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The dilution impact of daily fund flows on open-end mutual funds

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Abstract

We examine how mutual fund flow flows that are correlated with subsequent fund returns can have a dilution impact on the performance of open-end funds. Active trading of open-end funds has a meaningful economic impact on the returns of passive, nontrading shareholders, particularly in U.S.-based international funds. The overall sample of domestic equity funds shows no dilution impact, but we find an annualized negative impact of 0.48% in international funds (and nearly 1% for a subsample of funds whose daily flows are particularly large). The exchange and pricing policies of mutual funds can thus have important performance-related implications.

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1. Introduction

Many open-end mutual funds provide virtually free and unlimited liquidity to those who wish to buy or redeem fund shares. The fund itself must either engage in costly trade or alter its cash position in response to mutual fund traders' exchanges. In effect, the active mutual fund trader imposes costs on the fund, which are passed on to the fund's passive shareholders. This paper focuses on how fund flows cause a shift in the fund's cash balance, resulting in a *dilution impact*. Active mutual fund traders contribute cash that is pooled with the mutual fund's existing risky assets. Once "in" the fund, the trader receives the pooled risky return – the same as any fellow shareholders. A trader who can accurately predict the future returns to the fund's risky assets can then capture the price swings in these assets without incurring a cost. Such traders dilute short-lived positive returns (and concentrate negative returns) with cash. This dilution impact is most plausible from short-horizon (e.g., daily) cash flows, since long-horizon cash flows can be invested quickly enough in risky assets to capture long-horizon returns.[1]

This paper considers the empirical question of whether daily fund flows from *active* mutual fund traders result in a measurable dilution impact. Chalmers, Edelen, and Kadlec (2001) (hereafter CEK) argue that a "wildcard option" exists in a broad cross-section of domestic and international open-end mutual funds as a result of stale prices. These stale prices give rise to profitable trading strategies in which active traders can earn abnormal returns of 10% to 20% annually. Bhargava and Dubofsky (1999) and Goetzmann, Ivkovich, and Rouwenhorst (2001) show that successful trading or market timing is possible in three international mutual funds. We confirm this finding and show that abnormal returns result from a market timing strategy in a large sample of international mutual funds. Though these previous studies establish the potential existence of profitable trading strategies, our paper is the first to show whether traders appear to adopt such strategies and how their net fund flows impact mutual fund

[1] The term *dilution* has been used by others to describe the issue examined herein. Specifically, Pozen (1998) presents a case in which dilution was a major factor during volatile global equity markets in October 1997. Discussing the same incident, Barry Barbash of the SEC refers to dilution in a speech in 1997. We note that the dilution effect examined here is different than the *tax*-dilution identified in Brown, Goetzmann, Hiraki, Otsuki, and Shiraishi (1999). However, the sense in which fund flows from one party result in an impact on another party through the structure in which a fund is organized remains similar.

returns. We find that net fund flows in international mutual funds in particular are consistent with active traders who take advantage of stale prices. We show a significant negative dilution impact in these funds of nearly 0.50% on an annualized basis. For the funds in our sample (representing approximately 20% of the assets of all U.S.-based open-end funds) we estimate that the dilution impact has brought about a net wealth transfer from passive shareholders to active traders in international funds in excess of $420 million over a 26-month period. In contrast, we find no dilution effect on average in domestic equity or bond funds. Our results suggest that the dilution impact from frequent fund flows involves material wealth and can have a significant effect on mutual fund returns.

Beyond the dilution impact, fund flows affect other direct and indirect costs of the mutual fund, such as processing fees, increased cash holdings, and transaction costs. Edelen (1999) focuses on how some of the indirect costs from this liquidity role can affect the performance of mutual funds and the inferences made in studies of managers' selection and timing skills. Using monthly fund flows and semi-annual fund transactions data, his analysis shows that liquidity-motivated flows can have an economically significant impact on the return to the mutual fund's passive investors through increased expenses and trading costs. Like Edelen, we find that fund flows affect the pooled return to all fund shareholders. However, we focus on *daily* fund flows that we expect to be transient and to induce only short-lived changes in the fund's cash balance. Such flows might not cause mutual fund managers to incur transaction costs. However, these flows could impose a cost on the fund by diluting the fund's risky asset returns. In the face of large daily fund flows, the type of impact primary to Edelen's analysis might not be observed even though a measurable impact due to dilution exists.

Our analysis of daily fund flows reveals patterns that are often different from those found in studies of longer-term flows. For example, Gruber (1996) and Zheng (1999) show a "smart money" effect, wherein fund flows tend to find funds that have a higher likelihood of good future performance. We show that daily fund flows in international funds appear able to predict subsequent-day returns, while flows in domestic funds are unrelated to the following day's returns. Sirri and Tufano (1998) show that net new money into a fund is affected by past performance, load fees, and management expenses. We find that daily fund flows appear larger in front-end load funds than in no-load funds and are seemingly invariant to stated restrictions listed in the fund's prospectus.

Other recent studies examine how short-term fund flows are related to overall equity market returns. Goetzmann and Massa (1999) and Edelen and Warner (2001) find that daily fund flows into and out of domestic mutual funds are correlated with, and could even cause, movements in the underlying U.S. markets. These two studies suggest that the flows of money into and out of mutual funds can have a measurable impact on the overall market. In contrast to examining how they affect the market for the underlying assets, we show how short-lived flows impact individual mutual funds' returns. We also show that daily flows in U.S.-based international funds *are motivated by* predictable future returns rather than *cause* movements in international markets.

This paper proceeds as follows. We first establish that there is ex ante reason to expect fund flows that originate from profitable trading strategies. Section 2 describes a simple trading rule that results in a "market timing" success rate high enough to earn expected abnormal returns of 15% to 20% per year by trading international open-end mutual funds. We empirically demonstrate fund flow patterns consistent with this profitable trading rule in Section 3, but find no evidence that profitable trading occurs on average in domestic funds. We develop and estimate a measure of the dilution impact from mutual fund flows in Section 4. Section 5 concludes the paper and offers implications for future research.

2. Daily market timing in international mutual funds

2.1. A market timing rule

A large body of literature documents the interaction between the U.S. market and international markets.[2] These studies generally show a contagion effect, in which price movements in one market spill over into other markets. The strongest correlation appears to originate in U.S. market moves. For example, a late-afternoon (New York time) increase in the U.S. market creates expected increases in the Asian and European markets which are closed at the time of the U.S. move.

Most U.S.-based international mutual funds hold securities that trade outside the U.S., though many maintain some holdings of U.S.-traded ADRs. U.S. Securities and Exchange Commission (SEC) rules require mutual funds to value their portfolios at least daily.[3] As stated by SEC Division of Investment Management Director Barry Barbash, "A fund is generally required to price its portfolio using readily available market quotations." Most funds routinely use each security's last traded price in its home market. In rare cases in which market quotes are not readily available or market conditions are extreme, the "fund is permitted to value the securities at their fair value determined in good faith by, or under the direction of, the fund's board of directors."[4] The portfolio's underlying securities' quoted (closing) prices are stale as of late-afternoon New York time, since they can not reflect the systematic information revealed in U.S. trading. This pricing structure creates a lead-lag relation between daily returns on the U.S. market and international mutual funds. Since most open-end mutual funds allow traders to submit orders to buy or sell fund shares as late as 4:00 P.M. New York time, CEK's "mutual fund wildcard option" is frequently in-the-money for international open-end mutual funds. That is, a profitable trading strategy might exist that exploits the stale prices of international mutual funds. Copeland and Copeland (1998) show that some profit opportunity exists in trading foreign-market futures contracts based on this correlation.

Consider the market timing rule of following an S&P 500 signal as a proxy for the U.S. market return. If today's S&P 500 return is positive just prior to the market close (e.g., at 3:55 P.M. Eastern), hold an international mutual fund tomorrow. Hold cash tomorrow if today's S&P 500 return is negative. To demonstrate the profitability of this stale-price trading strategy, we use daily fund net asset value (NAV) data from January 1, 1993 through December 31, 1997. The sample consists of 84 funds for which we have NAV and Morningstar data for funds with prospectus objectives of "World Stock" or "Foreign

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[2] See, for example, Becker, Finnerty, and Gupta (1990), Connolly and Wang (1998), Craig, Dravid, and Richardson (1995), Eun and Shim (1989), Hamao, Masulis, and Ng (1990), Karolyi and Stulz (1996), King and Wadhwani (1990), and Lin, Engle, and Ito (1994).
[3] See the Investment Company Act of 1940 Rule 2a-4 (definition of "current net asset value") and Rule 22c-1 (pricing of redeemable securities for distribution, redemption, and repurchase).

Stock." We match these fund returns with daily close-to-close returns for the S&P 500. We ignore fund distributions (typically occurring only annually or semiannually) in our sample, which biases downward (by 1% to 4% annually) our return estimates.

Panel A of Table 1 reports a 13.3% average annual return to a buy-and-hold investor (ignoring distributions) across these international open-end mutual funds from 1993 through 1997, compared with the S&P 500's 18.4% return. For each fund, we calculate the return to a market timer using the daily timing strategy based on the S&P 500 signal. This averages slightly over 34% per year across the international funds. These results are consistent with the expected returns in CEK, Goetzmann, Ivkovich, and Rouwenhorst (2001), and Bhargava and Dubofsky (1999). We also calculate the success rate by determining the percentage of days that the market timer is correct (i.e., invested in the fund on up days and in cash on down days). Across these funds, the average success rate is 63%. A buy-and-hold investor in the market index has a success rate of about 52%, as this investor is correct on all "up" days and incorrect on all "down" days. Though the strategy requires daily decisions, a market timer using international funds spends an average of 2.12 days holding a position (cash or the fund). Panel B shows that the abnormal return (alpha) of the market timer is significantly positive. The market timing success rate of this strategy is substantially positive in a quadratic model specification. Consistent with the fact that the market timer spends nearly half the time holding a cash position, the market index exposure (beta risk) of the timing strategy is about half that of the buy-and-hold investor. These results are comparable to the simulation results in Greene and Hodges (2000) in which a market timer with a 65% success rate earns an expected return of 34.16% per year and beats the buy-and-hold investor in the market index nearly 98% of the years. Their results indicate that the time-series standard deviation of annual returns at this success rate is 12.34%. Overall, this trading strategy yields expected returns substantially higher than the market's with slightly lower risk.

2.3. iShares versus international mutual funds

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[4]These quotes are from a speech by Barry Barbash given on December 4, 1997 at the 1997 ICI Securities Law Procedures Conference.

We might expect the iShares to be better signals of the mispricing of international mutual fund shares compared with the S&P 500 since they potentially reflect up-to-the-minute values of international market baskets during U.S. trading hours. To examine this possibility, we construct an iShares signal for trading open-end funds in the following manner. We form region portfolios of iShares using weights based on MSCI (Morgan Stanley Capital International) market capitalizations. Using the Morningstar-reported portfolio composition weights by country or region (e.g., Japan, Europe, etc.), we obtain a signal for each fund. Though we do not claim to optimize the iShares signal, this procedure should conceptually yield a high-quality iShares signal since it takes into account portfolio-specific information. Panel C reports the trading strategy returns using either an iShares signal or the S&P 500 signal over the same sample period. The S&P 500 signal appears to yield a higher return. These results suggest that iShares prices might not be completely marked to market vis-à-vis the U.S. markets, perhaps due to the relatively infrequent trading of these instruments.[5]

In summary, stale prices in open-end international mutual funds give rise to a market timing trading strategy using the S&P 500 return as a signal. To the extent that this strategy is feasible and can be followed nearly costlessly, traders would find this strategy profitable. We examine below whether traders do follow this strategy and, if so, what impact their trades have on passive shareholders in these funds.

3. Daily mutual fund flows

3.1. Sample description

TrimTabs, Inc. provided mutual fund data for a period beginning February 2, 1998 and ending March 31, 2000. A description of TrimTabs, Inc. can be found in Edelen and Warner (2001), who associate daily aggregate mutual fund flows with overall market returns. We have daily observations of per share net asset value (p_t), total net assets (a_t), and a distribution indicator for all funds covered by TrimTabs, Inc. We put the data through rigorous screens for errors. Since the focus in this paper centers

[5] In examining trading volume for iShares (not reported in the tables), we find slightly higher afternoon trading volume on S&P 500 signal days than on other days. We find these results interesting but puzzling since it is difficult to discern whether the increased trading could be profit-motivated from a stale-price iShares strategy or hedging-motivated from arbitrage strategies using iShares are to hedge the purchases of open-end mutual funds.

on the interaction of returns and fund flows, we want to minimize the potential for errors in the total assets, fund flows, and NAV series. We search for extreme observations in each series. When the NAV appears to be the source of the extreme observation, the NAV is hand-checked against alternative sources. Those that can be corrected and verified are kept, while remaining suspicious observations, such as apparent keying errors, are discarded. In total, less than 0.30% of our sample observations are discarded.

We match the TrimTabs data with fund description data from Morningstar, including the prospectus objective of each fund. From the prospectus objective, we categorize funds to fit four style categories: bond, growth, stock, and international. We intend these style categories to proxy for the potential profitability of stale-price trading strategies as described by CEK, where profits might be expected in international and growth categories more so than in stock and bond categories. Any fund listing a bond objective is classified as a bond fund. Any fund with an objective of emerging markets, Europe, foreign, Pacific, or world stock is classified as an international fund. Domestic growth and aggressive growth funds are classified as growth funds, while the remaining domestic equity funds are classified as stock funds. The weightings across prospectus objectives between our sample and the Morningstar universe are quite similar. Across all categories, our sample funds represent approximately 20% (in number and asset size) of the universe of U.S.-based mutual funds. We have conducted our analysis with alternative classifications of these objectives with no meaningful change in our results. We exclude 47 funds in eight "specialty" categories and 12 funds in the "asset allocation" category, as they do not readily fit into any of our other groups, have little in common, and represent a small subset of assets.

Funds for which we do not have at least 100 days of data or do not have matching Morningstar data are discarded. We also remove funds that average less than $10 million per day in net assets. This results in a sample of 433,670 daily observations from 833 mutual funds. Counted among these 833 "funds" are multiple classes of the same fund (e.g., Class A or B shares). Since there is no a priori reason to assume that the flow to one class would be the same as that to another class of the same fund, we do not aggregate classes into one fund. For example, the distinguishing feature of one class versus the other of the same fund can be a front-end load or exchange privilege. This could influence the daily flow characteristics across different classes of the same fund. We have conducted our analysis using funds aggregated across classes and find no meaningful difference in the results.

Table 2 reports descriptive statistics for our sample of funds. The average (median) size of the funds in our sample is $954 million ($402 million). Growth funds are significantly larger than the other fund types, with an average (median) of about $1.7 billion ($648 million) in net assets. Domestic stock and bond funds have average (median) net assets of $973 million ($552 million) and $539 million ($303 million), respectively. International funds have average (median) net assets of $688 million ($163 million). Since a few funds enter our sample after the start of our sample period and some exit before the end of our sample period, we annualize each fund's return, assuming daily compounding, for comparability. The average stock fund over the 26-month period has a 14.97% annualized return compared with a 20.5% annualized return for the S&P 500 index over the same period. Bond and growth funds have average annualized returns of –2.51% and 33.70%, respectively, while international funds average a 26.44% annualized return.

3.2. Daily fund flows

From the changes in NAV and total net assets, TrimTabs computes a mutual fund's net fund flow (purchases less sales of fund shares) on date *t* as

$$c_t = a_t - a_{t-1}\frac{p_t}{p_{t-1}}. \tag{1}$$

This calculation accurately yields date *t* fund flows as long as the total net asset numbers are *post-flow* (i.e., they reflect date *t* flow). We compare TrimTabs data with GAAP-conforming balance sheets filed with the SEC, since GAAP requires total net assets to be reported *post-flow*. In most cases, TrimTabs receives *pre-flow* daily net asset numbers from the mutual fund companies (i.e., they do not account for the current day's flow). In these cases, flow attributed to date *t* actually occurs on date *t*-1. Appendix A discusses more thoroughly the methodology we employ to determine whether flow for a particular fund is timely or is lagged by one day. For those funds that we infer report flow with a lag, we adjust the date on the flow by one day. This adjustment is at the heart of the conflict between our results and those of

Goetzmann, Ivkovic and Rouwenhorst (2000). Also, an adjustment should be made for distributions, such as dividends, income, or capital gains. However, TrimTabs advises that mutual funds do not handle distributions in a uniform manner. Therefore, we discard any observations on distribution dates, mostly occurring in December. TrimTabs suggests using caution with December data due to the high frequency of distributions in this month and the possible resulting errors. We have checked our results by removing December data from the sample with no meaningful change.

Fund flow statistics appear in Table 3. Panel A reports the cross-sectional distribution of average daily flow as a percentage of the fund's assets. Both stock and international funds have a daily net flow statistically reliably different from zero at –0.02%, which implies an annual flow of approximately –5%. In Panel B, we report the average daily flow magnitude, which gives an indication of the daily net trading activity of mutual fund shares. The magnitude of daily net fund flows averages 0.43% of fund assets across all sample funds. Bond funds experience the lowest average amount of fund exchanges at 0.31% of assets. Stock and growth funds have daily fund flows of 0.34% and 0.45%, respectively. The magnitude of fund flows is significantly higher across international funds, averaging 0.91% of assets. With 250 trading days per year, this implies that the average international fund experiences an annual turnover of about 225% of its assets, compared with an average of less than 100% for the other equity fund categories.

Large or frequent net fund flows could be consistent with large numbers of either liquidity traders with correlated demands or active market timers. Therefore, we examine further evidence to determine if the large flows in international funds, in particular, appear to be the result of successful market timers. First, we establish that the funds in our sample would be good candidates for the stale-price market timing strategy using international funds. Panel A of Table 4 shows the average correlation between the S&P 500 return and the following day's mutual fund return for our sample. International funds have a significantly higher average correlation of 0.3492 compared with 0.1000 across all other categories.

To be successful, the daily order flow for a mutual fund must, on average, result in profits to the traders as evidenced by daily net fund flows that predict the following day's fund return. We examine this in two ways. First, we consider whether the direction of a mutual fund's flow is correlated with the direction of the next day's fund return. If net fund flow is positive, we assign the flow direction variable the value one. If flow is negative, we assign a zero to the flow direction variable. We classify the direction of the following day's return similarly. Panel B of Table 4 reports the correlation between the direction of net fund flows with the direction of the following day's fund return to be a statistically significant 0.0689 for international funds and 0.0150 for bond funds. This correlation is slightly positive but statistically indistinguishable from zero for the other fund styles.

Second, we examine the correlation between daily percentage fund flows and the following day's fund return. It could be that successful trading is more pronounced on days prior to larger moves in prices. We expect this if some traders find it costly to trade or are restricted to trading only infrequently, as suggested in Bhargava, Bose, and Dubofsky (1998). Panel C of Table 4 shows that the cross-sectional average of this correlation is negative for all fund styles except for international funds, which average a correlation of 0.0512 (significant at the 0.01 level). These results suggest that daily fund flows in international funds exhibit good market timing ability. The negative correlations in domestic funds are consistent with the results in Edelen and Warner (2001), where aggregate fund flows exert price pressure on the day they occur followed by price reversals the next day.

The correlations reveal the ex post profitability of daily fund flows in international mutual funds. However, we still must establish that the fund flows are ex ante profitable to argue that the flows are the result of rational traders following a market timing strategy. As noted earlier, we do not claim to be detecting the optimal timing strategy with respect to international funds. We are simply seeking evidence of fund flows that are consistent with what historical data suggest to be a profitable trading rule. If flows in international funds follow daily market timing signals from movements in the U.S. market, we should find a high correlation between international fund flows and the S&P 500 index return. Panel D of Table 4 shows that international fund flows have a correlation of 0.1729 with the same day's S&P 500 return. Growth and stock funds have a correlation of 0.1193 and 0.0446 (both significant), respectively. These correlations are consistent with Edelen and Warner (2001) and Goetzmann and Massa (1999), who find evidence that domestic equity fund flows are associated with concurrent movements in the U.S. market. Bond funds have a significant negative correlation of 0.0146. The international fund flow's correlation is significantly higher than any other style's correlation. Of the international funds, 83% have a positive correlation between fund flows and the same day's S&P 500 return.

Overall, these results differ markedly from those reported in Goetzmann, Ivkovic, and Rouwenhorst (2001), who also examine the stale-price market timing rule and offer policy solutions. They find little evidence of a correlation between international fund flows and subsequent international fund returns and conclude that traders do not appear to exploit this simple, feasible, and profitable trading rule. Though their sample originates from the same source as ours, they do not make the adjustment to properly align fund flows in time. Appendix A argues why we maintain the accuracy of our results against theirs. Moreover, anecdotal evidence from the popular press and the mutual funds themselves suggest that the mutual fund industry observes the same patterns in the data that we estimate in our sample. Fidelity Funds claims to dedicate significant resources to detecting and restricting accounts engaged in active trading of international funds (*New York Times*, April 9, 2000, Section 3, p. 17).

3.3. International fund flows, trading strategies, and international fund returns

The evidence we have presented thus far is consistent with two explanations: 1) U.S.-based international mutual fund flows cause movements in the underlying markets; or 2) international mutual fund flows exploit the correlation between the U.S. and international markets by trading stale-priced mutual funds. Though we believe no direct methodology exists for disentangling these two explanations, this section reports evidence consistent with the latter explanation by examining fund flows and their relation to trading signals, liquidity shocks, and market moves.

We estimate whether international fund flows appear motivated by the S&P 500 trading signal by including the signal as an independent variable in a regression of international fund flows. We assign the "trading signal" variable, $signal_t$, a value of "+1" (move into international funds) when the S&P 500 return is positive on a day that follows a negative return. The signal is "-1" (move out of international funds) when the S&P 500 return is negative on a day that follows a positive return. On days when the S&P 500 return has the same sign as the previous day, the signal is "0" (no trade). Since the flows on day t, f_t, are measured in terms of the proportion of fund assets, the coefficient on the trading signal variable is an estimate of the proportion of international fund dollars that follow this signal. If international fund flows are liquidity motivated and uncorrelated with this signal, then we will fail to find significance of this variable. We also include fund flows into domestic stock funds, $USFlow_t$, in the regression as an instrument to control for systematic liquidity shocks and possible momentum investing by U.S. investors. We estimate the international fund flows model,

$$f_t = b_0 + b_1 signal_t + b_2 USFlow_t + h_t \,. \qquad (2)$$

The regression results in Table 5 indicate that approximately 0.40% of the assets per day in international mutual funds follow the S&P 500 "trading signal." The coefficient on the trading signal remains significant and close to the same point estimate after controlling for the significant effect of aggregate flows into U.S. equity mutual funds. We have performed this analysis using alternative models of international fund flows, including models that control for the magnitude of S&P 500 returns and others using U.S. fund flows that are orthogonal to S&P 500 returns. We have also performed the analysis on a disaggregated basis, using individual international mutual fund flows. In all cases, the results remain qualitatively the same. As an additional check, we perform the same analysis using domestic stock fund flows. In this case, the coefficient on the trading signal variable is insignificant when considered alone and significantly negative when considered in the model with the S&P 500 returns.

Our results indicate that a significant proportion (approximately 45%) of international fund flows are consistent with profit-seeking traders. However, we have not ruled out the possibility that these traders' flows are self-fulfilling prophecies. That is, fund flows in international funds could be causing the subsequent returns to the fund's assets that trade in the international markets. To distinguish between these two alternative explanations, we estimate a simple model of international fund returns.

Let r_{t+1} denote international mutual fund returns on day t+1 and S_t be the day t return on the S&P 500 index. Taking $\overline{F}_t$ as the day t average percentage international mutual fund flow that is orthogonal to the day t S&P 500 return, we estimate the model

$$r_{t+1} = l_0 + l_1 S_t + l_2 \overline{F}_t + e_t . \tag{3}$$

If fund flows into international funds today cause positive returns in the international markets (i.e., the international funds) tomorrow, then the coefficient on the orthogonalized flow should be significant. Alternatively, if the returns in today's U.S. market are the primary driving force behind tomorrow's international markets (funds), then only the coefficient on the S&P 500 returns will be significant. The regression results in Table 6 indicate no significance on the orthogonalized international fund flows, consistent with the conclusion that fund flows add no information to or influence on the following day's international market moves beyond that contained in the S&P 500 returns. As a robustness check, we also conduct the Davidson and MacKinnon (1981) *J* test to distinguish between the two competing hypotheses of international market returns. We find that U.S. market returns alone account for movements in international fund returns.

In summary, we find evidence of large daily net fund flows that are correlated with the subsequent day's mutual fund returns only for international funds. These flows are consistent with the behavior of active mutual fund traders who take advantage of stale prices in international mutual funds. The evidence is inconsistent with alternative explanations that international fund flows are liquidity-motivated or that these flows give rise to international market returns.

4. The dilution impact of daily fund flows

This section develops a methodology to measure the impact of daily fund flows on mutual funds' NAV returns. Specifically, we motivate a measure of the dilution impact which results from short-lived shifts in a fund's cash position that dilute the returns to the fund's risky assets.

4.1. Estimating dilution from daily fund flows

Consider an open-end mutual fund with assets of a_{t-1} at the beginning of this period (i.e., the end of last period). Suppose that over the next period these assets generate a rate of return of r_t. If there are no flows of cash into or out of the fund, then the return on the fund's NAV over the next period is

$$r_t = \frac{a_t}{a_{t-1}} - 1 = \frac{a_{t-1}(1+r_t)}{a_{t-1}} - 1. \tag{4}$$

Now consider a fund flow of c_{t-1} that is marked to the fund's account at the end of last period. If we assume that the fund manager does not invest the cash in risky assets for at least one period, then the mutual fund's NAV return in the presence of cash flows is

$$\hat{r}_t = \frac{a_{t-1}(1+r_t) + c_{t-1}}{a_{t-1} + c_{t-1}} - 1. \tag{5}$$

This is simply the return to the fund's assets in place prior to the fund flow, averaged with the zero return on the new cash. Since the shares represented by the new cash share in the return from the assets in place, we must use the new cash in the denominator. This new cash eventually is invested to capture the risky assets' returns. Under the assumption that cash is invested costlessly after a one-period lag, no further consideration of the interaction of returns and time *t*-1 cash flow is required.[6] We calculate the impact of the *t*-1 fund flows on the fund's time *t* return to be the difference between the with-flow and the without-flow returns. Subtracting Eq. (5) Eq. (4), the dilution impact is

$$d_{t-1} = \hat{r}_t - r_t = -1 \times \frac{c_{t-1}}{a_{t-1}} \times \hat{r}_t. \tag{6}$$

The impact of fund flows is the negative of the (signed) percentage fund flow multiplied by the following period's realized fund return. Simply put, this measures the extent to which the return to the assets in place is diluted by new cash. Note that the dilution effect is related to the covariance of fund flows with subsequent periods' returns. Indeed, if either the expected flow or the expected return is zero,

[6] We have derived the dilution impact when cash is invested after multiple-day lags. We estimate this impact for two- and four-day lags and find our results (assuming a one-day lag) to be somewhat conservative, but overall quite similar. These results are available upon request.

then the dilution effect is simply the negative of the covariance of the two. Therefore, the dilution effect could be positive or negative, primarily depending on the sign of the covariance. Cash flows that exhibit good market timing would have a positive covariance with subsequent returns, hence a negative impact from the dilution of positive returns. Conversely, flows that exhibit bad market timing would have a negative covariance and a positive impact on a fund's reported returns.

The dilution effect could be zero if the fund manager could trade the fund's underlying assets at the prices used when calculating the fund's NAV. Edelen and Warner (2001) report that fund managers typically do not receive a report of the day's fund flows until mid-morning the next trading day, which would make a zero lag unlikely. Since it is virtually impossible for international fund managers to trade their funds' underlying assets at the same values used in calculating their funds' NAV, it is reasonable to assume that international fund managers react to fund flows with at least a one-day lag.

Throughout this discussion we have focused on market timers making *daily* decisions. This need not be the case for us to focus on daily fund flows. That is, multiple traders could be following longer-horizon strategies that result in relatively infrequent trading. However, if their trading strategies have idiosyncratic components, then the fund manager observes daily net fund flows that are indistinguishable from those of a single trader following a *daily* strategy.

For each fund in our sample, we calculate the daily dilution impact of fund flows given by Eq. (6). We then calculate dilution's total impact on each fund by compounding the daily dilution impact over the 26-month sample period. To express the impact more transparently than reporting a 26-month impact, we calculate the *annualized* impact for a fund by scaling its total impact based on a 250-trading-day year. If fund flows are uncorrelated with the fund's next-day return, we expect the average impact to be zero. We conduct this two-sided hypothesis test with each style of fund. We also conduct a nonparametric test of whether a significant majority (different from 50%) of the funds show an impact.

4.2. Dilution estimates

Panel A of Table 7 shows the average annualized dilution impact of daily fund flows on open-end mutual funds. Over our sample period of February 2, 1998 through March 31, 2000, the average annualized impact is -0.06% across all funds. This estimate is statistically different from zero at the 0.01 level. However, of the 833 mutual funds, 49% (statistically insignificantly different from 50%) have a positive impact. When examining the subsamples based on the mutual fund style, a clearer picture emerges. For bond funds, growth funds, and stock funds, the average and median dilution impact from fund flows is essentially zero, and slightly more than half of the sample funds have a positive impact estimate.

For international funds, we find significantly different results. The cross-sectional average (median) annualized dilution impact in international funds is -0.48% (-0.11%).[7] Only 29% of the 109 international funds have a positive impact. All of these results are statistically significant at the 0.01 level. This evidence suggests that market timers' fund flows adversely impact the passive investors in the international funds in our sample. For each fund, we calculate the dollar impact by multiplying the percentage impact for a fund by the fund's assets. For the international funds in our sample only, these results imply a total transfer of wealth from the passive fund shareholders to the market timers exceeding $420 million for the 26 months of our sample.

We next allow the data to tell us which funds are amenable to frequent exchanges. We presume that those funds in the upper 50% of fund flow activity within each style category are those for which more frequent fund exchanges are possible. Panel B of Table 7 examines the average impact conditional on the level of fund flows. Bond funds with within-style below-median average daily fund flows show no impact, while growth funds and stock funds have average impacts of *positive* seven and four basis points, respectively. While Eq. (5) shows that, all things equal, the larger the percentage flow, the larger the impact, the positive impact here on low-flow funds demonstrates the importance of considering the interaction (i.e., correlation) of flows and the following period's returns. Nearly 60% of the growth and stock funds have a positive impact, while 51% of the bond funds have a positive impact for low levels of

[7] When using only the 69 international funds that we unambiguously classify as "pre-flow" or "post-flow" (see Appendix A), we estimate an average annualized dilution impact of –0.57%.

fund flow activity. Below-median average daily flow level international funds have a statistically insignificant average impact of positive one basis point.

For the funds with high levels of fund flow activity, the annualized impact is statistically insignificant for bond, growth, and stock funds. However, high-flow international funds have an average (median) annualized dilution effect of –0.94% (-0.65%). Only 16% of these funds have a positive impact from fund flows. So, for those international funds that facilitate frequent trading, the impact of fund flows appears statistically and economically significant. A test of the average difference of the annualized impact between the two fund flow levels is statistically significant for growth and international funds.

4.3. Feasibility, exchange restrictions, and portfolio composition

Heretofore we have taken an ex post approach to the feasibility of profiting from stale-priced international funds. That is, we have assumed that the strategy is feasible in those funds in which we observe high fund flows. Ex ante, we would expect high fund flow levels and significant dilution only in funds with permissive exchange policies. Similarly, we would expect the magnitude of the dilution impact to vary by the potential "staleness" of the fund's NAV.

Some fund families state that they allow only a limited number of exchanges per year, while others put no limit on the number of exchanges. Virtually all fund families that we are aware of "reserve the right to limit exchanges," especially if they suspect market timing activity. Enforcement of limited exchange policies varies widely. We contacted over 30 fund families in late 1999. Approximately one-third of those with whom we spoke stated either that there are no restrictions on exchanges or that the restrictions are limits in print, but only sporadically enforced. Some funds, for example, state that they restrict large accounts or exchanges of $1 million or more, but do not monitor smaller accounts systematically. We justify our implicit a priori assumption that daily trading is feasible based on several observations. First, most 401k and 403b plan contracts have unlimited exchange features. Second, fund supermarkets allow traders to jump from one fund family to another, effectively bypassing fund families' restrictions. Finally, fund supermarkets and some 401k plans batch or net account trades into one "order" that is passed on to the fund family, which makes impossible the fund family's detection of individuals' trades. Though not systematic proof of the feasibility of frequent mutual fund exchanges, we are aware of traders who have successfully engaged in a daily mutual fund trading strategy in a number of mutual fund families for over three years.

To examine these issues, we partition the international fund sample according to stated exchange restrictions and portfolio composition. For the exchange restrictions, we search each fund's prospectus for stated exchange restrictions (e.g., "exchanges limited to four per year"), market timing language (e.g., "do not allow market timing"), exchange fees (e.g., "0.25% per exchange" or "$10 per exchange"), minimum holding periods (e.g., "may not exchange within seven days of last exchange"), and loads (e.g., front-end or deferred load). As noted earlier, any *stated* exchange policy can vary from the *effective* policy based on the level of monitoring or enforcement. Therefore, we expect the more operational restrictions, such as exchange fees and minimum holding periods, to have a larger impact on exchanges than the other policies, such as timing language and stated exchange restrictions. Table 8 shows the level of fund flows and the dilution impact for the sample funds partitioned by exchange restrictions. Only the "minimum holding period" results in significantly lower fund flows and less (in magnitude) dilution. While "exchange fees" show little effect on flows, we have little power to detect an effect in this case. Seven of the 17 "exchange fee" funds initiate fees during our sample period. We have found (but do not report in the table) a significant decrease in fund flows and dilution when funds initiate redemption fees. Interestingly, front-end load funds have significantly *higher* daily fund flows and more dilution. Our results suggest that market timers are more concentrated in front-end load funds compared with no-load or deferred load funds. The convention with front-end loads is that an investor is charged the load when entering the fund family. In nearly all cases, investors can exchange into and out of the funds within the same family without paying an additional load fee. Furthermore, most funds waive the load if investors return to the fund family within 90 days of a redemption.

The level of fund flows and the magnitude of the dilution impact also vary by the attractiveness of the fund for stale-price market timing purposes. Asian funds appear to offer the most potential for stale prices compared with European funds, since Asian markets are closed prior to the open of trading in the

U.S. Similarly, funds with significant North American (e.g., U.S. or Canada) holdings, which we classify as "world" funds, should be less attractive to strategic traders. Finally, funds concentrating in emerging markets are least attractive to market timers since these funds tend to concentrate their holdings in Latin America. Table 8 shows that both fund flows and dilution are largest in Asian funds, with European funds, world funds, and emerging market funds having significantly lower average dilution and flows.

4.4. Portfolio performance and dilution

Daily fund flows offer precise information regarding the trading decisions of investors, including those of profit-seeking traders exploiting stale prices. Using these daily flows and the returns they capture, our dilution impact measure directly estimates the effect of fund flows on returns. To reinforce this claim, we estimate whether our dilution measure can explain variation in monthly fund returns. We augment the market model with a quadratic term to capture any manager-related market timing skill, and a coefficient on our dilution measure. This results in the following time-series regression for monthly fund returns:

$$r_t = b_0 + b_1 r_{m,t} + b_2 r_{m,t}^2 + b_3 d_t + e_t \,, \tag{7}$$

where $r_{m,t}$ is the return on a market index and d_t is the dilution measure for a fund in month t. Recall that $d_t < 0$ indicates that flows dilute returns. Therefore, a positive coefficient on the dilution measure would be consistent with our measure capturing the negative impact of dilutive flows on fund returns. For this analysis we aggregate all classes of each fund, since fund returns are most likely determined at the fund level rather than the class level.

Table 9 reports the cross-sectional distribution of the regression parameter estimates for both the full sample and the international funds. The coefficient on the dilution measure is positive on average. For international funds, the average coefficient estimate is statistically significant. Though we cannot reject that it is equal to one, we note that a point estimate greater than one could indicate that dilutive flows impose other costs on the fund, such as increased expenses or transaction costs, as in Edelen (1999).

Whether the dilution impact explains the cross-sectional distribution of common portfolio performance measures is an open question. As Edelen discusses, the mutual fund manager could appear to be a poor market timer as a result of the dilution effect if investors with good timing performance trade mutual fund shares. He finds evidence consistent with this possibility by showing that market model estimates are significantly affected by the inclusion of fund flows in the model. Similarly, this effect could be consistent with evidence presented in Ferson and Schadt (1996) and Ferson and Warther (1996) that fund flows could be correlated with time-varying returns, leading to the apparent poor market timing performance of mutual fund managers.

A thorough analysis of how dilutive fund flows affect the measurement of portfolio performance is beyond the scope of this paper. However, our results suggest that the dilution effect is potentially an important consideration in estimating portfolio performance. Given that fund flows in some funds are correlated with subsequent market returns, the flows' impact on performance measures is uncertain, as discussed in Dybvig and Ross (1985) and Lehman and Modest (1987). If dilutive fund flows cause a fund's cash holdings to vary with risky asset returns, then this could manifest itself in the fund's measured market timing performance, index sensitivity, or abnormal return, or some combination thereof.

5. Conclusions

We demonstrate empirically that a simple international fund trading rule based on one highly observable variable, daily S&P 500 returns, generates expected annualized returns of approximately 30% due to mutual funds' use of stale prices. We find patterns in daily fund flows consistent with traders who strategically exchange into and out of international funds to take advantage of short-term market returns that follow U.S. market movements. The gains to these traders, who induce well-timed fund flows in international funds, dilute the returns of the nontrading, or passive, shareholders. For international mutual funds exhibiting the highest level of fund flows, we estimate a –0.94% average annualized dilution impact on returns. For the 109 international funds in our full sample, representing approximately 20% of all international open-end mutual funds, we estimate an actual net transfer of wealth from passive investors to market timers in excess of $420 million over a 26-month period.

Chalmers, Edelen, and Kadlec (2001) suggest that profit opportunities exist in domestic equity funds. We find little evidence of daily fund flows consistent with profitable trading in domestic funds and find no significant average dilution impact. One explanation of our results is that investors who "play" the wildcard option game by taking advantage of stale prices in mutual funds optimize their returns, given their limited capital. Since the most profitable opportunities exist in international funds, this is where these traders currently focus their efforts. If the opportunities in international funds dissipate (e.g., through enforcement of exchange restrictions), then these traders might focus their attention on domestic funds.

Collectively, this paper and the studies of Edelen (1999) and Brown, Goetzmann, Hiraki, Otsuki, and Shiraishi (1999) suggest that the design of open-end mutual funds is an important consideration in the study of performance and manager skill. Recently, many fund companies have revised their exchange policies to address the attempts of "market timers" to exploit stale prices (see, for example, TIAA-CREF's *Participant* magazine, November 1999, pp. 2-3; and *Business Week*, September 6, 1999, p. 74). For example, some fund companies have begun restricting fund exchanges to a few per month and/or are initiating "fair value" pricing on days of extremely high volatility. While these policies would appear to diminish the opportunities for any given market timer to trade daily, they do not eliminate the dilution impact. Specifically, if traders still find a strategy profitable, within the constraint of trading infrequently, then funds still could be faced with exchanges that dilute their returns. We leave for future research an analysis of the conditions under which a measurable impact is possible.

Though the returns earned by the strategic traders in this paper appear anomalous, one way in which these results can be viewed as consistent with an efficient market is that fund companies are free to set and enforce their exchange policies. Meanwhile, investors are free to self-select into funds that meet their preferences regarding fund exchange privileges. Our results suggest that the passive investor is better off in the same fund absent well-timed fund flows. However, passive investors might choose a fund in which there is a large dilution impact from fund flows if that fund's manager can compensate for the negative impact with positive abnormal returns from selection or timing skill. Overall, our analysis suggests further consideration of mutual fund policies that allow dilutive trading and their consequent impact on investor welfare.

Appendix A: Timing of Fund Flows in TrimTabs, Inc. Data

Suppose a mutual fund begins day 1 with net assets of a_0, which originate from the end of the previous day. These assets begin day 1 valued at day 0's end-of-day price per share, p_0. As the day progresses, the mutual fund receives orders to exchange fund shares (purchases and/or sales). These orders are held to be transacted after calculating the end-of-day price for the fund's assets. At the end of day 1, the fund updates the value of its net assets to $\hat{a}_1$, reflecting the day's change in the underlying assets' prices, but not the day's flow. Using $\hat{a}_1$ and pre-flow shares outstanding, the fund calculates the per share net asset value (NAV), p_1. The fund then executes the exchange orders, f_1, at NAV, resulting in the fund's post-flow assets, $a_1 = \hat{a}_1 + f_1$. Thus, the fund begins day 2 with net assets of a_1. TrimTabs receives reports of the previous day's end-of-day net assets from mutual fund companies. The key question is whether funds report $\hat{a}_1$ or a_1 to TrimTabs.

A reliable source with which we can check the net assets in the TrimTabs data are the N-SAR and N-30D reports that mutual funds file semiannually with the SEC. These SEC-filed documents must be in accordance with GAAP, which require that the financial statements reflect *post-flow* (a_1) net assets (see *Audits of Investment Companies*, 1998, Chapter 3, § 3.13 – 3.24). Other sources of mutual fund net asset numbers, such as the CRSP mutual fund database and Morningstar reports, are also available. However, it is possible that CRSP and Morningstar rely on net asset numbers self-reported by mutual funds in a similar manner as TrimTabs. Therefore, if funds are consistent in their self-reporting to vendors, TrimTabs data can be misclassified as post-flow (pre-flow) if a false assumption is made that CRSP or Morningstar is post-flow (pre-flow) when checked against these alternative sources. For example, Goetzmann, Ivkovic, and Rouwenhorst (2000) check TrimTabs net asset numbers against CRSP and find that virtually all observations between the two sources are the same. Since they have assumed that CRSP data are post-flow, they classify their sample as post-flow. Since the SEC filings must conform to GAAP by reporting post-flow data, they are a reliable and independent starting point against which to check the TrimTabs data in this matter.

Since N-SARs are machine-readable, we start with them for all of the funds in our sample during our sample period. The N-SARs have the drawback that they do not always break down the net asset numbers by class within a fund. Therefore, we are not able to match all funds in our sample with N-SAR data, since we treat different classes of the same fund as separate funds. For these funds, we also search for N-30D data. Since N-SARs and N-30Ds are filed semiannually, we potentially have up to five observations per fund in our 26-month sample window. We match the N-SAR and N-30D data with our TrimTabs data using the fund name and date, matching N-SARs dated on weekends with the prior Friday. Taking the N-SAR date as date *t*, and the TrimTabs asset number on that date as x_t, we calculate $\hat{x}_t = x_{t+1}\frac{p_t}{p_{t+1}}$. We attempt to determine whether x_t or $\hat{x}_t$ matches the N-SAR and N-30D post-flow net assets. For these two net assets, we take the absolute percentage error from the N-SAR (or N-30D) net assets. If the x_t has a lower absolute percentage error then we categorize the observation as *post-flow*. If $\hat{x}_t$ has a lower absolute percentage error then we categorize the observation as *pre-flow*. We require that the absolute percentage error of the "matched" asset number (x_t or $\hat{x}_t$) be within a tolerance of 2%. Otherwise, we categorize the observation as *no match*. Additionally, in cases where x_t is exactly the same as $\hat{x}_t$, we categorize the observation as a *draw*.

The goal is to categorize each *fund* in our sample as *pre-flow* or *post-flow*. Once we have done this, we can calculate the daily flow for our sample funds and be confident of the timing of these calculations. For the funds in our sample with which we can match N-SAR or N-30D data, Panel A of Table A1 breaks down how the observations are categorized. Across our sample of 833 funds, we have 1,649 observations. We have multiple observations for many funds in our sample and no observations for some funds in our sample, since some N-SAR's and N-30D's do not break out assets across classes of funds. Therefore, we take the following approach to categorize a fund in our sample as *pre-flow* or *post-flow*. We discard the *no match* and *draw* observations, since they offer us no reliable information toward our goal. This leaves us with no reliable observations for 99 funds, one observation per fund for 234 funds, two observations for 227 funds, and at least three observations for the remaining 273 funds. Funds for which all observations for that fund are "pre-flow" ("post-flow") are categorized as *pre-flow* (*post-flow*) funds. This "unanimous rule" categorizes 488 of our 833 funds (331 as *pre-flow* and the remaining 157 as *post-flow*). Other than the 234 funds for which there is only one observation, 130 funds are classified under the "unanimous rule" based on two observations, while the remaining 124 funds are classified using three or four observations. The "unanimous rule" classification uses multiple observations for 64% of the international funds, compared with 50% of the other fund types.

In some cases, the N-SAR and N-30D data reveal that a fund has *pre-flow* data using one date's observation, but *post-flow* data using another date's observation. For these funds, we use "majority rules" – classifying the funds depending on the majority of observations. This classifies an additional 133 funds (87 as *pre-flow*). Remaining are 212 funds for which we could not find matching N-SAR or N-30D data, or for which we could find no non-"draw" observations that match either pre- or post-flow assets within our tolerance constraint. In some cases, these are different classes of funds that we have already classified. Therefore, we next rely on the classification of the other classes of the same fund to classify 26 more funds (20 as *pre-flow*). For funds unclassified thus far, we rely on each fund family's majority to classify 124 as *pre-flow* and 47 as *post-flow*. In the remaining 15 unclassified funds, we assign them as *pre-flow*, since the strong majority of funds in the overall sample are found to be *pre-flow*. Panel B of Table A1 summarizes these results.

As mentioned in the text, TrimTabs calculates the flow on day t as $f_t = x_t - x_{t-1} \times {p_t}/{p_{t-1}}$. Since this is only accurate for *post-flow* funds, we must adjust the *pre-flow* funds' flow. We do this by noting that the fund flow calculated by TrimTabs for *pre-flow* funds on date t+1 is actually date t flow, inflated by the fund's return on date t+1. In our analysis, we assign the deflated flow from date t+1 to date t for the *pre-flow* funds and leave the *post-flow* funds' flow unadjusted.

For robustness checks, we conduct all of the analysis in this paper using only the 488 funds for which we have unanimous observations as *pre-* or *post-flow* and a subsample of these funds for which we have multiple observations. The results of the paper are unaffected. Indeed, the dilution effect for the full sample of international funds that we report in the paper is a bit conservative compared with a dilution effect for the "unanimous" sample (–0.48% and –0.57%, respectively). We note here that the proportion of *pre-flow* funds outweighs the proportion of *post-flow* funds by two to one and is relatively constant across all fund categories (bond, growth, stock, and international). Finally, there appears to be no time trend with respect to matching TrimTabs' asset numbers as pre- or post-flow asset numbers.

Our results differ from the inferences made by Goetzmann, Ivkovic, and Rouwenhorst (2001) (GIR), who use the monthly observations in the CRSP mutual fund database to check the net asset numbers of TrimTabs during the 1998 and 1999 sample periods. Conclusions drawn by matching against the CRSP database are questionable. In fact, TrimTabs reported to us that, in TrimTabs' own "audit" of one mutual fund family that has over 20 funds in our sample across all categories (four international), they found (as did we) that this fund family systematically reported pre-flow assets to them. In contrast, GIR report that the CRSP data classifies only three funds in their entire sample as pre-flow. Since GIR report that virtually all of their TrimTabs observations match with the CRSP data, we infer that the CRSP data also reflect (daily) pre-flow assets. In spot-checks of several funds in our sample that we classify as "pre-flow" we find that the 1998 and 1999 CRSP and Morningstar databases match each other and match TrimTabs, but that the observations do not match the GAAP-conforming financial statements. In all cases with these funds, the one-day adjustment to the TrimTabs data results in a match with the GAAP-conforming financial statements, reinforcing our confidence in our pre-flow classifications. Finally, we note that we would not tend to classify funds as pre-flow erroneously if the financial statement (SEC) data are pre-flow. In this case, the more likely bias would be to classify funds as post-flow. On the other hand, if the TrimTabs, CRSP, and SEC data are all post-flow, it is very unlikely that our methodology would spuriously classify the majority of our sample funds as pre-flow.

Table A1

Classification of TrimTabs funds as reporting *pre-flow* or *post-flow* net assets

We match TrimTabs' reported net assets with the net assets reported in N-SAR and N-30D filings with the SEC. Panel A reports the how we classify observations. When pre-flow and post-flow assets are the same in TrimTabs, we classify the observation as a draw. We classify observations where neither pre-flow nor post-flow assets match the N-SAR or N-30D with a 2% tolerance. Panel B reports how a fund is classified. We use a unanimous rule first where all observations of a fund are pre- or post-flow. Non-classified funds are then classified by a majority of observations within the fund, within other classes of the same fund, using other funds in the same family, and the full-sample majority.

Panel A: Classification of observations from N-SAR and N-30D data

Classification	Number	% of sample	Pre-flow abs % error	Post-flow abs % error
Draw	35	2.1%	-	-
No match (outside tolerance)	87	5.3%	-	-
Pre-flow	963	58.4%	0.05%	0.47%
Post-flow	564	34.2%	0.43%	0.08%

Panel B: Classification of funds

Method of Classification	*pre-flow*	*pre-flow* total	*post-flow*	*post-flow* total	total classified
Unanimous within fund	331	331	157	157	488
Majority within fund	87	418	46	203	621
From other classes of fund	20	438	6	209	647
From fund family	124	562	47	256	818
From full sample	15	577	0	256	833

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Table 1
Descriptive Statistics for Daily Market Timing Strategies

Panel A shows the returns to buy-and-hold international mutual fund investors versus market timers following a trading rule of exchanging cash for international fund shares when the day's S&P 500 index return is positive and exchanging international fund shares for cash when the day's S&P 500 index return is negative. The panel also presents the cross-sectional distribution of the market timing success rate and the market timer's position length calculated as the number days holding a position in the risky or risk-free asset. Panel B presents performance measures for international fund buy-and-hold versus market timing investors using a market model (and a quadratic form to capture market timing ability). The sample includes 84 international mutual funds for which daily NAV data are available for the period January 2, 1993 through December 31, 1997. The market timer's rule of switching from the risk-free asset to an international mutual fund based the daily return of the S&P 500 index required 595 trades.

Panel C shows the returns to buy-and-hold iShares (formerly known as WEBS) investors versus market timers following the S&P 500 trading rule. Panel D reports international fund market timing returns using a trading signal based on either the S&P 500 return or the iShares return. The sample includes 16 iShares securities and 84 international mutual funds for which daily price quotes are available for the period April 1, 1996 through December 31, 1997.

Panel A: Mutual fund stale-price trading strategy, using S&P 500 signal

	Buy-and-hold fund returns	Market timing strategy returns	Market timing success rate	Strategy position length
Mean	13.33%	34.24%	0.6333	2.12
Std. dev.	3.80	4.24	0.0139	1.43
Maximum	23.10	43.58	0.6609	12.00
75%	15.49	37.56	0.6410	3.00
Median	13.22	34.00	0.6359	2.00
25%	11.14	31.02	0.6260	1.00
Minimum	4.60	25.33	0.5911	1.00
N	84	84	84	595

Panel B: Average regression parameter estimates (*t*-statistics) using daily returns (*N*=84)

Dependent variable	Intercept	R_M	R_M^2	R^2
Buy-and hold fund returns	0.0003*	0.7040**	-	0.6251
	(1.92)	(36.63)		
	0.0004**	0.7014**	-3.5662**	0.6302
	(2.85)	(36.69)	(-2.80)	
Market timing strategy returns	0.0013**	0.3282**	-	0.3110
	(9.60)	(16.99)		
	0.0007**	0.3364**	11.32**	0.4123
	(5.65)	(19.17)	(10.65)	

Panel C: International mutual fund market timing, using S&P 500 versus iShares trading signal

	Using S&P 500 signal		Using iShares signal	
	Trading strategy returns	Trading success rate	Trading strategy returns	Trading success rate
Mean	41.26%	0.6576	29.65%	0.6143
Std. dev.	7.00	0.0173	7.82	0.0294
Maximum	61.18	0.6982	56.14	0.6892
75%	45.82	0.6689	34.55	0.6329
Median	41.80	0.6577	27.09	0.6149
25%	36.44	0.6475	24.93	0.5901
Minimum	22.77	0.6126	10.93	0.5428
N	84	84	84	84

* and ** indicate significant difference from zero at the 5% and 1% levels, respectively.

Table 2
Cross-sectional Distribution of Total Assets and Annualized Returns

Cross-sectional distribution of average daily total assets of each sample mutual fund from February 2, 1998 through March 31, 2000. The sample includes 833 mutual funds followed by TrimTabs, Inc. whose objective is categorized as bond fund, growth fund, stock fund, or international fund. Assets are reported in millions of dollars.

Panel A: Average daily assets

	Full Sample	Bond	Growth	Stock	International
Mean	954.09	538.89	1,705.57	973.13	687.81
Std. dev.	2,147.29	696.80	3,660.76	1,232.07	2,088.74
Median	402.38	303.24	648.71	552.48	162.65
Category Assets	788,187	156,589	356,459	206,583	68,556
Category Funds (N)	833	309	204	211	109

Panel B: Annualized returns

	Full Sample	Bond	Growth	Stock	International
Mean	14.57%**	-2.51%**	33.70%**	14.97%**	26.44%**
Std. dev.	24.37%	7.79%	29.97%	17.52%	21.19%
Median	7.24%	-3.02%	30.23%	11.44%	23.59%
N	833	309	204	211	109
%Positive	61.7%††	4.7%††	95.1%††	83.4%††	97.2%††

** indicates significant difference from zero at the 1% level.
†† indicates significant difference from 50% at the 1% level.

Table 3
Average Daily Percentage Fund Flows

Cross-sectional distribution of daily fund flows for a sample of open-end mutual funds from February 2, 1998 through March 31, 2000. The sample includes mutual funds followed by TrimTabs, Inc. whose objective is categorized as a bond fund, growth stock fund, international fund, or stock fund. Fund flows are expressed as a percentage of fund assets. Panel A reflects average daily fund flows, where daily net outflows are negative and daily net inflows are positive. Panel B reflects only the magnitude (i.e., absolute value) of daily fund flows.

Panel A: Average daily fund flows

	Full Sample	Bond	Growth	Stock	International
Mean	-0.01%	-0.01 %	0.01%	-0.02%*	-0.02%**
Std. dev.	0.11%	0.08%	0.13%	0.13%	0.10%
75%	0.04%	0.03%	0.06%	0.04%	0.03%
Median	-0.01%	-0.01%	-0.01%	-0.02%	-0.02%
25%	-0.06%	-0.05%	-0.04%	-0.08%	-0.07%
N	833	309	204	211	109
%Positive	42.3%†	42.1%	47.5%	39.3%††	38.5%††

Panel B: Average absolute value of daily net fund flows

	Full Sample	Bond	Growth	Stock	International
Mean	0.43%	0.31%	0.45%	0.34%	0.91%
Std. dev.	0.57%	0.28%	0.71%	0.30%	0.91%
75%	0.48%	0.38%	0.50%	0.37%	1.20%
Median	0.28%	0.24%	0.32%	0.26%	0.56%
25%	0.18%	0.16%	0.20%	0.17%	0.33%
N	833	309	204	211	109

Difference-in-means test *t*-statistic

	Growth	Stock	International
Bond	2.67**	0.89	6.79**
Growth		-2.16*	4.58**
Stock			6.45**

* and ** indicate significant difference from zero at the 5% and 1% levels, respectively.
† and †† indicate significant difference from 50% at the 5% and 1% levels, respectively.

Table 4
Correlations among Key Variables

Cross-sectional distribution of correlations among key variables for a sample of open-end mutual funds from February 2, 1998 through March 31, 2000. The sample includes mutual funds followed by TrimTabs, Inc. whose objective is categorized as a bond fund, growth stock fund, international fund, or stock fund.

Panel A: Fund returns on day *t*+1 with the S&P 500 return on day *t*

	Full Sample	Bond	Growth	Stock	International
Mean	0.1141**	0.0882**	0.0885**	0.0553**	0.3492**
Std Dev	0.1256	0.0940	0.0712	0.0854	0.0836
%Positive	85.7%††	86.3%††	90.7%††	68.2%††	100.0%††
N	833	309	204	211	109

Difference-in-means test *t*-statistic

	Growth	Stock	International
Bond	0.04	-4.15**	27.10**
Growth		4.31**	27.64**
Stock			29.59**

Panel B: Direction of fund flows on day *t* with the direction of fund return on day *t*+1

	Full Sample	Bond	Growth	Stock	International
Mean	0.0192**	0.0150**	0.0106	0.0080	0.0689**
Std Dev	0.0824	0.0986	0.0608	0.0636	0.0830
%Positive	62.8%††	60.8%†	59.3%†	57.3%	85.3%††
N	833	309	204	211	109

Difference-in-means test *t*-statistic

	Growth	Stock	International
Bond	-0.62	-0.99	5.54**
Growth		0.43	6.46**
Stock			7.29**

Panel C: Signed fund flows on day *t* with the fund return on day *t*+1

	Full Sample	Bond	Growth	Stock	International
Mean	-0.0048	-0.0105	-0.0160*	-0.0148**	0.0512**
Std Dev	0.1056	0.1199	0.1015	0.0778	0.1009
%Positive	49.5%	49.2%	44.6%	43.6%†	70.6%††
N	833	309	204	211	109

Difference-in-means *t*-statistic

	Growth	Stock	International
Bond	0.55	-0.49	5.22**
Growth		-0.13	5.60**
Stock			5.97**

Panel D: Signed fund flows on day *t* with the S&P 500 return on day *t*

	Full Sample	Bond	Growth	Stock	International
Mean	0.0577**	-0.0146**	0.1193**	0.0446**	0.1729**
Std Dev	0.1435	0.0871	0.1503	0.1061	0.1920
%Positive	64.8%††	45.3%†	83.3%††	66.4%††	82.6%††
N	833	309	204	211	109

Difference-in-means test *t*-statistic		Growth	Stock	International
	Bond	11.51**	6.71**	9.85**
	Growth		-5.83**	2.53*
	Stock			6.48**

* and ** indicate significant difference from zero at the 5% and 1% levels, respectively.
† and †† indicate significant difference from 50% at the 5% and 1% levels, respectively.

Table 5
International Fund Flows and Trading Signals

This table reports parameter estimates (with *t*-statistics in parentheses) of the proportion of assets, as measured in daily aggregate international fund flows, f_t, that follow a trading signal, $signal_t$, based on the direction of day *t* returns on the S&P 500 index. To proxy for liquidity or momentum-based flows, we also include the aggregate flows to U.S. stock funds, $USFlow_t$. We estimate alternate forms of the regression model

$$f_t = b_0 + b_1 signal_t + b_2 USFlow_t + h_t .$$

	b_0	b_1	b_2	N	R^2
Without U.S. stock fund flows	-0.0001	0.0044**		534	0.233
	(-0.66)	(12.72)			
With U.S. stock fund flows	0.0003	0.0041**	2.0305**	534	0.385
	(0.98)	(13.31)	(11.57)		

** indicates significant difference from zero at the 1% level.

Table 6
International Mutual Fund Returns

This table reports coefficient estimates (with *t*-statistics in parentheses) of two alternative explanations of daily international mutual fund returns, r_{t+1}. The estimated model is

$$r_{t+1} = l_0 + l_1 S_t + l_2 \overline{F}_t + e_t,$$

where $\overline{F}_t$ is the day *t* average percentage international mutual fund flow that is orthogonal to the day *t* S&P 500 return, S_t. Under the explanation that U.S. market moves lead to international market returns, the parameter estimate on the S&P 500 return should be significant. Alternatively, if flows of money into international funds cause the international market returns, then the parameter estimate on the fund flows should be significant.

l_0	l_1	l_2	N	R^2
0.0003 (0.59)	0.3089** (6.28)	0.0034 (0.03)	534	0.164

** indicates significant difference from zero at the 1% level.

Table 7
The Dilution Impact of Fund Flows on Mutual Fund Returns

Cross-sectional distribution of annualized percentage impact due to the dilution effect of daily fund flows for open-end mutual funds from February 2, 1998 through March 31, 2000. The sample includes mutual funds followed by TrimTabs, Inc. whose objective is categorized as a bond fund, growth stock fund, international fund, or stock fund. The dilution effect is calculated assuming a one-day lag for investing new cash in risky assets. Panel A reports the unconditional results, while Panel B conditions on the median average daily flow level within each category.

Panel A: Full sample

	Full Sample	Bond	Growth	Stock	International
Mean	-0.06%**	0.01%	0.00%	0.01%	-0.48%**
Std. dev.	0.47%	0.16%	0.44%	0.23%	0.95%
75%	0.05%	0.02%	0.13%	0.08%	0.03%
Median	0.00%	0.00%	0.00%	0.01%	-0.11%
25%	-0.06%	-0.01%	-0.13%	-0.06%	-0.68%
N	833	309	204	211	109
%Positive	49.0%	51.1%	49.5%	55.5%	29.4%††

Difference-in-means test *t*-statistic		Growth	Stock	International
	Bond	0.18	0.30	-5.30**
	Growth		0.33	-4.98**
	Stock			-5.30**

Panel B: Conditional on the level of fund flows

	Bond	Growth	Stock	International
Below median flow				
Mean	0.01%	0.07%**	0.04%**	-0.01%
Std. dev.	0.04%	0.20%	0.14%	0.18%
Median	0.00%	0.02%	0.01%	-0.01%
N	154	102	105	54
%Positive	51.3%	56.9%	61.9%†	42.6%
Above median flow				
Mean	0.01%	-0.06%	-0.01%	-0.94%**
Std. dev.	0.23%	0.59%	0.30%	1.16%
Median	0.00%	-0.08%	-0.01%	-0.65%
N	155	102	106	55
%Positive	51.0%	42.2%	49.1%	16.4%††
Difference-in-means *t*-statistic	-0.25	2.16*	1.63	5.86**

* and ** indicate significant difference from zero at the 5% and 1% levels, respectively.
†† indicates significant difference from 50% at the 1% level.

Table 8
Fund Flows and Dilution Impact Conditional on Trading Restrictions and Portfolio Composition For International Mutual Funds

Daily fund flow and annualized dilution impact statistics are reported for subsamples partioned by exchange restrictions and portfolio composition. Classifications "with exchange restrictions" and "with timing language" are assigned if the prospectus states explicit limits on exchanges per year or mentions restrictions on market timing, respectively. Funds that charge redemption or trading fees for exchanges are classified as "with exchange fee" and funds that prohibit trading within a specified number of days upon entering a fund are classified as "with minimum holding period." Funds that have front-end loads are labeled "with front-end load." Funds with either a front-end or a deferred load are classified as "with front-end or deferred load." We also report the *t*-statistic on the test of the null hypothesis that the means between the two subsamples are the same. "Asian funds" and "European funds" hold primarily stocks that trade in Asian markets or European markets, respectively. "Emerging markets funds" hold stocks that trade predominantly in Latin American and other emerging markets. "World funds" have holdings across diverse regions of the world, possibly including significant holdings in the U.S. or Canada.

	Daily Fund Flows		Annualized Dilution Impact		
	Mean	St. Dev.	Mean	St. Dev.	*N*
With exchange restrictions	0.89%	0.98%	-0.47%	0.98%	50
Without exchange restrictions	0.93%	0.85%	-0.48%	0.93%	59
t-test of equality of means	-0.22		0.03		
With timing language	0.87%	0.88%	-0.49%	0.99%	68
Without timing language	0.98%	0.97%	-0.46%	0.91%	41
t-test of equality of means	-0.57		-0.15		
With exchange fee	0.95%	0.97%	-0.55%	1.50%	17
Without exchange fee	0.91%	0.90%	-0.46%	0.82%	92
t-test of equality of means	0.16		-0.23		
With minimum holding period	0.49%	0.38%	-0.09%	0.50%	15
Without minimum holding period	0.98%	0.95%	-0.54%	0.99%	94
t-test of equality of means	-3.54**		2.75%**		
With front-end load	1.54%	1.14%	-0.94%	1.02%	30
Without front-end load	0.67%	0.67%	-0.30%	0.87%	79
t-test of equality of means	3.93**		-3.02**		
With front-end or deferred load	0.99%	1.00%	-0.49%	0.86%	61
No-load	0.82%	0.78%	-0.47%	1.07%	48
t-test of equality of means	0.99		-0.17		
Asian funds	1.69%	1.19%	-1.64%	1.66%	14
European funds	1.06%	0.99%	-0.53%	0.84%	36
World funds	0.68%	0.68%	-0.19%	0.50%	48
Emerging markets funds	0.48%	1.61%	-0.08%	0.36%	11
F-test of equality of means	6.55**		11.85**		

** indicates significant difference from zero at the 1% level.

Table 9
Portfolio Performance and the Dilution Impact

This table reports the cross-sectional distribution of coefficient estimates of a market model of monthly fund returns with the addition of a component due to the dilution impact. For each fund we calculate the monthly dilution impact due to daily fund flows, d_t, and the monthly return, r_t. We specify the market model using the CRSP value-weighted index return for domestic funds and the MSCI World Index return for international funds. Coefficient estimates are obtained for each fund using an estimation period of March 1998 through March 2000 for the model

$$r_t = b_0 + b_1 r_{m,t} + b_2 r_{m,t}^2 + b_3 d_t + e_t .$$

The 833 (109) full sample (international) funds are aggregated so that there are not multiple classes of funds. This results in a sample of 705 (83) funds in the full (international) sample. The table reports the model specified both with and without the market-timing coefficient.

Coefficient on	b_0	b_1	b_2	b_3	R^2	N
Full Sample						
Mean	-0.0013	0.69**		1.32	0.54	705
St. Dev.	0.0093	0.51		45.23	0.36	
%Positive	50.5%	79.1%††		55.0%††		
Mean	0.0001	0.67**	-0.44**	2.39	0.55	705
St. Dev.	0.0098	0.49	2.15	41.45	0.36	
%Positive	48.4%	84.0%††	47.5%	55.9%††		
International funds						
Mean	0.0015	1.10**		2.89*	0.65	83
St. Dev.	0.0130	0.28		14.02	0.19	
%Positive	62.7%†	100.0%††		71.1%††		
Mean	0.0073**	1.04 **	-1.98 **	2.79*	0.67	83
St. Dev.	0.0122	0.28	3.89	13.45	0.19	
%Positive	78.3%††	100.0%††	10.8%††	73.5%††		

* and ** indicate significant difference from zero at the 5% and 1% levels, respectively.
† and †† indicate significant difference from 50% at the 5% and 1% levels, respectively.