Mutual funds and other institutional traders often have self-imposed restrictions on taking short positions. In general, papers show that institutions are smart, have better private information on firm fundamentals, and move prices in the correct direction (Nofsinger and Sias (1999), Sias (2004), and Wermers (1999, 2000)). However, it is difficult to reconcile why institutions only earn 1-2% profits and Jegadeesh and Titman (1993, 2001) show profits of 12%. One of the goals of our study is to shed light on this puzzle.

Lesmond, Schill, and Zhou (2004) (hereafter LSZ) find that momentum stocks involve trades in small, illiquid stocks that are costly to transact. They control for trade costs and recalibrate the study methods of Jegadeesh and Titman (1993, 2001) and Hong, Lim, and Stein (2000). LSZ show that trade execution costs absorb the premia. However, Jegadeesh and Titman (2001) show momentum in larger capitalization stocks, where trade costs are smaller (See Jegadeesh and Titman (2001) Table I.), and LSZ do not consider large stocks. Fama (1998) writes that market efficiency tests should concentrate on large stocks that better capture investor wealth effects. He argues that anomalies tend to shrink when we use larger stocks. Momentum tests for large-stock portfolios are more economically important, and we test this question for 1946-2002. Chen, Stanzl, and Watanabe (2002) and Korajczyk and Sadka (2004) estimate price-impact costs. Chen, Stanzl, and Watanabe (2002) find evidence of only small opportunities for trade gains, and Korajczyk and Sadka (2004) find opportuni-

[1] Berk, Green, and Naik (1999), Chordia and Shivakumar (2002), and Johnson (2002)

[2] Barberis, Shleifer, and Vishny (1998), Daniel, Hirshleifer, and Subrahmayam, (1998), and Hong and Stein (1999)

ties for larger trade gains. We concentrate on large stocks where price-impact costs are small. For our large-stock tests, we assume that traders can execute trades at reported prices. This assumption makes our tests conservative and likely overstates the probability of finding an after-trade momentum premium. We also study a longer time frame and draw on pricing from earlier periods of the NYSE than previous papers that study momentum and trade costs.

Past empirical papers assume a zero-investment strategy where losers fund winners. The idea is straightforward: a low-return investment funds a high-return investment. Because momentum self-finances, the strategy assumes that investors have access to extremely large amounts of capital and can efficiently exploit stock mispricing. Moskowitz and Grinblatt (1999) summarize well the pricing anomaly:

> Behaviorally driven momentum profits should at least be constrained by the fact that some rational investors exist who may perceive momentum as an arbitrage opportunity. Rational investors can profit from their irrational counterparts at low risk with positions in large numbers of stocks if the bulk of investors persistently and *irrationally* underreact to information that is sufficiently uncorrelated across firms. There are virtually no limits to this arbitrage if stock returns are generated by a factor model. A self-financing momentum portfolio that is long the high past return stocks and short the low past return stocks (weighted to have a similar factor beta configuration as the winner portfolio) could be created with zero factor risk. Such a portfolio would have a firm-specific risk that was almost perfectly diversified away and, because of momentum, would enjoy a positive expected return. It seems unlikely that rational investors would not exploit such a low-risk near arbitrage.

There are four key ideas from this passage: the presence of rational traders, mispricing from underreaction of traders, zero-investment financing, and hedging factor risk.

A key idea is the zero-investment financing assumption. In practice, buying and selling short stocks are not symmetric trades. For buys, we need capital or must borrow. For short sales, we require that our broker locate the shares that we short-sell. The lending market that supplies stocks for short sales is quite specialized. Fees go to the original lender to induce lending and to the broker for setting up the transaction. Jones and Lamont (2002) describe this lending market for short sales:

> Suppose A lends shares to B and B sells short the stock. When the sale is made, the short sale proceeds do not go to B but rather to A. The actual term of the loan is one day, though the terms can be renewed in subsequent days. Because A is effectively using collateral to borrow, A must pay interest to B. When the loan is closed, A repays cash to B and B returns the shares to A. Although sometimes various terms of the transaction (such as the amount of collateral provided) are negotiated between the two parties, in most cases the interest rate received by B is the only important variable. This one day rate, called the ... "rebate rate"..., serves to equilibrate supply and demand in the stock lending market.

In foreign countries, collateral for short sales may be any high-quality common or preferred stock; in the United States, collateral is almost always cash (Faulkner (2005)).[3] Jacobs and Levy (1996) write, "institutional holders do not have access to the [short-sale] cash proceeds." They note collateral is typically 102% of the short sale and the investor often reserves additional cash for mark-to-market changes. Jacobs and Levy (1996), Jacobs, Levy, and Starer (1998), and Alexander (2000) model short-sale strategies where the investor typically adds a 10% buffer to cover the potential for additional collateral if short-sale prices rise. Most importantly, in practice there is no simple self-financing strategy to sell losers to purchase winners. Because the investor cannot short sell to finance the long position, long positions are limited to what the investor can invest with his capital or borrow through margin. Chen, Stanzl, and Watanabe (2002) also note that investors cannot short-sell to finance winner positions. They study the strategy where one shorts losers, earns returns for rebate cash, and goes long in winners with invested capital.

To illustrate the role of trade frictions, we measure 4 different momentum returns and analyze their returns. The 4 returns give us a more complete picture of pricing that investors face and allow us to characterize our results to those of the previous literature. First, we assume a frictionless economy and study the frictionless momentum return. We do not include trade costs, rebate cash, or borrowing costs. We call this return "notional momentum." Jegadeesh and Titman (1993, 2001), Fama and French (1996), and Grundy and Martin (2001) study the notional momentum return. These papers explore, but cannot find, a risk-based explanation for this premium. Consistent with the past literature, we also call this strategy *winner-loser*.

[3]For the U.S. market, D'Avolio (2002) reports that 98% of the positions are cash and 2% are Treasury securities.

Second, we measure the winner-loser strategy net of trade costs. In this strategy, the investor owns losers. The investor sells losers and buys winners. LSZ measure the returns for this strategy for the standard 6-month ranking and 6-month investing rule.

Third, we measure the winner-loser strategy that is long in winners, short in losers, and long in cash from the collateral on the short position. This strategy mimics the investment strategy where the investor does not own losers and invests capital to buy winners. The short-sale cash earns the rebate rate. D'Avolio (2002) shows that the best available rebate rates currently approximate the Federal Funds rate less 25 basis points. We refer to this strategy as *winner-loser+rebate*. The winner-loser+rebate strategy requires capital and is closest to how the practitioner uses long-short strategies (Faulkner (2005)). We include trade costs. Since the strategy requires capital for each long position, the strategy is *not* zero-investment financing. Nevertheless, the winner-loser+rebate is an important strategy. This strategy could be the strategy of a hedge fund that takes short positions but invests in long positions with capital. Chen, Stanzl, and Watanabe (2002) measure this type of strategy.

Fourth, a zero-investment setup is interesting because a premium, net of transaction costs, even if small, that is hedged from factor risk allows for potentially large gains. To model the zero-investment strategy with its full implementation costs, we long winners, short losers, and finance buys from borrowing against other investments that the investor holds. The investor also earns the rebate interest from the short-sale cash, which offsets the margin costs. To compute the cost of borrowing, we use the call money rate (sometimes called the broker's loan rate) less the rebate rate. We call this spread the "net-margin cost," and we estimate it over the full sample from 1946 to 2002 at 139 basis points. In more recent years, the net-margin cost is higher. We refer to the strategy that longs winners, shorts losers, and finances the strategy with margin as *winner-loser-margin*.[4] Note that collateralized securities are now at risk for liquidation. While we note this friction, we do not consider this friction in a

[4] In addition, this strategy also faces the risk for new capital infusions if short stock prices rise or if the long or collateral positions fall. However, we do not include a cash buffer, which makes our transaction costs conservative. We assume that traders can secure additional collateral when required. The winner-loser-margin strategy assumes that there are well capitalized institutional investors. We do not consider the retail investor, who typically does not earn the rebate rate on the short sale cash, and typically pays margin costs on the short sales.

risk-based argument.

We first test for the presence of small stocks. LSZ and our tests find that the standard momentum portfolios typically have a high proportion of small stocks. Small stocks have high transaction costs and are likely to have high trade-impact costs, and we restructure our tests to exclude these stocks. We trim in two ways. First, we rank on the basis of NYSE market-size deciles and trim the smaller market-size deciles from *both* the ranking and test portfolios. We call this approach the "full trim." Second, as before, we rank all stocks by past performance and form test portfolios. We then independently rank by market size and trim smaller stocks from the test portfolios. We call this approach the "partial trim." We find that the partial trim gives stronger momentum premia, and we concentrate our tests here.

For stocks in the larger half of the market, the notional, partial-trim portfolio earns 11% per year during 1946-2002, consistent with past papers, such as Jegadeesh and Titman (1993, 2001). For large-stock strategies for the 1946-2002, we find the following results:

1. Loser short sales, as stand-alone trades, lose 2% per year after including rebate returns and without including transaction costs.

2. Prior to May 1, 1975, stock commissions were fixed for all stocks and regulation kept commissions artificially high for large-stock trades. In the deregulated period, large-stock trade costs fall by half, but small-stock trade costs do not materially change. Large-stock winner-loser returns fall by slightly more than the commission cost declines. Standard momentum strategies, based primarily on small stocks, show no material change.

3. The winner-loser+rebate strategy (which requires capital) has less risk, as measured by the Capital Asset Pricing Model or the Fama and French (1993) 3-factor tests, than it should. The risk-based premia continue to represent an asset pricing puzzle.

4. The raw return winner-loser-margin strategy (which does not require capital but requires other long positions for collateral), after trade and net-margin costs, earns 3-4% per year the 1946-2002 full sample, but this return is not statistically

significant. In 1983-2002, this strategy earns about 1%, which seems too small to attract smart investor trades.

The remainder of the paper is organized as follows. Section 2 reports the data portfolio construction methods, and the transaction-cost assumptions. Section 3 shows the raw returns for different market-size trims. Section 4 computes raw returns for a range of winner-loser-margin strategies. Section 5 provides tests with standard asset pricing models with and without transaction costs. Section 6 provides a discussion and concludes.

2 Setup for empirical tests

2.1 Data

Our data consist of U.S. stocks for 1946-2002 from the Center for Research in Security Prices (CRSP). To be consistent with past papers, we use NYSE and AMEX stocks. We also made tests with NASDAQ stocks. In these tests, we trimmed all NYSE, AMEX, and NASDAQ firms that fall into the smallest market-size level, based on NYSE market-size cutoffs, and all stocks with prices at $5.00 or less. We found that the inclusion of NASDAQ stocks does not change the results. We report results for the NYSE and AMEX so that we can compare our results to past papers. One advantage of excluding NASDAQ stocks is that trade costs are higher on the NASDAQ (Christie and Shultz (1994) and Huang and Stoll (1996)). We break the 1946-2002 period into 1946-1962 and 1963-2002 because 1963 is the first full year of the AMEX. We then break 1963-2002 into two, 20-year periods, 1963-1982 and 1983-2002. Broker commissions fall in the second period because of commission deregulation. This deregulation gives us a natural experiment to test if reductions in trade costs predict falls in momentum.[5] If trade costs bind, we should see momentum fall after commissions fall.

D'Avolio (2002) finds that the rebate rate earned on the short-sale cash is 25 basis

[5]Our 1983-2002 test period is not too far off from the LSZ test sample of 1980 to 1998. While they make tests on standard sorts on past performance, we concentrate on large-stock strategies. Thus, our results are complimentary.

points lower than the Federal Funds rates. To obtain a reliable estimate of the rebate rate, we subtract 25 basis points from the Federal Funds rate, which we obtain from the St. Louis Federal Reserve website. Their Federal Funds data start on July 1954. For Federal Funds data before July 1954, we hand collected rates from the *Wall Street Journal.*

We require that short sales have no "special" costs[6] and face no likelihood of a short squeeze.[7] The problem is that if short-sale constraints bind, the rebate estimate will be too high and overstate the winner-loser+rebate and winner-loser-margin returns. Since we require that short-sale constraints not bind, we concentrate our tests on larger market-size stocks that are more liquid.

2.2 Ranking methods

For forming our ranking and test portfolios, we use the standard Jegadeesh and Titman (1993) methodology. P10 are the past winners and P1 are the past losers. We specify the momentum strategy as the triple (J,S,K) where J is the length of the ranking period, S are the months skipped between the rank and test periods, and K is the length of the holding period. To increase the power of tests, Jegadeesh and Titman (1993) use an overlapping-period design, and we follow their setup. We start at month t, rank stocks by the past performance, group firms into 10 past-performance groups, skip S months between the ranking and test periods, and hold positions for the next K months. We then repeat the process using month $t + 1$ as the portfolio formation date. In the (6,0,6) setup, the momentum return is the sum of 6 different long-short portfolios, 1/6 formed one month prior, 1/6 formed 2 months prior, and so forth. At the end of each month, the investor closes the positions taken out 6 months ago and opens new long and short positions.

We also rank stocks by NYSE market-size rankings to test the influence of small stocks in the P1 and P10 portfolios. As is standard in the literature, we call MV1

[6] The term "special" implies a lower rebate return. See Jones and Lamont (2004).

[7] If the stock is in short supply, the rebate rate may be less and in some instances negative. Further, if the stock is in short supply, the stock is more likely to have a "short squeeze," where the short-seller must buy the stock on the open market and close the position. See D'Avolio (2002) and Geczy, Musto, and Reed (2002).

the smallest and MV10 the largest market-size deciles.

To gain more compact terminology for our tables, we call winner-loser *P10-P1*, winner-loser+rebate *P10-P1+rebate*, and winner-loser-margin *P10-P1-margin*.

2.3 Return components

We define the momentum-neutral portfolio as the equally-weighted (EW) return of all stocks in the test period ($r_t^{EW} = \frac{1}{n}\sum_1^n r_{i,t}$ for the universe of n stocks in the test period). Thus the EW, momentum-neutral portfolios match the test portfolio designs, and these EW momentum-neutral portfolios are like a restricted CRSP-EW portfolio. For example, in the MV1-MV5 trim, we trim all the stocks in the smaller market-size half. The momentum-neutral portfolio here is the EW portfolio for all stocks in the larger half of the market.

The EW momentum-neutral portfolio gives us a way to break out the momentum returns. We break the notional-momentum return into two components. The "EW-P1" is the *loser component* and summarizes the return from going long in the momentum-neutral portfolio and short in losers. The "P10-EW" is the *winner component* and summarizes the return from going long in winners and short in the momentum-neutral portfolio. The components give a more complete description of the P10-P1 premium and allow us to compare our results to other papers.

We also examine long and short positions as stand-alone trades. The P10 return is the standard return from buying winners. The "rebate-P1" is the return from shorting losers and earning the rebate rate on the short-sell cash.[8] We test the feasibility of loser shorts as stand-alone trades. Shorts are self-financing.

Figure 1 illustrates the P10-P1+rebate strategy. There are two panels. In Panel A, we assume that the rebate rate is positive, the P1 return is negative, and the P10 return is positive. Thus, all three generate a positive return for the the P10-P1+rebate strategy. As we draw the setup, P1 shorts are profitable as stand-alone trades. In

[8]For institutions, the loser short, as a stand-alone trade, is a near-self-financing trade. Retail investors typically do not earn the rebate interest and most often pay margin positions on the short sales. We assume that the institutional investor, who receives the rebate return, is the marginal price setter.

Panel B, we assume that the rebate rate is positive, the P1 return is positive and greater than the rebate return (thus the sum of the rebate return and the P1 short return is negative), and the P10 return is positive. Here P1 shorts are not profitable as stand-alone trades, and the P10-P1+rebate return is smaller than the return in Panel A. If P1 shorts lose money as stand-alone trades, they may still have value for hedging risk factor risks from P10 long positions. In the hedging strategy, the investor faces a tradeoff of the benefits from hedging relative to the losses from the short positions.

[Insert Figure 1 about here.]

2.4 Margin costs

We estimate margin costs from the call money rate, also sometimes called the broker's loan rate. The call money rate is the most favorable loan rate for large margin positions. For example, on November 18, 2005, the *Wall Street Journal* reported a call money rate of 6%. If the loan balance is less than $1,000,000 and equal to or more than $200,000, an additional 1% is added to the 6% base. If the loan balance is less than the $200,000, 2% is added to the 6% base. From the *Wall Street Journal*, we collected by hand the call money rates from 1946 forward. We compute the net-margin cost as the difference between the call money and our estimate of the rebate rate. Recall that we estimate the rebate rate at the Federal Funds rate less 25 basis points.

Table I shows rates for call money, Federal Funds, 30-day T-bill in the secondary market, and estimates of the net-margin cost. Table I breaks the full period into 1946-1962, 1963-1982, and 1983-2002 subperiods. In each period, we also show the standard deviation of the net-margin costs. These periods are the test periods for our stock return tests. Table I shows that the call money rates are higher than the Federal Funds rates which are higher than the T-bill rates. For 1946 through 2002, the net-margin cost is 139 basis points. The net-margin cost varies over the time period. In the last 20 year period, 1983-2002, the net-margin cost is 177 basis points.[9]

[9]Hogan, Jarrow, Teo, and Warachka (2004) also use a 2% estimate for their net margin costs in their momentum tests. We also report, but do not show in tables to save space, that 1994-2004 the

[Insert Table I about here.]

2.5 Trade costs

Papers often group trade costs into direct and indirect costs. Direct costs are commissions. Indirect costs are from the bid-ask spread and price impacts. The security market deregulated commissions on May 1, 1975 and as time passed, commissions fell. Summarizing these events, Stoll (2003) writes,

> In 1970, commissions on a 500 share trade of a 40 dollar stock were $270. While institutional investors received a quantity discount, they still paid substantial amounts (for example 26.2 cents per share on a 5000 share trade). ...
>
> ....
>
> Today the cost of a 500 share trade, handled electronically, is typically less than $25 (despite the inflation since 1970), and institutions typically trade for 5 cents per share. [p. 590.]

In Stoll's example, the difference of 21.2 cents between the 1970 and current trade commissions for a $40 stock creates a 0.53% trade cost change. Jones (2002) notes commissions for NYSE stocks in 1962 are 0.82% of value and in 1997 fall to 0.12% of value. This fall implies a 0.70% trade cost change. Consider the hypothesis that trade costs cause frictions that cause momentum. The P10-P1 should fall as commissions fall.

There is a large literature on the costs to execute trades. One method is based on the specialist's bid-ask spread quotes plus commissions. Stoll and Whaley (1983) estimate bid-ask spreads and commissions for 1963-1979 trades. They suggest that trade costs explain at least some of the small-firm premia. Bhardwaj and Brooks (1992) use specialist spreads and commissions and suggest that trade costs can explain the De Bondt and Thaler (1985) contrarian premia. However, Lee and Ready (1991) use trade data and show that executed prices are sometimes within the reported bid

net margin cost is 194 basis points, which is quite close to the costs of borrowing that Hogan et al (2004) use.

and ask prices. They find that "effective spreads" are less than those from specialist quotes.

Keim and Madhavan (1995, 1997, 1998) estimate transaction costs for institutional trades with 1/91-3/93 trade-by-trade data. Keim and Madhavan (1998) divide costs into explicit and implicit trade-cost components. The explicit cost is the commission. Their implicit cost is from price impact and bid-ask spread costs. They break trading costs into buyer-initiated and seller-initiated trades and report trade costs by market-size quintile. Berkowitz, Logue, and Noset (1988) also estimate trade costs during the post-deregulation period. They test on large stocks. They estimate commissions paid to brokers at \$0.07 per share, which is similar to the more recent estimate of Stoll (2003). They estimate one-way trade costs at 0.50% of value. The Keim and Madhavan (1998) estimates for MV9 and MV10 are lower than those of Berkowitz, Logue, and Noset (1988) but the Keim and Madhavan (1998) estimates for MV6 and MV7 stocks are higher. The Berkowitz, Logue, and Noset (1988) and Keim and Madhavan (1998) trade-cost estimates work if (1) tests are in the deregulation period and (2) stocks are at least in the larger half of the market. These cost estimates do not appear to work well for small stocks in any years or for any trades in regulated-commission years when commissions are higher. We use the Keim and Madhavan (1998) trade costs for our 1983-2002 large-stock momentum tests. Even though short sales must be sold on an uptick, which slightly increases short-sale execution costs, we ignore this requirement, which will overstate the premium.

Unfortunately, researchers do not have access to intraday pricing data for our earlier test periods where commissions are regulated. We make two estimates. First, Lesmond, Ogden, and Trzcinka (1999) (hereafter LOT) provide a model that estimates effective spreads from daily data. They argue that informed investors trade when information is large enough to overcome the bid-ask spread, trade impact, and commission costs. Their daily return data are from CRSP from 1963-1979, and their model estimates effective spreads plus commissions. They report trade costs by market-size decile. Second, the results of Jones (2002) and Stoll (2003) allow us to estimate falls in commissions and introduce a second trade cost estimate for the 1946-1982 period. Jones (2002) and Stoll (2003) estimate that, as a per cent of trade value, deregulation caused commissions to fall by 0.70% and 0.53% respectively. The estimate of Jones (2002) is a better choice for tests because it uses the average across NYSE stocks. We use the Keim and Madhavan (1998) costs plus 0.70% for a second cost estimate. This approach is conservative and also may understate trade costs because the indirect trade costs should fall as market depth has deepened over time. Table II summarizes the trade-cost assumptions that we use for our tests. We make tests on market-size deciles MV5 through MV10, and we do not test for smaller stock trades because trading here may incur additional trade-impact costs. Note that the trade costs for 1946-1982 are often more than 1% per and the 1983-2002 costs approximate 0.50%. Unfortunately, a common problem for past papers is that they take more current trade costs and apply them to early years when commissions are high. This approach will understate momentum trade costs and overstate the returns that investors would earn.

[Insert Table II about here.]

The (6,0,6) momentum strategy trades frequently. For this strategy, each month we (a) buy the recently ranked winners, (b) sell the winners that we bought 6 months ago, (c) sell the recently ranked losers, and (d) buy the losers that we sold short 6 months ago. Theoretically, each month we make 4 one-way trades, two on the buy-side and two on the sell-side. Over 12 months, we trade the long portfolio 4 times and the short portfolio 4 times. But some of the winners and losers repeat. We define turnover as the probability that a stock that enters at month $t-6$ exits the portfolio at month t when the new portfolio is formed. We estimate turnover separately for buy and sell portfolios for each test period. We estimate yearly sell-side trade costs as sell turnover times 4 trades times the sell trade cost. We estimate yearly buy-side trade costs as buy turnover times 4 trades times the buy trade cost.

3 Empirical results

3.1 Momentum returns without trims

To obtain a baseline, Table III shows the distribution results for 4 momentum strategies, (6,0,6), (6,1,6), (6,0,12), and (6,1,12). Returns are for each of the past-performance deciles and P10-P1 portfolio. The returns do not include estimates for trade costs. The table shows the mean, variance, skewness, and kurtosis of the monthly portfolio stock returns. For the 1946-2002 period, the $(6, 0, 6)$ strategy shows a momentum premium of 0.76% per month. The (6,1,6) strategy earns a somewhat higher return of 1.00% per month, consistent with the results of past papers. Skipping a month between the ranking and formation periods mitigates bid-ask spread bounce that is stronger for past losers, which are typically smaller market-size stocks that have low prices.[10] The (6,0,12) and (6,1,12) strategies yield smaller profits, consistent with the results of Jegadeesh and Titman (1993).

For completeness, Table III also reports higher moments for each of the 4 strategies. For the (6,0,6) 1946-2002 tests, the past loser (P1) variance is 0.60% and the past winner (P10) variance is 0.37%. The largest variances are for the P1 portfolios. After P1, variances fall, bottom out at P5 and P6, and rise again at P10. The P1 variance is more than twice those of P4, P5, and P6 portfolios. The P1 portfolio returns are rightward skewed and have fatter tails than the other past-performance portfolios. The P10-P1 momentum portfolio variance is 0.25%, about the same as that of P4, P5, and P6. Shleifer and Vishny (1997) argue that risk arbitrage bears risks from the total distribution, most especially the variance, and not simply the factor risk from standard asset pricing models. They argue that this type of arbitrage is risky because mispricing may not quickly correct and may, in the short run, deepen and restrain arbitrageurs from trades.

[Insert Table III about here.]

LSZ show that small stocks dominate standard momentum strategies. Their tests are from 1980 to 1998. Our sample is from 1946 to 2002. To look at the small stock influence, we sort independently by 6-month past-performance and market size. Table IV reports the percentage results of the two-way sorts. Panel A reports the (6,0,6) results for 1946-1962, which includes only NYSE firms. In the 1946-1962 period, 21.2% of P1 stocks are MV1 stocks. Panel B reports the (6,0,6) results for the 1963-2002 stocks, which includes both AMEX and NYSE stocks. Recall that the market-size break points are based on NYSE market-size rankings. In the 1963-2002 period, 53.7% of the P1 stocks are MV1 stocks. Consistent with LSZ, Table IV shows that past momentum strategies rely heavily on small stocks, which one cannot trade

[10] See Blume and Stambaugh (1982), Boynton and Oppenheimer (2006), Conrad and Kaul (1993), and Roll (1982).

inexpensively. To give the most complete picture, next we trim smaller stocks and report the momentum return results for each trim.

[Insert Table IV about here.]

3.2 Momentum returns after trims of small stocks

To keep the results compact, we report future test results with the (6,0,6) strategy, which is the most frequently studied strategy. We make trims of smaller stocks in two ways. First we rank on the basis of NYSE market-size deciles and trim the smaller size deciles from *both* the ranking and test portfolios. We designate this full trim as "FT." Second, we rank all stocks by past performance and form test portfolios. We then independently rank by market size over all stocks and trim smaller stocks from the test portfolios. We designate this partial trim as "PT." Fama and French (1996) show that the more extreme ranked winners and losers have more extreme test returns, and we expect that the PT strategy will give stronger premia.

In Table V, we show the FT strategies on the left and the PT strategies on the right. We trim at various market-size deciles in the following way. We trim MV1 stocks, then MV1-MV2 stocks, then MV1-MV3, and so forth through MV1-MV6. In Table V, the first two capital initials indicate the type of trim (FT or PT) and the next number indicates the largest market-size decile trimmed. Thus, PT5 is the partial trim that ranks all stocks by past performance, forms past-performance deciles, and then trims MV1 up through MV5 from the test-period portfolios.

There are three advantages to the trims that we use. First, the successive trims show how the results change when smaller stocks are trimmed. Second, tests in the larger half of the market give us stocks where short sales are possible, transaction costs are smaller, and trades have small, if any, trade-impact costs. Third, the FT6 and PT6 strategies test momentum for only very large stocks. These stocks are more actively traded and are similar to stocks included in the S&P500.[11] We report, but

[11]Recall that our sample is NSYE and AMEX stocks. The market-size deciles are based on NYSE cutoffs. NYSE stocks dominate the larger market-size deciles. AMEX stocks are smaller and dominate the smaller market-size deciles. Before trims based on market size, there are 100-120 stocks in each past-performance decile. Thus, the top four market-size deciles have about 400 to 500

do not include in tables to save space, that after trims, the (6,1,6) has similar returns to those of the (6,0,6) strategy.[12]

We divide each panel into three sections. First, we present P1, P10, EW, and P10-P1+rebate returns. These strategies require capital. Second, we report the P10-P1 (notional momentum) and its winner and loser components, P10-EW and EW-P1. Third, we present rebate-P1 and P10-P1-margin. These strategies are self-financing.

We present monthly returns for the 1946-2002 test period and three subperiods. None of these monthly returns includes trade costs, which we will later add. We break the full sample first at the end of 1962 so that the 1946-1962 returns can be entirely from the NYSE. We break the 1962-2002 into two parts, 1963-1982 and 1983-2002. This second break point is arbitrary. We also made tests with different break points and find the results similar.

We are interested in stocks for momentum tests that trim at least 40% of the smaller stocks in the market. For 1946-2002, FT4, FT5, and FT6 notional momentum (P10-P1) is 0.73%, 0.66%, and 0.62% per month. The PT4, PT5, and PT6 notional momentum is 0.97%, 0.93%, and 0.86% per month. Thus, the PT strategy is more profitable. The P10-P1+rebate returns are typically slightly less than those of the P10 portfolio. Table V shows three other results.

First, over the full sample, without trade costs, the rebate-P1 return is negative. For example, the FT4, FT5, and FT6 losses are 0.30%, 0.35%, and, 0.34% per month, and the PT4, PT5, and PT6 losses are 0.12%, 0.16%, and 0.17% per month, or about 2% per year. Thus, P1 stocks have poor returns relative to the EW momentum-neutral portfolio, but the P1 returns are greater than the rebate returns.[13] This loss

stocks.

[12]The similarity of the (6,0,6) and (6,1,6) strategies demonstrates that skipping a month has little effect on larger stock portfolios.

[13]The rebate-P1 negative return also implies that, on average, investors who momentum-trade will have to add cash to cover the increase in value of the short-sale stocks. While there will often be additional capital needed to cover the short-sale position, the additional cash required also earns the rebate return. The additional net margin costs are not large and we ignore them. Korajczyk and Sadka (2004) show a similar result. Their Table I Panel B shows the returns of losers less the risk-free rate. They make tests with both EW and VW strategies for a variety of (J, S, K) strategies. They find that losers less the risk-free rate are positive for all their tests. If losers less risk-free are positive, then loser shorts, rebate-losers, are negative. Thus, their results complement ours.

on a simple short has a simple implication: If the smart investor does not own losers and cannot benefit from hedging other positions, the investor ignores these overpriced stocks and their prices need not reflect fundamental value. At least in the medium term, the lack of interest of the smart investor to trade may sustain mispricing.

Second, for large stocks, notional momentum falls in the 1983-2002 period. For 1946-1962, for PT4, PT5, and PT6, the notional monthly returns are 1.09%, 1.12%, and 1.10% per month. Similarly, for 1963-1982, returns are 1.20%, 1.12%, and 1.10%. For 1983-2002, the PT4, PT5, and PT6 notional-momentum monthly returns are 0.64%, 0.53%, and 0.40%. On a yearly basis, notional PT5 momentum falls from about 13% to 6%. We view this result as interesting. In the Jones (2002) estimates, commission costs fall by 0.70%. We will later show that 7 one-way trades per year are necessary to implement the (6,0,6) strategy. Thus, large-stock P10-P1 falls by 7%, slightly more than 5% the reduction of commission costs. This result is consistent with the hypothesis that trade costs bind and create barriers to price discovery.

The Table V results that show a fall in momentum seem unusual because Jegadeesh and Titman's (2001) Table I shows economically material premia for large stocks in the 1990-1998 sample period. Their large stocks are similar to our PT5 stocks. We made tests for the 1990-1998 period and find similar results to theirs. We find lower momentum premia in the 1983 to 1989 period, which explains why our 1983-2002 results differ from theirs.

Third, the fall in momentum returns for large stocks is mostly from the fall in winner returns. For PT4, PT5, and PT6 for 1946-1962, the winner component returns are 0.47%, 0.50%, and 0.51%, and for 1963-1982, the winner components are 0.67%, 0.65%, and 0.62%. For 1983-2002, the winner components fall to 0.17%, 0.16%, and 0.10%. The loser components fall also but not as dramatically. In yearly returns, the 1983-2002 PT5 winner component is 1 1/2% and the loser component is 4 1/2%. Of course, these returns do not include trade costs. To summarize results, we use 3-year moving-average returns to smooth the monthly returns and give a simple picture of the annual return. Two-year and 4-year moving averages show similar pictures. Figure 2 draws the 3-year moving average of notional momentum returns for PT1 and PT5 trims. Our choice of PT1 as a baseline momentum return is based on the need to exclude very small stocks but include MV2 and larger stocks. We label the PT1 3-year moving-average notional return "Standard." We label the PT5 3-year moving-average notional return "Large." The graph shows that in the 1946-1975 years, the large and standard momentum premia are about the same. In the more current years, large-stock premia fall relative to standard premia. Figure 2 shows the results for our natural experiment on the change in commissions. Notional momentum falls for large stocks but not for standard momentum tests, which have a larger proportion of smaller stocks.

Hong, Lim, and Stein (1999) use a sample from 1985 to 1996 and LSZ use a sample from 1980 to 1998. Both show that loser returns dominate the momentum premium, which our 1983-2002 results also show. But in commission-regulation years (pre-1975), which neither Hong, Lim, and Stein (2000) nor LSZ measure, Figure 2 shows that the winner and loser components are the same size.

Figure 2 also shows poor momentum premia in the 1970's and early 1980's for both standard and large-stock portfolios. If we assume that transaction costs are zero, which is obviously wrong, there are periods where momentum sustains large losses. For example in the area around 1975, the past 3-year moving-average returns approximate -15% per year. These graphical results suggest that momentum premia vary across time. Note that the strategy is financed by securing other long positions, and these positions face liquidation risk from the failure of the strategy. These results are consistent with the models of risk arbitrage of Basak and Croitoru (2000), Gromb and Vayanos (2002), Liu and Longstaff (2004), and Shleifer and Vishny (1997).

[Insert Table V and Figure 2 about here.]

3.3 Turnover estimates to aid in the calculation of transaction costs

Table VI reports turnover for winners and losers and the average number of stocks in the monthly winner and loser portfolios. We report results for 1946-1962, 1963-1981, and 1983-2002 for the untrimmed tests and the partial trims from PT1 through PT6. For the full period, the winners and losers average 181 stocks, but as we implement market-size trims, the number of stocks for trades falls dramatically. For PT5, there are 51 winner stocks bought every month and 33 loser stocks sold short. For trade costs, we use these period-specific turnover rates for estimating the trade costs of each of the PT4, PT5, PT6 strategies that we will evaluate. For example, for PT5 for 1946-1962, the winner turnover is 84.9%.

The Table VI results show that turnover occurs at about the same rate across the different market-size rankings. With a turnover that approximates $\frac{7}{8}$, we must price the costs of 7 one-way trades each year.

[Insert Table VI about here.]

4 Raw returns for winner-loser-margin strategies, net of transaction costs

The PT strategy tests have stronger momentum raw returns, and we concentrate our tests here. Table VII shows the returns for the notional and winner-loser-margin results for PT4, PT5, and PT6 portfolios. We add t-values that test if the P10-P1 raw return is different than zero. As expected, the notional P10-P1 raw returns are large and statistically significant. We next report the P10-P1 return, net of trade costs. We then add net-margin costs to estimate the P10-P1-margin returns. To keep the discussion brief, we focus on the PT5 strategy.

The 1946-2002 P10-P1-margin return with our first trade-cost estimate is not different than zero. (The monthly return is 0.325 and the t-value is 1.81.) With the second trade-cost, the premium falls further. (The monthly return is 0.232 per month and the t-value is 1.29.) We next examine subperiods.

The 1946-1962 P10-P1-margin return with the first trade-cost estimate is abnormally positive. (The monthly return is 0.453 and the t-value is 2.50.) With the second trade-cost estimate, the return is not different than zero. (The monthly return is 0.309 per month and the t-value is 1.70).

The 1963-1982 P10-P1-margin return with the first trade-cost estimate is not different than zero. (The monthly return is 0.469 and the t-value is 1.38.) With the second trade-cost estimate, the return falls further. (The monthly return is 0.325 per month and the t-value is 0.95).

The 1983-2002 P10-P1 return, net of trade costs, is 0.221 (t value: 0.61). The

P10-P1-margin return is close to zero. (The monthly return is 0.073, less than 1% per year, and the t-value is 0.20.)

Figure 3 shows the PT5 3-year moving-average returns, net of trade and net-margin costs. This figure uses the first estimate for trade costs. In the more recent years, the yearly returns are distributed near zero. This result is consistent with the empirical literature on financial institutional trades that suggests that momentum profits are small.

[Insert Table VII and Figure 3 about here.]

5 Regression tests

Jegadeesh and Titman (1993, 2001), Fama and French (1996), and Grundy and Martin (1998) study the covariation properties of momentum strategies. Jegadeesh and Titman (2001) report P10-P1 monthly abnormal performance of 1.24% and 1.36% for the CAPM and Fama and French (1993) 3-factor tests. There are two questions. First, we test if the covariation properties that we see in past papers appear for large stocks. Second, we test if transaction costs absorb the premia in these risk-based tests.

Table VIII Panel A shows the factor regressions without considering trade costs. These regressions replicate past asset pricing tests. For the P1 and P10 regressions, we subtract the risk-free rate. For the P10-P1 regressions, we use the P10-P1 premium. We use the CAPM and Fama and French (1993) 3-factor models. The P10 tests show abnormal gains, P1 tests show abnormal losses, and both P10 and P1 $\hat{\beta}$'s are higher than one. The P10-P1 regressions show no apparent factor risk. The P10-P1 $\hat{\beta}$'s are small, the size and book-to-market coefficients are also small, and most of the slopes are negative. For 1983-2002, the premia are smaller, however. The performance measures are sometimes larger than the P10-P1 raw return.

Panel B subtracts trade costs for P10-P1+rebate and P10-P1-margin tests. The P10-P1+rebate tests the pricing for a unit of invested capital, and we subtract the risk-free rate, as we do in the Panel A P1 and P10 tests. Thus, the P10-P1+rebate strategy is like that of the P1-P10 strategy but includes trade-cost adjustments. For

1946-2002 for P10-P1+rebate, with the first trade-cost estimate, the CAPM intercept is 0.532 (t-value: 2.81) and the 3-factor intercept, is 0.573 (t-value: 3.02). With the second trade-cost estimate, the CAPM intercept is 0.410 (t-value: 2.29) and the 3-factor intercept is 0.480 (t-value: 2.53).

The P10-P1-margin tests the pricing for a unit of borrowed capital. For P10-P1-margin tests for 1946-2002, for the first estimate of trade costs, the CAPM intercept is 0.385 (t-value: 2.16) and the 3-factor intercept is 0.457 (t-value: 2.41). For the second estimate of trade costs, the CAPM intercept is 0.294 (t-value: 1.64) and the 3-factor intercept is 0.363 (t-value: 1.92).

[Table VIII about here.]

The P10-P1+rebate risk-adjusted premia suggest mispricing. Trade execution costs lower premia substantially but do not fully explain the premia. These risk-based tests continue to represent a puzzle, but net of trade costs, these premia are not large. Investors that take the P10-P1+rebate strategy earn slightly lower returns than the would earn from investing in the market but at a substantially lower risk. This result also says that investors that have losers should sell them and use the funds to buy winners. The P10-P1-margin tests show positive premia in the first trade cost estimate and premia that are not statistically different than zero in the second trade-cost estimate.

6 Conclusion

Momentum is one of the most interesting and actively studied asset pricing anomalies. The past literature explores two questions. The first concerns whether there are risk-based explanations. Several papers suggest that the premium is inconsistent with efficient markets. Some papers suggest that the results imply that investors have cognitive bias that causes them to systematically underreact to information. The second concerns the role of frictions. We add to papers of the second literature.

Our empirical results show a simple picture with 5 results.

1. For the full sample from 1946-2002, short sales of losers are unprofitable as stand-alone trades. Loser shorts only work to hedge risk.

2. Across the 1946-2002 sample, large-stock P10-P1+rebate (which requires capital) has lower risk than the CAPM and 3-factor pricing models predict. This premium appears anomalous and continues to represent a puzzle.

3. Across the 1946-2002 sample, the P10-P1-margin strategy (which does not require capital but requires other long positions to secure the long positions) earns 3-4% per year. With the second trade-cost estimate, the returns are not different than zero. Further, pledging other securities as collateral for the strategy is a risk that we do not incorporate in our tests.

4. Congress deregulated trade commissions on May 1, 1975. We find that when trade commissions fall, momentum falls. Our interpretation of these results is that trade costs bind.

5. In 1983-2002, large-stock momentum premia appears to be too small to draw smart investors into trades. In the more current period, after trade and net-margin costs, the momentum premium is quite close to zero.

We get a split decision on market efficiency. On the one hand, asset pricing tests show unpriced premia, net of transaction costs, for the P10-P1+rebate strategy. Certainly, investors that own losers would typically benefit from selling them and buying winners. On the other hand, consistent with market efficiency, the P10-P1-margin return in the last 20 years appears to exhaust gains from trade.

The central idea of full-information pricing is that investors are smart and prices reflect fundamental value. What makes full-information pricing attractive as a normative model is this lack of opportunity for arbitrage. In market efficiency tests, the rejection of the null of an unpriced premium sets up a variety of alternative hypotheses. The first alternative is that trade costs and zero-investment frictions create barriers.

The second alternative is that arbitrage is risky and arbitrageurs may not fully invest in trades to drive prices to fundamental value. This alternative is the Shleifer and Vishny (1997) argument, which is a specialized, risk-based argument. We find some evidence to support this hypothesis. The P10-P1 strategy has a substantial variance, and our results show losses during the 1970's that could endanger collateral for the P10-P1-margin strategy.

A third alternative is that the risk-based model is incorrect. This is Fama's bad-model problem (Fama (1998)). The bad-model problem seeks a risk-based covariate. One reason why we believe that the risk-based story does not hold is that, as commission costs falls, momentum falls. If momentum is a risk-based story, then one would have to argue that risks fall for large stocks but not for small stocks. We know of no reason to believe that there is such a change in risk across time.

A fourth alternative is that investors have cognitive biases, such as those stated in behavioral finance. This alternative has received extensive attention but remains controversial. We also believe that the behavioral story as inadequate for the same reason that we reject a risk-based story. If momentum is from behavioral bias, we should see falls in momentum from falls in behavioral bias. There is no evidence that suggests behavioral under-reaction changes across time.

Further, attempts at risk-based explanations for momentum require a number of assumptions that are thorny because ex post we typically can always find a set of pricing factors that can explain a left-hand variable. Similarly, the cognitive bias arguments of behavioral finance requires that agents do not make optimal decisions and give up gains from trade. Both the risk-based and behavioral arguments require strong assumptions. These two sets of explanation are more complex, and we surrender a great deal when we use them. In our opinion, it is best to explore the second through fourth explanations *only* if the first alternative fails. The reason that we prefer the friction hypothesis is that it is the most modest in additional assumptions. By the rule of Occam's Razor, simple models do better than complex ones. Occam's Razor tells us that when we are faced with multiple competing explanations, we prefer the simplest one.[14] The friction hypothesis proposes that the P10-P1 notional return does not contradict rational pricing because trade costs and net-margin costs limit severely the opportunity for profits. However, the friction explanation does not say that information is fully reflected in prices. In fact, our results suggest that momentum premia are mispricings but that trade frictions bind. That trade frictions explain

[14]For Latin fans, Occam's Razor is, "Numquam ponenda est pluritas sine necessitate," which means, "Multiples should not be posited without necessity." See www.wikepedia.com for a further description.

most of momentum does not diminish the enormous contribution that papers such as Jegadeesh and Titman (1993) bring to our understanding of stock prices, return predictability, and the factors for asset pricing tests. Indeed, we know a great deal more about the role of pricing assets because of this important work.

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Table I: Yearly Call Money Rates, Federal Funds Rates, 30-Day T-Bill Rates, and Net Margin Costs: 12/47-12/02

The call money rate, sometimes called the broker's loan rate, is the base rate for margin loans that brokers extend to their clients. The rate information was hand-collected from different issues of the *Wall Street Journal*. The call money rate that we use is the midpoint of the high and low estimates. For 7/54 through 12/02, The Federal Funds data are from the St. Louis Federal Reserve. For 12/47 through 6/54, we hand-collected Federal Funds rates from the *Wall Street Journal*. The 30-day T-bill rate in the secondary market is a similar interest-earning instrument to the Federal Funds rate and we include these rates for comparative purposes. The 30-day T-bill data are from the St. Louis Federal Reserve.

In the winner-loser-margin strategy, the investor longs winners, shorts losers, and invests in winners through a margin position secured from other securities. We assume that the investor earns the rebate interest on the short position and pays the call money rate on the long position. D'Avolio (2002) estimates the rebate rate at the Federal Funds rate less 25 basis points, and we use that approach for estimating the rebate rates. The "net-margin cost" is the difference between the call money rate and the rebate rate estimate.

	Call money	Federal Funds	T-Bill	Average net-margin	Standard deviation of net-margin
1/46-12/02	6.366	5.229	4.798	1.387	0.723
1/46-12/62	2.890	1.775	1.833	1.365	0.666
1/63-12/82	8.117	7.348	6.542	1.019	0.678
1/83-12/02	7.568	6.045	5.574	1.773	0.614

Table II: Estimates of Trade Costs As a Percent of Trade Value

Keim and Madhavan (1998) estimate transaction costs for the large institutional trader. These estimates are based on the effective spread and estimates of commissions. We use their estimates from their Table 2 (p. 59) for our 1983-2002 tests. Panel A shows the Keim and Madhavan (1998) estimates trading costs for institutions from 1990-1991 data. They report trading estimates based on market-size quintiles. They organize the results for buyer-initiated and seller-initiated trades. They divide costs into explicit (trade commissions) and implicit (price impact, bid-ask spread) costs. For estimating trade costs, for each market-size quintile, after controlling for stock portfolio turnover (that we estimate in Table VI), we multiply the proportion of stocks from the market-size quintile times the transaction-cost estimate and sum over quintiles.

Lesmond, Ogden, and Trzcinka (1999) use a limited dependent variable regression to estimate trade costs. Their estimates approximate those of the effective-spread-plus-commission estimates. We use their Table 4 (p. 1133) estimates for our 1946-1962 and 1963-1982 test periods. Panel B shows Lesmond, Ogden, and Trzcinka (1999) estimates by market-size decile for 1963-1979. These estimates use market-size deciles. To estimate trading costs, for each market-size decile, after controlling for stock portfolio turnover, we multiply the proportion of stocks from the market-size decile times the transaction-cost estimate and sum over deciles.

To obtain an a second estimate for trade costs, we add 0.70%, which we estimate is the commission cost decline, onto from the Keim and Madhavan (1998) Panel A estimates. We show these second estimate in Panel C. The 0.70% of trade cost is from Jones (2002) estimate of the decline in commissions from deregulation.

Panel A: Percentage costs of value for one-way trade costs for institutions (Keim and Madhavan (1998): 1/91-3/93 data): We use these estimates for trade costs for the 1983-2002 tests.

	Buyer-initiated			Seller-initiated		
Market-size quintile	Implicit	Explicit cost	Total cost	Implicit	Explicit	Total cost
MV1-MV2 (Small)	1.35	0.42	1.78	1.36	0.67	2.07
MV3-MV4	0.70	0.30	1.00	0.92	0.41	1.33
MV5-MV6	0.41	0.24	0.64	0.72	0.30	1.02
MV7-MV8	0.28	0.17	0.43	0.41	0.23	0.63
MV9-MV10 (Large)	0.17	0.13	0.31	0.11	0.15	0.26

Panel B: Percentage costs of value for one-way trade costs (Lesmond, Ogden, and Trzcinka (1999)): 1963-1979 data): We use these estimates for the first for the trade-cost estimates for the 1946-1982 tests.

Market-size decile	Cost
MV1 (Small)	2.91
MV2	2.01
MV3	1.67
MV4	1.48
MV5	1.32
MV6	1.18
MV7	1.06
MV8	0.94
MV9	0.85
MV10 (Large)	0.72

Panel C: Percentage costs of value for one-way trade costs for institutions (Keim and Madhavan (1998): 1/91-3/93 data plus 0.70% for MV5 and larger market-size deciles): We use these estimates for the second trade-cost estimates for the 1946-1982 tests.

	Buyer-initiated			Seller-initiated		
Market-size quintile	Implicit	Explicit cost	Total cost	Implicit	Explicit	Total cost
MV1-MV2 (Small)	1.35	0.42	1.78	1.36	0.67	2.07
MV3-MV4	0.70	0.30	1.00	0.92	0.41	1.33
MV5-MV6	0.41	0.24+0.70	1.35	0.72	0.30+0.70	1.72
MV7-MV8	0.28	0.17+0.70	1.15	0.41	0.23+0.70	1.34
MV9-MV10 (Large)	0.17	0.13+0.70	1.00	0.11	0.15+0.70	0.96

Table III: Momentum premia: 1946-2002

The return data are for the NYSE and AMEX from the Center for Research in Security Prices (CRSP) for 1946-2002. The momentum strategy is described as the triple (J,S,K) where J is the number of months of the ranking period, S is the number of months skipped between the rank and test periods, and K is number of months of the holding period. To increase power, Jegadeesh and Titman (1993) use an overlapping-period design, and we follow their setup. We start at month t and rank stocks by the previous J months ($t-J-1$ through t), accumulate returns by past performance, skip S periods, form portfolios based on past performance rankings, and hold the positions for the succeeding K months. We then repeat the process using month $t+1$ as the portfolio formation date. Thus, each month the investor holds K winner portfolios and K loser portfolios. The monthly momentum return is the average of the winner portfolios less the loser portfolios. For example, when $K = 6$, the monthly portfolio return is the average of these 6 long and short portfolio returns. The table presents the portfolio mean, variance, skewness, and kurtosis for $(6, 0, 6)$, $(6, 1, 6)$, $(6, 0, 12)$, and $(6, 1, 12)$ for the ten past-performance-ranked portfolios and the P10-P1 momentum portfolio.

	(6,0,6)				(6,1,6)			
	Mn	Vr	Sk	Kr	Mn	Vr	Sk	Kr
P1 (Losers)	0.78	0.60	1.6	9.2	0.59	0.56	1.3	7.5
P2	0.99	0.34	0.7	5.8	0.91	0.33	0.5	5.0
P3	1.12	0.28	0.4	5.8	1.08	0.27	0.3	5.4
P4	1.15	0.25	0.2	5.5	1.14	0.24	0.1	5.6
P5	1.21	0.23	-0.1	4.7	1.21	0.23	-0.1	4.9
P6	1.25	0.22	-0.3	4.5	1.25	0.22	-0.3	4.5
P7	1.27	0.23	-0.4	4.4	1.29	0.23	-0.4	4.6
P8	1.32	0.24	-0.6	4.2	1.35	0.24	-0.5	4.2
P9	1.40	0.27	-0.7	4.0	1.44	0.28	-0.6	4.0
P10 (Winners)	1.55	0.37	-0.6	2.9	1.59	0.38	-0.5	2.8
P10-P1	0.76	0.25	-3.1	23.1	1.00	0.20	-2.4	16.5

	(6,0,12)				(6,1,12)			
	Mn	Vr	Sk	Kr	Mn	Vr	Sk	Kr
P1 (Losers)	0.78	0.54	1.1	6.4	0.76	0.52	1.0	6.1
P2	0.97	0.33	0.4	4.8	0.97	0.32	0.3	4.7
P3	1.09	0.27	0.2	5.0	1.09	0.27	0.1	5.1
P4	1.13	0.24	0.1	5.1	1.13	0.24	0.0	5.1
P5	1.20	0.23	-0.2	4.6	1.19	0.23	-0.1	4.7
P6	1.22	0.22	-0.3	4.2	1.21	0.22	-0.3	4.3
P7	1.27	0.23	-0.3	4.1	1.25	0.23	-0.3	4.1
P8	1.32	0.25	-0.4	3.8	1.30	0.24	-0.4	3.7
P9	1.37	0.28	-0.5	3.3	1.34	0.28	-0.4	3.2
P10 (Winners)	1.43	0.38	-0.4	2.6	1.38	0.38	-0.4	2.5
P10-P1	0.66	0.15	-2.0	11.0	0.61	0.14	-1.8	9.3

Table IV: Distribution of Portfolios Formed By Independent Sorts on Market Size and 6-Month Past Performance: 1946-2002

Table IV follows the setup of Table III. We use a momentum (6,0,6) setup. The return data are for the NYSE and AMEX from CRSP for 1946-2002. To increase power, Jegadeesh and Titman (1993) use an overlapping-period design, and we follow their setup. P10 is the winner portfolio and P1 is the loser portfolio. Independently, we rank stocks by NSYE market size and form deciles. MV1 is smallest decile and MV10 is the largest. AMEX stocks are often small, implying that the NYSE size cutoffs will generate a large number of stocks in the MV1 portfolio. In July 1962, CRSP adds AMEX stocks, and in January 1963 AMEX stocks enter the test-period portfolios.

For each past-performance ranking, as we move across the right, the table shows the percentage of the test-period stocks returns that fall into the ten market-size groups. For example, for Panel A (only NYSE stocks), 21.2% of the P1 (past losers) are MV1 stocks and 4.6% of the P1 are MV10 stocks. In Panel B, (both NYSE/AMEX stocks), 53.7% of the P1 stocks are MV1 and 2.5% of the P1 stocks are MV10 stocks.

Panel A: 1946-1962 (NYSE stocks only)

	MV1 (Small)	MV2	MV3	MV4	MV5	MV6	MV7	MV8	MV9	MV10 (Large)
P1 (Losers)	21.2	14.2	11.6	10.7	9.4	7.8	7.6	7.0	5.9	4.6
P2	12.5	11.6	11.0	10.4	9.8	9.9	9.3	8.8	8.8	8.0
P3	9.7	10.7	10.4	9.8	10.6	9.8	9.6	9.7	9.5	10.1
P4	8.2	10.0	9.8	10.2	10.3	10.1	10.2	10.1	10.5	10.6
P5	7.9	9.6	9.6	9.6	9.7	10.4	10.4	10.3	11.2	11.5
P6	7.2	8.8	9.6	9.6	10.0	10.6	10.7	10.5	11.0	11.9
P7	7.0	8.3	9.4	9.3	9.6	9.9	11.3	11.1	11.6	12.6
P8	6.9	8.2	9.1	9.7	9.6	10.6	10.7	11.2	11.6	12.4
P9	7.4	8.2	9.5	9.5	10.1	10.3	10.8	11.4	11.2	11.6
P10 (Winners)	10.9	9.9	10.1	11.1	10.9	10.5	9.8	10.2	8.8	7.6
Av.	9.9	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.1

Panel B: 1963-2002 (NYSE and AMEX stocks)

	MV1 (Small)	MV2	MV3	MV4	MV5	MV6	MV7	MV8	MV9	MV10 (Large)
P1 (Losers)	53.7	11.5	7.8	6.0	5.0	3.9	3.6	3.3	2.7	2.5
P2	38.2	11.6	8.7	7.3	6.4	6.0	6.0	5.6	5.2	5.0
P3	31.5	11.3	8.6	7.7	7.3	7.0	6.8	6.7	6.6	6.4
P4	27.8	10.6	8.5	7.7	7.7	7.5	7.5	7.5	7.6	7.5
P5	25.2	10.1	8.5	7.9	7.9	8.0	8.1	8.0	8.2	8.2
P6	23.7	9.9	8.6	8.0	8.0	8.1	8.1	8.4	8.4	8.8
P7	23.3	10.0	8.5	8.0	8.2	8.1	8.2	8.4	8.6	8.9
P8	24.2	9.9	8.6	8.1	8.2	7.9	8.0	8.1	8.3	8.7
P9	26.9	10.9	9.0	8.5	8.0	7.7	7.5	7.3	7.2	7.0
P10 (Winners)	39.0	12.9	9.4	8.1	7.0	5.9	5.4	4.6	3.9	3.6
Av.	31.4	10.9	8.6	7.7	7.4	7.0	6.9	6.8	6.7	6.7

Table V: Momentum Monthly Raw Returns: Trims from Market Size Deciles: 1946-2002

The return data are from the NYSE and AMEX from CRSP for 1946-2002. We use a 6-month ranking and 6-month test period without skipping a month between the ranking and test periods. In the momentum strategy, month the investor buys the winner portfolio and sells the loser portfolio. P10 is the portfolio of past winners and P1 is the portfolio of past losers. The monthly momentum return is the average of the winner (P10) portfolios less the loser (P1) portfolios. To obtain a momentum-neutral benchmark, shown as EW, we equally weight the returns of all those stocks in the test period. Rebate-P1 is the return from shorting losers as a stand-alone trade. We estimate the rebate return from the Federal Funds rate less 25 basis points. P10-P1+rebate is the strategy of investing a unit of capital in winners, selling short losers, and investing the short-sale cash at the rebate return. P10-P1-margin is the return buying winners on margin at the broker's call rate and selling short losers and investing the short-sale cash at the rebate return. No transaction costs are included in the monthly returns.

We break the tests into three strategies. First, we consider strategies that require a unit of capital. These include the returns for P1, P10, EW, and P10-P1+rebate. Second, we show the P10-P1 return and break it into its winner and loser components. The winner component is P10-EW and the loser component is EW-P1. Third, we show the strategies that one can implement as self-financing. These strategies include rebate-P1 and P10-P1-margin.

We also sort stocks into market-size deciles. The MV1 is the smallest market-size decile and MV10 is the largest. We trim the data in two ways. In the first approach, shown on the left-side of the table, we first rank all stocks by market size. Using NYSE market-size cutoffs, we trim the universe for both rank and test periods. We call this the "full trim." In the second approach, shown on the right-side of the table, we independently rank by market size and use NYSE cutoffs. We keep the entire universe of stocks for ranking, but trim the test portfolios by market-size deciles. We call this the "partial trim." We designate this full trim as "FT" and the partial trim as "PT." We trim at various market-size deciles in the following way. We trim MV1 stocks, then MV1-MV2 stocks, then MV1-MV3, and so forth through MV1-MV6. The first two capital initials indicate the type of trim (FT or PT) and the next number indicates the largest market-size decile trimmed. Thus, PT5 is a partial trim that ranks all stocks on the basis of past performance, places them into past-performance deciles, and then trims stocks from MV1 through MV5.

	Trims are for both rank and test returns.						**Trims are for test returns.**					
Panel A: 1946-2002												
	FT1	FT2	FT3	FT4	FT5	FT6	PT1	PT2	PT3	PT4	PT5	PT6
Panel A1: Strategies that require capital												
P1	0.59	0.63	0.67	0.71	0.76	0.75	0.44	0.46	0.47	0.53	0.57	0.58
P10	1.49	1.46	1.45	1.44	1.42	1.38	1.48	1.47	1.48	1.50	1.48	1.44
EW	1.11	1.10	1.09	1.08	1.07	1.05	1.07	1.07	1.06	1.06	1.05	1.03
P10-P1+rebate	1.31	1.24	1.19	1.14	1.07	1.04	1.45	1.42	1.42	1.38	1.32	1.27
Panel A2: P10-P1 and its components												
P10-P1	0.91	0.83	0.78	0.73	0.66	0.62	1.04	1.01	1.01	0.97	0.91	0.86
P10-EW	0.39	0.36	0.36	0.36	0.35	0.32	0.41	0.40	0.42	0.44	0.43	0.41
EW-P1	0.52	0.47	0.42	0.37	0.31	0.30	0.64	0.61	0.59	0.53	0.48	0.45
Panel A3: Strategies that are self-financing												
Rebate-P1	-0.18	-0.22	-0.26	-0.30	-0.35	-0.34	-0.03	-0.05	-0.06	-0.12	-0.16	-0.17
P10-P1-margin	0.79	0.71	0.66	0.61	0.54	0.50	0.92	0.89	0.89	0.85	0.79	0.74

	Trims are for both rank and test returns.						Trims are for test returns.					
Panel B: 1946-1962												
	FT1	FT2	FT3	FT4	FT5	FT6	PT1	PT2	PT3	PT4	PT5	PT6
Panel B1:												
Strategies that require capital												
P1	0.46	0.45	0.47	0.49	0.52	0.55	0.46	0.39	0.39	0.39	0.40	0.42
P10	1.40	1.44	1.45	1.46	1.47	1.45	1.40	1.43	1.45	1.47	1.51	1.52
EW	1.02	1.02	1.02	1.03	1.04	1.04	1.00	0.99	0.99	1.00	1.01	1.01
P10-P1+rebate	1.07	1.12	1.11	1.10	1.08	1.03	1.07	1.17	1.19	1.21	1.24	1.23
Panel B2:												
P10-P1 and its components												
P10-P1	0.95	0.99	0.98	0.97	0.95	0.90	0.94	1.04	1.06	1.09	1.12	1.10
P10-EW	0.38	0.43	0.43	0.43	0.43	0.41	0.40	0.44	0.46	0.47	0.50	0.51
EW-P1	0.56	0.57	0.55	0.54	0.52	0.49	0.53	0.60	0.60	0.61	0.61	0.59
Panel B3:												
Strategies that are self-financing												
Rebate-P1	-0.33	-0.32	-0.34	-0.36	-0.39	-0.42	-0.33	-0.26	-0.26	-0.26	-0.27	-0.29
P10-P1-margin	0.84	0.88	0.87	0.86	0.84	0.79	0.83	0.93	0.95	0.98	1.01	0.99
Panel C: 1963-1982												
Panel C1:												
Strategies that require capital												
P1	0.64	0.69	0.71	0.72	0.71	0.70	0.60	0.55	0.53	0.52	0.52	0.46
P10	1.68	1.60	1.61	1.59	1.48	1.40	1.70	1.67	1.69	1.71	1.63	1.56
EW	1.16	1.12	1.09	1.04	0.98	0.93	1.16	1.11	1.08	1.04	0.99	0.94
P10-P1+rebate	1.63	1.50	1.49	1.46	1.36	1.29	1.69	1.71	1.75	1.78	1.70	1.69
Panel C2:												
P10-P1 and its components												
P10-P1	1.04	0.91	0.90	0.87	0.78	0.70	1.10	1.11	1.16	1.20	1.12	1.10
P10-EW	0.53	0.48	0.52	0.55	0.51	0.47	0.54	0.55	0.61	0.67	0.65	0.62
EW-P1	0.52	0.43	0.37	0.32	0.27	0.23	0.56	0.56	0.55	0.52	0.47	0.49
Panel C3:												
Strategies that are self-financing												
Rebate-P1	-0.05	-0.10	-0.12	-0.13	-0.12	-0.11	-0.01	0.04	0.06	0.07	0.07	0.13
P10-P1-margin	0.95	0.82	0.81	0.78	0.69	0.61	1.01	1.02	1.07	1.11	1.03	1.01

Panel D: 1983-2002	Trims are for both rank and test returns.						Trims are for test returns.					
	FT1	FT2	FT3	FT4	FT5	FT6	PT1	PT2	PT3	PT4	PT5	PT6
Panel D1: Strategies that require capital												
P1	0.64	0.73	0.81	0.89	1.01	0.98	0.25	0.42	0.46	0.65	0.76	0.83
P10	1.38	1.34	1.29	1.27	1.31	1.28	1.33	1.30	1.28	1.29	1.29	1.23
EW	1.14	1.15	1.15	1.16	1.18	1.18	1.05	1.09	1.09	1.12	1.13	1.13
P10-P1+rebate	1.24	1.11	0.98	0.88	0.80	0.81	1.58	1.38	1.32	1.14	1.03	0.90
Panel D2: P10-P1 and its components												
P10-P1	0.74	0.61	0.48	0.38	0.30	0.30	1.08	0.88	0.82	0.64	0.53	0.40
P10-EW	0.25	0.18	0.14	0.12	0.13	0.10	0.28	0.21	0.19	0.17	0.16	0.10
EW-P1	0.49	0.42	0.34	0.27	0.17	0.20	0.80	0.67	0.63	0.47	0.37	0.30
Panel D3: Strategies that are self-financing												
Rebate-P1	-0.14	-0.23	-0.31	-0.39	-0.51	-0.47	0.25	0.08	0.04	-0.15	-0.26	-0.33
P10-P1-margin	0.59	0.46	0.33	0.23	0.15	0.15	0.93	0.73	0.67	0.49	0.38	0.29

Table VI: Turnover of Winners and Losers in (6,0,6) Momentum: 1946-2001

Our momentum tests use a (6,0,6) setup. We start at month 6 and rank stocks by the previous 6 months (t-5 through t), accumulate returns by past performance, form portfolios based on past performance rankings, and hold the positions for the succeeding 6 months. We then repeat the process using month $t+1$ as the portfolio formation date. Thus, each month the investor holds 6 winner portfolios and 6 loser portfolios. The monthly momentum return is the average of the 6 long less 6 short portfolio returns. Each month, the investor liquidates positions formed 6 months ago and forms new positions. For the winners, we sell 1/6 to close the position and buy 1/6 to open the position. For the losers, we buy 1/6 to close the position and sell short to open the position. But some stocks repeat as winners and losers. We define turnover is the probability that the individual stock will be eliminated and replaced by a new stock position. This table shows the turnover of the different momentum winner and loser positions and the average number of stocks in each of the winner and loser positions. We use the turnover results for estimating transaction costs. The central result from this table is that since turnover is about 7/8 and there are 8 one-way (4 round-trip) trades over the year, we have about 7 one-way trades to estimate transaction costs for.

We report tests for the untrimmed sample and all partial trimmed samples through PT6. Recall for the partial trim sample, we first rank stocks by past performance. We independently rank all stocks by market size. We call the smallest market-size decile MV1 and the largest MV10. We NYSE market-size cutoffs for the market-size deciles. We trim the test portfolios by the designated market-size cutoffs. Thus, PT1 trims MV1, PT2 trims MV1 and MV2, and so forth. Note that the last test ends in 2001 because the last portfolio formation date is June 30, 2002 in our momentum tests. The test asks to what extent does a stock repeat when we look forward 6 months. Since our last portfolio formation date is June 30, 2002, our last test asks to what extent does the December 31, 2001 portfolio formation date turnover at June 30, 2002.

	Full				PT1				PT2				PT3			
	Losers		Winners		Losers		Winners		Losers		Winners		Losers		Winners	
Period	Stocks	Turn	Stocks	Turn	Stocks	Turn	Stocks	Turn	Stocks	Turn	Stocks	Turn	Stocks	Turn	Stocks	Turn
1946-2001	181	0.833	181	0.846	91	0.842	122	0.859	70	0.850	99	0.865	55	0.858	82	0.868
1946-1962	100	0.837	101	0.837	78	0.845	91	0.840	64	0.845	81	0.839	52	0.849	71	0.841
1963-1982	221	0.857	222	0.850	101	0.853	132	0.865	78	0.858	103	0.871	62	0.863	82	0.874
1983-2001	210	0.803	211	0.852	93	0.827	139	0.870	66	0.845	111	0.880	49	0.860	90	0.886

	PT4				PT5				PT6			
	Losers		Winners		Losers		Winners		Losers		Winners	
Period	Stocks	Turn	Stocks	Turn	Stocks	Turn	Stocks	Turn	Stocks	Turn	Stocks	Turn
1946-2001	43	0.864	66	0.871	33	0.869	51	0.878	25	0.875	39	0.884
1946-1962	41	0.854	60	0.843	32	0.859	49	0.849	24	0.864	38	0.856
1963-1982	50	0.863	64	0.876	40	0.865	49	0.884	31	0.868	37	0.890
1983-2001	36	0.874	72	0.890	26	0.883	56	0.898	18	0.892	41	0.904

Table VII: Momentum Raw Returns: Trade Costs and Margin Costs (Net of Rebate Returns): 1946-2002

The return data are from the NYSE and AMEX from CRSP for 1946-2002. We use a 6-month ranking and 6-month test period without skipping a month between the ranking and test periods. We also rank stocks independently by market size and form ten market-size deciles. For these partial trim tests, we rank over the full universe of available stocks and trim the test portfolios by different market-size levels. For example, in PT4, we trim by the lower four market-size deciles. In PT5, we trim by the lower five market-size deciles. Each month the investor buys the winner portfolio and sells the loser portfolio. The monthly momentum return (P10-P1) is the average of the winner (P10) portfolios less the loser (P1) portfolios.

Table II shows the trade cost estimates. There are two different trade-cost estimates for the period. The first is from Lesmond et al. (1999); the second is from Keim and Madhavan (1998) plus .700 cost per trade to estimate the higher commission costs prior to commission deregulation. The 1983-2002 costs are from Keim and Madhavan (1998). We describe these in Table II. We compute the trade by multiplying the winner and loser proportions of stocks in each market-size decile or quintile times the market-size trading cost. We estimate and report the portfolio turnover in Table VI. We adjust trade costs for turnover.

First we report P10-P1 without transaction costs. We then show the P10-P1 adjusted for trade costs. This is the strategy where investors would gain by selling losers that they own and buy winners. (There is no short selling involved.) We then estimate the zero-investment mimicking strategy in the winner-loser-margin strategy. The strategy longs winners, shorts losers, and finances winners by a margin position from other long securities. We call this "P10-P1-margin." Newey and West t values are in parentheses.

	First trade-cost estimate			Second trade-cost estimate		
	PT4	PT5	PT6	PT4	PT5	PT6
Panel A: 1946-2002						
Notional P10-P1	0.972	0.913	0.860	0.972	0.913	0.860
	(5.64)	(5.03)	(4.43)	(5.64)	(5.03)	(4.43)
Trade costs	0.511	0.472	0.428	0.600	0.565	0.510
P10-P1 (net of trade-execution costs)	0.461	0.441	0.432	0.372	0.348	0.350
	(2.70)	(2.45)	(2.49)	(2.18)	(1.94)	(1.82)
Net-margin costs	0.116	0.116	0.116	0.116	0.116	0.116
P10-P1-margin (net of trade costs)	0.346	0.325	0.316	0.256	0.232	0.234
	(2.01)	(1.81)	(1.64)	(1.50)	(1.29)	(1.22)

	First trade cost estimate (Lesmond et al. (1999))			Second trade cost estimate (Keim and Madhavan (1998) plus .700 per trade)		
	PT4	PT5	PT6	PT4	PT5	PT6
Panel B:1946-1962						
Notional: P10-P1	1.097	1.129	1.112	1.097	1.129	1.112
	(6.53)	(6.22)	(5.77)	(6.53)	(6.22)	(5.77)
Trade costs	0.599	0.562	0.526	0.737	0.706	0.652
P10-P1 (net of trade-execution costs)	0.498	0.567	0.586	0.360	0.423	0.460
	(2.97)	(3.13)	(3.04)	(2.14)	(2.33)	(2.39)
Net-margin costs	0.114	0.114	0.114	0.114	0.114	0.114
P10-P1-margin (net of trade costs)	0.384	0.453	0.472	0.246	0.309	0.346
	(2.29)	(2.50)	(2.45)	(1.47)	(1.70)	(1.80)
	PT4	PT5	PT6	PT4	PT5	PT6
Panel C:1963-1982						
Notional: P10-P1	1.196	1.116	1.104	1.196	1.116	1.104
	(3.66)	(3.28)	(3.21)	(3.66)	(3.28)	(3.21)
Trade costs	0.599	0.562	0.526	0.737	0.706	0.652
P10-P1 (net of trade-execution costs)	0.597	0.554	0.578	0.459	0.410	0.452
	(1.83)	(1.63)	(1.69)	(1.41)	(1.20)	(1.32)
Net-margin costs	0.085	0.085	0.085	0.085	0.085	0.085
P10-P1-margin (net of trade costs)	0.512	0.469	0.493	0.374	0.325	0.367
	(1.57)	(1.38)	(1.43)	(1.15)	(0.95)	(1.07)

	Trade cost estimate from Keim and Madhavan (1998)		
	PT4	PT5	PT6
Panel D: 1983-2002			
Notional: P10-P1	0.641	0.527	0.402
	(1.85)	(1.44)	(1.00)
Trade costs	0.347	0.308	0.250
P10-P1 (net of trade-execution costs)	0.295	0.221	0.155
	(0.84)	(0.61)	(0.38)
Net-margin costs	0.148	0.148	0.148
P10-P1-margin (net of trade costs)	0.146	0.073	0.008
	(0.42)	(0.20)	(0.02)

Table VIII: Larger Half of the Market Momentum Tests: Jensen Measure and Fama and French (1993) Risk-Based Tests: 1926-2002

The return data are from the NYSE and AMEX from CRSP for 1946-2002. We independently rank by past 6-month performance and by market size and form past-performance and market-size deciles. We trim the MV1 through MV5 stocks for test portfolios. For the regressions, for tests of P1 and P10, as is standard, we subtract the risk-free rate. We then regress this stock premium on factors. The $\hat{\alpha}$ and $\hat{\beta}$ are the parameter estimates for the intercept and the slope on the market less the risk-free rate for CAPM and $\hat{\alpha}$, $\hat{\beta}$, $\hat{s}$, and $\hat{h}$ are for the intercept and slope on the market less the risk-free rate, the SMB size factor, and the HML factor for Fama and French (1993) 3-factor model. Newey-West (1987) t values that test whether the parameter estimate is different than zero are shown in parentheses. Panel A shows the regression results without adjustments for transaction costs. Panel B restates the intercepts, reports the transaction costs for each of the strategies, and the new t-values. In Panel B, we use the two transaction cost estimates. See Table VII, In the final period, 1983-2002, we use only one trade cost estimate (from Keim and Madhavan (1998), but we keep the labels “First trade-cost estimate” and so forth to make the table more compact.

Panel A: Regression results without considering transaction costs

	(P10)					(P1)					(P10-P1)				
Period	$\hat{\alpha}$	$\hat{\beta}$	$\hat{s}$	$\hat{h}$	R^2	$\hat{\alpha}$	$\hat{\beta}$	$\hat{s}$	$\hat{h}$	R^2	$\hat{\alpha}$	$\hat{\beta}$	$\hat{s}$	$\hat{h}$	R^2
1946-2002	0.409	1.198			.77	-0.560	1.307			.66					
	(3.48)	(29.11)				(-3.72)	(23.07)				(5.49)	(-1.35)			
	0.369	1.145	0.390	0.071	.80	-0.669	1.273	0.433	.207	.69	1.044	-0.128	-0.043	-0.135	.01
	(4.06)	(33.14)	(6.07)	(0.88)		(-4.47)	(20.70)	(2.47)	(1.56)		(5.49)	(-1.68)	(-0.24)	(-0.83)	
1946-1962	0.269	1.211			.88	-0.822	1.192			.78	1.107	0.025			.00
	(1.89)	(32.02)				(-3.87)	(19.81)				(5.72)	(0.28)			
	0.335	1.197	0.296	-0.029	.87	-0.674	1.129	0.843	0.149	.86	1.008	0.072	-0.528	-0.174	.09
	(2.41)	(28.78)	(3.73)	(-0.29)		(-5.65)	(25.61)	(8.15)	(1.74)		(4.67)	(0.92)	(-3.29)	(-1.05)	
1963-1982	0.749	1.314			.76	-0.378	1.364			.73	1.130	-0.050			.02
	(3.53)	(15.25)				(-1.60)	(17.20)				(3.37)	(-0.39)			
	0.679	1.132	0.450	-0.260	.80	-0.642	1.172	0.657	0.024	.79	1.327	-0.042	-0.171	-0.245	.02
	(3.93)	(13.96)	(3.62)	(-2.02)		(-2.99)	(18.29)	(4.15)	(0.20)		(3.98)	(-0.32)	(-0.62)	(-1.23)	
1983-2002	0.211	1.086			.77	-0.457	1.325			.57	0.668	-0.240			.03
	(1.64)	(19.85)				(-1.38)	(11.94)				(1.89)	(-1.63)			
	0.082	1.140	0.405	0.271	.82	-0.647	1.428	0.251	.345	.59	0.727	-0.290	0.154	-0.074	.04
	(0.57)	(29.32)	(7.52)	(2.35)		(-1.89)	(10.15)	(1.16)	(1.72)		(1.79)	(-1.93)	(0.74)	(-0.28)	

Panel B: Regression intercepts with adjustments for transaction costs

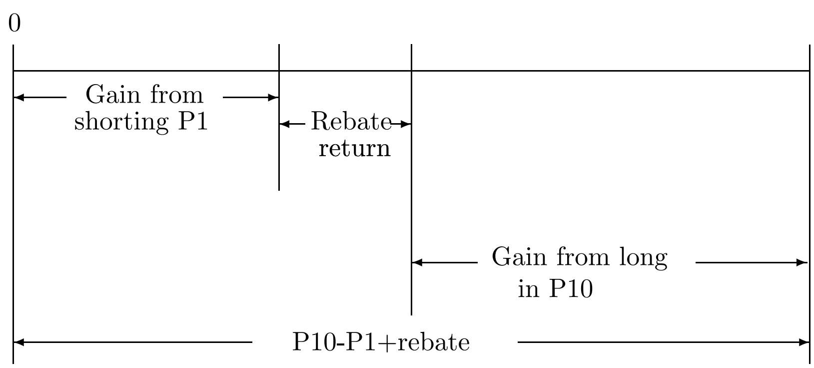
		P10-P1+rebate (net of transaction costs)		P10-P1-margin (net of transaction costs)	
		First trade-cost estimate	Second trade-cost estimate	First trade-cost estimate	Second trade-cost estimate
Period	Model	Rev $\hat{\alpha}$	Rev $\hat{\alpha}$	Rev $\hat{\alpha}$	Rev $\hat{\alpha}$
1946-2002	CAPT	0.532	0.410	0.385	0.294
		(2.81)	(2.29)	(2.16)	(1.64)
	3-factor	0.573	0.480	0.457	0.363
		(3.02)	(2.53)	(2.41)	(1.92)
1946-1962	CAPT	0.545	0.401	0.431	0.287
		(5.82)	(2.07)	(2.23)	(1.48)
	3-factor	0.467	0.323	0.353	0.209
		(2.12)	(1.47)	(1.60)	(0.95)
1963-1982	CAPT	0.568	0.42	0.483	0.339
		(1.69)	(1.26)	(1.44)	(1.01)
	3-factor	0.765	0.621	0.680	0.536
		(2.29)	(1.86)	(2.29)	(1.86)
1983-2002	CAPT	0.360	0.360	0.212	0.212
		(0.99)	(0.99)	(0.58)	(0.58)
	3-factor	0.423	0.423	0.381	0.381
		(1.04)	(1.04)	(0.67)	(0.67)

Figure 1: Decomposition of Momentum Profits into Trading Returns

In the zero-investment financing strategy, the investor shorts past losers and buys past winners. In practice, investors must buy winners (P10), short losers (P1), and earn the rebate rate on the cash that secures the short sale. There are thus, three investments to record: the long and short positions, and rebate returns. Note that this strategy requires capital.

For illustration purposes, in Panel A, we assume that the P1 returns are negative (investors profit from shorts), P10 are profitable, and cash earns a positive return. Thus, each of the three returns contributes to a positive overall return from the P10-P1+rebate strategy. In Panel B, we assume that the P1 returns and rebate returns are positive, but the P1 returns are greater than the rebate returns (investors lose on the stand-alone short sales of P1 stocks).

Panel A: Assume that P1 returns are negative



Panel B: Assume that P1 returns are positive and greater than the rebate returns

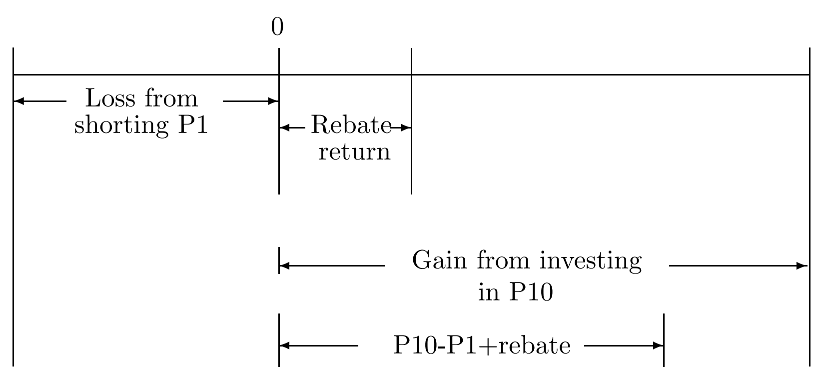


Figure 2: 3-year Yearly Moving Average: Notional Large Stock Momentum Returns: MV1 and MV1-MV5 Trims: 1948 - 2002

The return data are for momentum (6,0,6). The data are from the NYSE and AMEX from the Center for Research in Security Prices (CRSP) for 1946-2002. To increase power, Jegadeesh and Titman (1993) use an overlapping-period design, and we follow their setup. We independently sort stocks by the market-size and past 6-month performance and trim the smallest market-size decile (MV1). We call this "Standard." The PT1 trim portfolio gives a portfolio that is close in spirit to those of the past literature. In a similar way, we trim the smaller half of the market (MV1-MV5). We call this "Large." To smooth the returns, we compute a 3-year moving-average for each monthly return series. The returns do not include trade-execution or zero-investment carry costs.

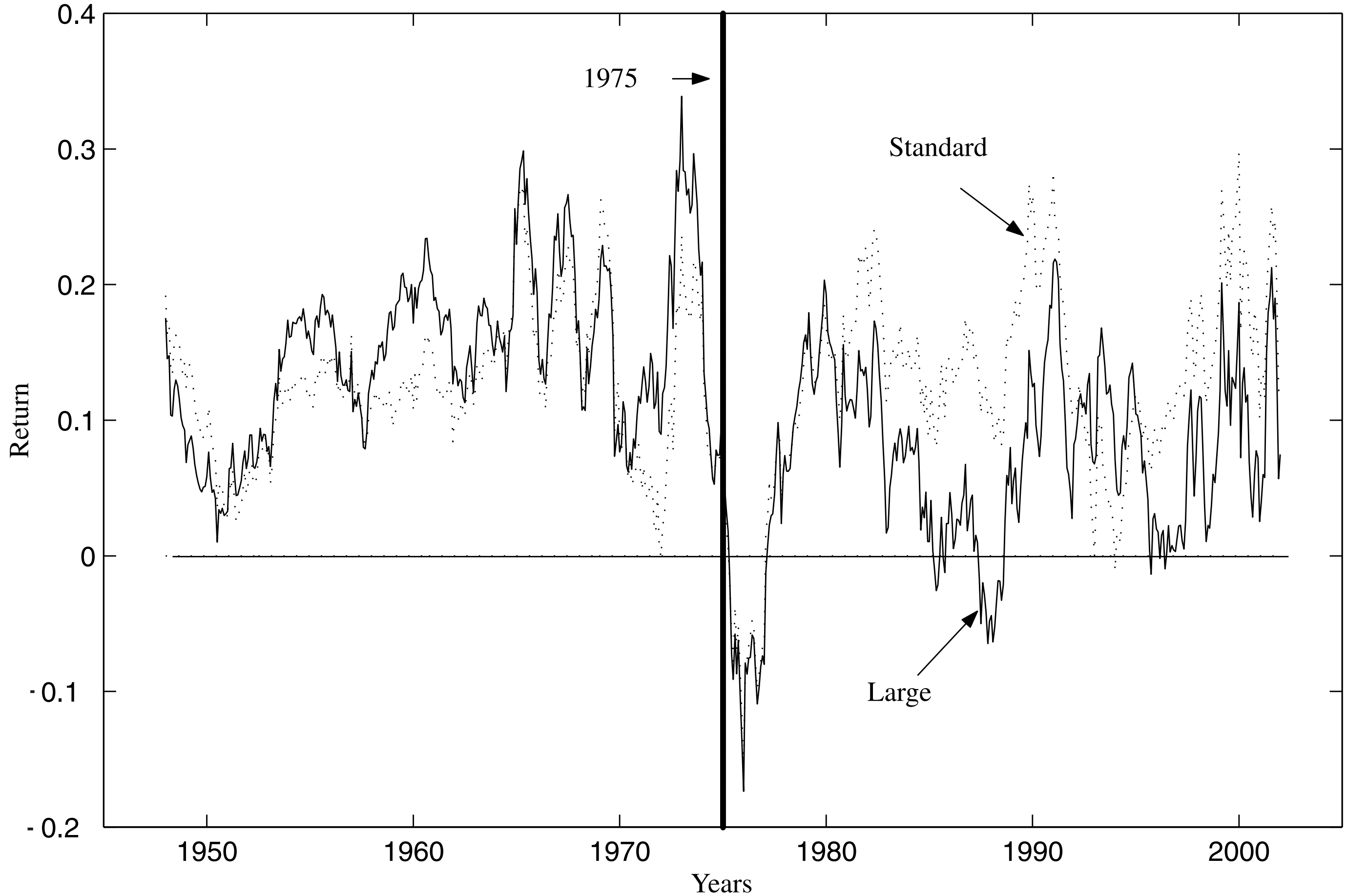


Figure 3: 3-year Yearly Moving Average: Large-stock Momentum Returns, Net of Trade-execution and Carry Costs: MV1-MV5 Trims (PT5): 1948 - 2002

The return data are for momentum (6,0,6) for the MV1-MV5 trim, which we call PT5. The data are from the NYSE and AMEX from the Center for Research in Security Prices (CRSP) for 1946-2002. To increase power, Jegadeesh and Titman (1993) use an overlapping-period design, and we follow their setup. We independently sort stocks by the market size and past 6-month performance. We then trim the smaller half of the market. We compute 3-year moving-average returns. We include the first estimate transaction cost (See Table I). for P10-P1-margin.