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The wildcard option in transacting mutual-fund shares

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The wildcard option in transacting mutual-fund shares*

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Abstract

This study documents high-frequency (daily) mutual fund return autocorrelations and examines the causes and consequences. We assert the cause to be nonsynchronous trading in the underlying assets of the fund, which presents investors with an option to (indirectly) trade those assets at stale prices. We refer to this option as the mutual-fund wildcard option. We show that investors who exploit this option can make abnormal returns of about 1.20% with only four (roundtrip) trades in fund shares. Approximately 45% of the equity fund universe allow this frequency of transacting without load or transaction fees. Using data on the daily flow into and out of individual mutual funds, we find some evidence that investors exploit this wildcard option, but that the total resources extracted from exercise of the option amounts to only 6 basis points per year. Thus, investors appear to be generally unaware of the mutual-fund wildcard option.

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1. Introduction

Daily changes in funds' net asset value per share (NAV) are autocorrelated, for both equity funds and non-equity funds. This autocorrelation is both statistically and economically significant. In addition to documenting this fact, this study examines the causes and consequences of this autocorrelation. We focus on equity funds so that the leading hypothesis for the phenomenon, stale pricing data due to nonsynchronous trading, can be examined with transaction-level data (i.e., the New York Stock Exchange's (NYSE) TAQ dataset) and tick data on equity indices (i.e., Futures Industry Institute data for the S&P 500 spot series).

Mutual-fund return autocorrelation has been documented in studies dating back to Carlson (1970).[1] However, these studies examine return intervals of 1 to 3 years. The daily autocorrelation documented and analyzed in this paper is likely of a different nature. It is not attributable to differences in risk, expense ratios, or other factors found to account for most of the longer-horizon return autocorrelation. Our tests indicate that the primary source of daily autocorrelation at funds is nonsynchronous trading in the underlying assets held by the fund.

It is well known that nonsynchronous trading contributes to portfolio return autocorrelation.[2,3] For example, Kadlec and Patterson (1999) show that nonsynchronous trading is capable of explaining more than 50 percent of the autocorrelation in daily portfolio returns. However, the autocorrelation caused by nonsynchronous trading is generally viewed as an illusion: attempts to trade the stale-priced assets are likely to refresh the asset's price to it's appropriate level (Lo and

[1]For evidence of autocorrelation in long-horizon (annual) fund returns see, e.g., Hendricks, Patel, and Zeckhauser (1993), Goetzmann and Ibbotson (1994), Brown and Goetzmann (1995), and Carhart (1997).
[2]For evidence of autocorrelation in short-horizon (daily/weekly) portfolios returns see, e.g., Cowles and Jones (1937), Fisher (1966), Perry (1985), Lo and MacKinlay (1990), Lebaron (1992), and Mech (1993).

MacKinlay (1990)). Moreover, even if the autocorrelation were real, transaction costs would render such trading strategies unprofitable.

While mutual fund shares represent claims on portfolios of assets, there are two important distinctions between trading fund shares and trading the underlying assets directly. First, the readjustment effect associated with trading (i.e., marking the asset's price to market with your transaction) does not occur with trade in fund shares. Second, hundreds of funds offer trading in their shares with no costs or frictions, essentially offering unlimited depth at net asset value per share (NAV). Specifically, most funds accept transactions in their shares at any time up to the 4:00 P.M. Eastern close of trading on the NYSE. These transactions are executed at the NAV reported to the NASD by 5:50 P.M., which is almost universally set using closing prices of the underlying assets of the fund. Closing prices are, in turn, almost always the price of the last trade in the stock. These distinctions make the autocorrelation in daily fund returns a fundamentally different phenomenon than the autocorrelation in daily portfolio returns.

The wildcard option. When investors trade fund shares they effectively trade each of the underlying assets of the fund at the same price as the last recorded transaction in the market for that asset. With a telephone transfer, fund investors can feasibly make their trading decision as late as, say, 3:55 P.M. At 3:55 P.M., many of the underlying assets held by the fund have experienced their last transaction of the day. Especially among small cap stocks we find that a substantial number of stocks do not trade at all during in the last 90 minutes of trading. Thus, fund investors who defer their investment/redemption decision to the end of the day possess an option to trade at least some

[3] For analyses of non-synchronous trading and portfolio autocorrelation see Atchison, Butler, Simonds (1987), Lo and MacKinlay (1990), Boudoukh, Richardson and Whitelaw (1994), and Kadlec and Patterson (1999).

of the underlying assets of the fund at stale prices. We say that prices are stale if there is extant public information that changes the anticipated price at which the next buyer and seller will agree to transact (i.e., the quotes on the stock no longer straddle that price). We refer to this option as the mutual-fund (MF) wildcard option.

The underlying asset of the mutual-fund wildcard option is the portfolio of assets held by the mutual fund at the close of business on the previous day.[4] The exercise price of the wildcard option is the portfolio-weighted price of the last trade in each asset held by the fund. The option expires at 4:00 P.M. (or, more realistically, '4:00 P.M. – *delta*,' where *delta* is the time it takes to make a phone call), and it regenerates daily. Investors who currently hold fund shares possess both a wildcard-put and a wildcard-call, whereas the rest of the investment universe possesses a wildcard-call.

Wildcard options also exist in the Treasury bond futures market as well as the S&P 100 index option market (see Kane and Marcus (1986) and Harvey and Whaley (1992), respectively). However, the wildcard option in Treasury bond futures is exercisable only at expiration, and exercise of the wildcard option in S&P 100 index options is practical only a few days out of the month (near expiration when the value of keeping the option alive is small). With the mutual-fund wildcard option, keeping the option alive is never a factor in the exercise decision as it expires and rejuvenates daily. Moreover, the market size of the MF wildcard option (several trillion dollars) compares favorably to that of the Treasury bond or S&P 100 index option markets. Thus, the

[4] The NAV set on day t is the day t-1 balance sheet, marked-to-market as of the closing prices on day t. Flow occurring during day t is not included in this calculation since it is not generally known when NAV is set. Even if the day's flow was known, however, accounting for that change in cash would not change the ratio of the total net assets of the fund divided by the total equity claim (shares outstanding).

mutual-fund wildcard option arguably has far more economic relevance than the Treasury bond futures or S&P 100 index option wildcard options.

Empirical evidence. We find the average exercise value of the MF wildcard option to be approximately 0.15% when attention is restricted to the bottom and top quartile of return days. This implies 125 exercises per year, or about 60 roundtrip fund transactions yielding an annual return premium of 18%. Note that there is no more risk in this strategy than found in a buy-and-hold equity position, implying a Sharpe ratio of three to four times that of a buy and hold strategy.

Funds employ a variety of tactics to limit short-term traders, including load fees, transaction fees, and outright restrictions on trade frequency. For example, about half the funds in our sample employ a load fee, and approximately 22%[5] of the no-load funds in our sample explicitly state in the fund prospectus a limit of 4-6 round-trips per year. While this leaves a substantial number of funds with no explicit transaction limit, we also note that virtually all funds retain the right to refuse short-term traders. Therefore, a credible, sustained exercise campaign would have to be disguised. To be conservative we limit the analysis to four round trip trades per year, which leaves most no-load funds as viable targets. With this restriction on exercise frequency, a mean wildcard-option exercise value of 0.15% implies an annual return premium of 1.20% (again, conditioning only on top/bottom quartile returns).

The nonsynchronous trading hypothesis. The value of the MF wildcard-option can be improved upon by being more selective in cross section (which funds to trade) and over time (when to trade). The non-synchronous trading hypothesis underlying the wildcard option logic guides the refinement. First, nonsynchronous trading in the underlying assets of the fund is likely to be a greater problem at funds holding smaller capitalization stocks (which trade less frequently) and more volatile stocks (which have a greater potential price move during the non-traded period). We find that the average exercise value of the wildcard option at aggressively managed funds (again, top and bottom return quartiles) is about 0.20%, versus 0.08% for more conservatively managed equity funds. These figures translate into 1.60%, versus 0.64%, annual return premium with four round-trip trades per year. Second, nonsynchronous trading in the underlying assets of the fund is likely to be a greater problem on days with high late-afternoon market volatility. We find that the mean annualized return premium from four round-trip trades increases to about 2.00% when we use this logic to refine the (ex ante) selection of exercise days.

We present another test of the nonsynchronous hypothesis, based on the style classification of mutual funds provided by Morningstar. Morningstar employs a three by three matrix of market capitalization and valuation (a composite of book-to-market and price-earnings ratios) to classify a fund's investment style. This classification is based on the fund's typical stock holdings. We partition the universe of stocks on the New York Stock Exchange's (NYSE) TAQ data set into the same three by three matrix. We then examine the average time of the last trade in each stock in the Morningstar bins, and show that this pattern lines up closely with the average wildcard option value for funds in the corresponding bins. This evidence suggests that MF return autocorrelation is only a symptom of a deeper phenomenon: pricing errors in the setting of funds' NAV. Indeed, the problem of stale pricing and the associated wildcard option it presents could lead to return predictability that far exceeds that implied by the autocorrelation in fund returns.

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[5] This is a preliminary estimate based on a small subset of our full sample.

Daily flow and return autocorrelation. Using individual-fund flow data, we examine the extent to which fund investors currently take advantage of the wildcard option (whether inadvertently or by intent). We find that there is a statistically significant inflow on positive return days and significant outflow on negative return days, therefore capturing the wildcard option. However, this component to flow is not economically significant, from the fund's perspective, as it leads to only six basis points per year in depleted assets.

Scope. For expository purposes, much of the focus in this paper is on the profitability of trading strategies that exploit the autocorrelation of fund returns caused by nonsynchronous trading. However, the implications of our study are much more general. In any financial market, inefficient pricing adversely affects investors' welfare. We show that the method that most funds currently use to set the NAV of their shares results in inefficient pricing, and thus, adversely affects the welfare of investors who trade fund shares. This is true even if there is no deliberate effort to game that mispricing, as described here.

The potential inefficiencies arising from setting NAV using closing (last trade) prices extend beyond the effects of nonsynchronous trading. For example, bid-ask bounce – the tendency for closing prices to represent either the bid price or the ask price depending on whether the last transaction of the day was a sale or a purchase – is another potential source of mispricing. Keim and Stambaugh (1984) document systematic patterns in closing prices at the bid and ask across days of the week. In particular, they find that closing prices on Mondays tend to be at the bid while closing prices on Fridays tend to be at the ask. Thus, funds that set NAV using closing prices under-price their shares on Mondays and over-price their shares on Fridays.

This paper first documents in Section 2 the autocorrelation in daily fund returns. We then calibrate the magnitude of gaming possibilities in Section 3. In Section 4, we explore the hypothesis that the source of autocorrelation is nonsynchronous trading. Using the finer filters provided under this hypothesis, we show that investors can earn a 2% return premium in a simulated run using data over the past 18 months. In Section 5 we look at actual fund inflow and outflow to see whether money has been actively pursuing the mutual-fund wildcard option. Section 6 concludes the study.

2. Data

The fund returns data used in this study come from TrimTabs.com of Santa Rosa, California. This vendor has collected daily data on fund NAV (per share) and total assets since February 1, 1998. The sample ends June 30, 1999. We focus on equity funds because of the availability of transaction-level data in the underlying assets of those funds. To isolate equity funds, we use the investment-objective classification provided in the CRSP mutual-fund database. All funds with investment objective: income, balanced, total-return (equity and bond funds); government, corporate, and municipal (bond funds); global (equity and bond funds); or money-market are classified as non-equity funds. The TrimTabs sample consists of 492 domestic equity funds and 437 other funds with an average of 280 observations per fund. The total number of equity-fund observations after error filters (see section 2.1) is 137,688.

The reporting of daily NAV by funds in the TrimTabs data is voluntary. The average daily return for the equity funds in our sample is 6.2 basis points compared to 9.5 basis points for the S&P 500 over the same period (Table 1, panel A, 3rd column). Sample funds are also larger than average (median $1122 million versus $477M for the universal-average equity fund) and older (average year of initiation 1983 versus 1987 for the universal-average equity fund). About one-third of the equity sample is aggressive growth or sector, 40% growth, and one-fourth growth and income.

For comparison purposes and to complete the analysis we also present basic results for non-equity funds. Of the non-equity funds 184 are international/global, 68 are government or agency, 76 are corporate bond and general bond funds, and 109 are municipal bond funds. The average size of these funds is 526 million, and the average return 0.5 basis points per day.

2.1. Filters

Filtering is important. With hand-entered data such as TrimTabs', solitary typographical errors (e.g., NAV = 13.12, 13.17, 1**1.3**2, 13.15) are a concern. Visual inspection of the data (after searching for extreme cases) confirms that such errors are present. A solitary error in the level of NAV (or total assets) induces negative autocorrelation in the changes series. Since the autocorrelation of returns and flow is a key statistic in this study, we want to ensure that inferences are driven by the true processes rather than data errors. Two filters are applied.

The first filter removes observations if the absolute value of the daily return is greater than five standard deviations, where the standard deviation is calculated on a fund by fund basis. A five standard-deviation move in the value-weighted NYSE-AMEX index has happened 14 times since 1965, implying that this a decidedly rare event in the true data. A similar five standard-deviation filter is applied to the daily change in total assets.

The second filter is designed to catch false reversals. It looks for a three standard deviation move followed by a reversal back to within 1.5 standard deviations of the original (two days prior) value. Again, this filter is applied to both the return series and the change in total assets series. A three standard deviation move in the NYSE-AMEX index has happened 92 times over the past 33 years, or about three times a year. However, a subsequent reversal back to within 1.5 standard deviations of the original (two days prior) value has happened only 15 times. Thus, this filter is less than ¼% likely to remove true data. Nevertheless, the data that this filter removes is extremely negatively autocorrelated. Removing true extreme negative autocorrelation biases the remaining data toward positive autocorrelation. To offset this, we also apply a similar filter for continuations: remove if the observation is a three standard deviation move followed by a further 1.5 standard deviation move in the same direction the next day. This happened with the NYSE-AMEX index 26 times between 1965 and 1999.

The autocorrelation of daily returns of the value-weighted NYSE-AMEX index over the 1965 – 1999 period is 14% without filters and 15% with filters. Assuming that the index data are free from errors, this implies that the two filters do not materially distort true autocorrelation. On the other hand, they almost surely remove most data errors. If a data-entry error is present, e.g. a digit transposition, then it is likely to be greater than 3 or 5 standard deviations, or about 5%, in magnitude. For example, digit transpose in NAV is generally about a 10% error even if in the cents' columns and far greater in the dollars column. While we cannot conduct a similar examination of the bias effect (or lack therein) of filtering the flow data, this suggests that no bias arises.

In the sample fund data, the filters have a tremendous effect on the standard deviation and autocorrelation statistics. For example, the standard deviation of daily equity-fund returns without filtering is 20.7%, shown in Table 1, panel A. This is clearly not a reasonable number. With filters, the standard deviation of daily equity-fund returns is 1.2%. By comparison, the standard deviation of the value-weighted NYSE-AMEX index returns over this period is 0.94% per day. Similar comments apply to the standard deviation of the daily change in assets and flow at equity funds. This indicates data errors in the raw data, suggesting that the filtered data provides more reliable inferences. In the remainder of the paper we use filtered data.

3. Estimates of mutual fund wildcard option value

3.1. Simple autocorrelations and wildcard value

After filtering for errors, there is evidence of positive autocorrelation in daily fund returns. At a lag of one day, the correlation is 8% for equity funds and 11% for non-equity funds. While the autocorrelation at equity funds is not large in magnitude, it is strongly significant statistically. It is worth noting that the autocorrelation of daily returns for the value-weighted NYSE-AMEX index during the sample period (Feb. 1988-June 1999) was abnormally low, (about 1%) compared with the 14% autocorrelation for the period 1965-1998. Thus, we are inadvertently using a sample period biased against finding profitable trading strategies based on daily return autocorrelation.

In panel b, of table 1 we report properties fund returns from another source, Micropal (a subsidiary of Standard & Poors) to confirm the data. The Micropal data is not available for the same time period (1992-1996) as the TrimTabs data (1998-1999) and does not contain flow figures. From panel B. the behavior of the Micropal sample fund returns is similar to that of the TrimTabs sample fund returns. In particular, data errors are again a factor. Prior to filtering, the return standard deviations are unreasonably large. After filtering they are quite reasonable. While they appear to be low, one should note that market volatility in this period, particularly 1994-1995 was unusually low. The return autocorrelation at a one-day lag is on the order of that found in the value-weighted NYSE-AMEX index, about 14%.

The return autocorrelation estimates in Table 1 provide a rough sense of the value of the daily wildcard option offered by equity mutual funds. A correlation of 8% implies that investors who exercise a put (call) on down- (up-) market days get about 0.08% per day in abnormal return (the square root of the explained variation in next-day returns). Compounded over 250 trading days this adds up to an 20% annual abnormal return, averaged across all equity funds. This estimate is on the high-side to the extent that the wildcard option is not exercised every day (due to processing costs, restrictions, fees, etc. – see section 3.4). On the other hand, it is on the low side to the extent that exercise activities are focused on funds with the greatest prospects for gains, and at times when those gains are likely to be greatest. Sections 3.3 and 4 explore the implementation of the strategy in more detail.

3.2. Time-series conditioning and wildcard option value

Table 2 reports estimates of the average exercise value of the MF wildcard option when the fund's daily return is in the tails of the distribution of daily returns. This arguably provides a more meaningful estimate of the value of the wildcard option than that inferred from return autocorrelation. Besides nuisance costs, funds often restrict the number of transactions allowed or impose transaction fees (section 3.4). In the face of these costs and restrictions, exercise of the MF wildcard option is most reasonable on days where the exercise value is relatively high. The nonsynchronous trading explanation for funds' return autocorrelation suggests that the wildcard option is most valuable on extreme return days.

There are two panels in Table 2, corresponding to equity funds (panel A) and non-equity funds (panel B). Within each panel there are three columns. The first column is the average return across all observations in both tails of the return distribution (e.g., in the "most extreme 15%" cell, the column reports the average daily return given a return percentile rank of (0, 15) or (85, 100)). This sets up the benchmark with which to assess the abnormality of conditional next-day returns (i.e., conditional on an up or down return day). The second and third columns, titled "ranking period return: low, high," present mean returns for all funds whose daily return is in the left tail (for the column labeled "low") or right tail (for the column labeled "high") on the ranking day. The row labeled "same-day" is the average return on the ranking day; the rows labeled "next day" and "next 5-days" are the average return on the day and week after the ranking day, respectively.

The sort for the ranking procedure is global – across funds and days. Thus, good-return observations tend to clump on certain days and bad-return observations tend to clump on other days, primarily determined by the market return. Having noted that, we emphasize that the table presents the relation between the return at the individual fund during the ranking period and *that fund's* subsequent return.

When returns are relatively low, the next days' returns also tend to be low. Looking across the three cells (the 15%, 25%, and 35% critical values) in Panel A (Equity funds), the next-day return is roughly 15 basis points lower than the unconditional average ("normal") return. Thus, if an investor were to exercise a wildcard put option on days where the fund return is in the left tail of the return distribution, the investor would on average, sell one day before an abnormal decline in NAV of 15 basis-points. Persistence in returns on the upside is similar, with positive returns being followed by returns that are 15 – 20 basis points higher than normal. This indicates similar exercise values of the MF wildcard call option when returns are in the right tail of the distribution.

There is some indication that the value of exercise increases when focusing on more extreme return days. This is consistent with the intuition that more-extreme returns imply a greater deviation between the exercise price of the wildcard option and the intrinsic value of the underlying fund assets. The logic is that, *ceteris paribus,* the deviation between the true value of the underlying stocks held by the fund and their last trade price is likely to be greatest on extreme return days. Caution is advised with this intuition, however, as the *ceteris paribus* assumption may not be appropriate. More-extreme return days may also be associated with more frequent trade, thus, decreasing the average time between last trade and the market close.

In panel B, we find a similar mean exercise value for the wildcard option for non-equity funds – about 15 basis points for the 25% tails of the daily return distribution. Interestingly, in this sample the value of the wildcard option increases significantly when conditioning on higher volatility days. This suggests that there may be a different relation between volatility and frequency of trade (i.e., stale prices) for equity and non-equity securities.

The *annual* abnormal return from exploiting the equity MF wildcard option, estimated from Table 2, is similar to that implied by the return autocorrelation statistics (section 3.1). However, the autocorrelation estimates assume daily exercise of the wildcard option (an average holding time of 1-2 days), whereas the estimates in Table 2 assume much less frequent exchanges. For example, using the 15% extremes, exercise occurs about 75 times a year (an average holding time of about two weeks) and garners a 12% annualized abnormal return. However, these exercise frequencies are still quite high: few funds are likely to tolerate such rapid exchanges. In section 3.4 we examine restrictions on the frequency of fund transactions. Before turning to that matter, we first examine cross-sectional conditioning. As with the *timing* of exercise, fund investors seeking to exploit the wildcard option are likely to target funds where the problem of nonsynchronous trading is likely to be greatest. The next section presents such an analysis.

3.3. Cross-sectional conditioning and wildcard option value

In this analysis we present the estimated wildcard-option value for several partitions of the sample:

equity:	Aggressive (aggressive growth, precious metals, or sector) or Conservative (growth and income, utility)
non-equity:	international/global funds, government and agency bonds, corporate bonds and balanced, and municipal bonds.

Table 3, panel A presents the same return statistics as Table 1 for the above partitions of the sample. Aggressive equity funds have greater return persistence. In results not presented, differences with respect to the funds' size and age were found to be immaterial. The evidence that return autocorrelation is highest for aggressive funds, whose holdings are likely to be less frequently traded, supports the conjecture that non-synchronous trading provides fund investors with a wildcard option in the underlying assets of the fund.

Estimates of the value of the wildcard option for the various sub-samples are reported in panel B that repeats the Table 2 analysis with a slight modification. We condense the selling option value (the tendency for NAV to fall further subsequent to a down return day) and the purchase option value (the tendency for NAV to rise further subsequent to an up return day) into one number. The intuition behind this presentation is as follows. Imagine holding a portfolio of positions in various mutual funds, and cash. On extreme down return days we sell our fund holdings, and forego the next-day return. This amounts to exercising the wildcard put. We value that exercise by noting that a negative next day return means we benefit and a positive next-day return means we lose. Thus, we record the value of the wildcard option as –1 times the next-day return for extreme down return days. For extreme up return days, we purchase fund shares, and then record the next-day captured return as the value of the wildcard option exercise. Panel B presents the average value of the wildcard option conditional on both tails of the daily returns distribution: the avoided loss on sales plus the captured gain on purchases. We find that the average wildcard exercise value at aggressive funds (about 20 basis points) is substantially higher than at conservative funds (about 8 basis points). Thus, focusing MF wildcard option strategies on particular funds indeed leads to higher abnormal returns than those reported in Sections 3.1 and 3.2.

The partitioning of the non-equity sample helps clarify the source of the wildcard option for these funds. Most of the action is in international funds, where we see a mean wildcard option value of about 35 basis points. This is consistent with the nonsynchronous trading hypothesis. For example, Asian markets close at about 3:00 A.M. Eastern time, and European markets close at about 11:00 A.M. Eastern. Thus, international funds typically set the NAV five to twelve hours after the last trade, allowing ample time for substantial pricing errors due to the unaccounted for correlation with returns in the U.S. market.

*3.4. Loads, transaction fees, and transaction restrictions (**preliminary**)*

Mutual funds can utilize a variety of tools to prevent excessive exercise of the wildcard option: loads, transaction fees, and explicit restrictions on the number of redemptions allowed per year. Table 4 presents a preliminary analysis of these frictions. To collect these data we read each fund's prospectus. The table shows the number of funds employing various restrictions that would limit the value of the wildcard option.

From Table 4, load funds make up at least 49% of the sample regardless of the fund objective or type. The magnitude of most loads undoubtedly swamp the value of the wildcard option. Not reported in Table 4, we estimate that 45% domestic equity funds in our sample are no-load and no-fee domestic funds. Among this set of funds, 78% allow unlimited transactions. These ratios provide an indication of the fraction of the mutual-fund universe that is vulnerable to exploitation of the wildcard option. The results also imply that transaction restrictions are more frequent among the domestic equity funds than in the bond funds, and loads appear to be more prevalent in the bond funds than in the equity funds.

The analysis of fund restrictions and fees is undertaken to examine the impact that these fund policies may have on the value of the wildcard option. We find that loads are the single most important restriction. Future work will refine these tests regarding the importance of trading restrictions.

4. Why do we call it the mutual fund wildcard option? Evidence on non-synchronous trading

We argue that an explanation for mutual-fund return autocorrelation is the mispricing of fund shares, at NAV, due to stale closing price data.[6] We have seen indirect evidence of nonsynchronous trading in that the autocorrelation is highest for aggressive funds, and when returns are extreme. This section further explores the nonsynchronous trading hypothesis and the value of the MF wildcard option with two more direct tests.

The intuition of the wildcard option guides the tests. When investors trade fund shares, they effectively purchase or sell the underlying asset (the fund portfolio) at a strike price set by the last trade of each asset in the portfolio. The intrinsic value of this option depends on the gap between the last-trade price and the true value of the fund's assets. In this section we consider two predictions as to when and where that value is likely to be largest.

4.1. Intra-day variation in exercise value

Two factors likely to be associated with increased mutual-fund return autocorrelation under the nonsynchronous trading hypothesis are the magnitude of late-afternoon market returns and frequency of trade in the underlying assets of the fund. In Table 5 we present an analysis of the average MF wildcard exercise value on days with large late-afternoon market (S&P 500) moves. Following the results of Section 3, the results are presented for the aggressive/conservative partition

[6]Alternative causes of portfolio-return autocorrelation have been examined in the literature. For delays in price adjustment due to market frictions see Goldman and Sosin (1979), Cohen et al (1986) and Mech (1993). For time-varying expected returns see Keim and Stambaugh (1986), Conrad and Kaul (1988), and Conrad and Kaul (1989) and Campbell, Grossman, and Wang (1993).

of the fund universe and for various tails of the distribution of late-afternoon returns. We consider several specifications for late-afternoon.

We use the data on the spot intraday return on the S&P 500 obtained from the Futures Industry Institute. To present an implementable strategy, we look at the return up to 3:50 P.M., ten minutes before the market closes and most funds stop accepting orders. We explore return periods that begin at 3:20 P.M., 2:35 P.M., and 1:50 P.M. We rank all days according to the S&P 500 return from the indicated time until market close, and then select days that are in the tails of the distribution (35%, 25%, or 15%). As in the partitioned analysis of section 3.3, we combine the wildcard put option exercise value (the next-day loss avoided by selling fund shares on down market days) with the wildcard call option exercise value (the next-day gain associated with purchasing fund shares on up market days). That is to say, on sell days we multiply the next-day return by –1, and then we average the next day return on both tails of the distribution. We report next-day returns in excess of the next day S&P 500. This can be interpreted as purchasing a hedge against next day market moves.

Table 5 provides further evidence consistent with the nonsynchronous trading hypothesis. First, when the late afternoon market return is extreme, a failure of a stock to trade late means a relatively large (predictable) pricing error in the funds' NAV. We find the greatest wildcard option exercise value conditioning on the last thirty minutes' market return. Note, however, that conditioning on very late-in-the-day-returns is most important for funds with conservative (large cap, heavily traded stocks) holdings. For aggressive funds, the difference between conditioning on the last 30 minutes and conditioning on the last 2 hours is only marginal, For conservative funds, the wildcard option value nearly triples. Finally, note that the wildcard option value for international funds is both larger than that for domestic equity funds, and that it increases in value as the conditioning time increases (i.e., larger for the 120 minute sort than the 30 minute sort). Again, this is as would be predicted by the stale-pricing explanation. Since the assets of these funds don't trade anyhow, one is naturally better off conditioning on a longer time period (and greater return volatility).

Table 5 also presents the next day return to the S&P 500. Note that the next-day return on conservative funds is very similar to that of the S&P 500. However, in an important sense these two are very different. The S&P 500 return predictability is not necessarily real: the fund's return predictability is real. All one has to do is pick up the phone and call the fund company at 3:50 P.M. and execute an exchange and the next-day return is captured.

4.2. Cross-sectional variation in exercise value

Morningstar provides a style classification of mutual funds based on a three by three matrix of market capitalization and value (a composite of book-to-market and price-earnings ratios). Morningstar assigns this classification by examining the fund's typical stock holdings. The classification allows us to test the nonsynchronous trading hypothesis by examining differences in the wildcard option value across funds that hold securities with different trade frequencies. The first step in the procedure is to partition the universe of stocks on the New York Stock Exchange's (NYSE) TAQ dataset into the same three by three matrix as that used by Morningstar. We then document across the matrix the pattern of the primary variable relevant to nonsynchronous trading: the elapsed time between the last trade and the market's close. Finally, we document the mean wildcard-option value across this matrix.

The three-by-three Morningstar partition is constructed by first assigning the 5,000 largest domestic stocks to large cap (top 5%), mid-cap (next 15%) and small-cap (the 80% to 10%) portfolios. To avoid overstating of the non-trading characteristics of the individual stocks, we discard the smallest 10% of stocks by market capitalization. Morningstar then determines a fund's market-capitalization rank by ranking the stocks in a fund's portfolio from the largest market-capitalization stock to the smallest, and then calculating the average market capitalization of stocks in the middle quintile of the portfolio. After a fund's market-capitalization rank has been determined Morningstar then assigns a valuation rank. Specifically, each stock in the 5,000 stock universe receives a price/earnings and price/book score. These scores are determined by dividing each stock's P/E and P/B by the asset-weighted median P/E and asset-weighted median P/B (respectively) of the stock's market-cap group. Next, to calculate the P/E and P/B valuation score for each fund, Morningstar ranks each stock in a fund's portfolio by their median market capitalization and an average weighted P/E score and average weighted P/B score from stocks in the middle quintile of each fund's portfolio. These average weighted scores are the P/E valuation score and the P/B valuation score. If the fund has a combined P/E and P/B score that exceeds 2.25, the fund is categorized as growth. If the combined score is less than 1.75, the fund is categorized as value. If the combined score is between 1.75 and 2.25 the fund is categorized as blend.

Table 6 panel A presents non-trading characteristics of stocks within each cell of the Morningstar partition. Panel A provides the 90^{th}, 75^{th} and 50^{th} percentiles of the distribution of the elapsed number of minutes between the last trade and the market's close at 4:00 p.m. The longer the time between the last trade and the market close, the greater the opportunity for the arrival of information that changes the true value (but not the closing price of the stock. Not surprisingly small cap funds have more stocks with longer intervals of non-trading prior to the close. For example, at the 90th percentile small cap value funds have 124 minutes elapsed time between last trade and close. Value funds appear to have more non-trading than growth funds. For example, large cap value funds there are 18 minutes between the last trade and the close at the 90th percentile. For comparison, large cap blend and large cap growth funds have 1 minute of elapsed time at the 90th percentile. Table 6 panel A implies that the Morningstar classifications can help to identify funds' susceptibility to the wildcard option due to differences in the trading patterns of the stocks that they hold.

Panel B presents the results on the funds' wildcard option value. Days are sorted according to the late-afternoon return from 3:20 P.M. to 3:50 P.M. We use the return in the last 30 minutes of trading, as that had the most predictive content in Table 5. We then examine the next day abnormal return (again, multiplied by -1 for down-market days) on 15%, 25% and 35% extreme return days.

Table 6 panel B presents the next day average abnormal returns for the funds, categorized by the Morningstar grid. The small cap growth funds exhibit the greatest wildcard option exercise value. Initially, this is somewhat surprising given that it would appear that the large-cap value funds are subject to the greatest non-trading problem. We believe that the explanation for this is that the volatility of the value stocks is likely to be lower than the volatility of the growth stocks. Thus, what appears to be a larger non-trading problem for value stocks is mitigated by lower volatility in those shares and as a result the wild card option is less valuable than it is in the case of the small cap growth funds. Overall, Table 6 panel B implies that growth and small cap are the categories of funds that have the most valuable wildcard options associated with them.

5. Flow and returns

We now address the question of the extent to which fund investors currently exploit the MF wildcard option. Although a fund's daily flow and its concurrent daily return might be correlated for a variety of reasons, that association provides an upper bound on the extent to which a subset of investors capture the benefits of the MF wildcard option.

5.1. Data and basic characteristics

Our data include daily observations of the total assets of the fund as well as NAV. Flow refers to the percentage change in total assets less the percentage change in NAV per share, i.e., the net dollar purchases of fund shares. Summary characteristics of flow are presented in Table 1. As with returns, filtering is necessary to purge errors from the data. After imposing the filters discussed in Section 2, the mean and median daily flow is essentially zero in this sample, but the variability (daily standard deviation) is a fairly substantial 1.2%.

The first-order (one day lag) autocorrelation of flow is strongly negative, -20%. The source of this autocorrelation is unclear. One possibility is errors arising from distributions. Capital gains distributions are typically reinvested, but, according to sources at TrimTabs, there is some concern that the total assets of the fund gets somewhat unreliable in the day's surrounding distributions. For example, the entire distribution may be removed from the balance sheet one day only to return in large measure (with reinvestment) the following day. One test of whether distributions contribute artificial negative autocorrelation to the flow series is to separately examine December, when most (76%) capital gains distributions occur, from the rest of the year. The autocorrelation of flow in December is –29%, versus -19% for all other months, suggesting that a lack of distributions data causes some bias in the autocorrelation estimates, but it is not the explanation for the one-day reversal tendencies of flow.

5.2. Flow and returns

Table 7 replicates the analysis of Table 2, except that the focus is on flow rather than returns. As in Table 2, fund-days are ranked according to returns, and then subsets of fund*day observations are formed for the tails of this distribution. In this table, however, we present the *flow* (rather than return) on the ranking day, the flow on the subsequent day, and the flow over the subsequent week. Panel A (B) presents the results for domestic-equity (other) funds.

At domestic equity funds the same-day flow on down (up) return days is typically about 6 basis points lower (higher) than normal. The relation is statistically significant at conventional levels. This same-day correlation with flow is consistent with a small contingent of fund investors who knowingly time the exercise of the MF wildcard option to coincide with opportunities to capture abnormal next-day returns. Note also that this is seen with both put (down-return days) and call (up-return days) exercises. While statistically significant, this relation is almost immaterial economically: the standard deviation of flow is over 100 basis points so the "hot money" contingent is indeed small. Further, the total annual drain on fund assets from this concurrent exercise of the wildcard option amounts to only a few basis points.

It is worth pointing out that next-day flow is highly correlated with returns and about three times as large as the concurrent flow. The nature of this "one-day-late" flow is unclear. It may represent naïve attempts to chase return autocorrelation, but there is no profit from such a strategy. This flow is priced at the 4:00 P.M. close on the day following the return, after the one-day autocorrelation has passed. That is to say, these investors exercise their wildcard option one day too late, if that is indeed the objective behind their decision to trade fund shares.

Turning to non-equity funds, we see similar results: same-day flow is statistically significant but not particularly significant economically. When comparing to equity funds, non-equity funds exhibit a greater tendency for flow to occur on the same day rather than the subsequent day. However the overall (two-day) association between flow and returns is similar at the two classes of funds.

6. Conclusion

This study documents the profitability of trading strategies designed to exploit the autocorrelation of daily fund returns caused by nonsynchronous trading. We find evidence that significant abnormal returns are attainable by following these strategies. The implications of our study, however, are much more general. Fund investors are adversely affected when funds mis-price their shares. This is true whether investors deliberately game the mispricing or not. Further, the potential for mispricing by funds who set the NAV of their shares using closing (last trade) prices extend well beyond that caused by nonsynchronous trading. For example, bid-ask bounce, the tendency for closing prices to represent either the bid price or the ask price depending on whether the last transaction of the day was a sale or a purchase is another potential source of mispricing. Keim and Stambaugh (1984) document systematic patterns in closing prices at the bid and ask across days of the week. In particular, they find that closing prices on Mondays tend to be at the bid while closing prices on Fridays tend to be at the ask. Thus, funds that set NAV using closing prices under-price their shares on Mondays and overprice their shares on Fridays. Similarly, Keim, (1989) finds that closing prices during the last few days of year tend to be at the bid while closing prices during the first few days of the year tend to be at the ask.

If robustness checks substantiate the existence and magnitude of the mutual fund wildcard option, we argue that the mutual fund wildcard option is of great concern to mutual funds and their investors. The wildcard option involves the transfer of wealth to those that exercise wildcard options from the rest of the mutual fund's investors. We believe that the most fruitful solutions to the MF wildcard option problem should focus on obtaining a corrected NAV. While imposing other frictions can indirectly reduce the incidence of MF wildcard option exercise, indirect solutions generate their own redistributions of fund holder's wealth.

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Table 1. Daily equity-fund data

Panel A presents daily fund assets, daily returns, and daily flow characteristics for domestic equity funds. TrimTabs.com provides the data we use in Panel A. Panel B presents daily return characteristics for domestic equity fund data from Micropal. Daily returns are not annualized. The reported autocorrelation is the average autocorrelation coefficient across funds. The **absolute-value filters** remove all observations in which the absolute value of the fund's return exceeds 10%, and all observations in which the absolute value of the fund's change in assets exceeds 10%. The **Reversal filters** are applied after the absolute-value filters, and remove all observations in which the one-day return (or change in assets) exceeds 5% and the two day (day t + day t+1) return (or change in assets) is less than 1.5%. Other filters are: mean total assets > $3.5 Million, NAV > $2.5, and number of observations > 40.

		Filters		
Panel A: TrimTabs sample		*None*	*Absolute value*	*Absolute value + Reversal*
Time period: 2/01/98 - 6/30/99 (daily observations)			Sample: 434 U.S. Equity Funds	
daily observations		141,920	139,132	137,688
daily observations/fund		327	320	317
mean assets under management		$1122M	$1122M	$1122M
		--- (*all units below = %*) ---		
return	*mean*	0.11	0.06	0.06
	std. dev.	19.74	1.29	1.23
	autocorr.	-5.5	7.1	7.6
% change in assets	*mean*	0.09	0.05	0.06
	std. dev.	5.6	1.89	1.79
	autocorr.	-8.6	3.6	5.9
% flow	*mean*	-0.03	-0.00	0.01
	std. dev.	20.3	1.28	1.21
	autocorr.	-16.3	-21.6	-19.9
Panel B: Micropal sample				
Time period: 1/01/92 - 12/30/96 (daily observations)			Sample: 3241 U.S. Equity Funds	
daily observations (millions)		2.923	2.917	2.902
		--- (*all units below = %*) ---		
return	*mean*	0.053	0.07	0.07
	std. dev.	8.83	0.69	0.67
	autocorr.	3.2	14.5	14.1

Table 2. Rank analysis of daily return autocorrelation at equity funds and non-equity funds

Panel A analyzes equity funds (CRSP classifications of maximum capital gains, growth, growth and income, sector, and precious metals) and Panel B analyzes non-equity funds (international, global, total return, balanced, income, and bond funds). **Procedure:** Daily fund returns are ranked from lowest to highest across all days and all funds within each panel. Each observation is given a corresponding percentile value. Daily portfolios of funds are then constructed. The left-tail portfolio is the equal-weighted set of all funds whose global-percentile ranking on that day was less than or equal to the critical value 35% (or 25% or 15%). The right-tail portfolio is the equal-weighted set of all funds whose global-percentile ranking on that day was greater than or equal to the critical value 65% (or 75% or 85%, respectively). On any given day, either the left-tail or right-tail portfolio, or both, might be empty (since the ranking is global across fund*days). The table presents the mean portfolio return on the ranking day, the next day, and the next week. The normal value is the average daily or five-day return across all funds and all days. Units are % (i.e., 0.01 = one basis point). Standard errors are in parentheses. Time period: 2/01/98 - 7/30/99 (daily observations)

Panel A: Equity funds	*normal value (full sample)*	*492 funds* *ranking pd. return*	
		low	*high*
most extreme 35% returns			
same day	0.05	-1.15	1.25
standard error		(0.04)	(0.03)
next day	0.05	-0.09	0.19
standard error		(0.06)	(0.05)
next 5-days	0.26	0.13	0.06
standard error		(0.25)	(0.27)
most extreme 25% returns			
same day	0.05	-1.45	1.52
standard error		(0.03)	(0.03)
next day	0.05	-0.10	0.21
standard error		(0.07)	(0.06)
next 5-days	0.26	0.05	0.04
standard error		(0.27)	(0.03)
most extreme 15% returns			
same day	0.05	-1.90	1.92
standard error		(0.03)	(0.03)
next day	0.05	-0.06	0.25
standard error		(0.08)	(0.06)
Next 5-days	0.26	0.13	0.22
standard error		(0.31)	(0.03)

Panel B: Non-equity funds	*normal value (full sample)*	*437 funds* *ranking pd. Return*	
		low	*High*
Most extreme 35% returns			
Same day	0.02	-0.56	0.57
Standard error		(0.02)	(0.02)
Next day	0.02	-0.12	0.13
Standard error		(0.03)	(0.03)
Next 5-days	0.10	-0.02	0.12
Standard error		(0.17)	(0.16)
Most extreme 25% returns			
Same day	0.02	-0.74	0.74
Standard error		(0.03)	(0.02)
Next day	0.02	-0.16	0.17
Standard error		(0.04)	(0.03)
next 5-days	0.10	-0.05	0.10
Standard error		(0.20)	(0.20)
Most extreme 15% returns			
same day	0.02	-1.08	1.07
Standard error		(0.03)	(0.02)
next day	0.02	-0.23	0.24
Standard error		(0.05)	(0.04)
next 5-days	0.10	-0.10	0.15
Standard error		(0.23)	(0.24)

Table 3. Return characteristics equity fund sub-samples

The sample of equity funds is partitioned into aggressive funds (max. capital gains, sector, precious metals, and high-volatility growth funds) and conservative funds (growth & income and low-volatility growth funds). The sample of non-equity funds is partitioned into international (international equity, international bond, global equity funds), government and agency, corporate (general and high-yield funds), and municipal bond funds. Observations are daily, and units are percents (i.e., 0.01 is one basis point). Standard errors are in parentheses. Time period is 2/01/98 - 7/30/99 with daily observations.

Panel A. Statistics on returns and flow

See Table 1 heading for a description of the statistics.

	Equity funds:		*Non-equity funds:*			
	Consrv.	*Aggrs.*	*Internat'l*	*Gov't/ agency*	*Corp*	*Muni*
return						
mean	0.05	0.07	0.03	-0.01	-0.02	-0.02
standard deviation	1.00	1.40	1.14	0.21	0.27	0.15
autocorrelation	3.0	10.0	17.0	1.0	14.0	10.0

Panel B. Rank analysis of daily return autocorrelation on sub-samples of equity and non-equity funds

The procedure in this panel generally follows that of Table 2, except that the value of selling on down days (the "low" column in Table 2) is added to the value of buying on up days (the "high" column in Table 2). Daily fund returns are ranked from lowest to highest across all days and all funds within each partitioned-set of funds. Each observation is given a corresponding percentile value. Daily portfolios of funds are then constructed. The left-tail portfolio is the equal-weighted set of all funds whose global-percentile ranking on that day was less than or equal to the critical value 35% (or 25% or 15%). The right-tail portfolio is the equal-weighted set of all funds whose global-percentile ranking on that day was greater than or equal to the critical value 65% (or 75% or 85%, respectively). The table presents the mean next-day return from a strategy of selling the left-tail portfolio and buying the right-tail portfolio.

	Equity funds:		*Non-equity funds:*			
	Consrv.	*Aggrs.*	*Internat'l*	*Gov't/ agency*	*Corp*	*Muni*
Rank on return, 35% tails						
next day return	0.07	0.20	0.25	0.01	0.05	0.02
	(0.06)	(0.07)	(0.05)	(0.02)	(0.01)	(0.01)
Rank on return, 25% tails						
next day return	0.08	0.22	0.31	0.01	0.06	0.03
	(0.06)	(0.07)	(0.06)	(0.02)	(0.01)	(0.01)
Rank on return, 15% tails						
next day return	0.08	0.21	0.36	0.00	0.07	0.03
	(0.07)	(0.08)	(0.08)	(0.02)	(0.02)	(0.02)

Table 4. Funds' restrictions on the wildcard option (PRELIMINARY)

Mutual funds have various ways of preventing excessive exercise of the MF wildcard option. For example loads, transaction fees, and restrictions on the number of redemptions per year all discourage transacting. This table presents the number of funds with each type of restriction reported in their prospectus.

	Equity funds		*Non-Equity funds*			
	Conservative	*Aggressive*	*International*	*Govt/Agency*	*Corporate*	*Municipal*
Number of funds	162	189	119	58	48	88
Avg Assets (mil)	775	1,015	508	525	670	529
Load status						
Yes	61%	49%	66%	72%	63%	80%
No	39%	51%	34%	28%	38%	20%
Transaction Fee						
Yes	1%	1%	4%	0%	0%	5%
No	38%	50%	34%	28%	38%	16%
Missing	61%	49%	66%	72%	63%	80%
Limit redemption						
Yes	2%	6%	2%	0%	0%	0%
No Mention	7%	6%	9%	12%	6%	8%
Missing	91%	88%	89%	88%	94%	92%

Table 5. Average wildcard option exercise value conditional on the afternoon S&P 500 return

We rank the S&P 500 spot return over various late-day intervals (data from the Futures Industry Institute). We then examine the next-day return, in excess of the next day S&P return, to a strategy of buying (selling) funds conditional on extreme positive (negative) afternoon S&P 500 returns. The table presents the average next-day return when the strategy is applied to the subset of funds indicated in the column heading. Days are included in the sample only if there is a sufficiently extreme late-afternoon S&P 500 returns (either 35%, 25%, or 15% tails). If the S&P return is negative the next-day fund return is multiplied by –1, corresponding to a sale of fund shares on the ranking day. The second-to-last column is the average absolute S&P 500 return on the ranking day. The last column is the next-day return if the above strategy is applied to the S&P 500 index. Units are percents (i.e., .01 is one basis point). Time period is 2/01/98 - 7/30/99 with daily observations.

	Equity funds			Non-equity funds	S&P 500 return	
	Consrv.	*Aggrs.*	*All*	*international*	*rank day*	*Next day*
Rank on S&P500 return from 3:20 – 3:50 P.M. (30 minutes)						
35% tails	0.05	0.13	0.09	0.14	1.07	0.07
standard error	(2.1)	(3.4)	(3.1)	(3.3)	(8.2)	(0.7)
25% tails	0.07	0.17	0.12	0.17	1.25	0.08
standard error	(2.4)	(3.8)	(3.5)	(3.5)	(8.5)	(0.5)
15% tails	0.11	0.23	0.17	0.30	1.56	0.13
standard error	(2.6)	(3.8)	(3.6)	(4.5)	(6.8)	(0.6)
Rank on S&P500 return from 2:35 – 3:50 P.M. (75 minutes)						
35% tails	0.03	0.12	0.08	0.19	1.20	-0.06
standard error	(1.4)	(3.1)	(2.6)	(4.4)	(11.0)	(-0.5)
25% tails	0.05	0.15	0.10	0.23	1.39	-0.03
standard error	(1.7)	(3.3)	(3.0)	(4.4)	(8.9)	(-0.2)
15% tails	0.07	0.18	0.13	0.34	1.61	-0.05
standard error	(1.8)	(2.8)	(2.6)	(4.7)	(8.0)	(-0.2)
Rank on S&P500 return from 1:50 – 3:50 P.M. (120 minutes)						
35% tails	0.03	0.12	0.08	0.22	1.19	-0.04
	(1.1)	(3.6)	(2.8)	(5.3)	(10.2)	(-0.3)
25% tails	0.02	0.15	0.09	0.27	1.41	0.01
standard error	(0.7)	(3.3)	(2.4)	(5.6)	(9.5)	(0.1)
15% tails	0.04	0.19	0.12	0.33	1.65	0.04
standard error	(1.1)	(3.4)	(2.6)	(4.9)	(8.8)	(0.2)

Table 6. Nonsychronous trading characteristics of stocks and next day fund returns
The universe of stocks on the NYSE TAQ dataset is partitioned according to the 3x3 grid that Morningstar uses to classify funds. This grid is produced by first, ranking stocks into three groups according to market capitalization. Then, within market-cap groups, stocks are assigned value, blend, or growth styles depending upon the level of market-to-book and price to earnings relative to the median values. See www.morninstar.com.

Panel A. Elapsed minutes from the last trade to 4:00 P.M.
For each stock in the TAQ data set during 2/1998, 6/1998, 10/1998, 2/1999, 6/1999, the number of minutes between the last trade and 4:00 P.M. Eastern is calculated. The 90th, 75th and 50th percentiles of the last trade distribution are presented for stocks that fit within each Morningstar grid classification.

		Market Capitalization by percentile		
		Large Cap: Above 95th	Mid-Cap 80th – 95th	Small Cap 10th - 80th
Value	90th Percentile	18	10	124
	75th Percentile	3	1	35
	Median	0	0	6
	N stocks	6,241	20,488	98,466
Blend	90th Percentile	1	3	90
	75th Percentile	0	0	24
	Median	0	0	4
	N stocks	3,169	8,005	41,598
Growth	90th Percentile	1	3	53
	75th Percentile	0	0	12
	Median	0	0	1
	N stocks	6,783	21,477	83,043

Panel B. Fund returns on day *t*+1 following large S&P 500 moves in the last 30 minutes of trading
We report the returns (in basis points) to portfolios of mutual funds on the day after a relatively large return in the S&P 500 in the last 30 minutes of trading. To define large market returns, we rank by final 30 minute return each day on the S&P 500. 35th, 25th and 15th tails represent the positive and negative tails of the trading day return distribution. On extreme negative trading days we multiply the next day return by –1 and pool the results with the extreme positive days. For example, 35th tails picks up 70% of all observations omitting just the 35th – 65th percentile of late day return days. On an extreme day, the average abnormal return of all funds fitting each Morningstar cell is the abnormal return on the portfolio of funds the next day, using an S&P500 market model. The mean day-after abnormal returns are presented below in basis points.

		Market Capitalization by percentile of top 5,000 stocks		
		Large Cap: Above 95th	Mid-Cap 80th – 95th	Small Cap Below 80th
Value	35th tails (268 days)	4.0	4.1	8.5
	25th tails (228 days)	6.2	5.4	9.3
	15th tails (165 days)	7.2	6.6	11.3
	Number of Funds	90	27	10
Blend	35th tails (268 days)	5.3	9.1	8.6
	25th tails (228 days)	9.1	11.2	9.8
	15th tails (165 days)	10.3	13.5	12.0
	Number of Funds	66	9	8
Growth	35th tails (268 days)	8.6	14.2	14.8
	25th tails (228 days)	12.6	18.1	19.7
	15th tails (165 days)	11.0	20.1	25.5
	Number of Funds	50	39	20

Table 7. Rank analysis of daily flow at equity funds and non-equity funds, ranking on returns

Panel A analyzes equity funds and Panel B analyzes non-equity funds (entirely separate analyses). Observations of daily returns are pooled across all funds, and then ranked from lowest to highest. Daily portfolios of funds are then constructed based on the return ranking – the "low" (high") portfolio consists of all funds that had extreme low (high) ranking-day returns. The size of the extreme sub-sample ranges from 15% to 35%. The table presents the flow on the ranking day, the flow on the next day, and the accumulated flow over the next 5 days. Units are percents (i.e., .01 is one basis point). Time period includes 2/01/98 - 7/30/99 with daily observations.

Panel A: Equity funds *492 funds*

	Normal value (full sample)	*ranking pd.Return low*	*High*
most extreme 35% returns			
same day	0.00	-0.04	0.05
standard error		(0.018)	(0.017)
next day	0.00	-0.14	0.16
standard error		(0.016)	(0.015)
next 5-days	0.01	-0.19	0.46
standard error		(0.20)	(0.22)
most extreme 25% returns			
same day	0.00	-0.05	0.06
standard error		(0.023)	(0.021)
next day	0.00	-0.10	0.20
standard error		(0.067)	(0.055)
next 5-days	0.01	-0.19	0.57
standard error		(0.24)	(0.27)
most extreme 15% returns			
same day	0.00	-0.05	0.09
standard error		(0.032)	(0.030)
next day	0.00	-0.19	0.24
standard error		(0.075)	(0.062)
Next 5-days	0.01	-0.21	0.70
standard error		(0.27)	(0.28)

Panel B: Non-equity funds *437 funds*

	normal value (full sample)	*Ranking pd. Return Low*	*High*
Most extreme 35% returns			
same day flow	0.00	-0.07	0.07
Standard error		(0.022)	(0.025)
Next day	0.00	-0.09	0.09
Standard error		(0.020)	(0.024)
Next 5-days	0.01	-0.14	-0.02
Standard error		(0.037)	(0.040)
Most extreme 25% returns			
Same day flow	0.00	-0.11	0.09
Standard error		(0.026)	(0.031)
Next day	0.00	-0.12	0.12
Standard error		(0.026)	(0.031)
next 5-days	0.01	-0.20	-0.00
Standard error		(0.045)	(0.048)
Most extreme 15% returns			
same day	0.00	-0.18	0.13
Standard error		(0.034)	(0.040)
next day	0.00	-0.15	0.16
Standard error		(0.05)	(0.040)
next 5-days	0.01	-0.24	0.03
Standard error		(0.066)	(0.082)