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Day Trading International Mutual Funds: Evidence And Policy Solutions

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Abstract

Daily pricing of mutual funds provides liquidity to investors but is subject to valuation errors due to the inability to observe synchronous, fair security prices at the end of the trading day. This may hurt fund investors if speculators strategically seek to exploit mispricing or if the net flow of money into funds is correlated with these pricing errors. We show that mutual funds are exposed to speculative traders by using a simple day trading rule that yields large profits in a sample of 391 U.S.-based open-end international mutual funds. We propose a simple "fair pricing" mechanism that alleviates these concerns by correcting net asset values for stale prices. We argue that fund companies and regulators should look at alternatives that allow funds to offer fair pricing to investors, which in turn decreases the need to resort to monitoring for day traders and redemption penalties.

I. Introduction

The development of the open-end U.S. mutual fund industry over the past fifty years has yielded enormous benefits to small investors. The goals of the 1940 Investment Companies Act have largely been achieved. Small investors have access to honest, professional management at reasonable fees. Funds have a clear governance structure, regulated disclosure, and restrictions on activities that create the potential for conflicts of interest. Among other features, the open-end mutual fund structure provides daily liquidity to investors, enabling them to convert a portfolio of stocks or bonds to cash through the re-sale of shares to the mutual fund company. This liquidity is made possible by the requirement that mutual funds calculate their net asset value (NAV) daily. To do this, funds typically use closing transactions prices to calculate security values. For active, liquid securities whose last trade occurs near the end of the U.S. trading day this rule works well, but the globalization of the mutual fund industry has made daily NAV calculations challenging. Not all markets are as liquid as the U.S. stock market, nor do their trading hours coincide with those of the markets in the U.S.

In particular, time-zone differences create a special dilemma for U.S. mutual funds that invest in foreign securities. Consider a U.S. mutual fund that invests in Japanese equities, most of which are not cross-listed in the U.S. Suppose the fund wants to determine the NAV in dollars (U.S.D) of its shares as of 4 PM Eastern Standard Time (EST) to settle the buy and sell orders it receives during the day.[1] Which prices should the fund use to compute the value of its Japanese holdings? One option is to take the Yen closing prices from the Tokyo Stock Exchange (TSE) and use the Yen/U.S.D exchange rate that prevails at 4 PM EST to compute the dollar value of the portfolio. The TSE closes at 1 AM EST, about nine hours before the opening New York Stock Exchange (NYSE). Therefore, this pricing rule effectively allows U.S. investors to purchase or sell shares in the fund during NYSE trading hours at prices determined at least fifteen hours earlier. This leaves the funds and their long-term shareholders exposed to speculative trading. For example, suppose favorable information about Japanese share prices were released after the close of the TSE but before the NYSE close. Investors could trade on that information at "stale" prices by buying shares in a U.S. mutual fund that invests in Japan, in

[1] Among other reasons, 4 PM EST is desirable because it allows fund companies to transfer investor wealth among its funds on the same day.

anticipation that on the following day the information will be reflected in price adjustments on the Tokyo exchange, and hence on the NAV of the fund shares.

We are not the only researchers to point out the problem posed by the use of stale prices to compute NAVs. Neumark, Tinsley, and Tosini (1991) show that the opportunity for speculative profits in international mutual funds is not as much of an informational efficiency problem as it is an institutional efficiency problem. Contemporaneous research by Chalmers, Edelen, and Kadlec (1999), Greene and Hodges (2000), and Zitzewitz (2000) investigates the potential profitability of trading on stale prices using both international and small-cap funds. Using various performance measures, all three papers show that day trading in mutual funds using current information has the potential to generate profits. Chalmers, Edelen, and Kadlec (1999) and Greene and Hodges (2000) also present evidence from fund flows to suggest speculative day trading may be a problem for some funds. Chance and Hemler (1999) demonstrate the profitability of day trading in mutual funds using a different data set – daily returns to a number of self-reported timers who either manage accounts or make trading recommendations to clients. An important issue in the above studies of timing profits from day trading mutual funds is the issue of decomposing strategy profitability into gains due to stale prices and gains due to true market predictability. Most of Chance and Hemler's sample is comprised of managers who focus on funds rather than indices, however, and at least part of the profits due to timing in their sample may be due to factors other than stale prices.

Our paper differs from other work on the stale pricing problem in two ways. First, we focus on the econometric methods to differentiate stale pricing profits from profits due to true index predictability. This is important because the success of simple trading rules that condition portfolio weights on contemporaneous information does not mean that profits can be solely attributed to stale prices. Solutions to the stale pricing problem should therefore not be designed to stem legitimate profitable active strategies.

Second, we address the fundamental policy issue confronting mutual fund managers and regulators – how can stale price trading profits be curtailed without imposing costs on long and short-term investors alike? While it is tempting to regard stale pricing as simply a performance problem for fund companies or a profit opportunity for day traders, the issues it embodies are first and foremost those of fairness to investors. Regardless of whether fund investors on average are harmed by the use of stale pricing, or whether the exploitation of stale pricing by investors is

intentional or not, the need for accurate daily and intra-day settlement prices will continue to increase as web-based trading increases. Futures exchanges and closed-end fund companies compete actively with open-end fund companies in the market for index products. A question confronting the mutual fund industry is whether it will remain feasible to offer products based on periodically estimated NAVs in a market in which active traders continually seek opportunities to arbitrage stale price discrepancies. The mechanisms developed in this paper allow us to address both issues.

In our analysis we use a database of daily returns to 391 U.S.-based international open-end equity funds over the period from 1990 to 1998 to examine the potential profitability of a day trading strategy. The strategy is a simple one – it uses the S&P 500 as an indicator of whether to invest in the fund on any given day. We find that day trading – in the absence of loads, early redemption fees, and other transactions costs – is highly profitable on average, and strongly outperforms a buy-and-hold strategy in the funds. Our results thus indicate that almost all international funds are vulnerable to stale pricing. Load fees or short-term redemption fees may attenuate the profitability of this trading rule for an individual fund timer. Yet these fees are unable to resolve the problems induced by stale prices at the fund level if the aggregate net flows into the fund are correlated with the speculative strategy. As long as funds charge the wrong price at the gate, it is possible for timers to benefit at the expense of the existing shareholders.

We also investigate whether net fund flows show timing ability at the individual fund level. To address this problem, we obtain seventeen months of daily net fund flow information for 116 international funds from TrimTabs. Our tests suggest that daily speculation or investor-induced correlation between net flows and returns has been relatively modest for the average fund. This is in part because of the low correlation between returns and net flows, but also because net flows are small relative to the size of most funds. Nevertheless, we estimate the total transfer of wealth between buyers and sellers of mutual fund shares induced by stale prices at about $1.5 billion during our sample period.

An important issue is how the industry can reduce these pricing errors without introducing other costs and constraints on investors. Redemption fees and loads may stem daily speculative exploitation, but they are not popular with customers. The existence of various fees, restrictions, monitoring of activity, and charges represent unwanted constraints to long-term and short-term investors alike, yet they cannot resolve the stale pricing problem imposed by

potentially correlated net flows. Thus, a mechanism that results in fair pricing without such frictions would be desirable. We propose an econometric method that can be used to adjust stale prices in such as way as to make them orthogonal to later daily public information. This method can be used by custodians to check the quality of the daily prices from vendors and by mutual fund pricing committees to adjust daily NAVs. The procedure we develop has the potential to eliminate – at least in expectation – the speculative gains to short-term trading and economic loss to shareholders that result from stale pricing. The adjustment increases the volatility of the fund very slightly, but it leaves the mean return virtually unchanged.

The paper is organized as follows. Section II discusses the institutional background on NAV pricing. Section III discusses predictability and pricing errors. Section IV illustrates a simple stale-price trading rule using a single fund as an example. Section V provides a thorough analysis of profitability of the rule using 391 international equity mutual funds, broken down by investment style (as defined by the funds' Morningstar Category). Section VI evaluates the transactions costs associated with day trading and the mechanisms funds have in place to discourage speculation on stale prices. Section VII documents the correlation between daily net fund flows and fund returns. Section VIII presents and tests the effects of our correction methodology that adjusts NAVs in order to preclude the profitability of strategic day trading. Section IX addresses the issue of welfare effects of day trading international funds. The final section concludes.

II. NAV Pricing

According to the Investment Company Act of 1940, NAV calculations for open-end mutual funds are based on current market values "for securities with respect to which market quotations are readily available," and "on fair value as determined in good faith by the board of directors" (Invest Company Act, 1940, Section 270.2a-4). Notice that these alternative methods may lead to different values. Funds are thus not required always to use the last reported transaction prices for the computation of NAVs. "Fair value pricing" is an alternative, presumably to be used if the board of directors of the fund determines that market quotations do not accurately reflect value-relevant information. In order to make such adjustments, the boards of directors of funds typically have a pricing committee to evaluate the validity of prices and to make adjustments in the event of a dramatic price drop. For example, Fidelity decided to use fair

values to price some of its Pacific Asian funds on October 28, 1997, when the Hong Kong market dropped fourteen percent but rebounded during the U.S. trading day.[2] While a fair value mechanism exists for extraordinary events such as the Asian currency crisis, its use is an exception rather than a rule. It is rarely used on days of normal market volatility, nor it is clear that it could be, given the language of the Investment Company Act (1940) quoted above. The central issue is the practice of daily NAV pricing for open-end mutual funds using information provided by another institution. The 1940 Investment Companies Act requires mutual fund companies to place their securities with custodians, who provide mutual fund companies with daily valuation of the securities in their portfolios.[3] Custodians, in turn, contract for pricing information with several firms.[4] These firms, in turn, may use sub-contractors with expertise in local markets for updating prices. Custodians face a number of problems beyond asynchronicity in time zones – illiquid or non-traded assets, lags and delayed approvals for purchases or sales by international investors, dual share classes, and poor price records, to name a few. However, the particular problems of stale pricing due to time-zone differences has been recognized by mutual fund companies for at least six years. In September of 1994, the trade periodical *Pensions and Investments* listed pricing adjusted to the client's own time zone as an important challenge to custodians (Giudice, 1994).

III. Predictability and Pricing Errors

Return predictability induced by stale prices is unique neither to international markets nor to mutual funds. What is unique is that – absent special restrictions – mutual funds offer investors an opportunity to trade at stale prices, while equity markets generally do not. For example, consider the Russell 2000 index. It tracks a portfolio of small stocks in the U.S., many of which are traded infrequently. Because the value of the index is calculated using the most recently available transaction prices, many of which are stale, the return on a portfolio of larger and more frequently traded stocks, such as the S&P 500, tends to lead the return on the Russell 2000 (Lo and MacKinlay (1988)). When there are common factors in security returns, the computed return of a portfolio that quickly reflects the news about these common factors will

[2] At the end of the U.S. trading day the NAV of Fidelity's Hong Kong Fund increased by 2 cents to $10.88 despite the lower close of the market in Hong Kong (Wyatt, 1997).
[3] Chemical Bank, Bankers Trust Company, and State Street Corporation are some of the largest custodians serving the mutual fund industry.

tend to predict the computed return on a portfolio that is slow to incorporate this news. However, the predictability of the Russell 2000 return caused by stale prices does not provide a profitable trading opportunity in the component shares, because in an efficient market the relevant information will be quickly incorporated in the price of those securities the next time they trade. By contrast, using stale prices in the computation of mutual fund NAVs does create the potential for a profitable trading rule to investors if the funds use these NAVs to settle flows into and out of the fund, because this effectively allows investors to trade at stale prices.

Pricing errors affect not only those who trade fund shares but also the "long-term" shareholders who do not trade. Investors who do not trade are unaffected only on the days on which there are no *net* flows into the fund, in which case any gains to purchasers of fund shares are borne by those who sell their shares to the fund. However, long-term shareholders in the fund are affected when there are net flows. A negative pricing error creates a wealth transfer from the existing to the new shareholders if there are net inflows, and creates a benefit to the existing shareholders in the case of net outflows. Fund managers care about these transfers, because they affect the performance of the fund. Consider an international index fund that attempts to replicate the performance of its benchmark index with minimum trading costs. If the fund uses the wrong price to settle inflows and outflows, the fund performance will deviate from the benchmark index by the amount of the pricing error multiplied by the net flow. If investors strategically time their inflows and outflows because they understand the sign of the pricing error, or if net flows are negatively correlated with the pricing errors for other reasons, the fund will underperform its benchmark.

The magnitude of the pricing errors in the NAVs of international mutual funds induced by stale prices will depend on the amount of value-relevant information that is produced about foreign markets while they are closed. For example, French and Roll (1986) show that return variances in the U.S. are significantly higher during trading hours than during non-trading periods, which is consistent with a decline in information production during times when markets are closed. Yet, several researchers have shown that it is possible to learn significant information about the future returns of international markets every day through observation of the return to the U.S. stock market.

[4] The most commonly used services for international pricing are EXTEL, Reuters, and Telekurs.

Hilliard (1979) applies spectral analysis to the identification of contemporaneous and lagged relationships across international equity markets. While he finds no significant lagged inter-continental daily return effects he does find strong intra-continental connections. Other researchers have found evidence that the international capital markets transmit information rather efficiently around the globe. Eun and Shim (1989) study daily data from a number of exchanges around the world and find that shocks to U.S. equity markets are transmitted to other equity markets, but not vice-versa. Hamao, Masulis, and Ng (1990) use open-to-close and close-to-close data and find that both volatility and return innovation spill across markets. These lagged effects appear to be largely due to the informational efficiency of the U.S. market at incorporating information about shocks common to several markets. King and Wadwhani (1990) document strong informational spillovers between New York, Tokyo, and London around the crash of 1987. Neumark, Tinsley, and Tosini (1991) show that in the period following the crash of 1987 returns of NYSE shares that traded "after-hours" in London and Tokyo correlated to close-to-open returns on the NYSE. Craig, Dravid, and Richardson (1995) find that Japanese Nikkei index futures traded on the CME in the U.S. provide complete information about contemporaneous overnight Japanese index returns. Karolyi and Stulz (1996) use Japanese ADRs to explore whether the magnitude of the co-movement of Japanese stocks with the U.S. market can be explained via macro-economic factors. They find that the contemporaneous movement between U.S. stocks and Japanese stocks is strong, but not driven by macro-economic information. In summary, empirical work on international (intra) day return behavior suggests that foreign stocks respond contemporaneously or with a day lag to common news that affect U.S. stock prices. The extent to which U.S. mutual funds that invest internationally incorporate the information that becomes available during the U.S. trading day in their NAV calculations is an empirical matter. To assess the problems caused by stale pricing accurately, it is important to allow for the true predictability in foreign markets that would exist even if fund companies used current prices for NAV calculation.

IV. A Simple Example

XYZ Fund is a well-diversified global equity fund that invests in equity markets around the world, including the U.S. We have chosen not to identify it by name, although nothing about

its policy is unusual. At the end of 1998 the fund had over $2 billion in assets under management. A large component of the shares in which the fund invests trade only in their domestic markets that either close before or shortly after the start of the U.S. trading day. The first column of Table I summarizes the contemporaneous correlation between the total fund return and the return on the S&P 500. As expected, the XYZ Fund return is positively correlated with the same-day S&P 500 return (0.26). If we split the daily close-to-close S&P 500 return into the close-to-10 AM return and the 10 AM-to-close return an interesting pattern emerges. The XYZ Fund return is highly correlated with the previous close-to-10 AM return on the S&P 500 (0.42), during which time the international markets are open, but virtually uncorrelated with the 10 AM-to-close return (0.03), when many foreign markets are closed. A potential explanation for this difference is that during U.S. trading hours no information is produced that is value-relevant for international stocks. However, the second column of Table I, which gives the correlation between the S&P 500 return and the next-day fund return, shows that this is clearly not the case. First, the correlation between the S&P 500 return and next-day international fund return is 0.38. This is not only higher than the same-day correlation, but the next-day return is especially correlated with the current-day 10 AM-to-close S&P 500 return (0.34). This is inconsistent with the hypothesis that no value-relevant information is produced during the U.S. trading day, but is consistent with a situation in which the fund uses stale prices to compute its NAV. Apparently, the information produced during U.S. trading hours is reflected in the NAV on the next day. Each of the intra-day hourly S&P 500 returns is more correlated with the next-day fund return than with today's fund return. The current-day close–10 AM S&P 500 return is also positively correlated with the next-day international NAV return (0.17), which can be expected if the NAV calculation is based on closing prices from Asian markets, since the latter close well before 10 AM EST. The conclusion from Table I is that the daily NAVs values of the XYZ Fund are inefficient in that they do not incorporate much of the value-relevant information produced during U.S. trading hours. By allowing investors to trade at these inefficient prices the XYZ Fund opens itself up to speculative day traders who might attempt to take advantage of this situation.

A simple, yet very effective strategy could be based on the sign of the daily S&P 500 return: buy shares of the fund at the end of the days on which the S&P 500 is up and switch to cash at the end of the days on which the S&P 500 is down. A comparison between the

cumulative buy-and-hold return from a dollar invested in the XYZ Fund at the beginning of 1992 and the cumulative return from switching between the fund and cash based on the sign of the S&P 500 reveals that a dollar invested in the fund in August of 1992 would have grown to 2.47 in July of 1998, while a dollar invested the switching rule would have grown to $5.17. Moreover, a comparison of the risk of the two strategies shows that the higher return can be achieved with lower risk: the daily standard deviation of the buy-and-hold return is 0.605%, compared to 0.427% for the switching strategy. Because the switching strategy invests in the fund only on the days following an increase of the S&P 500, which occurs about one-half of the time, the variance of the strategy return is about one-half the variance of the buy-and-hold return, implying a ratio of standard deviations of about 0.7.

V. Empirical Evidence

A. Data Description

We obtain daily total returns for both active and defunct open-end mutual funds with certain Morningstar Categories in the period from 01/02/1990 to 07/24/1998 from Wall Street Web. The returns are not adjusted for sales charges (e.g., front-end charges, deferred fees, redemption fees), but are net of management fees, administrative fees, 12b-1 fees, and other costs that are automatically taken out of fund assets. In order to be included into our sample, each fund has to meet the following two criteria:

1. Fund returns should be available for at least 100 days (out of the 2165 trading dates) in the period from 01/02/1990-07/24/1998, and
2. The fund should belong to one of the following eight Morningstar Categories: Diversified Emerging Markets (DEM), Diversified Pacific/Asia Stock (DPA), Europe Stock (EU), Foreign Stock (FS), Japan Stock (JPN), Latin America Stock (LA), Pacific/Asia ex-Japan Stock (PXJ), and World Stock (WS).

The above criteria was met by 10 DEM funds, 34 DPA funds, 58 EU funds, 112 FS funds, 17 JPN funds, 31 LA funds, 65 PXJ funds, and 64 WS Funds. We use the total return for the Vanguard 500 Index Fund (ticker symbol VFINX) as our proxy for the S&P 500 return.

We also utilize the data on daily mutual fund net flows from TrimTabs for a sample of international funds during the period from 02/03/1998 to 06/20/1999. In addition to daily net flows, this database contains information on daily NAVs and total net assets (TNAs). We restrict

ourselves to 116 funds for which at least sixty days of flow data are available. Aside from limited coverage, the TrimTabs data seem to suffer from a variety of problems, including missing observations, interchanged digits, and what seem to be random jumps in the position of the decimal point. These problems are more frequent in the time series of net flows than in the time series of TNAs. For this reason, we discard the net flow series provided by TrimTabs and instead compute net flows on the basis of TNAs and NAVs. One particularly important data problem is that funds seem to vary in their reporting practices with respect to the TNAs – some funds tracked by TrimTabs seem to report their daily TNA *before* they process the purchase and sale orders submitted during the day, that is, since the last settlement.[5] This practice leads to inaccurate TNA figures, but does not invalidate the data. Rather, equipped with the awareness of a fund's practices, one can arrive at the exact net fund flow using the appropriate computation. We will revisit this issue in Section VII.

B. Summary Statistics

There are 391 funds in the final sample and their performance varies widely. Table II summarizes the daily performance of the "average fund" in each Morningstar Category. "Average fund" returns are computed by constructing an equally weighted (EW) portfolio of the available individual funds in each category. The table shows that the performance of EW portfolios reflects the performance of global markets in the first part of the 1990s. The S&P 500 has outperformed all broad international indices, and Europe and Latin America have fared better than the Pacific-Asia region, in part due to the poor performance of the Japanese market. For the purpose of this paper, the most interesting parts of Table II are its last columns. Column 4 gives the correlation between the S&P 500 return and the next-day returns on EW fund portfolios. The values range from 0.12 for Latin America to 0.41 and 0.42 for the World Stock and Foreign Stock funds, respectively. The lagged cross-correlation for Europe (0.36) is about the same as for the Pacific Asia funds, and is slightly higher than the Japanese Funds (0.25). For comparison, the autocorrelation of the S&P 500 is considerably smaller (0.04).

The last columns summarize the distribution of the correlation between the individual fund returns and the previous-day S&P 500 returns by category. The estimated lagged cross-

[5] We thank John Ameriks from TIAA-CREF for drawing our attention to this issue. It is also noted in Chalmers, Edelen, and Kadlec (1999), Edelen and Warner (1999), and Greene and Hodges (2000).

correlations are positive for all the 391 sample funds. For the Foreign Stock funds, the largest category with 112 funds, the cross-correlation with the next-day S&P 500 returns ranges from 0.20 to 0.50. The median correlation is above 0.30 in most categories, which suggests that the results for the XYZ Fund reported in Section IV are not unusual. In conclusion, the results suggest that most sample mutual funds – absent restrictions on trading and fees – are vulnerable to strategic day trading by market participants.

C. International Fund Returns Conditional on U.S. Market Movements

The positive correlation of international fund returns and prior-day S&P 500 index returns indicates that the S&P 500 can serve as an informative signal for investing in international funds. This is illustrated in Table III, which gives a breakdown of the average international fund returns by the S&P 500 return on the prior day. For each category, the EW portfolio returns are significantly negative on the days following a decline in the S&P 500 and significantly positive on the days following an increase in the S&P 500. With the exception of Latin American markets, which are open during much of the U.S. trading day, the difference exceeds 30 basis points per day. It is largest for the Pacific-ex-Japan and Diversified Pacific Asia categories (43 basis points). Volatility also tends to be slightly higher following a market decline in the U.S.

A simple trading strategy implied by these conditional averages is to invest in international funds at the end of the days on which the S&P 500 goes up, and avoid investing in international funds at the end of the days on which the S&P 500 declines. Shorting mutual funds is generally not possible, so in carrying out the analyses we assume that the position is held in cash following down days. As shown in Table III, the U.S. market is about equally likely to be up or down on a given day, which implies that the switching strategy would invest in international funds only about one-half of the time. Table IV summarizes the returns on this strategy applied to EW portfolios of international funds by category. The first three columns show that the strategy returns are positive and highly significant for all categories. The strategy returns are highest for European funds and lowest for funds that invest in Japan. Because the strategy only invests in the fund on about one-half of the days, the variance of the strategy returns is also only about one-half the variance of a buy-and-hold strategy, resulting in a 30% decline of strategy standard deviation relative to the respective category EW portfolio.

The category strategy returns reflect, in part, the average performance of the underlying markets. For example, the last row shows that the strategy applied to the S&P 500 itself yields positive average returns of 5.3 basis points per day, but this is almost entirely due to the performance of the U.S. market and not to the presence of positive autocorrelations. This can be seen from the next three columns, which compute for each category the strategy returns in excess of a buy-and-hold strategy. In terms of average returns, switching between the S&P 500 and cash does not pay, as the strategy underperforms the buy-and-hold strategy on average by 1.4 basis points per day. The reason is that, although the fund returns on average are positive on days following a decline in the S&P 500, any gains from exploiting the (small) positive autocorrelation are outweighed by the opportunity loss resulting from the cash position. By contrast, the excess strategy returns for the international funds are all significantly positive, and vary from 5.4 basis points (t=2.62) per day for Latin America to 10.8 basis points (t=8.24) per day for the funds that invest in Diversified Pacific Asia. Measured relative to a buy-and-hold strategy, these numbers translate to an excess return of the switching strategy of about 13.5 and 27 percent per annum, respectively. Except for the Latin American EW portfolio, which trades in the same time zone as the U.S. markets, the t-statistics for the equality of means of the strategy and buy-and-hold returns exceed 5 for all fund categories. These higher average returns occur despite the fact that the strategy returns invest in non-interest bearing cash about one-half of the days. As shown in Table III, the average returns of international funds for the days of a decline in the U.S. market are significantly negative, and a position in cash on such days dominates a position in the fund.

Figure I compares the cumulative wealth of a buy and hold investment in the average Foreign Stock fund to an investment in the switching strategy. A dollar invested in the buy and hold strategy doubles over the sample period, but the wealth of the switching strategy multiplies tenfold. Similar conclusion can be drawn for other categories as well.

The last columns of Table IV summarize the distribution of the strategy returns and the excess strategy returns relative to a buy-and-hold strategy for each category by fund. The raw strategy returns are positive for almost all funds. Except for a single European fund, all 391 excess strategy returns are also positive. The excess strategy returns are the highest for the Diversified Pacific Asia. Unreported results show that the median t-statistic of the mean excess strategy return exceeds two for every fund category.

The conclusion from Tables II, III, and IV is that the NAVs of most international mutual funds do not efficiently reflect information produced during U.S. trading hours. The market convention of using closing prices from foreign exchanges in NAV computation at the end of the U.S. trading day clearly induces substantial amount of predictability in fund returns.

VI. Transactions Costs and Barriers to Trade

What stops speculators from day trading on stale NAVs? First and foremost, fund fees. About 60% of the 1,796 U.S.-based international equity mutual funds currently listed in Morningstar's Principia have either a front-end or a back-end load, and in most cases the sum of the front- and the back-end load exceeds one percent. An early redemption fee is charged by 64 funds. The question of interest is whether the profitability of day trading based on the sign of the S&P 500 is limited to those funds that charge fees. If no-load funds are systematically different from the funds that do charge fees, perhaps by their deliberate and successful "fair pricing" efforts, the average strategy returns to no-load funds will be lower. We investigate this possibility by splitting our sample of mutual funds within each of the eight categories into no-load funds (i.e., funds that charge neither loads nor redemption fees) and funds that charge loads and/or redemption fees.[6]

Table V shows that the average returns of no-load and load funds are not statistically different. In addition, there are no statistically significant differences between the corresponding average strategy returns. Pooling all funds, the difference between the strategy returns of load and no-load funds is -0.3 basis points per day (t=-0.67). In sum, we do not find any statistical evidence to indicate that no-load mutual funds are less vulnerable to strategic exploitation than load funds.

Besides fees, a second impediment to taking advantage of stale NAVs is a common practice by funds to identify and exclude active traders. No-load and low-load funds are especially motivated to be vigorous in creating and maintaining safeguards against excessive switching of money in and out the fund via policies explicitly designed to discourage high-frequency market timing.[7] Also, funds can reject large purchases or revoke electronic exchange

[6] For 19 of the 391 funds we could not determine their load status, which reduces the number of funds used in this calculation to 372.

[7] For example, in their prospectuses several Vanguard funds caution timers by highlighting the following two sentences in red: "The Vanguard funds do not permit market-timing. Do not invest in this Fund if you are a market-

privileges if it regards them as disruptive to the fund's operation or performance management. The grounds for such a rejection could be either the timing of the investment or the investor's history of excessive trading. In addition, the proceeds from redemptions could be mailed to investors in the form of a check, which effectively delays the immediate availability of funds. Large redemptions can be delayed if they are disruptive to the operations of the fund, and can be met in kind, that is, by surrendering securities rather than cash. The array of weapons mutual funds have at their disposal thus appears capable of introducing barriers to daily speculation along two primary dimensions – increased cost of speculation and decreased liquidity of such investments.

Mutual fund "supermarkets," such as Schwab's OneSource Service, provide a special challenge to no-load mutual funds. These marketplaces bundle investments of multiple customers, which obscures the identity of potential day traders. While funds may ask Schwab to monitor market timing by its customers, it is not clear to which extent effective monitoring indeed takes place. Schwab charges a fee in case of short-term redemptions by its clients, but this fee has a stepwise structure and is capped to a maximum.[8] This implies that if day trading were performed on a sufficiently large scale, the round-trip costs could be driven down to several basis points.[9] This is a potential concern for many funds: out of 1,796 U.S.-based international mutual funds currently listed in the April 1999 Morningstar Principa, 714 funds do not charge front-end load, back-end load, or redemption fees.

To assess the potential vulnerability of such funds, we computed the average returns to the strategy performed on the respective EW portfolio for each category under a variety of

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timer." This warning is preceded by a plain-talk description of harmful effects of market-timing strategies. A Vanguard mutual fund prospectus typically contains the following explanation: "Some investors try to profit from a strategy called market-timing – switching money into investments when they expect prices to rise, and taking money out when they expect prices to fall. As money is shifted in and out, a fund incurs expenses for buying and selling securities. These costs are borne by all fund shareholders, including the long-term investors who do not generate the costs" (see, e.g., Vanguard International Value Fund Prospectus (1999), p. 3).

[8] For example, Schwab's Mutual Fund OneSource service, which presently includes over 1,000 no-load mutual funds, charges short-term redemption fees to customers who hold their investment for 180 days or less according to the following schedule: 0.75% of principal (or $39, whichever is greater); a maximum fee of $299 for trades placed through a registered representative; a maximum fee of $199 for trades placed through automated channels. For funds that do not participate in the service, Schwab charges their standard transactions fees (in addition to any redemption fees imposed by the fund): 0.7% of principal for transactions from $1,000 to $14,999; 0.7% on the first $15,000 and 0.2% on amount over $15,000, capped at $149, for transactions of $15,000 or more (Schwab, 1999).

[9] Specifically, round-trip costs of speculation through Schwab would be 20 basis points for an investment of $74,500 ($99,500) into a fund that participates in Schwab's Mutual Fund OneSource service (a no-load fund that does not charge redemption fees and is not a part of the OneSource service). Doubling the size of the investment to $149,000 ($199,000), of course, drives the round-trip costs to 10 basis points, etc.

assumptions about transactions costs. We find that transactions costs are ineffective at discouraging timing by large investors. Depending on the category, fees of 30-45 basis points per round trip are required for the average strategy returns to equal the returns of the underlying EW portfolios, which is well above the roundtrip transactions costs a marketplace like Schwab would charge on a $100,000 investment.

VII. Fund Returns and Net Flows

Transactions costs and monitoring may discourage day traders, but neither addresses the source of the stale pricing problem. The individual security values used in the NAV computation simply do not reflect available information. If net flows are correlated with the pricing errors, possibly even for reasons other than the deliberate actions of market timers, stale prices have a diluting effect on the existing shareholder value. As pointed out in Section V.A, the flow data from TrimTabs data suffer from a variety of problems, which appear to be more frequent in the time series of net flows than in the time series of TNAs. We thus computed net flows on the basis of TNAs and NAVs. A potentially important consideration is that funds seem to vary in their reporting practices with respect to the TNAs – some funds might report their daily TNA *before* they process the purchase and sale orders submitted during the day, that is, since the last settlement. This raises the concern that net flows may be computed incorrectly, and may in effect be lagged by a day. Specifically, on a given date *t* fund *i* might report its TNA either before net flows are added to it, denoted here as $TNA^{-}_{i,t}$, or after net flows are added to it, denoted simply as $TNA_{i,t}$. In our analyses we study the net relative flow (henceforth net flow), denoted as $flow_{i,t}$ into fund *i* on date *t*. We compute the net relative flow as $flow_{i,t} = NewMoney_{i,t} / TNA_{i,t-1}$, where $NewMoney_{i,t} = TNA_{i,t} - (1+R_{i,t})TNA_{i,t-1}$ is the net dollar flow of money into fund *i* on date *t*. Depending on the reporting practice of fund *i*, total net assets on date *t* in the above formulae should be either taken directly as $TNA_{i,t}$ (if the fund reported appropriately) or computed as the discounted value of tomorrow's "total net assets" $TNA^{-}_{i,t+1}$, that is, $TNA^{-}_{i,t+1}/(1+R_{i,t+1})$.

The method of computing total net assets may have considerable impact on the results.[10] It is therefore important to determine the reporting practices for each of the funds in our sample. To that end, we compared for each fund the data provided by TrimTabs, both the reported end-of-month total net assets and the modified end-of-month total assets (computed on the basis of the assumption that funds report $TNA_{i,t}^{-}$ instead), with the end-of-month total net assets reported in the 1998 CRSP Mutual Fund Data Base.[11] CRSP gets its data from Standard & Poor's Micropal, and is therefore an independent source of data. For most funds in our sample we found that there is a very close match between the two reported series; some funds exhibited a deviation in one or two observations (often in December), yet were matched precisely in all other months; only 3 funds appeared to follow the practice of reporting $TNA_{i,t}^{-}$. This is consistent with the findings of Edelen and Warner (2000) who conclude that the TrimTabs data seem generally timely. We could not classify a number of funds because they were added to the sample only in 1999.[12] In sum, 88 out of 116 funds in our sample appear to be reporting the appropriate total net assets, 3 funds seem to be reporting $TNA_{i,t}^{-}$, while the data for the remaining 25 funds were either too noisy to make a determination or were not available for 1998.[13] The results obtained under the

[10] The results presented in Table VI, computed under the assumption that TrimTabs reports the true total net asset values for all funds, differ from the results based on the assumption that TrimTabs reports the "pre-flow" total net assets for all funds. Differences are especially noticeable for the contemporaneous relationship between net flows and returns on the S&P 500. For example, the median contemporaneous correlation between net flows and returns on the S&P 500 increases for each of the eight Morningstar Categories by 0.126 or more if the "pre-flow" assumption is used for all the funds.

[11] Given the periods of coverage of the two sources of data, there were up to 11 points for comparisons per fund. Similarly to the methodology employed by Greene and Hodges (2000), we classified each point as either "post-flow" (indicating the practice of reporting $TNA_{i,t}$) or "pre-flow" (indicating the practice of reporting $TNA_{i,t}^{-}$), depending on the magnitudes of the absolute values of relative deviation of each TrimTabs-based total net asset values from the CRSP-reported total net assets. While for most funds for which there were sufficiently many valid data points to draw meaningful inferences there was a clear majority pattern indicating the likely reporting practice, a few funds featured only a slim majority in favor of the "post-flow" hypothesis – the numbers of likely "post-flow" and "pre-flow" observations were very close, say 6 v. 5. Prior to adopting the computed classification, we looked into the data for each such fund and verified that the classification is indeed appropriate.

[12] For several funds in our sample we found sizeable deviations (up to an order of magnitude) from the total net assets reported by CRSP in more than one month (in all such instances, we verified the validity of the CRSP data by matching it with the data from Morningstar Principia).

[13] Greene and Hodges (2000) employ a similar methodology, but they base their classification on the total net assets computed on the basis of the N-SAR and N-30D reports that mutual funds file semi-annually to the SEC (rather than on the 1998 CRSP Mutual Fund Data Base). While we find that the overwhelming majority of the funds in our sample seem to have followed the proper practice of reporting "post-flow" total net assets, Greene and Hodges (2000) find that about 2/3 of the funds from their sample (812 funds, not restricted to international stock funds) appear to have followed the practice of reporting "pre-flow" total net assets. An unsettling possibility, at the same

assumption that all 116 funds in our sample report the appropriate TNAs and the results obtained for the 91 funds whose likely reporting practice we were able to identify are very similar; for the sake of brevity, in Table VI we report only the former.

Table VI summarizes the correlations of daily net flows with the same-day S&P 500 return as well as the next-day returns for individual funds by category. A positive correlation suggests that net flows anticipate future fund returns. This correlation does not speak directly to the issue of gains and losses to the existing shareholders, because any market timing ability of the net flows will only affect the existing shareholders to the extent that it is correlated with pricing *errors*. However, a large positive correlation between the S&P 500 and net flows would be a cause for concern to fund managers in light of the documented profitability of the switching strategy. The left half of Table VI shows that the correlation between fund flows and next-day fund returns are on average positive, but small in magnitude. The slope coefficients of next-day returns on current flows are insignificantly different from zero for all categories. Also, the flows to international funds have low contemporaneous correlation with the SP500 returns. Unreported results show a similar pattern if we look at the correlations at the individual fund level. The median correlation between net flows and next-day fund returns range from –0.029 for Diversified Emerging Markets to 0.083 for the Europe Stock funds, and the median correlation among all 116 funds in the sample is 0.027. While these medians may appear small, the spread of the correlations is substantial. One-quarter of all funds experience a correlation between net flows and subsequent returns that exceeds 0.07. We also compared the no-load and load funds from the sample. Our analysis (not reported in detail for brevity) suggests that there were no statistically significant differences with respect to average correlations and regressions between the two; that is, fees did not to seem to have an impact on the degree to which speculative strategies were employed on the sample funds during the sample period.

These results differ somewhat from those reported by Greene and Hodges (2000), who find a significant negative impact of flows on fund returns. We believe that we have correctly identified the reporting practices of the funds in our sample and that the discrepancy appears to be driven by the differences in classification.[14]

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time a *caveat* to this methodology, is that some funds might be inadvertently inconsistent in their reporting practices over time.

[14] Our analyses under the assumption that all funds in the sample reported $TNA_{i,t}^{-}$ yielded results (not reported in the paper) consistent with the findings reported by Greene and Hodges (2000).

In summary, the spread of the correlations also suggests that there have been a number of funds in which the existing shareholders have either benefited or have been hurt at the expense of the outside investors. To quantify these gains and losses we develop a more precise definition of informationally efficient pricing in the next section.

VIII. Efficient NAV Pricing

There are a variety of solutions to the stale pricing problem. A simple one is to impose a transaction fee on trades of fund shares. While this may make day trading unprofitable, it is unattractive for uninformed investors with shorter investment horizons, and does not directly address the underlying problem of inefficient pricing.

The second one is to change the time of pricing of the fund shares, for example, to price European funds during the morning hours EST. This may be attractive for funds that invest in a single (foreign) country or time zone, but provides little relief for global funds that trade in markets located in many different time zones. The administration of resulting intra-day cash positions would also be cumbersome for fund families that allow exchanges between funds if these settle at different points in time.

The third solution is to improve the pricing of the fund shares by using the prices of close substitutes to the mutual fund portfolio. Futures contracts and American Depository Receipts traded during U.S. trading hours are likely to contain value-relevant information and can help improve the informational efficiency of the NAV computation. For example, as suggested in Craig *et al*. (1995), a portfolio of Japanese stocks may be priced using the information from the Nikkei 225 futures contract traded in Chicago. The intra-day return of a portfolio of ADRs with a similar industry and country composition as the fund portfolio may provide a good approximation to the return of the mutual fund shares.

A final and more encompassing solution is to use a framework to adjust the NAV and make it orthogonal (i.e. uncorrelated) to the available information in the market. This method is simple and intuitive. If the price of a portfolio of mutual fund shares reflects all information that is value-relevant, short-term portfolio returns should be approximately unpredictable. If funds base their NAVs on stale prices, some value-relevant information will be reflected in the NAV only on the next day (or even subsequent days). Our proposed adjustment is to take the

predictable portion of next day's NAV and include it in today's NAV. Consider the following regression:

(1) $$R_{i,t+1}^{NAV} = \alpha_i + \beta_i Z_t + \varepsilon_t ,$$

where $R_{i,t+1}^{NAV}$ is the next-day NAV-return on fund *i* (that is, the percentage change of fund *i*'s NAV) and Z_t is a set of current instruments useful in predicting the next-day NAV-return. In the context our trading rule Z_t would be the return on the S&P 500 for day *t*. In principle, Z_t could be a vector of a number of observable variables useful for predicting the next-day NAV return and could include, for example, the return on a Nikkei futures contract, or the return on a portfolio of relevant ADRs. The predictable component of the return is the fitted value of the regression $\alpha_i + \beta_i Z_t$. The correction would take the predictable component of tomorrow's NAV-return and simply add it to today's NAV:

(2) $$NAV_{i,t}^{*} = NAV_{i,t}(1+\alpha_i + \beta_i Z_t) .$$

This rule is quite simple to implement by estimating equation (1) and using the fitted values of the regression to make the adjustment in equation (2). In practical applications it should be easy to get accurate estimates of β_i using daily data. The constant term is the portion of the expected daily return uncorrelated with Z_t, and is substantially more difficult to estimate. However, α_i is likely to be very close to zero, and at least an order of magnitude smaller than $\beta_i Z_t$. It is, therefore, best ignored, which leads to the following correction:

(3) $$NAV_{i,t}^{*} = NAV_{i,t}(1+\beta_i Z_t) .$$

This correction adjusts each daily NAV to reflect the additional value-relevant information, and will therefore have a negligible impact on the long-term performance of the fund. This approach would be easy to implement in practice. The traditional NAV computed using the last observed market prices supplied by traditional pricing services continues to be the

anchor for daily valuation, and the correction only requires that Z_t be observed at the close of the market.

Table VII shows the effect of using this correction on the profitability of our trading strategy based on the sign of the S&P 500. We estimated Equation (1) for the EW portfolios for each category using the returns on the S&P 500 as the instrument Z_t. The first six columns summarize the category returns before and after the NAV correction. The correction has slightly increased the sample standard deviation of the returns, but, as expected, has had little or no effect on the sample average returns. Most important is the decline of the correlation with the lagged S&P 500 return. Before correction, correlations ranged from 0.121 for Latin America to 0.424 for Foreign Stock funds, but they decline to 0.002 and 0.015, respectively, for the returns based on the corrected NAVs.

The final three columns present the returns of the switching strategy applied to the corrected NAVs. As expected, the returns to the switching strategy applied to the corrected NAVs are close to zero. The correction thus increases the efficiency of the NAV and removes the profitability of trading strategies that exploit stale prices in the NAV calculation.

IX. Wealth Transfers

Our correction methodology also provides a useful framework to analyze the wealth transfers that result from the inefficiency of the reported NAVs. The difference between the reported and the corrected NAV is an estimate of the pricing error of the fund shares that results from ignoring the information contained in the S&P 500 return. It is the source of wealth transfers between those who buy and sell shares during the day and the long-term shareholders in the fund who do not trade.[15] As pointed out in the previous sections, if there are no net flows into a fund, the pricing error multiplied by the gross flow is simply a wealth transfer from those who buy to those who sell on a given day. The net flow multiplied by the pricing error is an estimate of the wealth transfer between the long-term shareholders in the fund who do not trade and those who do trade. Because TrimTabs does not report gross flows (that is, both inflows and outflows),

[15] Greene and Hodges (2000) report a "dilution effect," which is very different from the wealth transfers discussed in this section. They measure the return loss to incumbent shareholders due to short-term cash holdings of the fund, caused by a delay in the availability of new money for investment in risky assets. This is not a wealth transfer as long as a fund correctly computed its NAV.

we are unable to quantify the wealth transfers between buyers and sellers of fund shares and we concentrate on the effect of pricing errors on the wealth of the long-term shareholders.

We consider a variety of measures to characterize the wealth effects. The first is the net wealth transfer per fund, measured over the 17 months that comprise our sample. It is computed as the annualized percentage pricing error multiplied by net new money invested into each fund. Table VIII shows that the estimated annual wealth transfers vary by fund from -$3.34 million to $0.58 million (a negative number indicates a loss to the incumbent shareholders). Summed across all 116 funds in the sample, this translates into an annual net loss of $10 million to the incumbent shareholders. That this number is small compared to the 68 billion invested in these funds as of May of 1999 is not surprising because the correlation between net flows and next-day returns has been small for the vast majority of the funds in our sample. The second row of Table VIII gives the average size of the wealth transfer by fund, computed as the absolute value of the dollar gain and loss to the incumbent shareholders. We estimate that the wealth transfers between incumbents and outsiders total $521,000 per year for the median fund, and that the sum of wealth transfers across all funds is $216.78 million per year. The latter represents about 0.32% of the assets under management in these funds. Since our sample only covers about 20% of all international funds in terms of market capitalization, a reasonable estimate of the annual wealth transfers – both positive and negative – for all international funds is about $1.1 billion. Note that these estimates exclude any wealth transfers between purchasers and sellers of fund shares on a given day, and are therefore a lower bound on the total wealth redistribution between all investors who traded shares in international mutual funds. The next two rows of Table VIII report the distribution of losses and wealth transfers scaled by total fund net assets. Expressed as a percentage of total net assets, the median fund experiences a loss of 0.006% per year and wealth transfers of 0.317% per year. The remainder of Table VIII summarizes the distribution of estimated pricing errors associated with stale prices. It is computed as the predictable component of the next-day fund return based on the information in today's S&P500 return. The fifth and the sixth row of Table VIII look at the mispricing in the TrimTabs sample (Sample 1), while the last two rows are based on our broader sample of 391 international mutual funds (Sample 2). Both samples suggest that the price of mutual fund shares is about 2.5 basis points too low for the median fund. More importantly, fund return predictability causes the median fund to be

mispriced by between 22 and 28 basis points per day, which is at minimum a nontrivial fraction of the typical fund's expense ratio.

It is important to reiterate that the estimated wealth transfer of $1.1 billion is not indicative of the extent to which the incumbent shareholders suffer at the expense of traders, since it is a measure of the absolute value of mispricing. Rather, it is a measure of the "unfairness" of NAV pricing across international fund shareholders. While it may be comforting to find that, on average, stale pricing did not hurt investors, this does not mean that individual shareholders did not suffer from the use of incorrect prices. Given that the principal goal of the Investment Company Act (1940) was to create a regulatory framework for the fair treatment of all shareholders, it would seem that the reduction of total mispricing is a reasonable goal of the mutual fund industry as a whole.

X. Conclusion

This paper documents evidence that the mutual fund practice of using the final transactions prices of foreign exchanges to compute daily NAVs creates predictability in fund returns. We find that mutual fund prices are not efficient with respect to information that becomes available during the U.S. trading day. Before transactions costs, a simple trading strategy based on this information in the S&P 500 can generate returns that outperform a buy-and-hold strategy in those funds by around 20 percent per year over the period from 1990 to 1998 while incurring only 70% of the underlying funds' volatility. In light of these incentives, mutual funds have designed a variety of mechanisms to discourage day traders. An analysis of the pattern of flows into international funds shows that the amount of money involved in strategic exploitation of these opportunities has been relatively modest, either because funds have been successful in curtailing day traders, or because few investors have been aware of these strategies and their profitability. Despite the fact that long-term shareholders do not seem to have been seriously affected by day traders on average, a conservative estimate of the total of wealth transfers among investors stemming from inefficient fund pricing is roughly $1.1 billion per year during the 17 month period ending in June 1998. We propose a procedure to improve the efficiency of reported net asset values that is easy to implement in practice. This procedure requires a departure from the industry practice of using last transactions prices from foreign

markets. Given the global trend towards electronic trading and continuous pricing, fund companies and regulators should look at alternatives like this one that allow funds to offer fair pricing to investors. There is a direct trade-off between establishing a fair pricing rule for fund shares and the need to resort to the monitoring of active traders and the need to impose expenses such as loads and redemption penalties.

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Table I
Daily XYZ Fund and S&P 500 Returns

The table illustrates the speculative mechanism for XYZ Fund using intra-day S&P 500 data in the period 08/1992 – 07/1998. The table gives the correlation of the international fund NAV return with the return on the S&P 500. Note that the stocks in the international fund trade during a period that almost entirely precedes the opening of the U.S. market, but the NAV is computed only after (the opening and) the closing of the U.S. market.

	Correlation with XYZ Fund Returns	
S&P 500 Index Returns	same day	next day
Previous close – Close	0.26	0.38
Previous close – 10 AM	0.42	0.17
10 AM – Close	0.03	0.34
10 AM – 11 AM	0.05	0.18
11 AM – 12 PM	0.05	0.21
12 PM – 1PM	0.03	0.13
1PM – 2PM	0.02	0.07
2PM – 3 PM	-0.07	0.10
3 PM – Close	0.01	0.15
Previous Close – 3 PM	0.29	0.36
10 AM – 3 PM	0.03	0.33

Table II
Sample Funds – Summary Statistics

The table reports summary statistics for daily total returns on the funds in our sample in the period 01/02/1990 – 07/24/1998. The sample consists of 391 open-end international stock mutual funds belonging to one of the following Morningstar Categories: Diversified Emerging Mkts (DEM), Diversified Pacific/Asia Stock (DPA), Europe Stock (EU), Foreign Stock (FS), Japan Stock (JPN), Latin America Stock (LA), Pacific/Asia ex-Japan Stock (PXJ), and World Stock (WS). For comparative purposes, the Vanguard 500 Index Fund (VAN) is presented as well. Columns 2-4 provide the basic summary statistics of time series of daily total returns on equally weighted portfolios of funds in each category (constructed each day from the funds available on that day): arithmetic mean return, standard deviation, and the cross-autocorrelation with prior-day S&P 500 returns. The last five columns give for each category the quantiles of the distribution of correlations between individual fund returns and prior-day S&P 500 returns. For each fund the summary statistics are computed on the basis of daily total fund returns over all the days in the sample period on which the fund returns were available. Returns and standard deviations are expressed in percent per day.

Category (N)	Arithmetic Mean	Standard Deviation	Correlation with $R_{SP,t-1}$	Quantiles of $cor(R_{i,t}, R_{SP,t-1})$				
				Min.	1st Q.	Median	3rd Q.	Max.
DEM (10)	0.012	0.749	0.325	0.268	0.287	0.293	0.305	0.316
DPA (34)	-0.002	0.847	0.397	0.291	0.374	0.394	0.430	0.489
EU (58)	0.049	0.701	0.362	0.159	0.337	0.390	0.450	0.540
FS (112)	0.032	0.627	0.424	0.199	0.352	0.381	0.406	0.499
JPN (17)	-0.013	1.096	0.252	0.090	0.198	0.236	0.295	0.444
LA (31)	0.038	1.234	0.121	0.038	0.086	0.117	0.125	0.285
PXJ (65)	0.004	0.993	0.371	0.095	0.334	0.370	0.395	0.431
WS (64)	0.041	0.550	0.409	0.103	0.294	0.336	0.367	0.613
VAN (1)	0.067	0.793	0.039					

Table III
Average Fund Returns and Prior Day S&P 500 Returns

The table gives the average return and standard deviation (Stdev) of equally weighted portfolios of international funds by Morningstar Category – Diversified Emerging Mkts (DEM), Diversified Pacific Asia Stock (DPA), Europe Stock (EU), Foreign Stock (FS), Japan Stock (JPN), Latin America Stock (LA), Pacific ex-Japan Stock (PXJ), and World Stock (WS) – conditional upon the sign of the prior-day S&P 500 return. For comparative purposes, the returns for the Vanguard 500 Index Fund (VAN) are presented as well. Returns are expressed in percent per day. The t-statistic (t-stat) is the average return divided by its standard error, and Days refers to the number of daily returns used to compute the average returns and standard deviations.

Category	Full sample				Prior-Day S&P 500 Return ≤ 0				Prior-Day S&P 500 Return > 0			
	Average Return	Stdev of Returns	t-stat	Days	Average Return	Stdev of Returns	t-stat	Days	Average Return	Stdev of Returns	t-stat	Days
DEM	0.012	0.749	0.75	2165	-0.171	0.779	-6.94	999	0.169	0.684	8.44	1166
DPA	-0.002	0.847	-0.11	2165	-0.234	0.881	-8.39	999	0.196	0.762	8.78	1166
EU	0.049	0.701	3.25	2165	-0.137	0.723	-5.99	999	0.209	0.641	11.13	1166
FS	0.032	0.627	2.37	2165	-0.162	0.645	-7.94	999	0.199	0.561	12.11	1166
JPN	-0.013	1.096	-0.55	2165	-0.205	1.111	-5.83	999	0.151	1.057	4.88	1166
LA	0.037	1.234	1.25	1742	-0.117	1.260	-2.62	797	0.168	1.196	4.32	945
PXJ	0.004	0.993	0.17	1879	-0.228	1.021	-6.57	866	0.201	0.924	6.92	1013
WS	0.041	0.550	8.67	2165	-0.137	0.568	-7.62	999	0.192	0.479	13.69	1166
VAN	0.067	0.793	3.93	2165	0.030	0.848	1.12	999	0.098	0.742	4.51	1166

Table IV
Strategy Returns and Excess Strategy Returns

The table reports performance summary statistics of a strategy that selectively invests in international mutual funds on the days on which the prior-day S& P 500 return is positive and in non-interest bearing cash on the days following the days on which the S&P 500 return is negative. Average returns and standard deviations (Stdev) are measured in percent per day. The sample consists of 391 open-end international stock mutual funds with the following Morningstar Category: Diversified Emerging Mkts (DEM), Diversified Pacific/Asia Stock (DPA), Europe Stock (EU), Foreign Stock (FS), Japan Stock (JPN), Latin America Stock (LA), Pacific/Asia ex-Japan Stock (PXJ), and World Stock (WS). For comparative purposes, the strategy returns for the Vanguard 500 Index Fund (VAN) are presented as well. Columns 2-4 summarize the strategy returns for equally weighted portfolios of funds formed by category. Columns 5-7 summarize the strategy returns in excess of the buy and hold return in the same funds. The last five columns give the quantiles of the cross-sectional distribution of individual fund excess strategy returns. The t-statistic (t-stat) is the average return divided by its standard error.

Category	Strategy Returns			Excess Strategy Returns			Quantiles of Excess Strategy Returns				
	Average Return	Stdev of Returns	t-stat	Average Return	Stdev of Returns	t-stat	Min.	1st Q.	Median	3rd Q.	Max.
DEM	0.091	0.509	8.32	0.079	0.536	6.86	0.066	0.080	0.081	0.097	0.115
DPA	0.106	0.568	8.66	0.108	0.608	8.24	0.088	0.117	0.146	0.208	0.394
EU	0.112	0.482	10.87	0.065	0.496	5.91	-0.013	0.055	0.064	0.078	0.324
FS	0.107	0.423	11.77	0.075	0.445	7.84	0.039	0.065	0.074	0.082	0.120
JPN	0.082	0.779	4.87	0.095	0.761	5.78	0.062	0.080	0.107	0.122	0.280
LA	0.091	0.885	4.29	0.054	0.854	2.62	0.040	0.068	0.073	0.113	0.229
PXJ	0.109	0.686	6.87	0.105	0.702	6.49	0.532	0.889	1.040	1.206	2.646
WS	0.103	0.364	13.17	0.063	0.392	7.48	0.012	0.051	0.059	0.071	0.158
VAN	0.053	0.547	4.51	-0.014	0.576	-1.12			-0.014		

Table V
Cross-Sectional Comparison of Load and No-Load Funds

The table documents a comparison of cross-sectional means of average returns for international funds that charge neither loads nor redemption fees (No-Load) and funds that charge loads and/or redemption fees (Load) from the following Morningstar Categories: Diversified Emerging Mkts (DEM), Diversified Pacific/Asia Stock (DPA), Europe Stock (EU), Foreign Stock (FS), Japan Stock (JPN), Latin America Stock (LA), Pacific/Asia ex-Japan Stock (PXJ), and World Stock (WS). Panel A features fund returns and Panel B features strategy returns. The first column of each panel features the cross-sectional mean of average total fund returns for no-load funds; the second column of each panel features the cross-sectional mean of average total fund returns for load funds. The third column of each panel features the t-statistic (t-stat) for a two-sample t-test comparison of means of average returns for no-load and load funds. Throughout the table returns are expressed in percent per day.

Category (N)	No. No-Load/Load	**Panel A: Fund Returns**			**Panel B: Strategy Returns**		
		No-Load	Load	t-stat	No-Load	Load	t-stat
DEM (9)	6/3	0.006	0.011	-0.43	0.096	0.093	0.41
DPA (33)	7/26	-0.105	-0.068	-0.84	0.089	0.106	0.10
EU (56)	16/40	0.082	0.087	-0.30	0.145	0.167	-1.66
FS (105)	64/41	0.041	0.038	1.35	0.113	0.111	0.96
JPN (17)	8/9	-0.017	-0.027	0.59	0.109	0.080	1.41
LA (29)	6/23	0.024	0.027	-0.17	0.117	0.109	0.96
PXJ (62)	14/48	-0.081	-0.102	0.89	0.092	0.095	-0.24
WS (61)	15/46	0.046	0.046	-0.02	0.102	0.107	-0.97
Pooled (372)	136/236	0.021	0.004	2.01	0.111	0.114	-0.67

Table VI
Relationship between Fund Flows and Returns

The table summarizes the relationship between daily fund flows, same-day S&P 500 returns and next-day fund returns for each of the eight listed Morningstar Categories (characterized by a substantial portion of international equities in the portfolio). The first column gives the correlation (*cor*) between current-day average flows and next-day average fund returns. The next two columns give the slope coefficient, β_1, and the t-statistic, $t(\beta_1)$, of the regression of average flows on next-day average fund returns. Morningstar Category averages are computed each day using all funds available within a particular category on that day. The right half of the table gives correlation and regression slopes for average fund flows and same-day S&P 500 return. Individual fund flow is computed as $flow_{i,t} = NewMoney_{i,t} / TNA_{i,t-1}$, where $NewMoney_{i,t} = TNA_{i,t} - (1 + R_{i,t-1})TNA_{i,t-1}$ denotes net new money inflow into fund *i* on date *t*.

Category	Fund Flows and Next-Day Returns			Fund Flows and Same-Day S&P 500 Returns		
	cor	β_1	t(β_1)	*cor*	β_{SP}	t(β_{SP})
DEM	-0.041	-0.148	-0.75	-0.063	-0.021	-1.22
DPA	0.076	0.027	1.67	0.062	0.166	1.41
EU	0.091	0.035	1.67	0.001	0.026	0.20
FS	0.052	0.060	0.98	0.019	0.014	0.37
JPN	0.020	0.001	0.41	-0.080	-0.208	-2.08
LA	0.009	0.012	0.17	0.083	0.112	1.48
PXJ	0.058	0.043	1.26	0.029	0.047	0.67
WS	0.078	0.127	1.44	-0.061	-0.030	-0.96
Pooled	0.055	0.063	0.96	0.015	0.011	0.30

Table VII
A Comparison of Corrected and Uncorrected Fund Returns

The table reports summary statistics for the corrected daily total returns on the funds in our sample in the period 01/02/1990 – 07/24/1998. The sample consists of 391 open-end international stock mutual funds with the following Morningstar Category: Diversified Emerging Mkts (DEM), Diversified Pacific/Asia Stock (DPA), Europe Stock (EU), Foreign Stock (FS), Japan Stock (JPN), Latin America Stock (LA), Pacific/Asia ex-Japan Stock (PXJ), and World Stock (WS). The table displays for each category the mean, standard deviation, and correlation with prior-day S&P 500 returns for the equally weighted (EW) portfolio of all funds belonging to the category, the corrected EW portfolio returns, and the returns to the day trading strategy applied to the corrected EW returns. Returns and standard deviation are expressed in percent per day.

	Raw EW Returns			**Corrected EW Returns**			**Returns to Strategy Applied to Corrected EW Returns**		
Category	Arithmetic Mean	Standard Deviation	Correlation with $R_{SP,t-1}$	Arithmetic Mean	Standard Deviation	Correlation with $R_{SP,t-1}$	Arithmetic Mean	Standard Deviation	Correlation with $R_{SP,t-1}$
DEM	0.012	0.749	0.325	0.013	0.851	0.011	0.009	0.581	0.022
DPA	-0.002	0.847	0.397	-0.002	0.892	0.015	-0.008	0.608	0.019
EU	0.049	0.701	0.362	0.050	0.767	0.013	0.026	0.526	0.061
FS	0.032	0.627	0.424	0.033	0.706	0.014	0.017	0.478	0.058
JPN	-0.013	1.096	0.252	-0.013	1.125	0.009	-0.012	0.799	0.012
LA	0.038	1.234	0.121	0.038	1.296	0.002	0.041	0.913	0.049
PXJ	0.004	0.993	0.371	0.004	1.033	0.005	-0.016	0.722	0.012
WS	0.041	0.550	0.409	0.041	0.672	0.012	0.027	0.447	0.072

Table VIII
The Wealth Impact of Stale Pricing

The table documents several measures of the impact of stale pricing on mutual fund shareholders. Panel A documents quantiles of the cross-sectional distribution of annualized time-series averages for the 116 international open-end mutual funds for which the daily *NAV* and *TNA* data were obtained from TrimTabs (Sample 1). It lists (1) annualized dollar loss per fund, (2) annualized wealth transfers per fund, (3) annualized percentage loss per fund, (4) annualized percentage wealth transfers per fund, (5) daily pricing error, and (6) daily absolute mispricing. The six measures are computed for each fund as the time-series average of the following quantities:

(1) $\frac{NAV_{i,t} - NAV^*_{i,t}}{NAV_{i,t}} NewMoney_{i,t} = -\beta_i R_{SP,t} NewMoney_{i,t}$,

(2) $\left| \frac{NAV_{i,t} - NAV^*_{i,t}}{NAV_{i,t}} NewMoney_{i,t} \right| = \left| -\beta_i R_{SP,t} NewMoney_{i,t} \right|$,

(3) $\frac{NAV_{i,t} - NAV^*_{i,t}}{NAV_{i,t}} flow_{i,t} = -\beta_i R_{SP,t} flow_{i,t}$,

(4) $\left| \frac{NAV_{i,t} - NAV^*_{i,t}}{NAV_{i,t}} flow_{i,t} \right| = \left| -\beta_i R_{SP,t} flow_{i,t} \right|$,

(5) $\frac{NAV_{i,t} - NAV^*_{i,t}}{NAV_{i,t}} = -\beta_i R_{SP,t}$, and

(6) $\left| \frac{NAV_{i,t} - NAV^*_{i,t}}{NAV_{i,t}} \right| = \left| -\beta_i R_{SP,t} \right|$,

where flow and new money for fund *i* on date *t* are computed as $flow_{i,t} = NewMoney_{i,t} / TNA_{i,t-1}$ and $NewMoney_{i,t} = TNA_{i,t} - (1 + R_{i,t-1}) TNA_{i,t-1}$, respectively. Panel B reports the latter two pricing error measures for the other sample of 391 international open-end mutual funds used in this study (Sample 2).

	Average Wealth Impact	Min.	1st Q.	Median	3rd Q.	Max.
	Panel A: Sample 1					
(1)	Annual Dollar Loss per Fund ($MM)	-3.338	-0.062	-0.004	0.018	0.575
(2)	Annual Wealth Transferred per Fund ($MM)	0.005	0.181	0.521	1.307	22.550
(3)	Annual % Loss per Fund	-0.539	-0.035	-0.006	0.018	0.348
(4)	Annual % Wealth Transferred per Fund	0.007	0.147	0.317	0.790	3.788
(5)	Daily Pricing Error (%)	-0.043	-0.030	-0.026	-0.020	-0.011
(6)	Daily Absolute Mispricing (%)	0.118	0.211	0.278	0.320	0.458
	Panel B: Sample 2					
(5')	Daily Pricing Error (%)	-0.074	-0.029	-0.024	-0.020	-0.005
(6')	Daily Absolute Mispricing (%)	0.042	0.170	0.219	0.248	0.634

Figure I: Day Trading versus Buy-and-Hold Strategy
Average Across 112 Foreign Stock Funds

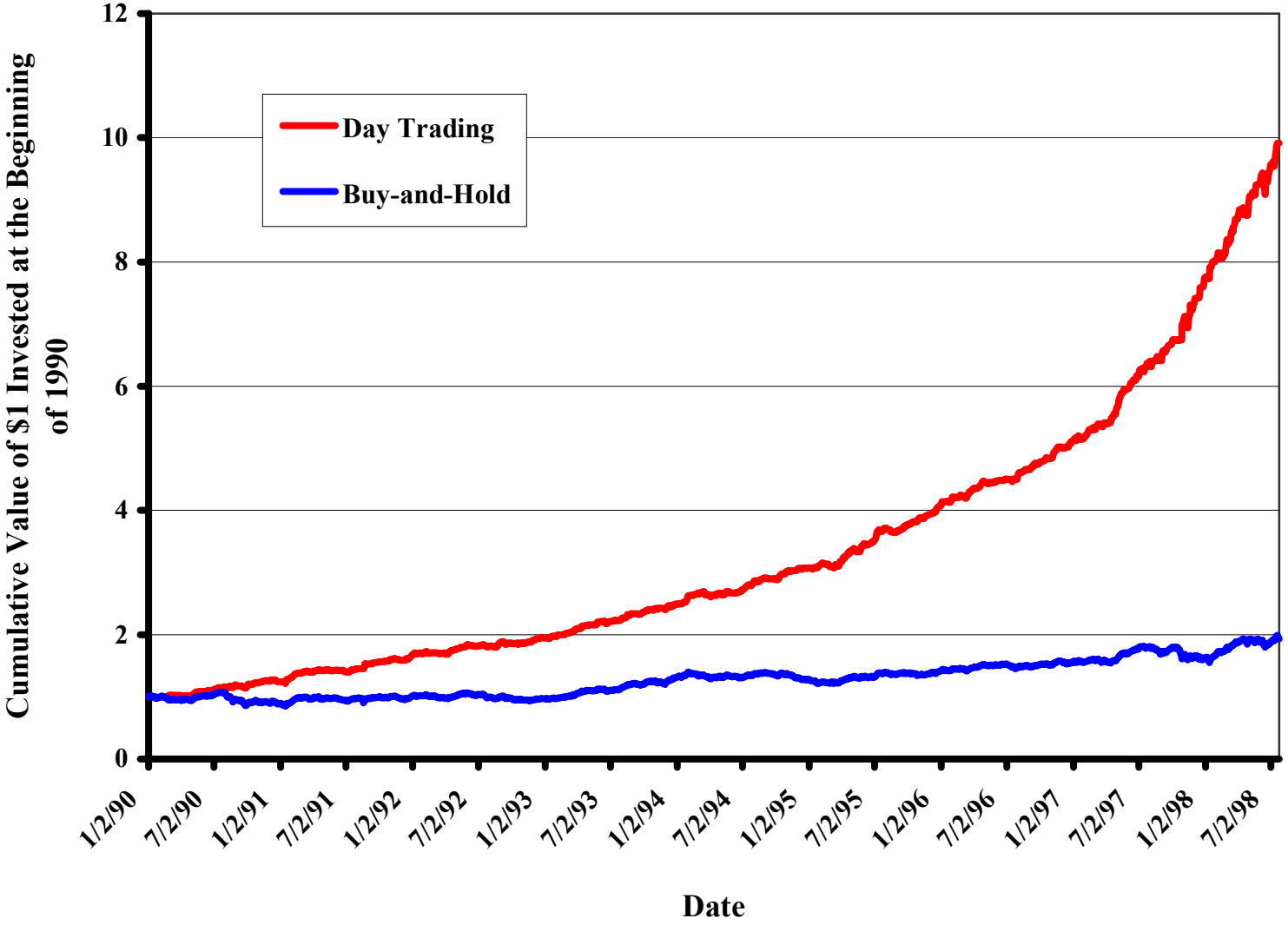

Figure I:

The figure displays the growth of one dollar invested in two alternative strategies in the period from 01/02/1990 to 07/24/1998. Buy-and-hold strategy means investing in the equally weighted portfolio of 112 Foreign Stock international mutual funds. Day trading strategy means employing the sign of the prior-day S&P 500 returns as the signal for switching between the equally weighted portfolio of 112 Foreign Stock international mutual funds and cash. Returns on the switching strategy do not include redemption fees and transactions costs.